

# Proposed Prompter Communication System for Supporting Non-Verbal Expressions in order to Encourage Development of Deep and Intimate Interpersonal Relationships

Li Jen Chen<sup>†</sup>, Mutsumi Suganuma<sup>†</sup>, Shigekazu Sakai<sup>†</sup>,  
Shunichi Yonemura<sup>††</sup>, Jun Ohya<sup>†</sup> and Yukio Tokunaga<sup>††</sup>

## SUMMARY

A text-based computer-mediated communication system, called the Prompter Communication System (PCS), in which 1 to 3 black circular images (“●”) are embedded onto the background of a text-field canvas, is proposed, and its ability to support non-verbal expression by encouraging the creation of pictogram-like pictorial-text messages during telecommunication sessions is examined. During the investigation, the concepts and features of emoticons and pictograms were integrated into the proposed system. Based on these concepts and features, it was observed that PCS was able to enhance and enrich the user experience and encourage participants to express their thoughts, feelings and emotions in a pictorial-text style, created using composite symbols and text in conjunction with the “●” prompter image, thereby mitigating the lack of emotional and visual expression in plain text messages, which is an essential element for intimacy and the development of deep interpersonal relationships. Communication experiments using the prototype PCS system have been conducted, where a Normal Communication System, NCS, which uses only a plain text-field canvas without the “●” prompter image, is compared with the PCS. The experimental results indicate that communication conducted using the PCS encourages the creation of an increased number of messages based on the pictorial-text style compared to when using NCS. Further analysis into the self-disclosure level of the message contents has shown that using the PCS results in a higher average frequency of the appearance of high self-disclosure information, with 65% fewer textual expressions in comparison to using NCS.

**keywords:** *Prompter Communication System, Communication, CMC, Emoticon, Smiley, Pictogram, Self-disclosure.*

## 1 Introduction

Communication plays an important role when

building and developing relationships between individuals within society. From face-to-face conversations, telephone conversations, electronic mail, instant messaging, video conferencing, chatting and more, the variety of communication methods has grown increasingly, mainly due to the rapid development of technology. Internet services and Information Communication Technology (ICT) provide and support communication via global networks using numerous methods, styles and channels. Computer Mediated Communication (CMC) services, including electronic mail, chat and SNS, help the individual to build, develop and sustain relationships with friends, family and colleagues without being hindered by distance or physical concerns. These new technologies and services have meant that face-to-face communication and physical presence are no longer essential elements for building and developing relationships. However, in order to build and sustain intimate and deep interpersonal relationships between individuals, non-verbal expressions and the information shared during communication where a physical presence exists, such as emotional expressions and gestures, and information with high self-disclosure, are still important [1].

Many studies have indicated that the fundamental basis of intimate and deep interpersonal relationships results from communications with high self-disclosure [2] [3]. Self-disclosure is defined as the act of revealing more about oneself to others, including thoughts, feelings, aspirations, and fears, as well as one’s likes, dislikes and preferences, etc. [4] [5], which usually occurs early in the development of the relationship, thereby forming the initial impression between individuals [6]. However, more intimate self-disclosure is usually observed later [7] [8].

Research into the support of non-verbal expressions and self-disclosure in network communication has attracted a great deal of attention and interest. Those studies have routinely investigated communications undertaken founded on CMC settings in comparison with face-to-face settings, or on text-based chat in comparison with

video conferencing settings, and have indicated that CMC communication settings with access to non-verbal elements or tools generate information with a similar or higher self-disclosure level than those of face-to-face settings [9] [10]. Many theories and systems for supporting non-verbal expression and self-disclosure for developing intimate relationships through CMC have been proposed. Several studies have proposed systems that use visual cues, such as virtual agents, VR (Virtual Reality) and photographs, to share virtual presence, co-presence, social presence and self-awareness in a virtual environment in order to make up for physical absence and to foster higher self-disclosure or discourse [11] [12] [13], while others have provided emotional icons or pictograms that convey social emotions and increase non-verbal information exchanges in order to reduce the perception of hostile or insulting interactions in text-based CMC, and offer a richer sense of expression and communication [14]. Additional studies have provided lists of pictograms or visual symbols that can be implemented by users with language differences, disabilities or handicaps in order to minimize hardships or boundaries when communicating [15]. These studies have confirmed that, while the results of the effect on non-verbal expressions and self-disclosure are positive, the limitations and constraints of those systems, such as a lack of pre-selection of emoticons and pictographs, have raised concerns. However, although there have been many studies into the effects of CMCs on non-verbal expression and self-disclosure, studies into the creation of non-verbal expression in text-based CMCs that enrich expression in order to encourage high self-disclosure and mutual understanding for the further development of intimate and deep personal relationships are rarely found.

In this paper, an approach to supporting pictogram-like expression in a text-based CMC that aims to enhance richness in non-verbal expression in order to encourage high self-disclosure and mutual understanding has been proposed and evaluated. The proposed Prompter Communication System (PCS) is a text-based communication system, in which 1 to 3 black circular images (“●”) are embedded onto the background of a text-field canvas. The “●” image is employed as the basis for users to compose symbols and text within the “●” image, thereby creating a pictogram-like representation of non-verbal expressions, such as emotional or visual expressions, together with textual expressions. The concepts and features of emoticons and pictograms have been applied when designing the prototype system. Communication experiments using the prototype PCS have been conducted and its effectiveness has been examined. The results indicate that communication using the PCS has the effect of encouraging participants to construct combinations of symbols and text to create pictogram-like representations of non-verbal expressions

and to express their thoughts or feelings in pictorial-text style. Moreover, further analysis of self-disclosure levels within the experimental results indicate that messages in the pictorial-text style created using PCS contain not only information with simple meanings or emotional cues, but also information with a high level of self-disclosure, which may foster intimacy and further lead to the development of deep interpersonal relationships.

The remainder of the paper is organized as follows: in Section 2, the concepts, theory and background of the research are described. Section 3 describes the features and the design of the proposed Prompter Communication System (PCS) prototype. Section 4 describes the methodologies used for both the experiments and subsequent evaluations, followed by an analysis of the results and a discussion of those studies, together with corresponding figures. A conclusion to the study is given in Section 5.

## 2 Concept, Theory and Background

### 2.1 Concept and Background of Pictograms and the Smiley (Emoticon)

Emoticons and pictograms are visual symbols often used in text-based communication to convey certain expressions and meanings. Emoticons are pictorial representations of facial expressions using punctuation marks and letters, usually used to alert the receiver to the sense, tone, mood or temper of the statement in order to improve the interpretation of plain text. In some web-based communication systems, such as the more popular instant messaging software, Facebook chat and Google Talk, text emoticons are automatically replaced with small corresponding images that provide a more direct visual expression [16]. Emoticons were first used in a digital form on the internet by Scott Fahlman [17] on 19 September 1982 in his proposal regarding a character sequence for joke markers, and soon spread widely to the ARPANET and Usenet.

Traditionally, the Western style of emoticon is written from left to right with eyes on the left and nose or mouth on the right. This form was altered in Japan in 1986 with a new style used by ASCII NET in Japan and added to by the Byte Information Exchange (BIX) [18]. The new style emoticons are usually found in a format similar to (^\_^) with the circumflex accents indicating the eyes, the underscore indicating the mouth and the parentheses indicating the outline of the face. Later, emoticon forms and styles became mixed when English-language users adopted emoticons that could be displayed using standard ASCII characters available on Western keyboards, and have been developed into many variations depending on regional, languages, cultural and national influences.

However, no matter whether it was in the early

days of the Internet or in modern times, emoticons still function as non-verbal representations of emotional and facial expressions to compensate for the lack of an emotional and/or visual presence in plan text during text-based communication. Emoticons aim to improve mutual understanding and encourage the sharing of higher self-disclosure information in order to promote the development of intimate and deep interpersonal relationships between conversational parties.

In contrast, a pictogram is an ideogram that conveys its meaning through its pictorial resemblance to a physical object, and is often used in writing, text and graphic systems in which the characters are pictorial in appearance [19]. The concept of pictograms can often be used to transcend language and cultural backgrounds [20] to promote recognition, understanding and communication. Pictograms are commonly used as signs and instructions, or in statistical diagrams, and are often applied as global standards. The basic design of a pictogram usually contains only two colors, a solid color as the canvas and white as the pictorial expression for the object or meaning, with simple lines and shapes that enable the viewer to grasp and recognize the meaning.

There have been numerous studies into the development of pictogram communication methods or systems, such as Pictogram Ideogram Communication, Picture Communication Symbols and LoCos, that focus on providing support for people from different cultural backgrounds or language boundaries, or for people having verbal or other language disabilities or handicaps, to enable them to understand and communicate [21]. These methods or systems usually provide a list of pictograms in either print or digital format, that allows users to express his/her thoughts, or feelings, or to describe a situation by selecting a single or several pictograms and then highlighting or transmitting them to their conversational partner in order to facilitate communication.

In this research, the concepts and features of emoticons and pictograms have been applied to the proposed prototype PCS system and an analysis has been performed into the effects of the “●” image on the ability to support non-verbal expression by encouraging users to create pictogram-like pictorial-text style message using composite symbols and text in conjunction with the “●” prompter. The aim of the pictogram-like pictorial-text style message is to compensate for the missing non-verbal information and to improve emotional and visual expression during text-based conversation. These concepts and features have been applied in the research so as to provide an “environment” for users to create messages using pictogram-like representations, such as emotional and visual expressions, in order to improve the richness of non-verbal expression and encourage communication with a high level of self-disclosure thereby

enhancing the development of deep and intimate interpersonal relationships.

## 2.2 Concepts of the “●” Prompter Communication System (PCS)

Based on the concepts of emoticons and pictograms mentioned in previous sections, the proposed PCS prototype was designed so that simple figures or images could be embed as the “basis” for users to create pictogram-like pictorial-text style messages. Preliminary experiments were conducted by providing a variety of forms that could be utilized by the participants to create messages using composite symbols and text in conjunction with the provided shapes, such as a square, circle or triangle, etc. as the basis for creating messages.

The results of the preliminary experiments suggested that the “●” prompter image was the most appropriate form that could be used as the basis for creating messages when composing symbols and text in text-based communication since alternative potential figures could easily refer to some other fixed or previously formed images and preconceptions. For example, a triangular image may bring to mind the concept of danger or “dangerousness”. In order to determine the most appropriate number of “●” prompter images and the ideal coverage rate on the background of the text-field canvas, further experiments were carried out by providing a variety of coverage rates and by varying the number of “●” prompter images that could be utilized by the participants to create messages using composite symbols and text in conjunction with the “●” prompter images and the results suggested that 1 to 3 circular images with a less than 60% coverage rate of the text-field canvas was the most suitable configuration for enabling participants to compose and create pictogram-like pictorial-text style messages.

The prototype system has also been designed to allow participants to freely insert text or symbols and position them by dragging and dropping them in the desired position on the text-field canvas, enabling users to instinctively and dynamically create pictorial-text form messages. A function for creating messages in series to form semi-animated messages has also been embedded. However, in this study, only four sets of two randomly chosen images were provided for selection by participants in the PCS experiments in order to constrain the time allowed for communication. An alternative system, known as the Normal Communication System (NCS), which does not include an embedded image on the background of the text-field canvas, has also been developed as a comparison to PCS in order to conduct studies into the effectiveness of the embedded “●” prompter image.

### 3 Development of the Prototype “●” Prompter Communication System

#### 3.1 System Concepts and Prototype

The prototype PCS was programmed using the Java™ 2 SDK Standard Edition Version 1.4.1 and is designed to operate in a Windows XP environment. The “●” image that appears on the background of the text-field canvas has been set to be automatically created and positioned using a random variable with an occurrence frequency of 1 to 3 “●” images and a canvas coverage of less than 60% per message, as indicated from the preliminary experimental results.

#### 3.2 PCS Interfaces and Operational Procedures

The initial interface of the PCS is shown in Fig. 1. 1. When the PCS is first launched, three dialog boxes are shown in the program window, which are (a) the Selection Dialog Box, (b) the Creation Dialog Box, and (c) the Communication Dialog Box. The Selection Dialog Box is used to select one set of messages (133 pixels × 106 pixels) from the four sets automatically generated by the system, and contains the “●” prompter image (s) embedded on the background of the text-field canvas. The Creation Dialog Box is used to insert text, characters, or symbols, and then drag and drop them into the desired position on the text-field canvas (200 pixels × 160 pixels). The Communication Dialog Box is used to view the messages created and transmitted by both the user and the conversational partner, and includes two buttons at the top of each message frame which allows users to switch between either of two messages for that particular message set.

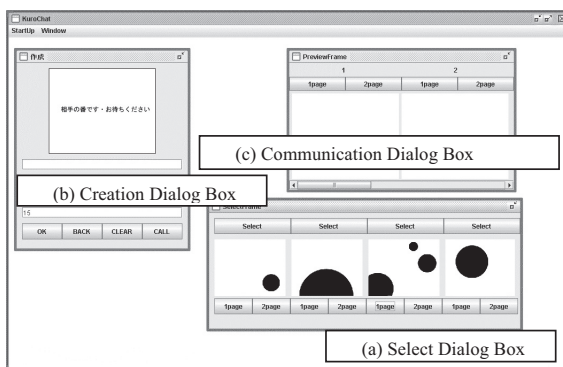


Fig. 1 The initial interface of the PCS when launching the system

An example of the PCS interface after the message set has been selected is shown in Fig. 2. After selecting the set of “●” prompter images from the Selection Dialog Box, the first image from the selected set will be displayed in the Creation Dialog Box to allow users to insert characters text or symbols into the text insert field located below the image, and then drag and drop the inserts onto the image in order to create the message.

The system allows users to freely adjust the font and

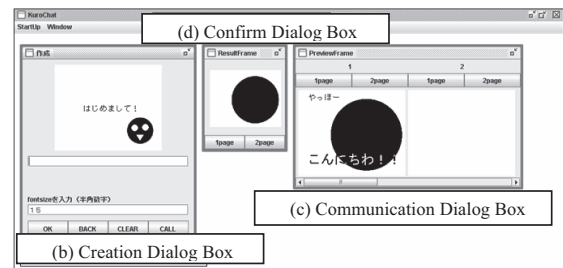


Fig. 2 The PCS interface after the message set is selected from the (a) Selection Dialog Box

size of the inserted text, although the color of the inserts has been limited only to black, which inverts to white when overlapping the background “●” images or other text that users have previously positioned. Messages are created by repeating the above procedure, and then sending them to the conversational partner. The conversational partner views the received messages, and then creates his/her own message using the same procedure and returns it to the other participant in order to continue the conversation.

## 4 Evaluation

### 4.1 Communication Experiment

Experiments were carried out in order to investigate and evaluate whether communication using the PCS with the “●” prompter image randomly embedded on the background of the text-field canvas (PCS condition) has any effect on users in the composition of symbols and text in conjunction with the “●” prompter image and whether it encourages the participants to create more pictogram-like pictorial-text style messages in comparison to using NCS, which has no prompter image on the background (NCS condition). An additional purpose was to evaluate whether pictogram-like pictorial-text style messages encourage a higher level of self-disclosure in text-based communication and further lead to the development of intimate and deep interpersonal relationships.

Two computers with 17-inch monitors were used in the experiments, and were placed in two different rooms and connected via a LAN cable. Both systems used in PCS and NCS conditions allowed users to create characters, symbols and sentences, and drag and drop them into the desired position on the text-field canvas. It should be noted that the only difference between the PCS and the NCS conditions was that the system for the PCS condition had the “●” prompter images embedded on the background of the text-field canvas where the system for the NCS condition did not. The remaining functions of the systems for both conditions were exactly the same.

### 4.2 Participants

The experiment was conducted using a total of 32 undergraduate and graduate students (16 pairs) as participants (24 males and 8 females). The participants



had basic computer skills, but had no experience of either PCS or NCS prior to participating in this experiment. All participants were either classmates or schoolmates, and had met or seen each other during classes or within their faculties.

### 4.3 Method

The participants were randomly paired, and each pair was randomly assigned to either PCS condition or NCS condition. During the experiment, the participants were situated in different rooms in order to prevent verbal communication or facial gestures during the experiment. Before starting the experiment, the instructions were clearly given to the participants, including the experimental procedure, the materials, the machines and the functions of the system. The participants were provided with 30 minutes of practice time in order to ensure familiarity with the system prior to performing the actual experiment. After the conclusion of the practice section, the participants were asked to begin communicating freely using the communication system. The experiment continued for approximately an hour, which was considered to be sufficient time to allow the participants to complete a total of 20 to 30 sets of messages. During the experiment, no conversational topics were provided or suggested. Although, the “●” prompter images embedded on the background of the text-field canvas of the PCS condition could be considered as providing potential conversational suggestions or hints, since this is the main feature of the PCS, it was not regarded as being unduly influential. Moreover, all participants were aware that the use of any text, symbol and/or combination of these, such as emoticons, was allowed in both systems. All messages generated during the experiment were automatically saved to the server as a record for later analysis. After the experiment, an interview was conducted separately with each participant in order to comprehend their rationale and intention towards the contents and expressions within the messages they created.

### 4.4 Experimental Results

A total of 428 messages were collected from the experiment. Figure 3 shows an example of the communication flow between participants from the PCS condition. Message A1-1 in Fig. 3 shows the message set created by Participant A, who saw the provided “●” prompter image as an “appreciation” and created a message to express his/her appreciation to the conversational partner, Participant B. The next message, A1-2, shows that Participant A combined symbols with the provided “●” and formed a “bomb” as the enlarged version of the “appreciation” in message A1-1. Message B1-1 in Fig. 3 shows the message set created by Participant B in replying to Participant A, where Participant B combined

symbols and text with the provided “●” and created a message with the impression of a character running away from the “bomb”. The next message, B1-2, shows that the “character” was run over by the “bomb” from the previous message. Message A2-1 in Fig. 3 shows the next message set created by Participant A, who continued the conversation and created a message with an impression of a character who has been broken into pieces after being run over by the bomb. The communication obtained using PCS were formed and created based on the random layouts and sizes of the provided “●” prompter images, which were often used to represent the key elements for information transmission during the conversation.

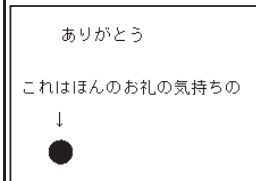

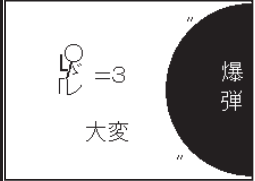
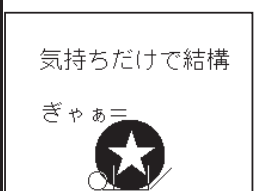
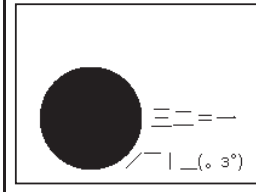
ParticipantA	ParticipantB
<p>A1-1</p>  <p>A1-2</p> 	<p>(A1-1: Top: Thank you. Middle: This is my little appreciation)</p> <p>(A1-2: Right: It is a bomb)</p>
<p>(B1-1: Left bottom: In trouble (terrible), Right: Bomb)</p>  <p>(B1-2: Middle: The appreciation is enough. Bottom: Ah=)</p> 	<p>B1-1</p> <p>B1-2</p>
<p>A2-1</p>  <p>⋮</p> <p>⋮</p> <p>⋮</p>	<p>⋮</p> <p>⋮</p> <p>⋮</p>

Fig. 3 An example of the communication flow created between participants using PCS

Figures 4 and 5 show an example of a message from the PCS condition and NCS condition, respectively. Message 1-1 in Fig. 4 shows that the participant combined a small square with the large “●” prompter image located on the left of the text-field canvas to form a “head”, and drew a stroke from the bottom to the right-side of the image frame to transform the small “●” prompter image located on the right into a “hand” with the stroke indicated as a “death beam” to express his/her message in a pictogram-like pictorial-text form. The next message, 1-2, shows that the participant combined dots of different sizes with the “●” prompter image located in the upper center to form a “head” and then attached squares, lines and circles to the “head” to form the body of the character “Krillin,” a character from the popular comic “Dragon Ball,” in pictorial-text form. The stroke from the bottom left corner to the upper right corner passing through the “body” of “Krillin” indicates the “death beam” from the previous message, which has now shot the “Krillin” character, thereby expressing both the action and story. These two messages in series give a perspective of the imagination and the story that the participant wanted to express in non-verbal visual form and will make little sense, or will generate different interpretation, if not viewed in conjunction with the pictogram-like pictorial-text messages. Message 2-1 in Fig. 5, which was produced using NCS, shows that the

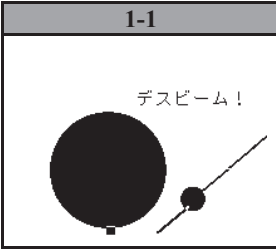
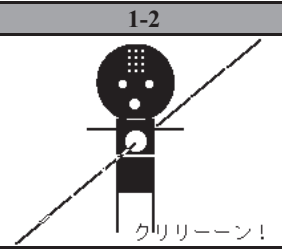
1-1	1-2
	
(Translation - Death beam)	(Translation - Krillin! (The name of a character in the comic Dragon Ball))

Fig. 4 An example of the experimental results from a set of messages created by participants using PCS

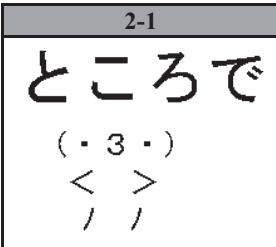
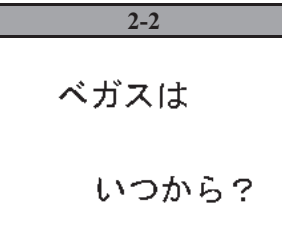
2-1	2-2
	
(Translation - By the way)	(Translation - When are you going to Vegas?)

Fig. 5 An example of the experimental results from a set of messages created by participants using NCS

participant expressed the emphasis phrase “by the way” in large font sizes and positioned the parentheses, dots and the numeral 3 to form a face, and used the less-than sign, the greater-than sign and the solidus to form the body of an emoticon below the text so as to generate emotional and visual expression. The next message, 2-2, shows the expressions “Vegas” at the top and “when are you going?” at the bottom, emphasizing his/her question in a similar style to that of the previous message. These two messages in series give a perspective of what the participants wanted to emphasize by using different font sizes and emoticons.

Figure 6 is another sample of a message from the PCS condition, where the message on the left shows an example of a pictorial-text style message where the participant combined dots, symbols and triangular shapes to form the image of a character with its hand up (center), a seal (right) and a snack (bottom). The message can be interpreted as a scene where the pictorial character is saying “hi” with one hand up, together with a seal and its snack within the space of the message frame. The impression and interpretation of the message would differ without the presence of the non-verbal visual pictorial elements. The message on the right shows an example of a text-only style message as the participant ignored the “●” prompter image and created the message using plain text. Figure 7 is another sample of a message from the NCS condition, where the message on

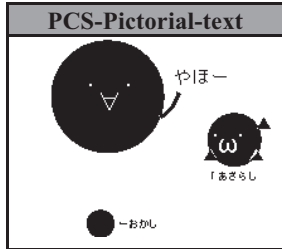

PCS-Pictorial-text	PCS-Text-only
	
(Translation - Top: Hi, Middle: Seal, Bottom: Snack)	(Translation - Middle: Windows ME had a serious error and wasn't able to recover)

Fig. 6 An example of the experimental results from a pictorial-text message and text-only message using PCS


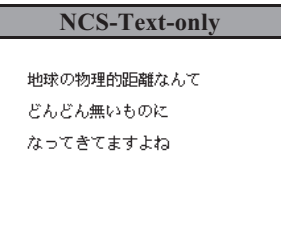
NCS-Pictorial-text	NCS-Text-only
	
(Translation - Bottom: Probably just have dinner with friends)	(Translation - Physical distance of earth has become nothing gradually)

Fig. 7 An example of the experimental results from a pictorial-text message and text-only message using NCS

the left shows an example of a pictorial-text style message as the participant combined a plus sign, the letter o, a solidus, a backslash, an underscore, a line and a tilde to form a Christmas tree corresponding to the textual message at the top, and used a question mark with an underscore to form an emoticon followed by the textual sentence "Probably just have dinner with a friend" to express his/her uncertainty. These non-verbal visual pictorial elements emphasize the status of the season and added flavor to the feelings and thoughts that the participant wanted to express in the message. The message on the right shows an example of a text-only style message as the participant created the message with lines of plain text to express his/her thoughts and feelings.

The average frequency of the appearance of messages in pictorial-text and text-only styles conducted by each pair of participants has been calculated and categorized into either pictorial-text or text-only styles using either PCS or NCS. Figure 8 shows the evaluation results, where the vertical axis indicates the degree of the average frequency of the appearance, and the horizontal axis indicates the style of the message. As shown in Fig. 8, the average frequency of messages evaluated as being pictorial-text for PCS and NCS conditions were 21.75 (Standard Deviation (SD) = 5.8) and 2.5 messages (SD = 5.24), respectively. The average frequency of messages evaluated as being text-only style for PCS and NCS conditions were 7 (SD = 3.7) and 22.25 messages (SD = 6.52), respectively. Further analysis of these results using ANOVA (System (two levels: PCS and NCS conditions)  $\times$  Message Style (two levels: pictorial-text and text-only styles)) revealed no main effects on either the System or Message style. However, a significant interaction of System  $\times$  Message style was observed ( $F(1, 14) = 77.8, p < .01$ ).

This result indicates that there were more messages generated in a pictogram-like pictorial-text style using PCS, whereas messages generated using NCS were founded more on the text-only style than the pictorial-text style. Based on this observation, it can be suggested that

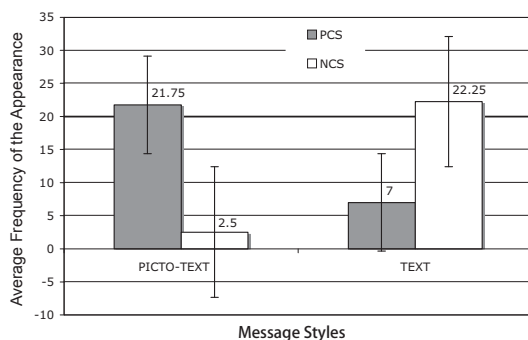


Fig. 8 Average frequency of the appearance of messages in pictorial-text style in comparison with text-only style using both PCS and NCS. Error bars indicate the Standard Error, SE.

communication using PCS with the "●" prompter image encouraged participants to create messages in a pictogram-like pictorial-text visual manner by combining text and symbols onto the "●" image. It may be assumed from these results that communication using PCS potentially provides the opportunity to improve the richness of non-verbal expression during text-based communication and further lead to the development of intimate and deep interpersonal relationships.

#### 4.5 Data Coding and Evaluation for Self-Disclosure Levels

Data coding was applied to all the collected messages by four coders in order to evaluate the degree of self-disclosure within the messages. The methodology and self-disclosure level definitions used for data coding were referenced from the study by Daibo et al. [22], but were altered to enable coders to define and assign those levels to each resultant message produced during the experiment.

##### 4.5.1 Daibo et al's Definitions of Self-Disclosure Levels

Daibo et al. [22] developed definitions that can be used to analyze and categorize verbal and computer-based chat/conversations in order to measure the degree of self-disclosure levels within those conversations. The definitions are divided into five levels, as shown in Table 1, where Level 0 indicates questions, Level 1 indicates the lowest degree of self-disclosure, and Level 5 indicates the highest degree of self-disclosure. It should be noted that no Level 2 was classified in the original definitions.




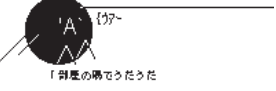
##### 4.5.2 Definition of Self-Disclosure Levels for Evaluating PCS and NCS

Due to the specific features and functions of the PCS, such as the embedding of the "●" prompter images on the background of the text-field canvas as a stimulus in PCS, and the ability to freely position the inserts on the text-field canvas in both PCS and NCS, it was difficult to directly apply Daibo et al's definitions to the messages resulting from the experiment. Therefore, the definitions have been adjusted in order to make the evaluation and assignment of self-disclosure levels within each message possible. Messages evaluated at lower than Level 1 self-disclosure based on Daibo et al's definitions, or those not related to self-disclosure, have been categorized as Level 0. Furthermore, from the experimental results, it was found that expressions or phrases that could be categorized as meeting the criteria for Level 4 of Daibo et al's definition: "Additional information or explanation towards to the conversation topics" and those meeting the criteria for Level 5: "Feelings and thoughts which involve emotional

expression”, are often contained within a single message and the message is therefore difficult to categorize due to the multiple forms. Consequently, in order to evaluate the messages generated using either PCS or NCS, Level 4 and Level 5 of Daibo et al’s definitions have been amended and combined into a single level, Level 4.

The amended definitions of the self-disclosure levels are as follows, where Level 0 refers to questions and messages evaluated at lower than Level 1 self-disclosure or not related to self-disclosure, Level 1 refers to information with a low degree of self-disclosure, Level 3 refers to information with a medium degree of self-disclosure and Level 4 refers to information with a high degree of self-disclosure. The original Daibo et al’s definitions and the examples of the equivalent altered definitions for the evaluation in this study are shown in Table 1.

Table 1 Daibo et al’s definitions and equivalent altered definitions of self-disclosure levels

Daibo et al’s definitions of self-disclosure levels	Equivalent definitions of self-disclosure levels for PCS’s evaluation
Level 0 - Questions, messages with lower than Level 1 self-disclosure or having no relationship to self-disclosure	<p>今研究どうなってるー？</p>  <p>(Translation: How’s the research going?)</p>
Level 1 - Yes/No responses, includes basic facts, repeats the questions or simple answers.	 <p>普通だよ～。君は？</p> <p>(Translation: Normal~. How about you?)</p>
Level 3 - Response to the questions with facts and agreements.	 <p>なかなかうまくいかない</p> <p>(Translation: It is not really going well...)</p>
Level 4 - Additional information or explanation of the conversation topics have been expressed, which leads or gives direction to the discussion. Inner Feelings and thoughts that involve emotional expression have been expressed.	 <p>ダメっばい</p> <p>(Translation - Top: In the corner of the room...) (Translation - Bottom: I don’t think it is going to work out.)</p>

#### 4.6 Data Coding and Evaluation Results

As mentioned in Section 4.4, a total of 428 messages were collected and data coding was applied by four coders in order to evaluate and assign levels of self-disclosure to each resultant message. Among the 428 messages, 230 were messages produced from the PCS condition, and 198 were messages from the NCS condition. The evaluation results were assigned to the corresponding self-disclosure levels based on a majority rule, where messages with equal evaluations have been counted as 0.5 messages for each corresponding level, and messages with split evaluations have been counted as 0.25 messages for each corresponding level. Examples of evaluated results for the different self-disclosure levels are shown in Figs. 9 and 10, where the examples shown on the left side of each figure are the results from the PCS condition, and those on the right side are the results from the NCS condition.

The left side of Fig. 9 shows an example where the participant combined a hyphen and a solidus with the provided “●” images located in opposite corners of the text-field canvas and created images of the South and North Poles with a textual expression of “What’s this?” in the middle as a repetition of the question posed by the

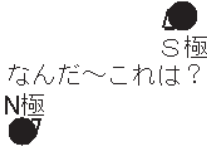
Level 0 PCS’s result	Level 0 NCS’s result
 <p>なんだ～これは？</p>	失踪？
(Translation - Top: South Pole Middle: What’s this? Bottom: North Pole)	(Translation - Disappeared?)

Fig. 9 Examples of experimental result messages categorized as Level 0 self-disclosure using both PCS and NCS.


Level 4 of PCS’s result	Level 4 of NCS’s result
 <p>ダメっばい</p>	<p>好きにできるのも 今だけ！！！！</p> <p>って感じですかね</p> <p>偉そうに言うことでもないですけどね</p>
(Translation - Top: sigh~ Middle: Corner of the room Bottom: Doesn’t seem good)	(Translation - Top: You can be as you like only now!!! Middle: Somehow feel so Bottom: Although it is not something so important to mention)

Fig. 10 Examples of experimental result messages categorized as Level 4 self-disclosure using both PCS and NCS.



conversational partner earlier in the conversation. On the right side of Fig. 9 is an example where the participant positioned the textual expression “Disappeared?” in the upper center using a small font so as to leave some empty space in the middle of the text-field canvas for emphasis, and to pose a question back to the conversational partner.

An example of a message created using PCS evaluated as Level 4 self-disclosure is shown on the left of Fig. 10, where the participant combined a comma, the letter A, a circumflex accent, an underscore and a vertical line with the provided “●” image located in the upper left corner of the text-field canvas and created a message featuring someone sitting in the corner of a room with knees bent and with the textual expression of “sigh~” close to the face and “doesn’t seem good” in the bottom right corner to create a scene with atmosphere that emphasizes and expresses her/his inner feelings and thoughts. An example of a message created using NCS evaluated as Level 4 self-disclosure is shown on the right of Fig. 10, where the participant expressed his/her inner thoughts and opinions in lines of sentences and positioned them on the text-field canvas using different font sizes to emphasize those thoughts and opinions.

The average frequency of the appearance of each self-disclosure level in messages produced by each pair of participants based on either a pictorial-text or text-only style using PCS and NCS have been calculated and categorized into the different self-disclosure levels for both PCS and NCS conditions, as shown in Figs. 11 (PCS) and Fig. 12 (NCS), respectively. The vertical axis indicates the degree of the average frequency of the appearance of the self-disclosure level, and the horizontal axis indicates the different self-disclosure categories.

As shown in Fig. 11, the degree of the average frequency of the appearance of each self-disclosure level for the pictorial-text style is generally higher than for the text-

only style for PCS condition. The highest degree was shown to be the pictorial-text style for Level 4 self-disclosure, and the lowest was the text-only style for Level 3 self-disclosure. As shown in Fig. 12, the degree of the average frequency of the appearance for each self-disclosure level for the NCS condition was generally higher for the text-only style than the pictorial-text style. The style with the highest degree was the text-only style in Level 4 self-disclosure and the lowest was the pictorial-text style in Level 0 self-disclosure.

Further analysis of these evaluation results using ANOVA (System (two levels: PCS & NCS)  $\times$  Message Style (two levels: Pictorial-Text and Text-only styles)  $\times$  SD Level (four levels)) revealed a significant main effect in SD Level, ( $F(3, 42) = 26.98, p < .001$ ), but no significant main effect in either the System or the Message style. Further, significant interaction of System  $\times$  Message ( $F(1, 14) = 77.77, p < .001$ ), System  $\times$  SD Level ( $F(3, 42) = 3.55, p < .05$ ), and System  $\times$  Message Style  $\times$  SD Level ( $F(3, 42) = 12.69, p < .005$ ) was observed, but no significant interaction of Message Style  $\times$  SD Level was found. The subordinate analyses for the interaction of System  $\times$  SD Level revealed a significant simple effect in System  $\times$  SD Level 0 ( $F(1, 56) = 1.00, p > .005$ ), System  $\times$  SD Level 1 ( $F(1, 56) = 1.71, p > .005$ ), System  $\times$  SD Level 3 ( $F(1, 56) = 0.12, p > .005$ ) and System  $\times$  SD Level 4 ( $F(1, 56) = 8.62, p < .005$ ).

These observations suggest that messages created using PCS resulted in a greater number of messages with information of a high degree of self-disclosure in the pictorial-text style, and messages created using NCS resulted in a greater number of messages with information of a high degree of self-disclosure in the text-only style. However, the evaluation results indicate that messages obtained using PCS generally resulted in a greater number of messages with information of a high degree of self-disclosure compared to messages obtained using NCS.

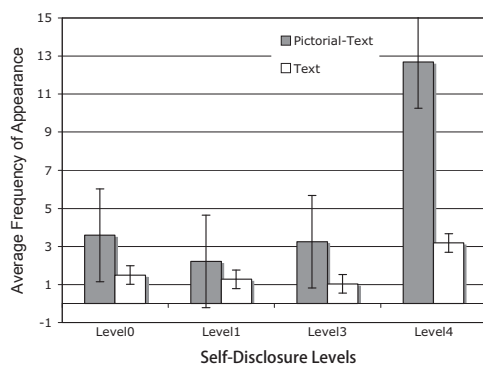


Fig. 11 The average frequency of the appearance of self-disclosure levels within experimental result messages between pictorial-text and text-only styles using PCS. Error bars indicate the Standard Error, SE.

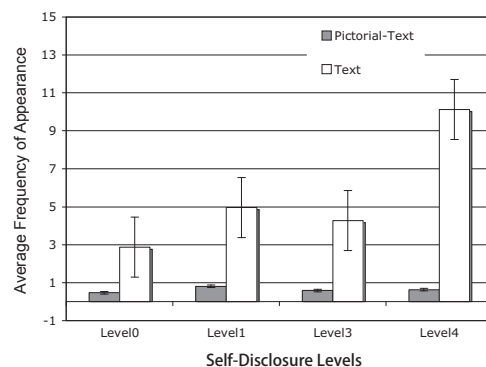


Fig. 12 The average frequency of the appearance of self-disclosure levels within experimental result messages between pictorial-text and text-only styles using NCS. Error bars indicate the Standard Error, SE.

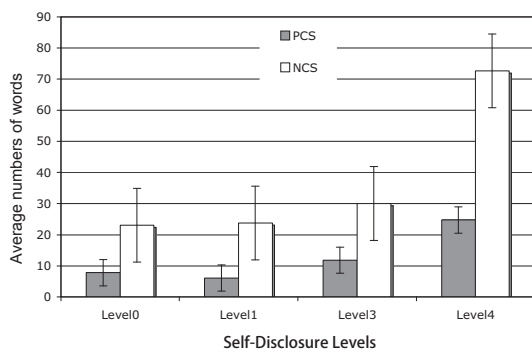


Fig. 13 The average number of words in each message for each self-disclosure level for both PCS and NCS. Error bars indicate the Standard Error, SE.

Fig. 13 shows the average number of words used in each message derived by counting the number of words used in each message for each self-disclosure level, and the average number of words for each message used in each category of self-disclosure level. Messages created using PCS had 7.8 words (SD=4.23) for Level 0 self-disclosure, 6.09 words (SD=3.23) for Level 1, 11.84 words (SD=6.76) for Level 3 and 24.74 words (SD=12.02) for Level 4 on average. Messages created using NCS had 23.10 words (SD=10.30) for Level 0 self-disclosure, 23.81 words (SD=14.61) for Level 1, 30.05 words (SD=14.37) for Level 3 and 72.5 words (SD=30.91) for Level 4 on average. ANOVA (System (two levels: PCS & NCS)  $\times$  SD Level (four levels)) analysis conducted on the average number of words in each message revealed a significant main effect of System ( $F(1, 14) = 19.3, p < .001$ ), a significant main effect of SD Level ( $F(3, 42) = 36, p < .001$ ) and an interaction of System  $\times$  SD Levels ( $F(3, 42) = 8.38, p < .01$ ). These results suggest that messages created using PCS were able to transmit and express information, including information with a high level self-disclosure, by employing 65% fewer textual expressions than was required to express a similar level of self-disclosure information in messages created using NCS.

From these observations, it can be strongly suggested that communication using PCS had a significant effect on supporting non-verbal expression by creating pictorial-text style messages, which not only contain simple meanings or emotional cues, but were also able to transmit and express information with a high degree of self-disclosure.

## 5 Conclusion

In this paper, an approach to supporting pictogram-like pictorial-text expression in text-based CMCs designed to improve the richness of non-verbal expression in order to encourage mutual understanding and high self-disclosure has been proposed, studied and evaluated. The proposed

Prompter Communication System (PCS) is a text-based communication system in which 1 to 3 black circular “●” prompter images are embedded on the background of a text-field canvas as the basis for users to compose symbols and text in order to create pictorial representations of non-verbal expressions, such as emotional or visual expressions, together with textual expressions. The concepts and features of emoticons and pictograms were applied when designing the prototype system. Communication experiments using the prototype PCS were conducted and its effectiveness examined. The results indicated that communication using the PCS with “●” prompter images embedded on the background of a text-field canvas had an effect on the participants, encouraging the construction of a combination of symbols and text with the provided “●” prompter image thereby creating a pictorial representation of non-verbal expressions that expressed their thoughts or feelings in a pictogram-like pictorial-text form. In addition, further analysis into self-disclosure levels within the resultant messages indicated that messages created using PCS not only contain information with simple meanings or emotional cues, but also information with a high level of self-disclosure requiring 65% fewer textual expressions in comparison to using NCS. These results suggest that communication using PCS may improve the richness of non-verbal expression in order to encourage mutual understanding and further lead to the development of intimate and deep interpersonal relationships. Although this study has shown the effect on non-verbal expression in a text-based CMC using the “●” prompter image as the basis for users to compose symbols and text in order to create pictogram-like pictorial-text expressions, studies and analysis into the effects on non-verbal expressions using other images and figures, as well as variations in color and the temporal (time consumption) aspects of communication using PCS and other communicating systems have not been considered in this study and remain an open question for future work.

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