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Doctoral Dissertation

Research on Communication Means for Prompting
Mutual Understanding and Self-Disclosure
相互理解と自己開示を促進するコミュニケーション手段に関する研究

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Summary

Communication is one of the most important factors for encouraging and sustaining personal relationships between individuals. The rapid development of technology has provided us with numerous methods, styles and channels for communication, such as mobile phones, electronic mail, chat or Social Network Services (SNS). These new types of communication, known as Computer Mediated Communication (CMC), have attracted a great deal of attention and interest, especially with regard to relationship formation, such as gaining mutual understanding and its effect on revealing information with high self-disclosure.

Many theories and systems for supporting self-disclosure and gaining mutual understanding in order to further lead to the development of intimate relationships through CMC have been proposed. These studies have confirmed that each of these systems is able to assist users in communicating with others with a higher level of inner self-expression or self-disclosure. However, telecommunication users may not have common knowledge and/or topics, and/or do not share one common space. This causes difficulties in continuing the conversation; therefore, mutual understanding is not deepened. In the case of existing telecommunication systems, the lack of the ability to pre-select emoticons and pictographs that can be used to express the user’s emotions or feelings could cause difficulties in encouraging self-disclosure by users; similarly, the constraints of actions and expressions of virtual agents and the virtual medium could also raise self-disclosure concerns. These issues are mainly caused by the fact that “beyond greeting level” conversation and/or full and free expressions of emotions or actions are virtually impossible.

This dissertation proposes a new communication means that is aimed at encouraging mutual understanding and self-disclosure between remote telecommunication users. The proposed communication method, which is motivated by Hasegawa’s manual operation-based technique for creating stories for fairy tales, randomly generates visual images that include black circle(s) called prompter(s) embedded on the background of a text-field canvas. More specifically, the proposed communication method, which is
called the Prompter Communication System (PCS) in the following, allows a participant to freely insert text or symbols and drag them to the desired position(s) on the text-field canvas so that a message is created in conjunction with the randomly generated visual image(s). Then, the participant sends the created message to his/her telecommunication partner via the network. As soon as the partner receives and views the message, another random visual image containing prompter(s) is generated for the partner. Using the generated image, the partner creates a message in reply using the above-mentioned procedure and sends it to the first participant. This process is then repeated to continue the conversation.

The PCS is considered to be modeled on the concepts of the Geneplore model, which describes the cognitive process of creative thinking, because the PCS is founded on the story creation process and is a communication means by which users construct messages based on new creative ideas prompted by the received message. In addition, the process for creating a prompter message can be modeled as a reflection or projection of the user’s mental representations. Consequently, by considering these models that describe the PCS, this thesis generates the following hypotheses to be verified:

(1) Based on the Geneplore model, the PCS can prompt users to create new topics for conversation and/or to frequently change from one topic to another so that mutual understanding between participants can be deepened.

(2) Based on the properties of the projection and reflection of mental representation, the PCS can encourage users to disclose more information about themselves: i.e., self-disclosure can be enhanced by using the PCS.

(3) Based on both the Geneplore model and the projection/reflection theory, users can create and express conceived ideas and generate mental representations by combining prompter(s) and text/symbols so that both mutual understanding and self-disclosure can be promoted.

The verification of these hypotheses by this thesis is described as follows.

Chapter 1 is the Introduction, which consists of the background, the related work, the purpose, the proposed approach and the organization of this thesis.

Chapter 2 describes the motivation and concepts of the PCS. Then, theories that
describe the PCS are explained, and an illustration of the implementation of the PCS is provided.

Chapter 3 explores whether hypothesis (1) can be verified. From the concepts developed by the Genelplore model, the PCS could prompt conversational topics and/or informal communication by telecommunication users; in addition, the PCS could foster the conception and switching of conversational topics during telecommunication sessions. Communication experiments using the prototype of the PCS were conducted. The experimental results suggest that the PCS encourages the conception of topics that are strongly related to conversations, such as discussions about the current situation related to either or both of the participants, inner feelings and thoughts combined with shared knowledge. Furthermore, an effect on deepening mutual understanding between the participants is confirmed.

Chapter 4 explores hypothesis (2). Founded on the projection/reflection theories, the PCS could influence users to associate ambiguous figures, such as the prompter image(s), with mental representations generated based on self-projection or self-reflection. This property could encourage users to reveal information with high self-disclosure during conversations. Communication experiments using the PCS and a comparison system, the Normal Communication System (NCS), which is implemented using only a plain text-field canvas without the prompter image(s), have been conducted. Experimental results indicate that communication conducted using the PCS results in an increased number of messages with the prompter images involved as part of the message contents rather than as background images. Further analysis into the self-disclosure level of the message contents and the relationships between the degree of self-disclosure and the representations of the prompter image(s) within the messages indicates that the degree of self-disclosure increases when the prompter images are used to represent the participant him/herself, or the participants thoughts and emotions, and decreases when the prompter images are used to represent animals or objects, or when the prompter images presented within the messages are ignored. Investigations into differences in self-disclosure level between message contents from the PCS and the NCS show that the PCS results in generally higher degrees in the average frequency of the appearance of high self-disclosure information than the NCS.
Chapter 5 explores hypothesis (3). Based on both the Genelore model and the projection/reflection theories, the PCS could support and encourage pictorial-text style communication by participants using text and symbols in conjunction with the prompter image(s), to compensate for the lack of non-verbal information and to improve emotional and visual expression. Experiments designed to explore the ability of the PCS to support non-verbal expression by encouraging the creation of pictogram-like, pictorial-text messages are conducted. It is observed that the PCS is able to enhance and enrich the user experience and encourage participants to express their thoughts, feelings and emotions in a pictorial-text style, thereby mitigating the lack of emotional and visual expression in plain text messages, which is an essential element for both intimacy and the development of deep interpersonal relationships. Communication experiments that compare the PCS with the NCS are conducted. The experimental results indicate that the PCS encourages a larger number of messages based on the pictorial-text style than the NCS.

In Chapter 6, a conclusion is given and future works are described.
Chapter 1
Introduction

1.1 Background

Communication is one of the most important factors for encouraging and sustaining personal relationships between individuals. The rapid development of technology has provided us with numerous methods, styles and channels for communication, such as mobile phones, electronic mail, chat or Social Network Services (SNS). These new types of media allow individuals to release, share, access, and interact with each other much more easily than in earlier times. However, at the same time, they prevent individuals from gaining information other than what is consciously released and shared [1], and the lack of non-verbal expression and the information shared during communication where a physical presence exists, such as emotional expressions and gestures, and information with high self-disclosure, have raised concerns [2].

A number of studies have indicated that computer-mediated communication (CMC), with its inherent anonymity, provides a shell for an individual to reveal his or her true self through private information and emotions without a sense of anxiety. Other research has presented alternative observations and has indicated that such a shell helps the individual to disguise or hide his/her true self. Several investigations into communication have indicated that certain individuals still find it difficult to reveal information with high self-disclosure and gain mutual understanding with others. This information includes the inner thoughts, emotions, problems and difficulties related to the individual, lack of knowledge sharing and collaboration, which result in a failure to initiate the development of intimate and deep interpersonal relationships with others [3][4].

There have been several studies indicating that, regardless of the communication media and methods, intimate and deep interpersonal relationships result from communications with high self-disclosure [5][6] and mutual understanding between
individuals. 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 favorites, etc. [6][7]. This basic self-disclosure usually occurs early in the development of the relationship, thereby forming the initial impression between individuals [8], but more intimate self-disclosure is usually observed later in the relationship [9][10]. Mutual understanding presupposes a common ground consisting of shared information, mutual knowledge, mutual beliefs, and mutual assumptions [51]. In the process of grounding this information and knowledge, conversation participants seek positive evidence of understanding via external sources such as feedback, acknowledgement through back-channel responses, continued attention, and the initiation of the relevant “next turn” in the conversation [52]. The relevant “next turns” can be produced in all kinds of media, whereas back-channel responses and signaling continued attention, such as eye gazing, require a form of co-presence similar to face-to-face communication [53]. However, it is very difficult to measure and determine whether or not mutual understanding has been achieved, therefore, the degree of revelation of personal information or self-disclosure might be seen as a parameter for determining the observable mutual understanding, since mutual understanding would not be possible to achieve without revealing personal information or self-disclosure. According to this assumption, the greater the revelation of personal information or self-disclosure, the higher the possibility of mutual understanding that can be obtained.

As online social interaction and communication have become a pervasive phenomenon, CMC has attracted a great deal of attention and interest with regard to relationship formation and its effect on self-disclosure. These studies have routinely investigated communication undertaken founded on CMC settings in comparison with face-to-face settings, or with video conferencing settings, and have have indicated that CMC communication settings generate information with a similar or higher self-disclosure level than those of face-to-face settings and video conferencing [1][11]. Although there have been many studies into the effects of CMCs on encouraging mutual understanding and self-disclosure in a text-based environment in order to encourage the further development of intimate and deep personal relationships, studies using stimuli to inspire the conception of conversational topics and promote the projection and expression of mental representations using a combination of text and symbols in order
to encourage mutual understanding and reveal information with higher self-disclosure, are rarely found.

The definition of prompting is the action of saying or doing something to persuade, encourage, or remind someone to do or say something in response [61]. However, the essence of the prompting portrayed in this research is closer to the concept of stimulating, persuading, inducing, promoting or encouraging someone to conceive ideas, conversational topics, or stories, either consciously or unconsciously, in order to share or reveal knowledge and information about oneself, and support the aim of this research so as to encourage higher self-disclosure and promote mutual understanding. The prompting method using the ambiguous image(s) is aimed at removing cognitive constraints, such as, for example, a yellow circle is easily associated with the moon or the sun, and allowing users to conceive, imagine, project or reflect their ideas or mental representations more purely, without cognitive distractions, when creating messages in order to fully express their imagination, messages or themselves. By sharing such information, images or messages, users may gain more information about each other, and at the same time, may also be able to discover more about themselves, which leads to better or deeper relationships between individuals.

1.2 Related Works

Many theories and systems for supporting self-disclosure and gaining mutual understanding in order to further lead to the development of intimate relationships through CMC have been proposed. Several studies have proposed systems that use visual cues, such as virtual agents, Virtual Reality and photographs, to share virtual presence, co-presence, social presence and self-awareness in a virtual environment. Each of these systems aim to compensate for physical absence and foster higher self-disclosure or discourse [11-13]. Other studies have proposed systems that provide emotional icons or pictographs to convey social emotions and increase non-verbal information exchanges. These systems are aimed at reducing 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 a selection of pictograms or visual symbols that can be implemented by users with language differences, disabilities
or handicaps in order to minimize hardship or boundaries when communicating [15]. Other studies have provided text-based web surveys or forums in order to promote communication with higher self-disclosure information and to increase the level of intimacy for interpersonal relationships [16].

These studies have confirmed that each of the systems mentioned are able to assist users in communicating with others with a higher level of inner self-expression or self-disclosure. However, the limitations and constraints of the systems, such as a lack of the ability to pre-select emoticons and pictographs, or constraints on the actions and expressions of virtual agents and the virtual medium could also raise concerns. These issues are mainly related to the concept of not being able to fully and freely express emotions or actions.

From 1960 to 1970, human-machine interaction systems, such as ELIZA, were quite famous and well known. ELIZA was a computer program that was an early example of primitive natural language processing. ELIZA was operated by processing user responses to scripts, and was implemented using simple pattern matching techniques [54]. Although ELIZA had an effect on inducing users to prompt conversation, it was one of the first chatterbots aimed at human-machine interaction in the artificial intelligence arena rather than aimed at prompting users for ideas for conversational topics.

Research into prompting users for ideas for conversations is very limited. As mentioned in the dissertation, that research usually provides a system that allows users to co-exist or physically represent themselves, using avatars or images, etc., as if they are in the same room or in a virtual space in order to encourage the formation of informal communication [55], or provides images and/or topics, etc., to prompt users to discuss or share information in order to encourage informal communication [56]. The most well-known techniques used as prompting methods, so-called response prompting procedures [57], have often been used for teaching chained tasks to infants and adults with mild to profound intellectual disabilities, autism or developmental delays. Response prompting techniques are systematic strategies used to increase the probability of correct responses, and as opportunities for positive reinforcement for learners by providing and then systematically removing prompts. The goal of response
prompting is to transfer stimulus control from the prompt to the desired discriminative stimulus and is quite different to the purpose of this research, which is to prompt ideas for conversational topics.

Other research related to prompting covers issues such as writing skills training where the aim is to support the process of writing rather than the input of the contents, and these methods prompt the trainee when necessary by referring to a flowchart or a help sheet, or to explanations, such as encouraging the trainee to think of a good word to use or have a good idea to write [58]. Other research, such as providing topics, themes, unfinished sentences or phrases, allow users to complete and create their own story using their imagination, or to apply the divergent thinking method that combines or integrates the inserted words, or to support and group the relevant words together and try to generate new ideas based on those words [59-60]. Those methods provide clear support for the user to achieve their goals, while, at the same time, restricting them from thinking freely without constraints.

In semiotics, a sign is something that can be interpreted as having a meaning, and is therefore able to communicate the information by interpreting or decoding the sign between individuals. A symbol is something that represents an idea, a process, or a physical entity and its purpose is to communicate a meaning, such as a red octagon may be referred to as “stop”. Whereas, a pictogram or pictograph is an ideogram that conveys its meaning through its pictorial resemblance to a physical object. Pictographs are often used in writing and graphic systems in which the characters are, to a considerable extent, pictorial in appearance and can be seen as a form of writing which uses representational, pictorial drawings.

Early written symbols were based on pictographs (pictures which resemble what they signify) and ideograms (symbols which represent ideas). Ancient Sumerian, Egyptian, and Chinese civilizations began to use such symbols over time, developing them into logographic writing systems. While developing them into these systems, meanings regarding the symbol have been constrained and limited to avoid ambiguity and confusion, which, at the same time, also diminished the richness and depth of its meaning and expression. This may seem to be one of the reasons for the lack of nonverbal expressions in text-based communication. The proposed communication
method is the opposite in comparison to the usual sign/symbolic communication methods, where the ambiguity is an essential element or feature of the method/system. The ambiguity of the provided medium allows users to imagine, create, express and transmit information that conveys more than verbal expressions in order to gain better understanding between individuals.

1.3 Purpose of the Research

Based on these notions, the purpose of this research is to propose a new communication method and a prototype text-based CMC system that is aimed at:

- Supporting the deepening of mutual understanding during informal communications
- Encouraging the revelation of information of higher self-disclosure between users

An investigation into and an evaluation of the proposed method and its ability to support mutual understanding and self-disclosure, as well as its effects, have been conducted.

1.4 Approach of the Research

In this dissertation, a new communication means aimed at encouraging mutual understanding and self-disclosure between remote users is proposed. The proposed communication method, which is motivated by Hasegawa’s manual operation-based technique for creating stories for fairy tales [17], was designed founded on the concepts of the Geneplore model [18], and integrated with the features of emoticons and pictograms [2], together with the notions of self-projection and self-reflection [19]. The main functional characteristic of the method is that it includes one to three black circular prompter images (“●”), referred to as “●” prompter image(s) in the following, are randomly embedded on the background of a text-field canvas. The “●” prompter image(s) represent an ambiguous figure which motivates the participants to use their imagination and turn the “●” prompter image(s) into any form, object, or emotion, etc., whereas other fixed representations, such as an avatar, can only represent the participant
him/herself and places limits on users in their imagination or creativity. More specifically, the proposed communication method allows participants to freely insert text or symbols and position them by dragging and dropping them to the desired position on the text-field canvas, thereby creating messages in conjunction with the randomly embedded “●” prompter image(s). After the creation is complete, participants send the messages to their conversation partner via the network. The conversational partner views the received messages, and then creates his/her message in reply using the same procedure and returns it to the participant in order to continue the conversation.

The PCS is considered to be modeled on the concepts of the Geneplore Model, which describes the cognitive process of creative thinking, because the PCS is founded on the story creation process and is a communication means by which the users construct messages based on new creative ideas prompted by the received message. In addition, the process for creating a prompter image message can be modeled as a reflection or projection of the user’s mental representations. Consequently, by considering these models that describe the PCS, this thesis generates the following hypotheses to be verified.

(1) Based on the Geneplore model, the PCS can prompt users to create new topics for conversation and/or to frequently change from one topic to another so that mutual understanding between telecommunication users can be deepened.

(2) Based on the PCS’s properties of the projection and reflection of mental representation, the PCS can encourage users to disclose more information about themselves: i.e., self-disclosures can be enhanced by using the PCS.

(3) Based on both the Geneplore model and the projection/reflection theory, users can create and express new representations by combining prompter(s) and text/symbols so that both mutual understanding and self-disclosure can be promoted.

These hypotheses have been verified and investigated through subjective evaluation experiments conducted using the proposed prototype system, the PCS, and a psychological analysis performed with the degree of self-disclosure level used as the measurement parameter.
1.5 Structure of the Dissertation

The structure of this dissertation is shown in Fig. 1.1, and the remainder of this dissertation is organized as follows:

Chapter 1 is the Introduction, and consists of the background, the related work, the purpose, the proposed approach and the structure of this thesis.

In Chapter 2, the motivation for the research, the concepts and theories of the proposed communication method, the models and theories of the PCS, the hypotheses generated by the models and theories, the details of the PCS used for verifying the hypotheses, and the implementation details of the PCS are introduced and explained.

Chapter 3 explores whether hypothesis (1) can be verified. This chapter introduces and evaluates the ability of the PCS to promote the conception of conversational topics by participants and encourage mutual understanding in order to support informal communication between distant users. The PCS is designed based on the concept of the Geneplore Model, and its basic functions are intended to foster the conception and switching of conversational topics during informal communication. Communication experiments using the prototype PCS have been conducted and are described in detail with the evaluated results and discussions related to mutual understanding.

Chapter 4 explores hypothesis (2), and introduces and evaluates the PCS for supporting the self-projection or self-reflection of generated mental representations onto the “●” prompter image(s) in order to encourage the revelation of information with high self-disclosure during communications. Communication experiments using the PCS and the comparison system, the Normal Communication System (NCS), are conducted. The experimental results are categorized for further analysis using the degree of self-disclosure level as the measurement parameter. The details of the statistical evaluation results are described and discussed in reference to self-disclosure.

Chapter 5 explores hypothesis (3), and introduces and evaluates the PCS for supporting and encouraging communication using a combination of text and symbols in conjunction with the “●” prompter image(s) in a pictorial-text style so as to compensate for missing non-verbal information, and to improve emotional and visual expression.
during text-based conversation in order to encourage mutual understanding and higher self-disclosure. The ability to support non-verbal expression by encouraging the creation of pictogram-like, pictorial-text messages is examined. The experimental results are categorized into pictorial-text style or text-only style and further investigation into the degree of self-disclosure for both styles is conducted and described in detail with regard to mutual understanding and self-disclosure.

In Chapter 6, the conclusion to the dissertation is provided and potential future works are discussed.
Figure 1.1 The structure of this dissertation
Chapter 2
Prompter Communication System

2.1 Motivation for the Research

The foundation and motivation for the research into the proposed method was originally inspired by a Japanese book entitled “Ehon-Zukuri (Picture/illustrated book making) Training”, by S. Hasegawa [17]. Among the methods proposed by S. Hasegawa, the method of making the “●” Obento (Lunch box) Picture/illustrated Book” has inspired and motivated us to apply the motif and features into text-based CMC methods. The procedure for making the “Obento Picture/illustrated Book” is shown in Fig. 2.1 and Fig. 2.2, an example of which is as follows:

1. Draw a black circle (“●”) in the middle of a paper card.
2. Glue the paper card with the black circle to another blank paper card and create the two paper cards as a set.
3. Draw various types of black circles on the blank paper cards of the set.
4. Repeat steps 1 to 3 and make 7 sets of paper cards.
5. Shuffle and exchange the paper cards with friends so as to randomize the order of the paper cards.
6. Bind the 7 sets of paper cards with a black paper card and make it into a booklet.
7. Flip through the booklet, and create a story that fits the variations of the black circles within the booklet.
8. Write textural expressions onto each paper cards to describe the story.
9. Write the title of the story and the name of the author on the cover of the booklet.
Figure 2.1 The procedure for how to make an illustrated “●” picture book (part 1)

1. Draw a black circle (“●”) in the middle of a paper card.
2. Fold in half.
3. Glue the paper card with the (“●”) to another blank paper card and create the two paper cards as a set.
4. Draw various types of black circles (“●”) on the blank paper cards of the set.

Repeat steps 1 to 3 and make 7 sets of paper cards.
Figure 2.2 The procedure for how to make an illustrated “●” picture book (part 2)

5. Place the cards on top of each other.

6. Bind the 7 sets of paper cards using a black paper card

7. Make it into a booklet.

Flip through the booklet and create a story to fit the variations of the black circles (“●”) within the booklet.

8. Write textural expressions onto each paper card to describe the story.

9. Write the title of the story and the name of the author
There are two important features mentioned in the book: the “contingency/fortuitous” aspect, and the “turn-over-the-page effects” aspect, which stimulate the unexpected or undiscovered creativity/imagination of the viewers. The “contingency/fortuitous” aspect of the black circles resulting from shuffling and exchanging the paper cards may be the visual stimulus that inspires the viewer to create a story beyond their own imagination. The “turn-over-the-page effects” aspect is similar to the “montage” technique used in film editing, in which a series of short shots are edited into a sequence to condense space, time and information [20]. As the viewer moves through the pages, the black circles appear on the pages in different sizes, positions and number as a condensed sequence of information. The information lacking within the condensed sequence is compensated for by the imagination of the viewer, which, as a consequence, may stimulate and train the ability of creativity.

2.2 Proposed Communication Means: Prompter Communication System

2.2.1 Conceptual Proposal of Prompter Communication System

The suggestion of using black circle as motifs and create picture/illustrated book and the features mentioned above has inspired and motivated the authors to propose a new communication method aimed at promoting the initiation of conversations and mental representations that reveal inner thoughts and feelings using ambiguous images/shapes as the motif/stimuli for text-based CMC techniques.

The shapes of the ambiguous images embedded on the background of the text-field canvas were chosen based on preliminary experiments conducted beforehand. The author et al. made a comparison between the shapes, such as a square or a triangle, etc., and the use of different colors for a variety of ambiguous figures, and the results suggested that a black circle, referred to as the “●” prompter image(s) in the following, having sufficient ambiguity to allow participants to represent it as any form, object, or emotion, was the most appropriate design that could be used as the stimuli and as the embryonic basis for creating messages [18]. The “●” prompter image(s) 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 “●” prompter image(s) and a canvas coverage rate (the ratio of the area of the background and the prompter) of less than 60% per message, which was determined to be the ideal number of prompter images and most suitable coverage rate required for users to create messages, as indicated from the preliminary experimental results [18].

The concept of the proposed communication method is as follows, as shown in Fig. 2.3.

1. The system randomly generates the “●” prompter image(s) on the background of the text-field canvas as stimuli.
2. UserA views the randomly generated “●” prompter image(s) and is stimulated by the images.
3. UserA is inspired by the randomly generated “●” prompter image(s) and conceives ideas or mental representations.
4. UserA inserts text and symbols and creates a message in conjunction with the “●” prompter image(s).
5. UserA sends the created message to UserB via the network.
6. UserB views the received message and creates his/her own message by repeating steps 1 to 4 and sends the created message in reply to UserA.
Randomly generate 2 messages with the “●” prompter image(s) on the background of text-field canvas

UserA views the messages with randomly generated “●” prompter image(s) and is stimulated by the images

UserB views the received message and creates his/her message in reply by repeating the above procedure

UserB views the received message and creates his/her message in reply by repeating the above procedure

UserA sends the created messages via LAN to conversational partner UserB

UserA inserts text or symbols in conjunction with the “●” prompter image(s) to create a message

Figure 2.3 Concept of the proposed communication method containing ambiguous images
2.2.2 Concept, Theory and Background

As illustrated in Fig. 2.4, the PCS can be considered as being founded on the Geneplore Model, which was first introduced by Finke et al. in 1992 [18]. The aim of the Geneplore model was to delineate the cognitive processes involved in domain-independent creative activities. According to the Geneplore model, creative activity is the process of generating, exploring, refining, and then regenerating mental representations in the service of task demands and goals.

The Geneplore model, as shown in Fig. 2.4, involves two major types of cognitive processes: a generative process and an exploratory process. The cognitive process constructs initial mental representations in an incomplete form, known as preinventive structures, and the exploratory process interprets the preinventive structures in meaningful ways, which are then modified to satisfy the specific goals of the task [21]. The Geneplre model also specifies that there are constraints on the form and function of the creative products that arise from the specific nature of the task or the generative processes involved. These constraints demonstrate additional regularities in cognitive
processing insofar as they focus generative processing on retaining certain domains of information as well as discarding or abandoning others [21].

The proposed system is also integrated with the concepts of self-projection that allow users to project and reflect their mental representations onto the provided ambiguous images, in order to encourage the revelation of inner thoughts and feelings during communication. Self-projection is a psychological defense mechanism where a person subconsciously denies his or her own attributes, thoughts and emotions, which are then ascribed to the outside world, usually to other people, but sometimes to animals or inanimate objects, etc. [19]. Thus, self-projection involves imagining or projecting the belief that others originate those feelings and thoughts, and reduces anxiety by allowing the expression of unwanted unconscious impulses or desires without allowing the conscious mind to recognize them. Self-projective assessments are based on the theory that the individual projects things of him/herself onto everything he/she does, either consciously or unconsciously. Thus, those assessments have often been used for personality assessments that are designed to encourage an individual to respond to ambiguous stimuli, presumably revealing hidden emotions and internal conflicts, thereby reducing resistance and anxiety when revealing high self-disclosure information [22][23]. The revealed inner thoughts and high self-disclosure information will not only help a psychologist to understand the individuals concerned, but also help the individuals to further understand him/herself, which may lead to, foster, or encourage the development of interpersonal relationships between individuals and their surroundings.

Figure 2.5 shows the conceptual model of the PCS with the expected effects and the related chapters. As shown in Fig. 2.5, the concepts of the Geneplore Model that were applied to the proposed PCS system, and aimed at promoting the conception of ideas for conversational topics during informal communication in order to foster mutual understanding, is described in Chapter 3. The concept of self-projection, which is aimed at projecting and reflecting the mental representations generated by users onto the provided ambiguous images in order to encourage the revelation of inner thoughts and feelings during communication, has been integrated into the PCS and is described in Chapter 4. In addition, it is necessary to insert text and symbols and drag and drop them onto the text-field canvas containing the embedded “●” prompter image(s) in order to
create a message. Therefore, the expressions used to convey the conceived ideas in the conversational topic and project the mental representations onto the message is one of the key factors for this research, which is discussed in Chapter 5.

![Conceptual Model of the PCS with the expected effects, together with the related Chapters](image)

**2.2.3 The Prototype Design of the PCS**

The prototype design of the PCS consists of the following concepts and functions in order to support the encouragement of mutual understanding and the revelation of higher self-disclosure during text-based communication.

1. **Support Related to the Generative Process/Phase (Concepts of the Geneplore Model):**

   Provide the “●” prompter image(s) as a highly abstractive visual stimuli: For example, the “●” is similar to the ambiguity of a designer’s hand-drawn sketch [24-26], where those ambiguities can be a factor or key in the encouragement of re-interpretation in a variety of ways, which is a phenomenon where, when reviewing an image based on a
certain intention/purpose or interpretation, the interpretation of the sketch changes. Therefore, the “●” prompter image(s) are provided in the PCS as highly abstractive visual stimuli which can be explained and interpreted in various ways in order to initiate conversational topics for informal communication. In detail, the PCS randomly provides a highly abstract shape with no color information, i.e., the black “●” prompter image(s), on the background of the text-field canvas as the visual stimulus, in order to support the generative process for conceiving conversation topics.

2. Support Related to the Exploratory Process/Phase (Concepts of the Geneplore Model)

I. Free text and space layout: It has been broadly known that a layout that contains a generated preinventive structure in a space where the relationships between the structures is visible will assist the conscious mind in making the leap from one pre-inventive structure to another [27-29]. Therefore, based on this knowledge, the PCS has been embedded with functions that allow entered text to be freely positioned onto the text-field canvas. The layout of the text on the text-field canvas will help to visualize the relationship between each text message and also support the exploratory process. The aim of this function is to encourage the expansion of the generated conversational topic and develop it into a formal topic. This function also enables users to instinctively and dynamically create their message by directly projecting or reflecting their mental representations as visual information together with textual expressions. It should be noted that, as the PCS is proposed for informal communication and is not aimed at any specific topics, domains or outputs, the constraints on the form and function, or task-related constraints, need not be taken into consideration. Therefore, the PCS will not take the constraints of products into account and will only be focused on the support of the generative and exploratory processes.

II. Externalize the idea using the “turn-over-the-page effect”: In order to reinterpret the pre-inventive structure and expand the conversation idea, it is important to switch the viewpoint of the conversational topic together with the process of externalization of the preinventive structure [30-32]. The change in perspective for the conversational topic is something similar to the effect when reading a
comic book, where the topic changes when the page changes, in order to raise the expectations of the topic in the next story, which is known as the “turn-over-the-page effect” [33]. Based on these observations, a function for creating messages in series to form semi-animated messages (the “turn-over-the-page effect”) was also embedded, together with a default of two messages to be displayed as a set when communicating using the PCS. It should be noted that in this study, only four sets of two randomly chosen images were provided for selection by the participants in the communication experiments conducted using the PCS in order to constrain the time allowed for communication.

In addition, based on the concepts of emoticons and pictograms mentioned later in Chapter 5, the embedded simple figures or images on the background of the text-field canvas could also be seen 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 to enhance richer expressions.

2.3 Hypotheses

From these designs and the models that describe the PCS, the following hypotheses have been generated:

1. Based on the Geneplore model, the PCS can prompt users to create new topics for conversation and/or to frequently change from one topic to another so that mutual understanding between participants can be deepened.

2. Based on the properties of the projection and reflection of mental representation, the PCS can encourage users to disclose more information about themselves: i.e., self-disclosure can be enhanced by using the PCS.

3. Based on both the Geneplore model and the projection/reflection theory, users can create and express the conceived ideas or generated mental representations by combining prompter(s) and text/symbols so that both
mutual understanding and self-disclosure can be promoted.

2.4 Prototype of The Prompter Communication System

The prototype of the PCS was programmed using the JavaTM 2 SDK Standard Edition Version 1.4.1 and designed to operate in a Windows XP environment.

![Figure 2.6 Configuration and relationships between the Server and Client Systems of the PCS](image)

The prototype PCS contains two major systems, the server system and the client system. The server system functions and controls the generation of the random “●” prompter image(s), the positioning of the text and symbols on the background text-field canvas, and the connections between each client, and saves all the log data and created messages. The client system functions and controls the display and selection of the
image sets, the font size settings, the text and symbol insertion, the drag and drop processes and the display of the received messages between each client [34]. Fig. 2.6 shows the configuration and relationships between the server and client systems of the PCS.

2.4.1 The PCS Interfaces and Operational Procedures

The communication flow using the PCS is shown in Fig. 2.6.

As shown in Fig. 2.7, communication using the PCS is conducted between two users, where User A creates two messages by freely inserting text or symbols and positions them by dragging and dropping them to the desired position on the text-field canvas, thereby creating messages in conjunction with the randomly embedded “●” prompter image(s). After the message creation stage is complete, User A sends the message to User B via the network. User B views the received messages, and then creates his/her own message in reply using the same procedure and returns it to User A in order to
continue the conversation.

The initial interface of the PCS is shown in Fig. 2.8. When the PCS Application is launched at each of the two sites, three dialog boxes are invoked in the program window at each site: (a) the **Selection Dialog Box**, (b) the **Creation Dialog Box**, and (c) the **Communication Dialog Box**. The Selection Dialog Box is used to select a set of two “●” prompter image(s) (133 pixels × 106 pixels for each) from the four sets automatically generated by the system [34]. 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 conversation partner, and includes two buttons at the top of each message frame which allows users to switch between either of the two messages for that particular message set.

![Figure 2.8 The initial interface of the PCS when launching the system](image)

Figure 2.8 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. 2.9. 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 the 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 second image from the selected set will be displayed in the Confirm Dialog Box for the user to view in order to visualize the story between the two selected sets of “●” prompter images.

An outline of the communication process is as follows:

1. When it is the turn of the first participant to create a conversation message, four sets of two “●” prompter images are automatically generated by the system and displayed in the “(a) Selection Dialog Box,” as shown in Fig. 2.8, above. The first participant then considers the provided four sets, which can be switched using fade-in and fade-out effects that are accessed by clicking the buttons “1page” or “2page” located above each message set, as shown Fig. 2.10 and Fig. 2.11. After choosing a set of “●” prompter image(s) by clicking the “Select” button at the bottom of the desired set, the first “●” prompter image of the set will be displayed in the “(b) Creation Dialog Box,” as shown in Fig. 2.8, above. The participant creates a message by dragging and dropping words, letters, symbols, or characters...
that they have entered into the blank text field located in the middle of the “(b) Creation Dialog Box,” as shown in Fig. 2.12. Participants can also set the font size for each inserted word, letter, symbol, or character, depending on their needs and to achieve the desired effect.

(2) After clicking the “Finish” button, the first created message of the message set will be displayed in the “(c) Communication Dialog Box,” as shown in Fig. 2.13 and in Fig. 2.8, above, which allows both participants to view it. The first participant then repeats step (1) to create a second message using the second set of “●” prompter image(s).

(3) After clicking the “Finish” button, the second message of the message set will be displayed in the “(c) Communication Dialog Box,” and it then becomes the turn of the second participant to create messages. After the second participant sends the message set, the Communication Dialog Box displays the created message sets from both participants side by side to allow each participant to view the message sets in sequence in order to continue the conversation.

The second participant repeats steps (1) to (3), according to, or in response to, the messages displayed in the “Communication Dialog Box,” and continues the conversation. The Communication Dialog Box only displays up to two sets of messages, where each frame automatically scrolls to show the most recent set. Clicking on the “<<” and “>>” icons on the scroll bar will allow the participant to view earlier frames.

Details for each Dialog Box of the PCS are as follows:

(a) Selection Dialog Box

![Selection Dialog Box](image)

Figure 2.10 Selection Dialog Box of the Prompter Communication System
Figure 2.11  The Selection Dialog Box after clicking the “2page” button

(b) Creation Dialog Box

Figure 2.12  The Creation Dialog Box of the PCS
(c) Communication Dialog Box

![Communication Dialog Box](image)

Figure 2.13  The Communication Dialog Box of the PCS

(d) Confirm Dialog Box

![Confirm Dialog Box](image)

Figure 2.14  The Confirm Dialog Box of the PCS

The Confirm Dialog Box is used by the participants to view the selected message set in order to visualize the story between the two selected messages. The Confirm Dialog Box includes two buttons at the bottom of the message frame which allows participants to switch between the two messages of the message set.
2.5 Summary

In this chapter, the foundation and motivation for the research, the concepts and the designs of the proposed method, the models and theories of the proposed prototype Prompter Communication System (PCS), the hypothesis generated by the models and theories, and the details of the PCS used for verifying the hypotheses have been described and explained, and an illustration of the implementation of the PCS is provided.

Section 2.1 describes Hasegawa’s manual operation-based technique for creating fairy tale stories using different black circles, which is the motivation for the communication method and the system proposed in Section 2.2.

Section 2.2 describes the proposed communication means, where Section 2.2.1 describes the conceptual proposal of the PCS, Section 2.2.2 explains the Geneplore model and the projection/reflection theory that supports the mental processes of participants when creating messages in the PCS, and Section 2.2.3 introduces the designs and functions of the PCS.

Section 2.3 introduces and explains the three hypotheses generated based on the Geneplore model and the projection/reflection theory in order to verify the effects of the PCS on promoting and encouraging mutual understanding between users and/or the revelation of information with higher self-disclosure.

Section 2.4 illustrates the implementation of the prototype PCS used in the communication experiments for verifying the hypotheses detailed in Section 2.3.
Chapter 3
Prompting Mutual Understanding by Conceiving Conversational Topics

3.1 Introduction

In general, communication can be categorized into either formal or informal approaches. Formal communication is usually used to transmit and communicate ideas based on an organized structure with certain rules and conventions depending on the organizations involved, such as those customs related to meetings, conference reports and presentations. In contrast, informal communication is usually used to communicate without relying on rules or regulations, sometimes even without specific topics or obvious goals for the conversation, such as internet chatting or small talk, but it is usually the communication method used by individuals to build or develop interpersonal relationships.

Informal communication plays an important role in society and organizations as a technique for gaining mutual understanding, deepening friendships and relationships and maintaining cooperative attitudes between individuals [36]. Based on these reasons and/or understandings, numerous systems for supporting informal communication have been proposed, often focusing on supporting awareness and co-presence, the essential factors for informal communication, and aimed at smoothing communication between distant users [37][38]. Others, however, have provided functions for users to share space and co-existence as if in the same room/environment so as to support the initiation and formation for informal communication [39-41]. From these works, the effects on supporting important factors for informal communication, such as presenting accidental encounters, providing conversational topics and creating the space/environment required for such communication, have been confirmed.

However, several studies have indicated that those conversations could not be recognized as informal communications since the conversational topics had been
provided by the systems, thereby possibly limiting the conversation and preventing natural communication [39]. Other research has mentioned that, even where the conversational opportunities had been given, the conversations still remained at the greeting level, which would make it difficult for the conversational partners to develop any trusting relationships. Therefore, it is necessary to promote communication that can encourage knowledge sharing and collaboration [42]. However, studies indicating how to support informal communication that encourages knowledge sharing and collaboration, and allows conversation beyond the greeting level without limiting the conversational topics, are rarely seen.

This investigation explores whether the PCS can promote the conception of conversational topics by participants in order to support informal communication between distant users, which corresponds to hypothesis (1) outlined in Section 2.3. In other words, the PCS could potentially support and encourage ideas for conceiving and expanding conversational topics during a conversation, so that mutual understanding between the users is deepened. The “topic” mentioned here is similar to the “seed” of the conversation, where its duration may continue for a certain period before the next conversation begins, or may finish quickly and move to the next “seed” conversation. In order to initiate new ideas or switch between topics, it is necessary to introduce a new viewpoint within the current conversation. In order to consider a suitable support method toward understanding those conception processes, it is first necessary to observe the process of creative thinking [32]. As described in Chapter 2, the PCS is designed based on the concept of the Geneplore Model [43][44], one of the most representative studies into the cognitive creative thinking process, so that the PCS fosters the conception and switching of conversational topics during informal communication.

Communication experiments using the prototype of the PCS are conducted to check whether hypothesis (1) is verified.

3.2 Approach

Based on the considerations and hypothesis outlined in Section 2.2, the PCS has been designed and modeled based on the concept of the Geneplore Model and is aimed at supporting a combination of both the generative process and the exploratory process as
a method of providing a form of total support in the initiation of conversational topics in order to encourage mutual understanding between remote users. The study will first investigate whether the “●” prompter image(s) stimulate the participant when conceiving or switching conversational topics by evaluating the meaning of the “●” prompter image(s) within the contents of the resultant messages created by the participants during communication experiments using the PCS. Then, further analysis into the messages evaluated as containing prompter image(s) determined as being meaningful will be conducted in order to examine the role of the prompter image(s) within those messages so as to understand the development of the ideas inspired by the image(s) and the conversational topics that have been conceived.

3.3 Communication Experiments, Evaluations and Results

Experiments were carried out in order to examine whether the PCS is effective in encouraging users to conceive and/or change conversational topics during communication. The equipment illustrated in Chapter 2 was used, where two computers with 17-inch monitors were placed in two different rooms and connected via a LAN cable.

3.3.1 Participants

The experiments were conducted by 36 undergraduate and graduate students, aged between 20 and 30, comprising 28 males and 8 females. Each of the participants had basic computer skills, but had no experience of using the PCS before taking part in the experiments. The participants were classmates or schoolmates and had met or seen each other during classes or inside the faculty.

3.3.2 Method

The 36 participants were randomly chosen and paired into 18 pairs. Each pair was asked to conduct only one experiment and an interview was carried out after each
session of the experiments. During the experiments, the participants of each pair were separated into different rooms in order to prevent verbal or facial communication during the experiments. For each experiment, the instructions were clearly explained to the participants, including the procedure for the experiments, as well as the materials, machines and functions of the system, but no specific instructions directing participants to use the “●” prompter image(s) were given in either the explanation or during the experiments. For each experiment, the participants were given a 30-minute practice session in order to familiarize themselves with the system prior to the actual experiment. After the practice session, the participants were asked to communicate freely using the PCS prototype for approximately an hour, which was considered to be enough time for the participants to exchange 30 sets of messages. After each communication experiment, an interview was carried out with each participant separately in order to understand the expressions used by the participants and comprehend their intentions with regard to the contents of the created messages. A log for each conversation was automatically saved to the server.

### 3.3.3 Experimental Results

A total of 994 messages were collected from the experiments. Figure 3.1 shows an example of the communication flow between participants using the PCS. As shown in Fig. 3.1, Participant A created Message A1, which represents his/her feelings towards and memories of his/her family. Message B1 in Fig. 3.1 shows the message set created by Participant B in reply to Participant A, where Participant B indicates that he/she lives together with his/her family and mentioned his/her thoughts towards people who live away from family. Message A2 in Fig. 3.1 shows the next message set created by Participant A, who changed the conversation topic to the upcoming New Year celebrations and mentioned how his/her family will gather during the New Year holidays. The conversation using the PCS continues from one topic to another, so that the participants share knowledge and gain understanding through the conversation.

Figure 3.2 shows another example of messages from the experiment. The left-hand message in Fig. 3.2 shows the participant associating the randomly generated “●” prompter image(s) with his/her from a third person point of view. The participant
imagines himself/herself dancing in the corner of a room with the textual expression of “Would that be possible to apply the act into the research?” in the lower-center to address his/her question towards the conversational partner. This example can be considered to be an example of how the size and layout of the randomly provided “●” prompter image(s) embedded on the background of the text-field canvas strongly encouraged the participant to conceive the idea of “expressing his/her current situation and emotional condition”. As mentioned in Section 2.2, the PCS aims to support both the “Generative Process” and the “Exploratory Process” as an overall (rather than individual) result toward initiating conversational topics. Therefore, the effects of the processes on the conversational topics and created messages were not distinguished and will be considered as being “stimulated by the prompter images as the initiating idea” within this experiment. The lower message in Fig. 3.2 shows an example of a message where the “●” prompter image(s) were ignored by the participant and the message was created using plain text. The prompter image(s) were involved and utilized as part of the background without any particular meaning within the message contents, therefore, the “●” prompter image(s) within this message can be considered as having no effect on stimulating the participant to conceive any ideas or conversational topics.
Figure 3.1  An example of a conversation using the PCS
The 944 messages obtained were classified into two categories, “Conceived” and “Non-conceived”, according to the meaning of the “●” prompter image(s) within the message contents and in conjunction with the interview results. The average frequency of the appearance of messages in each category has been calculated and evaluated. Figure 3.3 shows the evaluation results, where the vertical axis indicates the degree of the average frequency of the appearance, and the horizontal axis indicates the category of the message.

Figure 3.2 An example of messages from the experiment using the PCS

The average frequency of the appearance of messages in each category has been calculated and evaluated. Figure 3.3 shows the evaluation results, where the vertical axis indicates the degree of the average frequency of the appearance, and the horizontal axis indicates the category of the message.

Figure 3.3 The average frequency of the appearance of messages in each Category
As shown in Fig. 3.3, the average frequency of messages evaluated as “Conceived” is 27.5 messages (Standard Deviation (SD) = 14.3), and the average frequency of messages evaluated as “Non-conceived” is 13.8 messages (SD = 10.8). Further analysis of these evaluation results revealed a significant difference at 1%, \[F_{(1,70)} = 20.7, p< .01\].

These results suggest that the sizes and layout/position of the “●” prompter image(s) on the canvas have an influence on promoting the conception of conversational topics and ideas during communication. It should be noted that, although it would be ideal for the results to show high values biased toward conceived ideas, this has not been determined since it was not the aim of the experiment and the values of the ideas depend on and vary based on societal and social backgrounds, for which it is difficult to make any judgment.

### 3.3.4 Discussion

Among the 944 messages collected, 649 messages were classified into the “Conceived” category, and 295 messages were classified into the “Non-conceived” category. The 649 messages categorized as “Conceived” have been further evaluated and classified into four subcategories, Type 1 through Type 4, based on how the “●” prompter image(s) were expressed and what they represented within the message contents, where:

- **Type 1**: The “●” prompter image(s) are represented or expressed as a physical presence, such as an animal or an object, etc.

- **Type 2**: The “●” prompter image(s) were represented as a physical presence such as a human being, for example, the participant him/herself, the conversational partner or a third party, etc.

- **Type 3**: The “●” prompter image(s) were represented or expressed as a non-physical presence, such as emotional conditions, or the participant’s personal situation or emotional status, etc.

- **Type 4**: The “turn-over-the-page effect” was used within the messages.
Figure 3.4 is a sample of the messages of each Type, 1 through 4. The example of a Type 1 message shows that the participant sees the top two “●” prompter images as seals and the bottom prompter image as confectionary, and created a message with two seals that were happy when they found the confectionary. The example of a Type 2 message shows that the participant sees the small prompter image as himself/herself and the large prompter image as a burden, and created a message to express his/her feelings, and describe a situation related to how difficult life is when walking while carrying such a heavy burden. The example of a Type 3 message shows that the participant sees the large prompter image as his/her own head, where he/she placed both hands and knees on the ground and tried to move forward (to the left-side of the message window). The example of a Type 4 message shows that the participant and the conversational partner expressed their messages in a relay style and showed the “motion” of the prompter image through the relay messages.
Figure 3.4  A sample of the messages in each category obtained using the PCS
The average frequency of the appearance of Types 1 through 4 for messages generated by each participant has been calculated and evaluated. Figure 3.5 shows the evaluation results, where the vertical axis indicates the degree of the average frequency of the appearance, and the horizontal axis indicates the Type of the message. Note that some messages have been classified into more than one Type. For example, a message where there was an expression related to a human being together with the “turn-over-the-page effect” was classified as being both Type 3 and Type 4.

As shown in Fig. 3.5, expressions related to a physical presence such as an animal or an object, i.e., Type 1, were most often used as the conceived idea based on the prompter image(s). The second most commonly conceived idea was that of non-physical presence, i.e., Type 2, such as emotional conditions. The participant’s personal situation or emotional status, Type 3, where a physical presence as a human being was utilized, such as the participant himself/herself, the conversational partner or
a third party, was the third highest, and the “turn-over-the-page effect”, with an average of 4.5 messages per participant, was the lowest among the four types.

The statistical analysis of these results revealed a significant difference at 1% \( F(3,136) = 18.2, p<.01 \). Multiple analyses using the Turkey method indicated no significant difference between Type 2 and Type 3, but revealed significant difference at 1% between the other two categories. It should be noted that since both Type 2 and Type 3 represent human beings and human emotions, the total number of messages would be 13.4, which would mean that human related messages appear more often than Type 1. However, there is no significant difference observed between Type 1 and the Type obtained by merging Type 2 and Type 3.

These results suggest that communication using the PCS can encourage participants to conceive conversations referring to his/her emotional condition, which can be interpreted as implying that the PCS encourages the conception of conversational topics related to one’s inner thoughts, or thoughts of/for others, and allows the expression of emotions to others rather than simple communication based only on greetings, as would generally be the case in conversations between unrelated participants. In fact, many messages expressed details related to the participants’ current situation, their emotional conditions, or information about both the participant himself/herself and the conversational partners. Interestingly, this information was sometimes expressed from the first person point of view and sometimes from the third person point of view, and the switch between viewpoints within the conversational topics (meta cognition) was seen quite often.

In summary, it can be seen that these observations revealed that there were more “Conceived” messages than “Non-conceived” messages, as shown in Fig. 3.3, which indicates that the PCS strongly encourages the conception of conversational topic ideas, and the categorized results of the conceived messages, as shown in Fig. 3.4, which indicates that the human-related messages, Type 2 (emotional presence of human characteristics) and Type 3 (physical presence of human characteristics), have been added together to produce a greater number of messages than the other two Types. Therefore, based on those results, it can be suggested that from the aspect of observable mutual understanding, the prompted conversational topics contain a large amount of
information related to the participants themselves, which allows participants to gain and share more information about each other beyond the greeting level, and might generate a higher possibility of gaining mutual understanding of each other.

### 3.4 Conclusion

In this chapter, the effects of the prototype PCS with the black prompter image(s) on promoting the conception of conversational topics, and/or encouraging the participants to frequently change from one topic to another in order to support the deepening of mutual understanding during informal communication between distant users, have been investigated. The concept of the prototype PCS was based on the results of the representative research into the cognitive creative process, the Geneplore Model, and was designed to be equipped with functions that are intended to encourage the conception and furthering of ideas for conversational topics. Communication experiments have been conducted and the results have been evaluated.

The evaluated results and further investigation suggests that:

1. The prompter image(s) randomly embedded on the background of the text-field canvas have an important effect on stimulating the initiation of ideas for conversational topics.

2. The conceived ideas for conversational topics often include details and knowledge related to the participants’ personal information, situations and emotional conditions.

From the above observations, it can be suggested that communication using the PCS both supports and encourages the revelation of information related to the participants themselves, which allows participants to gain and share more information about each other, and might generate a higher possibility of strengthening mutual understanding between individuals, which may further lead to the development of deeper interpersonal relationships.

However, this study only investigates the ability of the PCS to support the encouragement of the conception and switching of conversational topics based on both the generative and exploratory phases/processes as a whole rather than as separate
approaches. It will be necessary to conduct further experiments in order to clarify the effects of the conception and switching of conversational topics through each individual phase/process, which have not been considered in this study and remain an open question for future work.
Chapter 4

Prompting Self-Disclosure based on Self-projection and Self-reflection

4.1 Introduction

Although the outcomes described in Chapter 3 indicated positive results for knowledge sharing and the deepening of mutual understanding between users, the reasons for users to reveal knowledge related to themselves during the conversation remained unclear. Yet, the meanings and representations of the “●” prompter image(s) within the message contents (referred to as “●” representations in the remainder of this chapter) remain uncertain.

This chapter aims to clarify the uncertainties described above, and investigate the “●” representations in order to understand the information revealed by the users within the message content. Another aim is to investigate the relationship between the “●” representations and the levels of self-disclosure.

4.2 Approach

Following the considerations and hypothesis outlined in Section 2.2, the PCS has been designed and modeled based on the concept of the Geneplore Model and is integrated with the concepts of Self-disclosure that allows users to project and reflect their mental representations onto the provided ambiguous “●” prompter image(s), in order to encourage the revelation of inner thoughts and feelings during the conversation.

The investigations and evaluations were conducted using three methods/procedures. Firstly, messages generated using the PCS were evaluated and classified into three categories based on the manner in which the “●” prompter image(s) were involved and
represented within the message contents. Since the results described in the previous chapter have indicated that the participants revealed knowledge related to themselves during communication using the PCS, messages have been classified into three categories as follows: Messages were categorized as “Category 1” when the “●” prompter image(s) were involved and characterized within the message contents as human beings, such as the participant him/herself, or the participant’s thoughts or emotions, etc. A message was determined to be “Category 2” when the “●” prompter image(s) were involved and characterized within the message contents as animals or objects, such as a bird, the sun, or a house, etc. A message was allocated to “Category 3” when the “●” prompter image(s) were involved and utilized as background images without any particular meaning within the message contents, or where the participant ignored the “●” prompter image and created the message using plain text. When multiple representations were present, messages were categorized based on the major representation within the message contents.

Secondly, evaluation was applied to messages allocated to each category in order to evaluate and assign a degree of self-disclosure within the messages for comparison between categories. Thirdly, evaluation was applied to messages conducted using 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, in order to evaluate the degree of self-disclosure within the messages so as to compare them with the messages conducted using the PCS.

The self-projection described in this study is indicated and referred to as expressing mental representations, such as one’s thoughts, emotions or imagination, by projecting or reflecting the mental representations onto the message, thereby creating messages that either include, or not include, the provided “●” prompter image(s) as part of the message contents. In addition, the evaluation method of the self-projection level applied in this study was developed by Daibo et al. and is described in detail in Section 4.3.5.3.

4.2.1 Concepts applied to the “●” prompter communication system

Based on the concepts of the Geneplore model and the types of self-projection
mentioned in Chapter 2 and the previous section, the PCS was designed so that ambiguous figures or images could be embedded as stimuli to support the generative process of the Geneplore model by inspiring users to create mental representations for their conversational topics.

4.3 Experiments, Evaluation and Results

4.3.1 Purpose of the Experiments

The purpose of the experiments was threefold: (1) Evaluate the meanings and representations of the “●” prompter image(s) within the message contents; (2) Investigate the relationships between the “●” representations and the self-disclosure levels; (3) Investigate whether using the PCS encourages higher self-disclosure levels than NCS.

(1) The meanings and representations of the “●” prompter image(s) was evaluated by investigating whether communication using the PCS has any effect on encouraging participants to generate mental representations, and whether messages were created by projecting or reflecting these mental representations onto messages involving the provided “●” prompter image(s) as part of message contents.

(2) The relationships between the “●” prompter image(s) and the self-disclosure levels were investigated by evaluating the self-disclosure levels within the resultant messages.

(3) Whether communication using the PCS encourages higher self-disclosure levels than using NCS.

4.3.2 Experimental Environment

As explained in Chapter 2, two computers with 17-inch monitors were used for the experiments. The two computers were placed in different rooms and connected via a LAN cable. Both systems used in the PCS and the NCS conditions allowed participants to employ any characters, symbols, sentences and/or a combination of these, and drag
and drop them into the desired position on the text-field canvas. The only difference between the PCS and the NCS conditions was that the NCS system did not generate “●” prompter image(s). The remaining functions of the systems for both conditions were exactly the same. For details concerning the specific usage of the PCS, refer to Chapter 2.

4.3.3 Participants

A total of 32 undergraduate and graduate students (24 males and 8 females) participated in the experiments. The participants were paired into 16 pairs. The participants had basic computer skills, but had no previous experience of using either the PCS or the NCS prior to participating in this experiment. All participants were either classmates or schoolmates, and some had met or seen each other during classes or within their faculties.

4.3.4 Method

The 16 pairs were randomly assigned to use either the PCS condition or the NCS condition (8 pairs per condition). During the experiment, participants were situated in different rooms in order to prevent verbal communication or facial gestures during the experiment. Before starting the experiment, instructions were clearly given to the participants, including details of the experimental procedure, as well as the materials, the machines and the functions of the system, but no specific instructions directing participants to use the “●” prompter image(s) was given in either the explanation or during the experiments. 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, participants were asked to begin communicating freely using the communication system. The main experiment continued for approximately one hour. Although the number or the frequency of messages was not controlled, it was considered to be sufficient time to allow participants to complete a total of 25 to 30 sets of messages in both the PCS and the NCS conditions.
During the experiments, no conversational topics were provided or suggested for either the PCS condition or the NCS condition. 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.

4.3.5 Experimental Results

4.3.5.1 Examples of messages by PCS and NCS

A total of 429 messages were collected from the experiment, where 231 were messages produced from the PCS condition, and 198 were messages from the NCS condition. Figures 4.1 and 4.2 show an example of a message from the PCS condition and the NCS condition, respectively.

Message 1-1 illustrated in Fig. 4.1 shows that the participant created the message in reference to his/her current situation, and projected and equated the small “●” prompter image located on the left of the text-field canvas as him/herself, and the large “●” prompter image located on the right as “thesis” with an expression of the “current situation” below to express and emphasize the scale of the difficulties he/she was facing and his/her emotional status. Message 1-2 shows that the participant projected and imagined the small “●” prompter image as being almost overwhelmed by the large “●” prompter image. Message 1-2 was compared and referred to as the thesis in the previous message, 1-1, with the expression “Trying hard not to be overwhelmed” in the upper center to indicate his/her worries and concerns. Message 2-1 in Fig. 4.2, which was created using the NCS, shows that the participant expressed the emphasis phrase “get refreshed by doing some sports” in a large font size and the suggestion phrase “how about” in a small font size. The next message, 2-2, shows the expressions “It makes you feel refreshed” on the top and “And also makes you feel powerful again” on the bottom to leave a space in the center of the message to give the atmosphere of refreshment. The two messages in series give a perspective of what the participant wanted to stress and emphasize by using different font sizes and space within the text-field canvas.
Figure 4.1  An example of the experimental results for a set of messages created by participants using the PCS

Figure 4.2  An example of the experimental results for a set of messages created by participants using the NCS

4.3.5.2 Categories for the Experimental Results from PCS condition

The 231 messages collected from the PCS condition have been evaluated and classified into three categories: Category 1 through 3.

- **Category 1**: The “●” prompter image(s) were represented as human beings, such as the participant him/herself, or the participant’s thoughts or emotions, etc.
• **Category 2**: The “●” prompter image(s) were represented as animals or objects, such as a bird, the sun, or a house, etc.

• **Category 3**: The “●” prompter image(s) were utilized as background without any particular meaning within the message contents, or the participant ignored the “●” prompter image and created the message using plain text.

When multiple representations were present, message was categorized based on the major representation within the message contents.

Figure 4.3 is a sample of messages in each category obtained from the PCS condition.

• The Category 1 message shows that the participant combined symbols and text with the “●” prompter image and formed an image that resembled his/her face with an expression of his/her thoughts in textual sentences. The message can be interpreted as a scene where the participant is trying to stop his/her conversational partner from getting any closer, and also telling the partner about his/her feelings.

• The Category 2 message shows that the participant combined symbols and text with the “●” prompter images and formed an image of a bird with a textual expression to emphasize the location of the bird.

• The Category 3 message shows that the “●” prompter image was involved and utilized as background without any particular meaning within the message contents, or the participant ignored the “●” prompter image and created the message using plain text.

The average frequency of the appearance of messages for each Category, 1, 2 and 3, conducted by each pair of participants has been calculated and evaluated. Fig. 4.4 shows the evaluation results, where the vertical axis indicates the degree of the average frequency of the appearance, and the horizontal axis indicates the category of the message.
As shown in Fig. 4.4, the average frequency for Category 1 is 14 messages (Standard Deviation (SD) = 4.66), for Category 2 is 9.88 messages (SD = 5.91), for Category 3 is 5 messages (SD = 4.31). Further analysis of these evaluation results using ANOVA (three levels: Category 1, 2 and 3) revealed a significant main effect in Category, \(F(2, 21) = 6.47, p<.01\). A post test of the main effect in each Category using Ryan’s method revealed significant differences in Category 1 × Category 3 \(t(14)=4.01, p<.01\), but no significant interaction in either Category 1 × Category 2 or Category 2 × Category 3 were observed.

These results can be summarized by noting that there were more messages where the “●” prompter image(s) were involved and represented as part of the message contents (Category 1 and 2), than just as background within the message contents (Category 3). The results also showed that there were more messages where the “●” prompter image(s) were involved and represented in the message contents in Category 1 than in

<table>
<thead>
<tr>
<th>Category 1</th>
<th>Category 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>いや、もう少し遠くに</td>
<td>上空</td>
</tr>
<tr>
<td>(It’s enough! Don’t get any closer!)</td>
<td>(Top: Upper sky, Bottom: Cloud.)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Category 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>今は5時前だよ！</td>
</tr>
<tr>
<td>(Top: Now is before 5(pm)!)</td>
</tr>
</tbody>
</table>
Category 2. Based on this observation, it can be suggested that communication using the PCS has an effect on stimulating and encouraging participants to conceive mental representations and involve the “●” prompter image(s) as part of the conceived mental representations when projecting and creating the messages. Moreover, it can also be suggested that the PCS has an effect on stimulating and encouraging participants to conceive mental representations related to themselves and involve the “●” prompter image(s) as representations of themselves and their thoughts or emotions within the created message contents.

Figure 4.4  Average frequency of the appearance of messages in each Category using the PCS. Error bars indicate the Standard Error, SE.

4.3.5.3 Evaluation for Self-Disclosure Levels

(1) Daibo et al’s Definitions of Self-Disclosure Levels

All the collected messages were evaluated by four evaluators in order to assign a degree of self-disclosure to the messages. The methodology and self-disclosure level definitions used for evaluation were referenced from the study by Daibo et al. [45], but were altered to enable evaluators to define and assign those levels to each resultant message produced during the experiment.

Daibo et al. [45] 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 4.1, 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.

(2) Definition of Self-Disclosure Levels for Evaluating the PCS and the NCS

Due to the specific features and functions of the PCS, such as the embedding of the “●” prompter image(s) on the background of the text-field canvas as a stimulus in the PCS, and the ability to freely position the inserts on the text-field canvas in both the PCS and the 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 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 the PCS or the 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:

- **Level 0**: Questions or messages evaluated as lower than Daibo et al’s Level 1, or not related to self-disclosure.
- **Level 1**: Information with a low degree of self-disclosure.
- **Level 3**: Information with a medium degree of self-disclosure
- **Level 4**: Information with a high degree of self-disclosure.

The original definitions by Daibo et al and examples of the equivalent altered
definitions for the evaluation in this study are shown in Table 4.1.

Table 4.1 Definitions by Daibo et al and the equivalent altered definitions of self-disclosure levels and translations of the messages

<table>
<thead>
<tr>
<th>Daibo et al’s Definitions of Self-disclosure Levels</th>
<th>Equivalent Definitions of Self-disclosure Levels for the PCS Evaluation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Level 0</strong> - Questions, messages with lower than Level 1 self-disclosure or having no relation to self-disclosure</td>
<td>今研究どうなってある？</td>
</tr>
<tr>
<td>(How’s your research going?)</td>
<td></td>
</tr>
<tr>
<td><strong>Level 1</strong> - Yes/No responses, includes basic facts, repeats the questions or simple answers.</td>
<td>う～ん</td>
</tr>
<tr>
<td>(hu~h)</td>
<td></td>
</tr>
<tr>
<td><strong>Level 3</strong> - Response to the questions with facts and agreements.</td>
<td>なかなかうるさくいかない</td>
</tr>
<tr>
<td>(It is not really going well...)</td>
<td></td>
</tr>
<tr>
<td><strong>Level 4</strong> - Additional information or explanation of the conversation topics have been expressed, which leads to or gives direction to the discussion, and <strong>Level 5</strong> – Inner feelings and thoughts that involve emotional expression have been expressed.</td>
<td>どううまくいかないかい</td>
</tr>
<tr>
<td>( Top: Why is it not going well?, Bottom: I am the type that always does things at the last minute!)</td>
<td></td>
</tr>
</tbody>
</table>
The evaluation was applied to the collected 429 messages by four evaluators in order to assign levels of self-disclosure to each resultant message. The evaluation results were assigned to the corresponding self-disclosure levels by the four evaluators 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. 4.5 and 4.6, 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.

(3) Examples of Self-Disclosure Levels

The left side of Fig. 4.5 shows an example where the participant combined symbols and text with the provided “●” prompter image located on the right of the text-field canvas to create an image of a face to represent him/herself with the textual expression “How are you?” in the upper left to express his/her greeting. On the right side of Fig. 4.5 is an example where the participant positioned the textual expression “What is it??” in the middle of the text-field canvas and “Medicine?” in the lower middle of the text-field canvas to emphasize the response and to pose a question back to the conversational partner.

<table>
<thead>
<tr>
<th>Level 0 PCS result</th>
<th>Level 0 NCS result</th>
</tr>
</thead>
<tbody>
<tr>
<td>🥚 気ー ？</td>
<td>ナニデスカ？</td>
</tr>
<tr>
<td>▼</td>
<td>薬?? ??</td>
</tr>
<tr>
<td>(Top: How are you?)</td>
<td>(Top: What is it? Bottom: Medicine?)</td>
</tr>
</tbody>
</table>

Figure 4.5 Examples of experimental result messages categorized as Level 0 self-disclosure using both the PCS and the NCS
Level 4 PCS result | Level 4 NCS result
---|---
(Top: sigh~; Middle: Corner of the room; Bottom: Doesn’t seem good) | (True. I can see the possibilities to connect whole world together. Although there are still lots of fights and minus points, but I think I have to be tough about those)

Figure 4.6  Examples of experimental result messages categorized as Level 4 self-disclosure using both the PCS and the NCS

An example of a message created using the PCS evaluated as Level 4 self-disclosure is shown on the left in Fig. 4.6, where the participant combined symbols and text with the provided “●” prompter 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 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 the participant’s current situation, emotions and thoughts. An example of a message created using the NCS evaluated as Level 4 self-disclosure is shown on the right of Fig. 4.6, where the participant expresses his/her inner thoughts and opinions in lines of sentences and has positioned them on the text-field canvas to express those thoughts and opinions.

(4) Evaluation Results for Self-Disclosure Levels from the PCS Condition

The average frequency of the appearance for each self-disclosure level for the collected messages have been calculated and categorized into different self-disclosure levels and categories, as shown in Fig. 4.7. The vertical axis indicates the degree of the average frequency of the appearance of the self-disclosure level, and the horizontal axis indicates the categories and self-disclosure levels. The average frequency of the appearance and the standard deviations for each self-disclosure levels are listed in Table 4.2.
Figure 4.7  The average frequency of the appearance of self-disclosure levels within experimental result messages between categories using the PCS. Error bars indicate the Standard Error, SE.

Table 4.2  The average frequency of the appearance and standard deviations for each self-disclosure level

<table>
<thead>
<tr>
<th>Category</th>
<th>Level 0</th>
<th>Level 1</th>
<th>Level 3</th>
<th>Level 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Category 1</td>
<td>1.72 (SD = 1.13)</td>
<td>0.97 (SD = .73)</td>
<td>2.22 (SD = 0.91)</td>
<td>9.10 (SD = 3.34)</td>
</tr>
<tr>
<td>Category 2</td>
<td>2.44 (SD = 2.58)</td>
<td>1.75 (SD = 1.41)</td>
<td>1.71 (SD = 1.03)</td>
<td>3.97 (SD = 2.36)</td>
</tr>
<tr>
<td>Category 3</td>
<td>0.81 (SD = 1.08)</td>
<td>0.72 (SD = 0.88)</td>
<td>0.53 (SD = .57)</td>
<td>2.94 (SD = 3.34)</td>
</tr>
</tbody>
</table>

As shown in Fig. 4.7 and Table 4.2, the highest degree of the average frequency of the appearance of a self-disclosure level is Category 1 for Level 4, and the lowest degree is Category 3 for Level 3. Additionally, Category 2 is generally higher than the other two categories for Level 0 and Level 1, and Category 1 is generally higher than the other two categories for Level 3 and Level 4. Category 3 is generally lower than the other two categories for all self-disclosure levels.

Further analysis of these evaluation results using ANOVA [Category (three levels: Categories 1, 2 and 3) × SD Level (four levels)] revealed a significant main effect in the following:
A significant interaction was also observed in the following:

- Category × SD Level \[ F(6, 42) = 5.12, p < .01 \]

The subordinate analyses for the interaction of Category × SD Level revealed a significant simple effect in the following:

- Category × SD Level 4: \[ F(2, 56) = 17.65, p < .01 \]
- Category 1 × SD Level: \[ F(3, 63) = 34.39, p < .01 \]
- Category 2 × SD Level: \[ F(3, 63) = 2.70, p = .054 \]
- Category 3 × SD Level \[ F(3, 63) = 3.10, p < .05 \].

These observations can be summarized as messages categorized as Category 1 resulted in a greater number of messages with information of a high degree of self-disclosure (Level 3 and 4), than the other two categories, while Category 2 resulted in a greater number of messages with information of a low degree of self-disclosure (Level 0 and 1), than the other two categories. Based on this observation, it can be suggested that messages obtained using the PCS involve information within the created messages with a high level of self-disclosure related to the participants themselves, and their thoughts and emotions (Category 1).

(5) Evaluation Results for Self-Disclosure Levels for both the PCS and the NCS Conditions

Communication experiments using the NCS, which does not contain any images on the background of the text-field canvas, have been conducted in order to further investigate the effects of the PCS. The average frequency of the appearance of each self-disclosure level in messages produced by each pair of participants for each category have been calculated and categorized into the different self-disclosure levels for both the
PCS and the NCS conditions, as shown in Fig. 4.8. The vertical axis indicates the degree of the average frequency of the appearance of the self-disclosure level, and the horizontal axis indicates the self-disclosure levels.

![Figure 4.8](image)

The average frequency of the appearance of self-disclosure levels within experimental result messages between the PCS and the NCS conditions. Error bars indicate the Standard Error, SE.

The average frequency of the appearance and standard deviations for each self-disclosure levels within messages for both the PCS and the NCS conditions are listed in Table 4.3.

<table>
<thead>
<tr>
<th>Level</th>
<th>PCS</th>
<th>NCS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level 0</td>
<td>4.97 (SD = 3.08)</td>
<td>3.84 (SD = 2.68)</td>
</tr>
<tr>
<td>Level 1</td>
<td>3.56 (2.17)</td>
<td>6.22 (7.19)</td>
</tr>
<tr>
<td>Level 3</td>
<td>4.28 (1.67)</td>
<td>4.91 (2.31)</td>
</tr>
<tr>
<td>Level 4</td>
<td>15.69 (3.12)</td>
<td>11.28 (4.02)</td>
</tr>
</tbody>
</table>

Further analysis of these evaluation results using ANOVA [System (two levels: PCS and NCS) × SD Level (four levels)] revealed significant differences in the following:

- Significant main effect in SD Level: \[F_{(3, 42)} = 24.8, p<.001\],
• Significant interaction of System × SD Level: [$F_{(3, 42)} = 2.83$, $p<.05$],

• No significant main effect in System was found.

The subordinate analyses for the interaction of System × SD Level revealed a significant simple effect in the following:

• System (PCS) × SD Level: [$F_{(3, 42)} = 20.79$, $p<.001$],

• System (NCS) × SD Level: [$F_{(3, 42)} = 6.85$, $p<.001$],

• No significant simple effect in System × SD Level 0, SD Level 1 and SD Level 3 was observed.

The post-hoc test of the main effect in SD Level using Ryan’s method revealed significant differences between the following:

• Level 0 × Level 4: [$t_{(14)} = 7.22$, $p<.001$],

• Level 1 × Level 4: [$t_{(14)} = 6.83$, $p<.001$],

• Level 3 × Level 4: [$t_{(14)} = 7.07$, $p<.001$],

No significant differences in SD Level 0, SD Level 1, or SD Level 3 were found.

These observations can be summarized by stating that messages obtained using the PCS resulted in a greater number of messages in self-disclosure Level 0 and 4, and messages obtained using the NCS resulted in a greater number of messages in self-disclosure Level 1 and 3. Further analysis of the messages evaluated as self-disclosure Level 0 for both conditions indicates that messages obtained using the PCS contained a greater number of “question” type expressions within the message contents compared to messages obtained using the NCS. This can be explained as the effect of conceiving conversational topics stimulated by the “●” prompter image(s) where the starting of a conversation usually involves questions between conversational partners in order to gain information about each other.

Based on this observation, it can be suggested that messages with the randomly
generated “●” prompter images obtained using the PCS have an effect on participants when generating mental representations and conceiving conversational topics. Consequently, it can be suggested that this effect encourages the projecting or reflecting of those mental representations and conversational topics onto messages using the “●” prompter image(s) during the conversation as part of the created message contents. The observation also suggests that the messages obtained using the PCS involve information with a higher level of self-disclosure than messages obtained using the NCS.

4.3.6 Discussion

From the results described in Section 4.3.5.2, it may be assumed that communication using the PCS supports and encourages participants to conceive and project their mental representations with information containing high self-disclosure levels, especially when those representations are highly related to themselves, such as their inner thoughts, emotions, or personal information. As mentioned in Chapter 3, communication using the PCS also allows participants to switch between first person and third person perspectives. Therefore, it may be assumed that the participants may see the “●” prompter image(s) as representations from both the first or third person perspectives, which allows participants to express themselves and their messages in both subjective and objective viewpoints.

Furthermore, from the results described in Section 4.3.5.3, it can be seen that communication using the PCS generated messages with a higher level of self-disclosure compared to when using the NCS. Therefore, it may be suggested that communication using the PCS may support and encourage participants to share and exchange information with high self-disclosure during the conversation, which may further lead to the development of intimate and deeper interpersonal relationships.

From the investigations and subsequent interviews, it has been suggested that the participant created messages that involved the “●” prompter image(s) as part of message contents either based on mental representations inspired by the “●” prompter image(s), or based on mental representations already present in the participant’s mind. For those messages created based on mental representations inspired by the “●” prompter image(s), it can be considered that the “●” prompter image(s) may have been seen or
used as an embryonic basis for the participants to express and create the message by projecting or reflecting their mental representations, in combination with text and symbols, on the provided “●” prompter image(s). The above observations also have re-confirmed that the PCS effectively supports the initiation of conversational topic ideas, as indicated in Chapter 3. The analysis of the resultant messages and subsequent interviews has also suggested that a number of participants used and indicated the “●” prompter image(s) as a mutual object and created messages in a relay style between each participant.

The process of using both symbols and text to create messages involving the “●” prompter image(s) as part of the projection or reflection of the mental representation is similar to the patterns that occur during the process of creative art therapy. Creative art therapy is a type of psychological self-projection assessment which indicates that the creative process itself is a form of therapy, and that users may consciously or unconsciously release stress or anxiety, or reveal information with high self-disclosure during the creative process [46]. Since the concepts of the PCS were based on the Geneplore creative cognitive thinking process model, communication conducted using the PCS can be considered as a form of creative process, which, therefore, might be considered as one of the reasons for the participants to reveal high self-disclosure information during communication. Also, one of the main aims of creative art therapy is to encourage participants to reveal information with high inner self-expression and self-disclosure levels, which is similar to the results observed when communicating using the PCS. Therefore, it may be assumed that the PCS, with further improvements, may provide an alternative approach as a communication tool for children, the elderly, or anyone with learning difficulties or disabilities. It may also be able to be used to support parents or teachers in better communicating with and understanding their children or students.

The results from this investigation have indicated that communication based on visual expression might encourage higher self-disclosure. Since self-disclosure is an aspect of personal sensations, where sensations are sometimes difficult to explain in textual contexts, this may explain the reasons why communication tools such as Skype, Line, or Google Talk, etc. are equipped with functions such as emoticons or picture icons that allow users to express themselves in a visual form in order to enrich their expression.
and also gain higher self-disclosure and understanding, which, in turn, fosters smoother communication.

4.4 Conclusion

In this chapter, investigations into the effects of the prototype PCS with the “●” prompter image(s) on encouraging users to disclose more information about themselves in order to support the revelation of information of higher self-disclosure between remote users have been conducted. The outcomes described in the previous chapter indicated that using the PCS has a significant effect on supporting the initiation of conversational topic ideas and encouraging mutual understanding between distant users. This chapter has further investigated and evaluated the “●” representations, and the relationships between the “●” representations and the levels of self-disclosure.

The evaluation results and further investigation suggests that:

1. The “●” prompter image(s) were represented as the participants themselves, their thoughts and/or emotions, or as animals or objects in more than 80% of the resultant messages.

2. Evaluations of the self-disclosure levels have indicated a high degree of self-disclosure when the “●” prompter image(s) within the message contents represented the participant him/herself, the participant’s thoughts or emotions, and indicated a lower level of self-disclosure when the “●” prompter image(s) represented animals or objects, or when the “●” prompter image(s) within the messages were ignored.

3. The effects of the “●” prompter image(s) by comparing messages obtained using both the PCS and the NCS indicated that messages obtained using the PCS generally have higher self-disclosure levels than messages obtained using the NCS.

From the above observations, the “●” prompter image(s) may be considered as the reasons for the participants to reveal information related to themselves, and explain why the revealed information contains a high level of self-disclosure. These results may also suggest that communication using the PCS supports and encourages the participants to
generate and express mental representations involving the prompter image(s) as part of the message contents by projecting or reflecting these mental representations directly onto the messages. During the conversation, these messages contain information with a high level of self-disclosure, which, consequently, may further lead to the development of intimate and deep interpersonal relationships.

Although this study has shown the effects on supporting and encouraging participants to reveal information with high self-disclosure levels in a text-based CMC using “●” prompter image(s) by projecting or reflecting their mental representations, studies and analysis into the effects on supporting and encouraging the projection of mental representations using other images and figures, as well as variations in color, have not been considered in this study and remain an open question for future work.
Chapter 5

Mutual Understanding and Self-Disclosure

Using Pictorial-Text Expressions

5.1 Introduction

In this chapter, an approach based on both the Geneplor Model and the Projection/Reflection theory intended to support users when creating and expressing conceived ideas or generating mental representations by combining “●” prompter image(s) and text/symbols into pictogram-like, pictorial-text expressions, and aimed at enhancing richness in non-verbal expression in order to encourage high self-disclosure and mutual understanding is proposed and evaluated. The “●” prompter image is employed as the basis for users to compose symbols and text in conjunction with the “●” prompter 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 are applied to the PCS. Communication experiments using the PCS are conducted and its effectiveness examined.

5.2 Concepts, Theory and Background

5.2.1 Concept and Background of Pictograms, Emoticons and Smileys

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 messenger software, Facebook chat and Google Talk, text emoticons are automatically replaced with small corresponding images that provide a more direct visual expression [47]. Emoticons were first used in a digital form on the internet by Scott Fahlman [48] 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 1986 with a new style used by ASCII NET in Japan and added to by the Byte Information Exchange (BIX) [49]. 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, language, 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 plain 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 [50]. The concept of pictograms can often be used to transcend language and cultural backgrounds [51] 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, which 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 [52]. These methods or systems usually provide a list of pictograms, in either print or digital format, that allows a user to express his/her thoughts or feelings, or to describe a situation by selecting either 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 and analysis has been performed into the effects of the “●” prompter image on the ability to support non-verbal expression by encouraging users to create pictogram-like, pictorial-text style messages using composite symbols and text in conjunction with the “●” prompter image. The intention behind the use of pictogram-like, pictorial-text style messages 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 to encourage communication with a high level of self-disclosure, thereby enhancing the development of deep and intimate interpersonal relationships.

5.3 Approach

Based on the considerations and hypothesis outlined in Section 2.2, the PCS has been designed and modeled based on the concept of the Geneplor Model and integrated with the theories of self-projection in order to encourage the creation and expression of conceived ideas or generated mental representations by combining prompter(s) and text/symbols so that both mutual understanding and self-disclosure can be promoted.

The investigation and evaluation was conducted using two procedures. Firstly, messages generated using both the PCS and the NCS were evaluated and classified into
two categories, pictorial-text style and text-only style, in order to investigate the effects of the prompter image(s) on encouraging users to create more pictorial-text style messages in comparison to using the NCS. Secondly, evaluation was applied to messages allocated to both categories so as to evaluate and assign a degree of self-disclosure within the messages for comparison between categories in order to examine the idea that the image(s) have promoted the revelation of information with higher self-disclosure and have fostered mutual understanding.

5.4 Experiments, Evaluations and Results

Experiments were carried out in order to investigate and evaluate whether communication using the PCS with the “●” prompter image(s) randomly embedded on the background of the text-field canvas (the PCS condition) has any effect on users in the composition of symbols and text in conjunction with the “●” prompter image(s), and whether the participants are encouraged to create more pictogram-like, pictorial-text style messages in comparison to when using the NCS, which has no prompter image(s) embedded on the background (the 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. The systems used in both the PCS and the NCS conditions allowed users to create characters, symbols and sentences, and then 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, whereas the system for the NCS condition did not. The remaining functions of the systems for both conditions were exactly the same.

5.4.1 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 previous experience of either the PCS or the NCS prior to participating in this experiment. All participants were either classmates or schoolmates, and some had met or seen each other during classes or within their faculties.

5.4.2 Method

The participants were randomly paired into 16 pairs, and each pair was randomly assigned to use either the PCS condition or the 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 details of the experimental procedure, the materials, the machines and the functions of the system, but no specific instructions directing participants to use the “●” prompter image(s) were given in either the explanation or during the experiments. 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 one hour, which was considered to be sufficient time to allow the participants to complete a total of 20 to 30 sets of messages, although the number or the frequency of messages was not controlled. During the experiment, no conversational topics were provided or suggested for either the PCS condition or the NCS condition. 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.
5.4.3 Experimental Results

5.3.3.1 General Results

A total of 428 messages were collected from the experiment. Figure 5.1 shows an example of the communication flow between participants from the PCS condition. Message A1-1 in Fig. 5.1 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 “●” prompter image 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 “●” prompter image 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. 5.1 shows the next message set created by Participant A, who continued the conversation and created a message with an impression of a character that has been broken into pieces after being run over by the bomb. The conversation obtained using the PCS was 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.
<table>
<thead>
<tr>
<th>Participant</th>
<th>ParticipantB</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1-1</td>
<td>(A1-1: Top: Thank you. Middle: This is my little appreciation)</td>
</tr>
<tr>
<td><img src="image1.png" alt="Image" /></td>
<td>(A1-2: Right: It is a bomb)</td>
</tr>
<tr>
<td>A1-2</td>
<td>(B1-1: Left bottom: In trouble (terrible), Right: Bomb)</td>
</tr>
<tr>
<td><img src="image2.png" alt="Image" /></td>
<td>(B1-1)</td>
</tr>
<tr>
<td>B1-1</td>
<td>(B1-2: Middle: The appreciation is enough. Bottom: Ah=)</td>
</tr>
<tr>
<td><img src="image3.png" alt="Image" /></td>
<td>(B1-2)</td>
</tr>
<tr>
<td>A2-1</td>
<td></td>
</tr>
<tr>
<td><img src="image4.png" alt="Image" /></td>
<td></td>
</tr>
</tbody>
</table>

Figure 5.1 An example of the communication flow created between participants using the PCS
<table>
<thead>
<tr>
<th>1-1</th>
<th>1-2</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1.png" alt="Image" /></td>
<td><img src="image2.png" alt="Image" /></td>
</tr>
</tbody>
</table>

(Translation - Death beam)  
(Translation – Krilli-n! (The name of a character in the comic Dragon Ball))

Figure 5.2 An example of the experimental results from a set of messages created by participants using the PCS

<table>
<thead>
<tr>
<th>2-1</th>
<th>2-2</th>
</tr>
</thead>
</table>
| ところで (・３・)  
＜＞  
/ / | ベガスは  
いつから？ |

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

Figure 5.3 An example of the experimental results from a set of messages created by participants using the NCS

Figures 5.2 and 5.3 show an example of messages from the PCS condition and the NCS condition, respectively. Message 1-1 in Fig. 5.2 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 a non-verbal, visual form, and will make little sense, or will generate a different interpretation, if not viewed in conjunction with the pictogram-like, pictorial-text messages. Message 2-1 in Fig. 5.3, which was produced using the NCS, shows that the 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.

<table>
<thead>
<tr>
<th>PCS - Pictorial-text</th>
<th>PCS - Text-only</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1.png" alt="Image" /></td>
<td><img src="image2.png" alt="Image" /></td>
</tr>
</tbody>
</table>

Hello World

Windows ME は
深刻なエラーから回復できなかった。

caution! caution! caution!

(Translation – Don’t you want to fly?)

(Translation - Middle: Windows ME had a serious error and wasn’t able to recover)

Figure 5.4 An example of the experimental results from a pictorial-text message and a text-only message using the PCS

Figure 5.4 is another sample of messages from the PCS condition, where the image on the left shows an example of a pictorial-text style message where the participant combined underlines, hyphens and strokes to form the image of a bird with stretched
wings. The message can be interpreted as a scene where the pictorial character is flying high in the sky. The impression and interpretation of the message would differ without the presence of the non-verbal, visual pictorial elements. The image 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.

<table>
<thead>
<tr>
<th>NCS-Pictorial-text</th>
<th>NCS-Text-only</th>
</tr>
</thead>
<tbody>
<tr>
<td>Merry X'mas!!!</td>
<td>地球の物理的距離なんてどうなんだろに トンケ ムスヨネ</td>
</tr>
<tr>
<td></td>
<td>(Translation - Bottom: Probably just have dinner with friends)</td>
</tr>
<tr>
<td></td>
<td>(Translation – The Physical distance of earth has gradually become nothing)</td>
</tr>
</tbody>
</table>

Figure 5.5  An example of the experimental results from a pictorial-text message and text-only message using the NCS

Figure 5.5 shows a sample of messages from the NCS condition, where the message on 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 using 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 the PCS or the NCS. Figure 5.6 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. 5.6, the average frequency of messages evaluated as being pictorial-text for the PCS and the 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 the PCS and the 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) × 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 × Message style was observed (F(1, 14) = 77.8, p<.01).

Figure 5.6  Average frequency of the appearance of messages in pictorial-text style in comparison with text-only style using both the PCS and the NCS. Error bars indicate the Standard Error, SE.

These results indicate that there were more messages generated in a pictogram-like, pictorial-text style using the PCS, whereas messages generated using the NCS were founded more on the text-only style than the pictorial-text style. Based on this observation, it can be suggested that communication using the PCS with the “●” prompter image(s) encouraged participants to create messages in a pictogram-like,
pictorial-text visual manner by combining text and symbols onto the “●”prompter image(s). It may be assumed from these results that communication using the 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.

5.3.3.3 Data Coding and Evaluation Results

A total of 428 messages were collected and data coding was applied by four coders, using the same coding schemes described in Chapter 4, 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 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 the PCS and the NCS have been calculated and categorized into the different self-disclosure levels for both the PCS and the NCS conditions, as shown in Figs. 5.7 (PCS) and Fig. 5.8 (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. 5.7, 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 the 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. 5.8, 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 for 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.
Figure 5.7  The average frequency of the appearance of self-disclosure levels within experimental result messages between pictorial-text and text-only styles using the PCS. Error bars indicate the Standard Error, SE.

Figure 5.8  The average frequency of the appearance of self-disclosure levels within experimental result messages between pictorial-text and text-only styles using the NCS. Error bars indicate the Standard Error, SE.
Further analysis of these evaluation results using ANOVA (System (two levels: PCS & NCS) × Message Style (two levels: Pictorial-Text and Text-only styles) × 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 × Message ((F1, 14) = 77.77, p<.001), System × SD Level (F, 42) = 3.55, p<.05), and System × Message Style × SD Level (F(3, 42) = 12.69, p<.005) was observed, but no significant interaction of Message Style × SD Level was found. The subordinate analyses for the interaction of System × SD Level revealed a significant simple effect in System × SD Level 0 (F(1, 56) = 1.00, p<.005), System × SD Level 1 (F(1, 56) = 1.71, p<.005), System × SD Level 3 (F(1, 56) = 0.12, p<.005) and System × SD Level 4 (F(1, 56) = 8.62, p<.005).

These observations suggest that messages created using the 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 the 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 the PCS generally resulted in a greater number of messages with information of a high degree of self-disclosure compared to messages obtained using the NCS.

Figure 5.9 shows an illustration of 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 the PCS had an average of 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. Messages created using the 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) × 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 × SD Levels (F(3, 42) = 8.38, p<.01).
Figure 5.9 The average number of words in each message for each self-disclosure level for both the PCS and the NCS. Error bars indicate the Standard Error, SE.

These results suggest that messages created using the 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 the NCS.

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

5.5 Conclusion

In this chapter, an approach to supporting pictogram-like, pictorial-text expressions 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 prototype PCS is embedded with “●” prompter image(s) on the background of the 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 to the prototype system. Communication experiments using the prototype PCS were conducted and its effectiveness examined.

The examined results and further analysis suggests that:

1. 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.

2. The self-disclosure levels within the resultant messages indicate that messages created using the PCS not only contain information with simple meanings or emotional cues, but also information with a high level of self-disclosure.

From the above observations, it can be suggested that communication using the PCS may improve the richness of non-verbal expression in order to encourage mutual understanding and reveal information with higher self-disclosure, which may foster intimacy and further lead to the development of deep interpersonal relationships.
Chapter 6
Conclusions and Future Works

6.1 Conclusion

This dissertation has proposed a new communication method that aims at supporting prompting and encouraging mutual understanding, and revealing information with higher self-disclosure. The proposed communication method was founded on the concepts of the Geneplore model, and was integrated with the features of emoticons and pictograms, together with the notions of self-projection and self-reflection. The main functional characteristic of the method is that it includes one to three black circular prompter image(s) (“●”) randomly embedded on the background of a text-field canvas. More specifically, the proposed communication method allows participants to freely insert text or symbols and position them by dragging and dropping them to the desired position on the text-field canvas, thereby creating messages in conjunction with the randomly embedded “●” prompter image(s). After the creation is completed, participants send the messages to their conversation partner via the network. The conversational partner views the received messages, and then creates his/her message in reply using the same procedure and returns it to the participant in order to continue the conversation.

The communication experiments and evaluations have been conducted in order to investigate the effects of the PCS, which includes the “●” prompter image(s), with regard to the following issues: (1) Support for the initiation or conception of conversational topics in order to share knowledge and information between individuals so as to deepen mutual understanding, (2) Support for the self-projection or self-reflection of mental representations in order to reveal information with high self-disclosure, and (3) Support for the encouragement of communication via both textual and visual expressions using text and symbols (similar to emoticons and pictograms) in order to compensate for missing non-verbal information and to enrich
expression during communication between users.

These issues are investigated in this thesis as follows.

In Chapter 1, the background of this thesis, the related work, the purpose, the proposed approach and the structure of this thesis were presented.

In Chapter 2, the motivation for the research, the concepts and theories of the proposed communication method, the models of the prototype system, the PCS, were introduced and explained. The hypotheses, details of the PCS to be used to verify the hypotheses, and details of the implementation of the PCS were illustrated and explained.

In Chapter 3, hypothesis (1) has been verified. The PCS, as a method of promoting the conception of conversational topics and/or informal communication in order to support mutual understanding between distant users, was introduced and evaluated. The PCS is designed based on the concept of the Geneplore Model, and its basic functions are intended to foster the conception and switching of conversational topics during informal communication. Communication experiments using the prototype PCS were conducted. The evaluated experimental results suggested that the “●” prompter image(s) randomly embedded onto the background of the text-field canvas encouraged the conception of conversational topics that were strongly related to conversations discussing either or both of the participants’ current situation, inner feelings and thoughts, combined with knowledge sharing. Furthermore, an effect on deepening mutual understanding between the participants is confirmed.

In Chapter 4, hypothesis (2) has been explored. The PCS, as an approach for supporting the self-projection or self-reflection of generated mental representations onto the “●” prompter image(s) in order to encourage the revelation of information with high self-disclosure during communications, was introduced and evaluated. Communication experiments using the PCS and the comparison system, the NCS, were conducted. The experimental results indicated that communication conducted using the PCS resulted in an increased number of messages with the prompter image(s) involved as part of the message contents rather than as background images. Further analysis into the self-disclosure level of the message contents and the relationships between the degree of
self-disclosure and the representations of the “●” prompter image(s) within the messages indicated that the degree of self-disclosure increased when the prompter images were used to represent the participant him/herself, or the participants thoughts and emotions, and decreased when the prompter images were used to represent animals or objects, or when the prompter images presented within the messages were ignored. Investigations into the differences in self-disclosure level between message contents from both the PCS and the NCS showed that using the PCS resulted in a generally higher degree in the average frequency of the appearance of high self-disclosure information than when using the NCS.

In Chapter 5, hypothesis (3) has been explored. The PCS, as a technique for supporting and encouraging communication using composite text and symbols in conjunction with “●” prompter image(s) in a pictorial-text style to compensate for missing non-verbal information in order to encourage mutual understanding and foster the revelation of information with high self-disclosure, was introduced and evaluated. The ability of the PCS to support non-verbal expression by encouraging the creation of pictogram-like, pictorial-text messages was examined. During this investigation, it was observed that the 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, thereby mitigating the lack of emotional and visual expression in plain text messages, which is an essential element for both intimacy and the development of deep interpersonal relationships. Communication experiments using the PCS were conducted, where a Normal Communication System, the NCS, which uses only a plain text-field canvas without the prompter image(s), was compared with the PCS. The experimental results indicated 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 the NCS.

6.2 Future Works

This study has shown the effect of the PCS on supporting and encouraging participants in gaining mutual understanding and revealing information with high self-disclosure levels in a text-based CMC using the “●” prompter image(s) as stimuli.
and as an embryonic basis for conversation. However, studies and analysis into the effects of the PCS on supporting and encouraging the conception of ideas for conversational topics and projecting/reflecting of mental representations using other images and figures, as well as variations in color, have not been considered. In addition, the effect on non-verbal expression in a text-based CMC using the “●” prompter image(s) as the basis for users to compose symbols and text in order to create pictogram-like, pictorial-text expressions, and 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 the PCS and other communicating systems have also not been considered in this study and remain an open question for future work.

Since the purpose of this research is focused on prompting users to conceive ideas and project their mental representations onto the provided image(s) in order to gain mutual understanding and encourage higher self-disclosure, the contribution of this research in regard to non-verbal communication has been discussed within a limited range, namely messages with pictorial-text style expressions created by participants engaged in the communication experiments. A more broad analysis and discussion from the perspective of non-verbal communication will remain an open issue for future work.

Moreover, investigations into the brainwave activity of users while operating the system, and an analysis of the brainwaves in association with the tasks of inspiring and conceiving ideas, revealing information with high self-disclosure and the creation process are also interesting and challenge topics to consider, and with the rapid development in telecommunication technologies, it may possible to integrate the PCS into a mobile device with the potential for investigating whether it has the same effect on the encouragement of mutual understanding and the revelation of information with higher self-disclosure among mobile device users.

Additionally, as mentioned in Section 4.3.6, the process of using both symbols and text to create messages is similar to the patterns that occur during the process of creative art therapy, which may allow users to consciously or unconsciously relieve stress or anxiety, or reveal information with high self-disclosure. Therefore, the development of the PCS might be an alternative approach as a communication tool for children, the
elderly, or anyone with learning difficulties or disabilities. It may also be able to be used to help anyone with mental health issues or communicative problems to express themselves, to understand themselves and allow others to understand them better. It may also be used by parents or teachers in order to enhance understanding of their children or students.

Technology has provided us with great convenience when communicating and connecting with each other, while, at the same time, potentially weakening the relationships and connections obtained through face-to-face communication between individuals that has existed in the past. The PCS may not be able to replace or re-establish the strong connection built between individuals through face-to-face communication in the past, but might be a new communication method that encourages individuals to reveal and share personal information and gain mutual understanding in order to establish better relationships and stronger connections in the digital era.
Bibliography


[35] 岡田謙一, 市村哲, 松浦宣彦, グループウェアにおけるコミュニケーション


# Appendix: List of academic achievements

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<tr>
<th>Category</th>
<th>Subheadings</th>
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<tr>
<td></td>
<td>○ Li Jen Chen, Shunichi Yonemura, Jun Ohya and Yukio Tokunaga, A study of Computer Mediated communication via the &quot;●&quot; prompt system</td>
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</table>


Technical meetings, forums and symposiums


Li Jen Chen, Shunichi Yonemura, Jun Ohya and Yukio Tokunaga, Creative Thinking Support Communication System with Random
Prompter “●” that Allows Hand-drawing, 電子情報通信学会技術報告, ヒューマンコミュニケーション基礎研究会（HCS）, March 2009.


<table>
<thead>
<tr>
<th>Domestic conference</th>
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<td>(And other 8 publications)</td>
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