Developing Trusting Relationships Through Communication

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Abstract

In this paper, we analyze the formation of trusting relationships between people through communication. To foster trusting relationships, individuals should disclose private and personal information. However, disclosing such information has both costs and benefits; therefore, both parties must decide on the optimal level of self-disclosure based on a variety of factors, such as the existing level of relationship and the benefits of deepening the trust level. We construct an economics model that explains the optimal way of self-disclosure. Our model is also consistent with the existing findings in the field of psychology; "Reciprocal self-disclosure" increases during the initial stages of relationship, and then declines after a certain level of relationship has been established, while non-intimate topics decrease as the relationship grows. Although the theoretical models of economics and those in psychology are very different in their methodology, both models reach the same conclusions. This implies not only the versatility of economics but also the possibility of more future collaborations between psychology and economics.

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1 Introduction

While communication is a means of facilitating understanding, it is also a means of building a trusting relationship between two individuals. Humans cannot establish trusting relationships without confessing something of themselves to one another. In other words, to establish a trusting relationship, self-disclosure by both parties is necessary. According to Jourard (1971), self-disclosure is "the act of making yourself manifest, showing yourself so others can perceive you." That is, self-disclosure is the conveyance of private and personal information, such as feelings, thoughts, values, desires, experiences and background, and future hopes to another party. Furthermore, Derlega (1984) demonstrated that the successful formation of a trusting relationship only occurs when an act of self-disclosure is favorably received by the other party, who then reciprocates with a similar self-disclosure.

Further, self-disclosure has both benefits and costs. One of its great benefits is the formation of trusting relationships. Another benefit is the one-sided positive effect of autocatharsis, whereby simply talking about personal burdens "lightens the load." In contrast, self-disclosure also involves the risk of the other party revealing private and personal information to others. From the perspective of economics, with these benefits and costs, there should be some optimal way of self-disclosure. Then, what is the most rational way for humans to develop relationships through self-disclosure?

Since Jourard (1959, 1964, 1971)'s pioneering work, there have been many psychological studies on self-disclosure processes (Altman 1973, Altman and Taylor 1973, Archer and Earle 1983, Chelune 1979, Derlega 1984, Derlega and Chaikin 1977, Kelvin 1977, Phillips and Metzger 1976). Altman and Taylor (1973) found that as interpersonal interactions deepen, self-disclosure progresses from the shallow to deeper regions of personality. They described this as the theory of "social penetration."[1][2]

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[1]Indeed, there are many papers that support social penetration theory, while there are also papers that criticize social penetration theory (Berg 1984, Berg and McQuinn 1986, Hays 1984, 1985).

[2]Chaikin and Derlega (1974) reported that private disclosure is considered more appropriate for those individuals who are considered intimate friends than with those who are new acquaintances. Altman and Taylor (1973) found that only 2% of their study participants indicated having disclosed private information to new acquaintances. In addition, Won-Doornink (1979, 1985) examined whether the phenomenon proposed by Altman and Taylor (1973) and Altman (1973) would hold using data gathered in South Korea. They confirmed a curvilinear association between the stage of interpersonal relationship and the degree of reciprocity of intimate self-disclosure. The results of Altman (1973)'s and

Furthermore, Altman (1973) noted that although reciprocal self-disclosure occurs up to a certain level of relationship developed, it declines once this level of trust has reached. At the same time, he also demonstrated that non-intimate topics decrease as the relationship grows. The existence of such behavioral trends in self-disclosure implies that people follow a certain decision-making process when they engage in self-disclosure. In this paper, we constructed an economics theory explaining the behavioral trends of self-disclosure observed/proposed in the psychological studies above. By doing so, we provide reasons why people behave in that way and explore the optimal way to self-disclose from a viewpoint of fundamental economics. We demonstrate that although a very sensitive process such as forming a trusting relationship between two individuals appears to be unrelated to rational behavior, it can be explained by economics, where rational human beings are assumed.

In the economics model of communication, this work is closely connected to that of Dewatripont and Tirole (2005), who examined communication as a means of promoting "understanding."[3] In the course of persuading another party to join a project, the persuader helps the other party understand the project's pros and cons and/or its details. Since joining and evaluating a project is closely related to rational behavior and optimization, it is relatively easy to explain the topic using the fundamental aspects of economics.

In this paper, however, we deal with more sensitive topics, which might appear to have nothing to do with the rational behavior assumed in economics. It is true that along with this "promotion-of-

Altman and Taylor (1973)'s studies were developed based on primarily American subjects. Therefore, Won-Doornink (1979, 1985) suggested that the reciprocity phenomenon may universally hold.

[3]There is a significant body of theoretical literature related to communication. Some communication models have been established in non-economics literature to understand communication psychologically or conceptually (Bedford and Baladouni 1962, Derlega and Grzelak 1979, Kenkyukai 1986, Ohashi and Osada 1987, Nishikawa and Komaki 2002). More recently, some communication models have focused on strategic interactions using economics models between a sender and receiver. Crawford and Sobel (1982) investigated the characterization of the Bayesian Nash equilibria within the context of a sender observing his/her "type" and then sending a signal that expresses a noisy estimate of this type to the receiver. The study showed that preference divergence between the two parties causes the sender to withhold information. Moreover, as preference divergence increases the amount of information disclosed by the sender decreases. Krishna and Morgan (2004) extended Crawford and Sobel (1982)'s study to allow for extensive communication so that the sender (the expert) and the receiver (the decision-maker) meet face-to-face before the sender communicates her final recommendation. Compared to Crawford and Sobel (1982)'s study, this amendment enables the sender who has private information and preference divergence to disclose more; that is, face-to-face communication leads to useful information transmission. Moreover, in the equilibrium realized by face-to-face communication, they show the existence of an equilibrium that is Pareto superior to all of the equilibria identified by Crawford and Sobel (1982). Crawford and Sobel (1982), Krishna and Morgan (2004), and Dewatripont and Tirole (2005) assumed that the relationship between the sender and the receiver is dichotomous, which means that the information flows in one direction.

4

understanding" aspect of communication, there is also the important aspect of "fostering a trusting relationship."[4][5] In this paper, we address the latter aspect of communication in an economics model, where we consider two types of people: a sender and a receiver.

In self-disclosure, unlike communication "to promote understanding," the order of self-disclosure is clear; therefore, the problem is solved as a Stackelberg game, with the sender as the leader. Both parties decide on the optimal level of self-disclosure based on factors such as the existing level of relationship, costs, and the payoff gained through the relationship formation.

The main conclusions of this paper are as follows: When the original level of intimacy is below a certain level, the risk to the receiver of his/her personal information being revealed by the sender is perceived to be high; therefore, the receiver does not reciprocate self-disclosure. Anticipating this, the sender has no incentive to self-disclose and thus, without prior communication (hereafter a "cue" communication), self-disclosure does not occur.[6] In a situation like this, the sender engages in a "cue" communication before self-disclosure. Once the sender gains a certain level of trust from the receiver through the "cue" communication, the receiver will also engage in self-disclosure. In contrast, when a certain level of trust already exists between the two parties, the receiver reciprocates the sender's self-disclosure, as the benefits of self-disclosure outweigh the costs. In this case, being aware of this, the sender directly self-discloses, avoiding a "cue" communication, which is also costly in terms of time and physical resources. This result is consistent with the findings of Altman (1973)'s study, i.e., the decrease in "non-intimate" topics as the relationship grows.

Furthermore, the higher the level of intimacy between the two parties the more frequently self-disclosure with deep content occurs. At the same time, there is a change in the quality of self-disclosure. That is, with increased intimacy, the focus moves away from the "trusting relationship fostering" elements of self-disclosure towards self-completion elements, such as "autocatharsis." Since the payoff from "autocatharsis" is obtained independent of the other party, it does not decline

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[4]Stein (2008) developed a model of bilateral conversation in which players exchange ideas, and information flows in both directions. Our model is similar because the receiver can decide whether to reciprocate the sender's self-disclosure. However, Stein (2008) examined the condition of competing players sustaining a conversation in which each player truthfully reports to the other. Therefore, the goals of their research were different from those of the current study.

[5]Penley and Hawkins (1985) focused on communication within an organization (particularly, communication between supervisors and subordinates).

[6]The "cue" communication includes conversation with shallow content (i.e., "non-intimate topics" defined in Altman (1973)'s study) and is done to get the receiver to perceive the sender as trustworthy.

as the level of intimacy rises. In contrast, the cost of self-disclosure is the decreasing function of the level of intimacy. Thus, when an individual decides on the level of self-disclosure at which the marginal benefit is the same as the marginal cost, the proportion of the overall marginal benefit accounted for by self-completion effects rises as the level of intimacy increases. This indicates that the tacit aim of self-disclosure, as the level of intimacy rises, shifts to self-completion factors.

In this way, the level of reciprocal self-disclosure increases as the level of intimacy rises but starts to decline beyond a certain level of intimacy, which is consistent with the findings of Altman (1973)'s study. The fact that our economics model was independently built within our field surprisingly leads to results consistent with the findings in the field of psychology. This implies that both academic fields have commonalities, which make us believe in a huge possibility of more collaborations between psychology and economics.

The remainder of this paper proceeds in five sections. Section 2 covers the explanations of self-disclosure in psychology and Section 3 introduces our economics model. In Section 4, we focus more on the concept of reciprocity and provide an economics explanation for the findings of Altman (1973). Section 5 concludes the paper.

2   Self-Disclosure

2.1   The costs and benefits of self-disclosure

To convert the idea of self-disclosure into an economics model, we need to figure out what its benefits and costs are. Thus, as a preparation for establishing an economics model, we will clarify them in this section. According to Derlega and Grzelak (1979), the benefits of self-disclosure include the following:

(B1) *Expression: Expressing and diffusing conflict, uncertainty, and pent-up emotions has a cathartic effect.*

(B2) *Self-clarification: Putting one's own problems and emotions into words requires organization. Further, verbalization can clarify chaotic problems and emotions.*

6

(B3) Social validation: One can receive a range of social support and feedback from the confidant. Self-understanding can be deepened when "blind spots" are brought to a person's attention.

(B4) Relationship development: The mutual disclosure of various hidden personal aspects prompts feelings of trust.

(B5) Social Control: People use disclosure as tool for constructing relationship and controlling their perspective effect.

These are the beneficial components of self-disclosure. Specifically, (B1) and (B2) are the effects arising from the act of self-disclosure itself, independent of the other party's behavior. On the other hand, (B3) to (B5) are the effects obtained from feedback from the recipient of that disclosure. Thus, the former are known as self-completion effects and the latter as interaction effects.

However, self-disclosure is also accompanied by psychological costs. According to Derlega (1984), the main reasons for hesitation to disclose private information are as follows.[7]

(C1) Self-concept is rejected.

(C2) Finding out that the other person is not interested in having an intimate relationship.

(C3) Information is used by others to gain control or power in the relationship.

(C4) Disclosure of information to others.

(C5) Breaking the relationship boundaries by divulging information to others.

(C6) Inequity derived from the lack of equivalent input into the relationship.

In this way, self-disclosure is accompanied by both costs and benefits. Therefore, it is natural to think that people unconsciously compare these costs and benefits to select the optimal level of self-disclosure.

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[7]See Derlega (1984) for the detailed meaning of each cost.

2.2 The reciprocity of self-disclosure and the stage of a social relationship

As depicted in Figure 1, Altman (1973) found that in the early stage of a relationship, reciprocity of non-intimate topics is frequently observed, while reciprocity of intimate topics is not. In the middle stage of the relationship, disclosures of intimate topics are enthusiastically exchanged. In the advanced stage of the relationship, the exchange of both intimate-topics and non-intimate topics between the two people decline.

Figure 1: Reciprocity of disclosure as a function of topical intimacy and stage of a social relationship
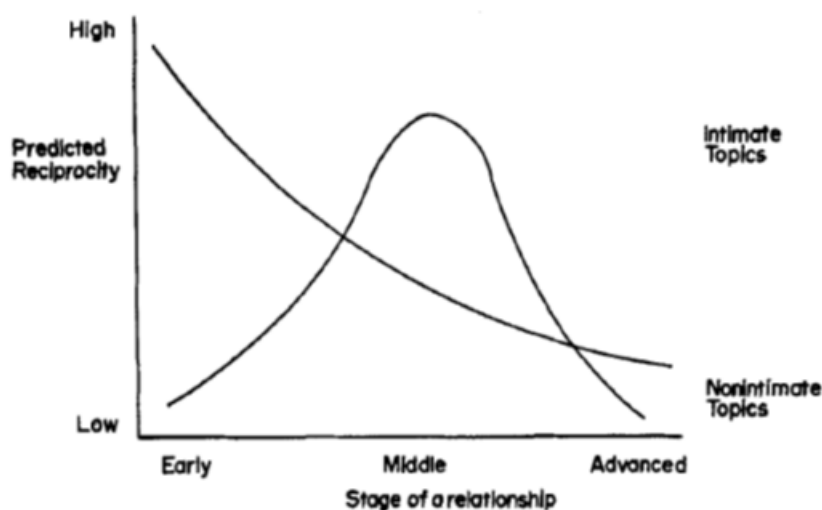
Note: This figure is sited from Fig.1. in Altman (1973) on pp.257.

Psychologists explain the phenomenon in the advanced stage of a relationship by the "loss of the sense of the necessity of returning self-disclosure for mutual gain." We demonstrate that this finding regarding reciprocity can be explained by the rational behaviors of both parties concerned using an economic model.[8]

3 Building an Economics Model

In this section, we construct an economics model that explains self-disclosure and reciprocity by assuming the rational behaviors of both parties concerned, which is the fundamental assumption

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[8]This curvilinear relationship between the stage of the interpersonal relationship was also found by Won-Doornink (1979, 1985), who used the data gathered in South Korea.

of an economics model. Note that we construct the model independently from the physiological theory or evidence found in psychological studies.

Upon self-disclosure, the sender and the receiver decide on their respective levels of self-disclosure, x, y. These indicate both the depth and breadth of self-disclosure. Both parties gain a payoff b at each level of self-disclosure from the act of self-disclosure itself, independent of the self-disclosure of the other party. Further, if the receiver reciprocates the sender's self-disclosure, the sender succeeds in creating a trusting relationship. Conversely, in returning the sender's self-disclosure, the receiver can construct a trusting relationship. The sender gains an additional payoff $s > 0$ from each unit of the trusting relationship created. On the other hand, in responding to the sender's self-disclosure and creating a trusting relationship, the receiver gains a payoff r_H with probability α or a payoff r_L ($r_H > 0 > r_L$) with probability $1 - \alpha$. At the point of self-disclosure, the receiver does not know which payoff will be realized, and the expected payoff at the point of self-disclosure is $\bar{r} \equiv \alpha r_H + (1 - \alpha) r_L$.

With regard to the asymmetric nature of the sender/receiver, this is due to the differences in the sender's and receiver's definitions and their roles. The sender initiates the communication, which means that he/she already believes in the value of their relationship with the receiver. In essence, the sender speaks first because he/she is attracted to the receiver. Mathematically, this means that the sender believes that the payoff "s" will be positive. Although the sender can make a mistake, he/she believes in the value of the relationship with the receiver. Thus, whether the estimate of "s" by the sender is really correct or not is not a problem here. In this subjective sense, for the sender, there is no uncertainty. In another example, if we consider one-sided love, one person may fall in love first, regardless of the existing level of relationship, become a sender, and try to initiate communication, expecting a positive outcome from their relationship with the receiver (loved one.)[9] Here, $\alpha \in [0, 1]$ can be interpreted as an indicator of the trusting relationship, i.e., the existing level of relationship. The value of α and the value of r_H and r_L are well known to both

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[9]In our model, for the receiver, with whom the sender communicated, there is some uncertainty in developing a relationship with the sender. Thus, the outcome of the communication can be written as the weighted average of that for a bad case and that for a good case. In addition, the reason why these probabilities depend on α (i.e., the existing level of relationship) is that the lower the α is, the higher the uncertainty is. For example, if we consider two people who have known each other for a long time and have high α, most of the value of developing a relationship between the two people has been already revealed. Thus, a high payoff, r_H, is very likely to have occurred. Thereby, the receiver utilizes the information of α to calculate the weighted average of the payoffs.

parties.[10]

Here, we define the trusting relationship as a concave and continuous differentiable function f with self-disclosure by the two parties as inputs (as below). f_x and f_{xx} represent the first- and second-order derivatives by x, respectively. The same rule applies to y.[11] The next Equation 1 lists all the assumptions about the functional forms, which are usually assumed in the economics model.[12]

$$f = f(x,y), \ f_x > 0, \ f_y > 0, \ f_{xx} < 0, \ and \ f_{yy} < 0 \tag{1}$$

Here, we develop our discussion based on the assumption that when developing a trusting relationship, the disclosure by the two parties is complementary, and not a substitute. Thus, $f_{xy} > 0$ holds. This is because it is a natural assumption that the level of self-disclosure of the receiver is complementary to that of the sender. The next equation describes the assumption about the communication breakdown.

$$f(0,0) = 0, \ f(x,0) = 0, \ and \ f(0,y) = 0 \tag{2}$$

Moreover, we make a technical assumption on the primitives, which is called the Inada condition.

$$\lim_{x \to 0} f_x = +\infty, \lim_{y \to 0} f_y = +\infty \tag{3}$$

The assumption rules out an equilibrium that both players select zero self-disclosure, that is, $x =$

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[10]The receiver predicts whether r_H or r_L will occur, based on the level of α. Thus, these can be written as conditional probabilities: $r(H|\alpha)$ and $r(L|\alpha)$. In sum, these probabilities are functions of α. For simplification, we assumed a linear function of α.

[11]You may imagine that the existing level of relationship, α, increased in accordance with the increase in the level of trust in the relationship $f(x,y)$ owing to two parties' self-disclosures from the dynamic aspect. However, this aspect was not considered in Altman (1973)'s experiment. In the experiment, the subjects were classified into three groups based on the level of intimacy. In group 1, the subjects had met within the previous 30 days; in group 2, they had known each other for at least 3 months but not longer than a year; in group 3, they were best friends who had known each other for many years. Then, he experimented under these subjects, which means that he fixed one group and did not take the method how "reciprocal self-disclosure" for the increase of the level of intimacy change in the long term. To make the methodology as parallel as possible to that used in Altman (1973)'s experiment, we modeled the game as a one-shot game given the level of α.

[12]In the economics field, where we assume that a rational person maximizes his or her utility, these assumptions about the functional forms are the most standard settings. In other words, the trusting relationship increases in x or y, but the degree of the increase is reduced as x or y increases.

$y = 0$, and allows us to focus on an equilibrium that they choose strictly positive self-disclosure. Self-disclosure is accompanied by psychological costs, such as the risk that the other party will reveal personal information to others, and we consider the cost for each level of self-disclosure as:

$$c(\alpha) > 0 \; and \; c'(\alpha) < 0 \tag{4}$$

Here, we assume that self-disclosure has a positive cost at all levels of the relationship developed. Thus, the scope of $c(\alpha)$ is

$$c(\alpha) \in [b, \infty) \tag{5}$$

The receiver, having observed the sender's self-disclosure, decides on his/her own level of self-disclosure. On the other side, the sender includes that factor in his/her thinking when deciding on his/her level of self-disclosure. Thus, the problem is a Stackelberg game led by the sender. The respective payoffs to each party from self-disclosing are defined as:

$$U_S = f(x, y^*(x))s + bx - c(\alpha)x \tag{6}$$

$$U_R = f(x, y)\bar{r}(\alpha) + by - c(\alpha)y \tag{7}$$

The receiver, having observed the sender's self-disclosure, decides on his/her own level of self-disclosure. The first-order condition (FOC) of the receiver is:

$$\frac{\partial U_R}{\partial y} = f_y(x, y)\bar{r}(\alpha) + b - c(\alpha) = 0 \tag{8}$$

The first term of the Equation 8 is the marginal benefit when an increase in the level of self-disclosure promotes the formation of a trusting relationship. The second term shows the marginal benefit arising from the act of self-disclosure itself, independent of the other party. The third term presents the marginal cost. Note that the sender decides on the optimal level of self-disclosure with

the behavior of the receiver in mind as mentioned above. The FOC of the sender is:

$$\frac{\partial U_S}{\partial x} = \left(f_x + f_y y'(x)\right)s + b - c(\alpha) = 0 \tag{9}$$

In this section, we assume that $\bar{r}(\alpha)$ is positive. The case in which $\bar{r}(\alpha)$ is non-positive is examined in Section 3.1. If $\bar{r}(\alpha)$ is positive, two parties do not select zero self-disclosure owing to the Inada condition.[13] Thus, as long as $\bar{r}(\alpha)$ is positive, we focus on the equilibrium so that both parties choose a strictly positive self-disclosure.

Here, we check whether the FOCs 8 and 9 are sufficient. If $\bar{r}(\alpha)$ is positive, we can confirm the receiver's optimized behavior since the second-order condition (SOC) for the receiver $\frac{\partial^2 U_R}{\partial y^2} = f_{yy}\bar{r}(\alpha)$ is negative by the assumption in Equation 1. On the other hand, we do not know the sign of SOC for the sender $\frac{\partial^2 U_S}{\partial x^2} \equiv \Omega$ in general, where let us denote Ω as follows:

$$\Omega = \left(f_{xx} + f_{xy}y'(x) + \left(f_{yx} + f_{yy}y'(x)\right)y'(x) + f_y y''(x)\right)s \tag{10}$$

To solve the sender's optimized behavior in this context using the economics tool, we assume that the trusting relationship f satisfies the sufficient condition for optimization, which means that $\Omega < 0$. In this case, from the FOCs of the Equations 8 and 9, it can be said that:

REMARKS 1: *If the SOC is satisfied and $\bar{r}(\alpha)$ is positive, the following statements hold. (a) As the existing level of relationship between the parties (α) increases, the level of self-disclosure by both parties increases. (b) For each of the parties, the higher the value "s" or "r_i" ($i = H, L$) gained from one unit formation of a trusting relationship, the higher the respective levels of self-disclosure. (c) The greater the payoff (b) produced by self-disclosure, the higher the level of self-disclosure.*

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[13]If both parties select $x = y = 0$ when $\bar{r}(\alpha)$ is positive, the FOC for the sender and the receiver will never be satisfied because the first term on the left hand side in Equations 8 or 9 goes to plus infinity by the Inada condition. Therefore, the equilibrium $x = y = 0$ is not optimal.

Proof of (a)

Differentiating both the FOCs in Equations 8 and 9 with respect to α, we get:

$$
\begin{bmatrix} \left(f_{yx} + f_{yy} y'(x) \right) \bar{r} & f_{yy} \bar{r} \\ \Omega & \left(f_{xy} + f_{yy} y'(x) \right) s \end{bmatrix} \begin{bmatrix} \frac{\partial x^*}{\partial \alpha} \\ \frac{\partial y^*}{\partial \alpha} \end{bmatrix}
$$
$$
= \begin{bmatrix} c'(\alpha) - f_y(r_H - r_L) \\ c'(\alpha) \end{bmatrix} \tag{11}
$$

Here, we denote the Hessian matrix as $|H|$. By rearranging and substituting $\frac{dy}{dx} = -\frac{f_{yx}}{f_{yy}}$ into $y'(x)$[14], the Hessian matrix can be rewritten as:

$$
\begin{aligned}
|H| &= \begin{bmatrix} \left(f_{yx} + f_{yy} \left(-\frac{f_{yx}}{f_{yy}} \right) \right) \bar{r} & f_{yy} \bar{r} \\ \Omega & \left(f_{xy} + f_{yy} \left(-\frac{f_{yx}}{f_{yy}} \right) \right) s \end{bmatrix} \\
&= \begin{bmatrix} 0 & f_{yy} \bar{r} \\ \Omega & 0 \end{bmatrix} \\
&= -\Omega f_{yy} \bar{r} < 0
\end{aligned} \tag{12}
$$

Using the re-formatted Hessian matrix in Equation 12 and Cramer's Rule, we get:

$$
\begin{aligned}
\frac{\partial x^*}{\partial \alpha} &= \frac{1}{|H|} \begin{bmatrix} c'(\alpha) - f_y(r_H - r_L) & f_{yy} \bar{r} \\ c'(\alpha) & 0 \end{bmatrix} \\
&= \frac{-c'(\alpha) f_{yy} \bar{r}}{|H|} > 0
\end{aligned} \tag{13}
$$

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[14]Mathematically, the complementary assumption results in $\frac{dy}{dx} = -\frac{f_{yx}}{f_{yy}} > 0$.

$$\frac{\partial y^*}{\partial \alpha} = \frac{1}{|H|} \begin{bmatrix} 0 & c'(\alpha) - f_y(r_H - r_L) \\ \Omega & c'(\alpha) \end{bmatrix} \tag{14}$$

$$= \frac{-\Omega\left(c'(\alpha) - f_y(r_H - r_L)\right)}{|H|} > 0$$

<div align="right">Q.E.D. <i>Proof of (b)</i></div>

Similarly, using the expression in Equation 11, we get the following for the impact of s on x^* and r_H (or r_L) on y^*:

$$\frac{\partial x^*}{\partial s} = \frac{1}{|H|} \begin{bmatrix} 0 & f_{yy}\bar{r} \\ -f_x - f_y y'(x) & 0 \end{bmatrix} \tag{15}$$

$$= \frac{\left(f_x + f_y y'(x)\right) f_{yy}\bar{r}}{-\Omega f_{yy}\bar{r}} = -\frac{f_x + f_y y'(x)}{\Omega} > 0$$

$$\frac{\partial y^*}{\partial r_H} = \frac{1}{|H|} \begin{bmatrix} 0 & -f_y \alpha \\ \Omega & 0 \end{bmatrix} = \frac{-\Omega f_y \alpha}{|H|} > 0 \tag{16}$$

$$\frac{\partial y^*}{\partial r_L} = \frac{1}{|H|} \begin{bmatrix} 0 & -f_y(1-\alpha) \\ \Omega & 0 \end{bmatrix} = \frac{-\Omega f_y(1-\alpha)}{|H|} > 0 \tag{17}$$

<div align="right">Q.E.D.</div>

Proof of (c)

Similarly, using the expression in Equation 11, we get the following for the impact of b on x^* and y^*:

$$\frac{\partial x^*}{\partial b} = \frac{1}{|H|} \begin{bmatrix} -1 & f_{yy}\bar{r} \\ -1 & 0 \end{bmatrix} = \frac{f_{yy}\bar{r}}{|H|} > 0 \tag{18}$$

$$\frac{\partial y^*}{\partial b} = \frac{1}{|H|} \begin{bmatrix} 0 & -1 \\ \Omega & -1 \end{bmatrix} = \frac{\Omega}{|H|} > 0 \tag{19}$$

<div align="right">Q.E.D.</div>

REMARKS 1(a) is tantamount to Altman and Taylor (1973)'s process of social penetration, which

states that, as the relationship deepens, self-disclosure progresses from the shallow to the deeper aspects of personality. In our model, the reason for increasing the level of self-disclosure as the relationship deepens is slightly different between the two parties. From the formula $\frac{\partial x^*}{\partial \alpha}$, the sender raises his/her level of self-disclosure because, as the relationship deepens, the marginal cost of self-disclosure decreases. In contrast, as the relationship deepens, the receiver increases the level of self-disclosure through i) a rise in the expected payoff from the formation of a trusting relationship and ii) a reduction in the marginal cost of self-disclosure. Regarding REMARKS 1(b), the higher the payoff to each party the higher the level of self-disclosure, which is highly intuitive. REMARKS 1(c) concerns the impact of a payoff obtained from the act of self-disclosure independent of the other party's self-disclosure (e.g., benefit through self-clarification). The increase in b, which is common to both parties, increases the level of self-disclosure for both parties. It is expected that the higher the benefit of this kind of self-disclosure, the more both parties self-disclose, but the type of self-disclosure becomes more self-completion.

Up to this section, we have considered only the case where communication occurs, but in the next section, we will consider cases where communication breakdown occurs.

3.1 Communication Breakdown

Up to here, the premise has been that the receiver reciprocates self-disclosure assuming that $\bar{r}(\alpha)$ is positive but, intrinsically, neither party is likely to self-disclose if there is no positive payoff from self-disclosing.

The sender self-discloses when the payoff $s > 0$ from the formation of a trusting relationship is great enough to give a non-negative payoff $U_S^*(\geq 0)$, where U_S^* is the maximized expected payoff of the sender. To word it the other way around, because the sender believes that the other party is trustworthy enough that there will be no loss from talking, the sender self-discloses first. In contrast, for the receiver, responding with self-disclosure is accompanied by risk. For the receiver to self-disclose, the condition $U_R^* \geq 0$ must be fulfilled, where U_R^* is the maximized expected payoff of the receiver. Hence, the following REMARKS 2:

REMARKS 2:*Where the receiver is uncertain of the trustworthiness of the sender; if the existing level of relationship is* $\alpha^* \equiv \frac{-r_L}{r_H - r_L}$ *or less, there is a breakdown in self-disclosure communication.*

Proof

Here, we define α, whereby the expected payoff ($\bar{r}$) becomes zero, as α^*, which is expressed by the following equation:

$$\bar{r}(\alpha^*) \equiv \alpha^* r_H + (1 - \alpha^*) r_L = 0 \tag{20}$$

Note that the receiver's expected payoff is described as Equation 7.

By the assumption of $f(x, 0) = 0$, if the receiver chooses not to reciprocate (i.e., chooses $y = 0$), the first term in Equation 7 becomes zero, and the latter two terms in Equation 7 also become zero, which means that $y = 0$ brings $U_R = 0$. Therefore, if U_R^* is positive, the receiver chooses an interior solution of $y^* > 0$. Anticipating this, as long as the U_S^* is positive, the self-disclosure by each party is realized. According to the Inada condition, this equilibrium can happen only for $\alpha > \alpha^*$, where $\bar{r}$ is positive.

This is because, by the definition of α^*, for any $\alpha < \alpha^*$, $\bar{r}$ is negative, which means that by the assumption of $c(\alpha) \geq b$, the receiver's payoff is negative for any y when he/she participates in this communication. Thus, the receiver chooses $y^* = 0$, and the sender, anticipating this behavior, chooses $x^* = 0$, thereby resulting in a breakdown in self-disclosure communication. Furthermore, when $\alpha = \alpha^*$, we have $\bar{r} = 0$; thus, by the assumption of $c(\alpha) \geq b$, the receiver's payoff is, at most, zero for any y.[15] Therefore, the receiver's best response is to choose $y^* = 0$ and the sender anticipating this behavior will choose $x^* = 0$, which results in a breakdown in self-disclosure communication.   Q.E.D.

3.2 Payoff

Next, for the region of α where the communication occurs (i.e., when $\alpha > \alpha^*$), we see the maximized level of U_R^* as a function of α and differentiate the receiver's expected payoff with respect

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[15]The first term in Equation 21 becomes zero and the summation of the latter two terms is zero or less for any y.

to α.

$$\frac{dU_R^*(\alpha)}{d\alpha} = f_x \frac{\partial x^*}{\partial \alpha} \bar{r} + f(x^*, y^*)(r_H - r_L) - c'(\alpha)y^* > 0 \tag{21}$$

Therefore, when $\alpha > \alpha^*$, a rise in the existing level of relationship boosts the overall expected pay-off for the receiver, owing to the following three effects: (1) A rise in the level of self-disclosure by the sender contributes to establishing a trusting relationship; (2) due to an increase in the expected payoff, the predicted value of fostering a trusting relationship directly rises; and (3) reduction in the psychological cost accompanying self-disclosure has a positive impact. In Equation 21, the order of the terms corresponds to each effect.

4   Cue communication

Until now, the results have shown that individuals do not self-disclose up to a certain level of intimacy. This is because the receiver is uncertain about the trustworthiness of the sender. However, if neither party self-discloses, a trusting relationship will never be fostered. Given that, we consider the situation when additional communication is carried out before self-disclosure, and having dispelled his/her wariness of the sender, the receiver self-discloses. This type of communication is defined in Dewatripont and Tirole (2005)'s study as "cue communication." Although the types of communication examined in their paper are somewhat different from ours, the same logic regarding cue communication works well in our case: Cue communication as discussed here does not have deep content, such as self-disclosure, and does not directly contribute to the development of a trusting relationship. Instead, cue communication provides clues about the trustworthiness of the sender. Here, the time spent in innocuous conversation in the modern world, for instance, is engaged in this type of communication. When cue communication succeeds, the receiver learns whether the potential payoff from establishing a trusting relationship with the sender is r_H or r_L. This communication, rather than aiming at fostering a trusting relationship, is intended to allow the receiver to gain an understanding of the sender's character such as trustworthiness. Before engaging in cue communication, the sender does not know what kind of judgment the receiver will

make about the value of a relationship with him/her. In other words, even if the sender knows the probability of realizing r_H and r_L, he/she does not know which of them will be realized in practice.

4.1 Communicating technology

For cue communication, we apply the same communication technology used in Dewatripont and Tirole (2005): p is the probability of the receiver arriving at a decision regarding the trustworthiness of the sender. The effort put into cue communication by the sender and receiver is expressed as x^c and y^c, respectively. For the receiver to come to a decision about the trustworthiness of the sender, cue communication by both parties is required. Given that, we define $p(x^c, y^c)$ as a function relating to the level of effort from both parties as:

$$p(x^c, y^c) = x^c y^c \tag{22}$$

Therefore, we assume $x^c, y^c \in [0, 1]$. In this type of communication, unlike in self-disclosure communication, the costs are physical and temporal rather than psychological. We define the cost for each person as an increasing convex function relating to the level of effort, as follows.

$$S = S(x^c), \ R = R(y^c), \ S'(1) = R'(1) = \infty \tag{23}$$

Where S and R can be continuously differentiated on intervals (0,1). Here, the sender and the receiver determine their own level of effort for cue communication simultaneously and independently. When a function has been defined, such as Equation 22, strategic complementarities arise and result in multiple equilibria. In particular, zero-effort equilibrium of $x^c = y^c = 0$ always exists. When there are multiple equilibria, we select the Pareto-dominant one and denote it by (x^{c*}, y^{c*}).

Next, we consider the scope of α, where cue communication can occur in practice. When cue communication is established, it becomes clear that $r = r_H$ or $r = r_L$, and therefore, the receiver does not take the chance of self-disclosing when $r = r_L < 0$.[16] Therefore, when cue communication occurs, only when it is clear that $r = r_H$ do the parties move on to self-disclosure communication

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[16]This is because if self-disclosure occurs when $r = r_L < 0$, then it follows that $U_R^* \equiv f(x^*, y^*)r_L + by^* - c(\alpha)y^* < 0$ by the assumption stated in Equation 5.

specified in the previous section. Thus, with the same utility settings, when the receiver has inter-preted from cue communication that $r = r_H$, the self-disclosure level of both parties is determined as:

$$x^* = \underset{x}{\arg\max} \, f(x, y(x))s + bx - c(\alpha)x \tag{24}$$

$$y^* = \underset{y}{\arg\max} \, f(x, y)r_H + by - c(\alpha)y \tag{25}$$

The only difference from the previous section is that $\bar{r}$ is replaced by r_H in Equation 25. Solving for the relevant FOCs, we set the maximized the expected payoffs as U_S^*, U_R^*.

$$U_S^* \equiv f(x^*, y^*(x^*))s + bx^* - c(\alpha)x^* > 0 \tag{26}$$

$$U_R^* \equiv f(x^*, y^*)r_H + by^* - c(\alpha)y^* > 0 \tag{27}$$

Considering the payoff, the sender and receiver determine the level of effort they will each put into cue communication. For both parties to obtain payoffs U_S^*, U_R^*, the receiver must perceive that $r = r_H$. Therefore, we multiply the potential payoff from self-disclosure by the probability α of this perception occurring. Thus, the respective expected payoff from cue communication for each party is:

$$U_S^c(x^c, y^c) = x^c y^c \alpha U_S^* - S(x^c) \tag{28}$$

$$U_R^c(x^c, y^c) = x^c y^c \alpha U_R^* - R(y^c) \tag{29}$$

Both parties engage in cue communication with the level of effort that maximizes Equations 28 and 29 above. Each FOC is:

$$S'(x^{c*}) = y^{c*} \alpha U_S^* \tag{30}$$

$$R'(y^{c*}) = x^{c*} \alpha U_R^* \tag{31}$$

4.2 Payoff

When we differentiate the receiver's expected payoff with respect to α, we arrive at:

$$\frac{\partial U_R^{c*}}{\partial \alpha} = \left(x^{c*} + \frac{\partial x^{c*}}{\partial \alpha} \alpha \right) y^{c*} U_R^* + x^{c*} y^{c*} \alpha \frac{\partial U_R^*}{\partial \alpha} > 0 \qquad (32)$$

$$where \ \frac{\partial U_R^*}{\partial \alpha} = f_x \frac{\partial x^*}{\partial \alpha} r_H - c'(\alpha) y > 0$$

When cue communication occurs, the relationship between α and the expected payoff is affected. That is, when α increases, the overall expected payoff for the receiver rises, owing to four effects: (i) The probability of self-disclosure increases as it becomes more likely that his/her perception will be $r = r_H$, which directly increases the expected payoff. (ii) The level of effort expended by the sender on cue communication rises, thereby increasing the probability of success in the communication and indirectly increasing the expected payoff. (iii) The level of self-disclosure by the sender rises and helps foster a trusting relationship, thereby increasing the payoff from self-disclosure. (iv) The psychological cost of self-disclosure declines, which increases the self-disclosure payoff. Each term in Equation 32 corresponds to each channel.

Similarly, we differentiate the sender's expected payoff with respect to α:

$$\frac{\partial U_S^{c*}}{\partial \alpha} = \left(y^{c*} + \frac{\partial y^{c*}}{\partial \alpha} \alpha \right) x^{c*} U_S^* + x^{c*} y^{c*} \alpha \frac{\partial U_S^*}{\partial \alpha} > 0 \qquad (33)$$

$$where \ \frac{\partial U_S^*}{\partial \alpha} = f_y \frac{\partial y^*}{\partial \alpha} s - c'(\alpha) x > 0$$

As α increases, the overall expected payoff for the sender rises, owing to the following four effects: (i) The probability of self-disclosure by the receiver increases as it becomes more likely that his/her perception will be $r = r_H$, directly increasing the expected payoff ($y^{c*} x^{c*} U_S^*$). (ii) The level of effort expended by the receiver on cue communication rises, which increases the probability of success in the communication, thereby indirectly boosting the expected payoff ($\frac{\partial y^{c*}}{\partial \alpha} \alpha x^{c*} U_S^*$). (iii) The level of self-disclosure by the receiver rises and contributes to fostering a trusting relationship, increasing the payoff from self-disclosure ($x^{c*} y^{c*} \alpha f_y \frac{\partial y^*}{\partial \alpha} s$). (iv) The psychological cost accompanying self-disclosure declines, increasing the payoff from self-disclosure ($-x^{c*} y^{c*} \alpha c'(\alpha) x$).

4.3 No Cue Communication vs. Cue Communication

In Section 4, our discussion has progressed on the assumption that cue communication will definitely occur; however, intrinsically, the parties concerned can decide (i) whether to self-disclose after engaging in cue communication and (ii) whether to self-disclose without cue communication. Below, we look at the circumstances in which cue communication proceeds and breaks down.

Here, we define $\hat{\alpha}$ as the minimum level for α that satisfy $U_R^{c*}(x^{c*}(\alpha), y^{c*}(\alpha)) \geq 0$ and $U_S^{c*}(x^{c*}(\alpha), y^{c*}(\alpha)) \geq 0$. Since having more options should not work to reduce payoffs, we can safely assume that $\hat{\alpha} < \alpha^*$, which means that we might improve our payoff using cue communication.[17]

Furthermore, we define the level of α that satisfies the following as $\tilde{\alpha}$:

$$U_S^c(r_H) = x^c y^c \tilde{\alpha} U_S^*(r_H) - S(x^c) = U_S^*(\bar{r}(\tilde{\alpha})) \tag{34}$$

Note that $\alpha^* < \tilde{\alpha}$ because $\bar{r}(\tilde{\alpha}) > 0$. Thus, for $\alpha > \tilde{\alpha}$, the intimacy level is high enough for the sender to skip the cue communication procedure. When $\alpha^* < \alpha < \tilde{\alpha}$, although the receiver does not experience a loss even if he/she self-discloses while still being uncertain about the trustworthiness of the sender, the uncertainty is not very low. Therefore, the gain is greater for the sender if he/she boldly engages in cue communication so that the receiver may believe that $r = r_H$ and thus, self-disclose at a high level. In this case, the sender attempts to engage in cue communication to elicit high-level self-disclosure from the receiver. Thus, sometimes cue communication is intended to elicit a higher level of self-disclosure when the receiver already has an incentive to self-disclose.

For $\alpha \leq \hat{\alpha} < \alpha^*$, we get $U_R^{c*}(x^{c*}(\alpha), y^{c*}(\alpha)) < 0$ or/and $U_S^{c*}(x^{c*}(\alpha), y^{c*}(\alpha)) < 0$. Thus, the cue communication breaks down. In addition, from $\alpha \leq \alpha^*$ and REMARKS 2, even a self-disclosure without a cue communication does not occur.

For $\hat{\alpha} < \alpha \leq \alpha^*$, we get $U_R^{c*}(x^{c*}(\alpha), y^{c*}(\alpha)) \geq 0$ and $U_S^{c*}(x^{c*}(\alpha), y^{c*}(\alpha)) \geq 0$, thus the cue communication occurs. Only when the information about the sender turns out to be r_H, they move forward to a self-disclosure. Since $\alpha \leq \alpha^*$, a self-disclosure without a cue communication never occurs.

For $\hat{\alpha} < \alpha^* < \alpha < \tilde{\alpha}$, the receiver does not experience a loss even if he/she self-discloses while

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[17]It is true that $\hat{\alpha} = \alpha^*$ is theoretically possible, but we differentiate the two criteria for simplicity.

still being uncertain about the trustworthiness of the sender. Due to $\alpha < \tilde{\alpha}$, the sender still chooses to undertake the cue communication procedure because the payoff of doing so is still greater than self-disclosing without a cue communication.

For $\hat{\alpha} < \alpha^* < \tilde{\alpha} \leq \alpha$, going directly to the self-disclosure stage is more beneficial for the sender. This situation can be true when $\bar{r}$ is very high due to high existing intimacy (α). This time, in practice, the sender has real authority, and there is a breakdown in cue communication. This result implies that as α approaches 1, cue communication definitely breaks down.

This is consistent with Jourard and Landsman (1980)'s study, which showed that only 2% of the subjects self-disclose at their first meeting.

4.4   Reciprocity

We now return to the concept of reciprocity of the amount of self-disclosure. From Equation 8, marginal benefits obtained by increasing the level of self-disclosure can be classified as gains obtained from the formation of a trusting relationship and gains arising from the act of self-disclosure independent of the other party. The reciprocity of self-disclosure means that "because self-disclosure by the other party works as a payment, by also self-disclosing oneself, one repays the other party". Therefore, when the gain from self-disclosure is b, which is independent of the other party, the self-disclosure no longer benefits the other party and is no longer reciprocal in nature. In our model, we consider "$f_y r$" as the reciprocity of self-disclosure, which corresponds to the benefits of the other party, as well as the self-disclosure of the receiver, and "b" as the gain from self-disclosure, which is independent of the other party. In this setting, let us define "the reciprocal ratio of self-disclosure" as "the proportion that also contributes to the other party".

$$P(\alpha) \equiv \frac{f_y \bar{r}}{f_y \bar{r} + b} \tag{35}$$

Using the FOC of the receiver, Equation 35 can be written as:

$$P(\alpha) = 1 - \frac{b}{c(\alpha)} \tag{36}$$

REMARKS 3:*(a) As the existing level of relationship (α) rises, the reciprocal element of self-disclosure, P(α), weakens. (b) Reciprocal self-disclosure (ŷ) has a maximum value on interval [α*, 1], and reciprocal self-disclosure has the inversed U shape over the stage of relationship.*

Proof of (a)

Differencing *P* with respect of α yields:

$$\frac{dP(\alpha)}{d\alpha} = \frac{bc'(\alpha)}{c(\alpha)^2} < 0 \tag{37}$$

The last inequality comes from the assumption that the cost of self-disclosure decreases as the existing level of relationship rises.   Q.E.D.

Proof of (b)

We define the level of reciprocal self-disclosure as the overall level of self-disclosure times the reciprocal ratio of self-disclosure, as shown below:

$$\hat{y} \equiv y\left(1 - \frac{b}{c(\alpha)}\right) \tag{38}$$

Differentiating ŷ with respective to α yields:

$$\frac{\partial \hat{y}}{\partial \alpha} = \frac{bc'(\alpha)}{c(\alpha)^2} y + \left(1 - \frac{b}{c(\alpha)}\right)\left(\frac{\partial y^*}{\partial \alpha} + y'(x)\frac{\partial x^*}{\partial \alpha}\right) \tag{39}$$

When $\alpha \to \alpha^*$, by REMARKS 2, $y \to 0$. Then, the first term in Equation 39 converges to zero. For the remaining term, we get:

$$\left(1 - \frac{b}{c(\alpha)}\right)\left(\frac{\partial y^*}{\partial \alpha} + y'(x)\frac{\partial x^*}{\partial \alpha}\right) \to \tag{40}$$
$$\left(1 - \frac{b}{c(\alpha^*)}\right)\left(\frac{\partial y^*}{\partial \alpha}\bigg|_{\alpha=\alpha^*} + y'(x)\frac{\partial x^*}{\partial \alpha}\bigg|_{\alpha=\alpha^*}\right) > 0 \; as \; \alpha \to \alpha^*$$

Therefore, as α becomes closer to α^*, the sign of $\partial\hat{y}/\partial\alpha$ becomes positive because the first term in the Equation 39 converges to zero and the second term converges to a positive number.

In contrast, when $\alpha \to 1$, $c(\alpha)$ converges to b, which can be derived by the assumption about the lower bound of the cost. Thus, the first term in Equation 39 becomes:

$$\frac{bc'(\alpha)}{c(\alpha)^2}y \to \frac{c'(\alpha)}{c(\alpha)}y \ as \ \alpha \to 1 \tag{41}$$

The second term in Equation 39 becomes:

$$\left(1 - \frac{b}{c(\alpha)}\right)\left(\frac{\partial y^*}{\partial\alpha} + y'(x)\frac{\partial x^*}{\partial\alpha}\right) \to 0 \ as \ \alpha \to 1 \tag{42}$$

Combining the two terms, we get:

$$\frac{\partial\hat{y}}{\partial\alpha} \to \frac{c'(\alpha)}{c(\alpha)}y + 0 < 0 \ as \ \alpha \to 1 \tag{43}$$

Note that $\hat{y}(\alpha)$ is continuous at closed and bounded intervals $[\alpha^*, 1]$, and we have $\frac{\partial\hat{y}}{\partial\alpha}|_{\alpha=\alpha^*} > 0$ and $\frac{\partial\hat{y}}{\partial\alpha}|_{\alpha=1} < 0$. Thus, according to the Weierstrass's theorem, there exists $\alpha^{**} \in [\alpha^*, 1]$ such that $\hat{y}$ is maximized at α^{**}. Q.E.D.

Figure 2 is just a conceptual figure to explain the mechanism in which we have the inversed U shape concerning reciprocal self-disclosure over the stage of relationship.

To support our theoretical results, we also implement a numerical simulation to confirm if we really obtained the shape depicted in Figure 2. This numerical result shown in Figure 3 is also consistent with the curvilinear association in Figure 1 found by Altman (1973).

Altman (1973) claimed the statement under the subject classified into three groups (first, middle, and advanced), which corresponded to the level of α in our model. Comparing our model with Altman (1973)'s study, those with $\alpha = \alpha^*$ correspond to the "first group," those with $\alpha = \alpha^{**}$ correspond to the "middle group," and those with $\alpha = 1$ correspond to the "advanced group." Then,
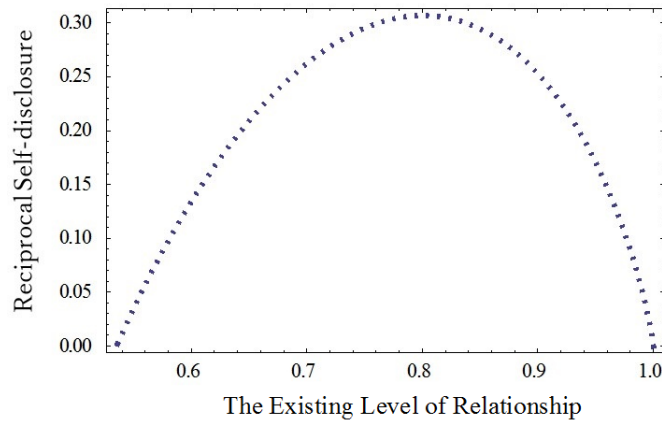
Figure 2: Reciprocal self-disclosure and the existing level of relationship
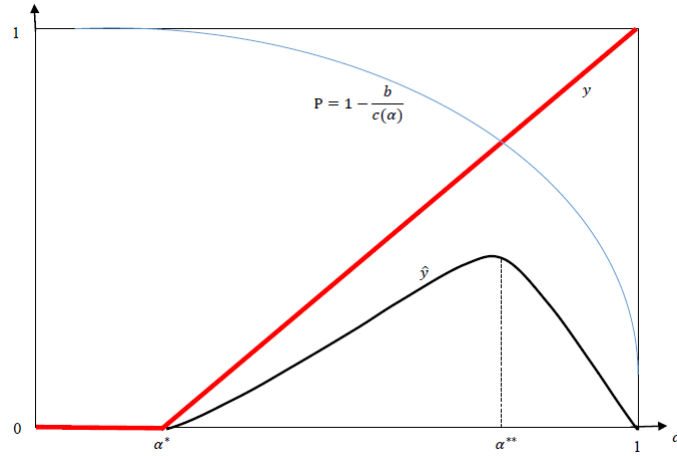
Note: When the existing level of relationship is low, as it rises, reciprocal self-disclosure increases; however, beyond a certain level, it starts to decline.

Figure 3: Reciprocal self-disclosure and the existing level of relationship

Note: In the simulation, we set the following assumptions: $f(x,y) = -e^{-x} - e^{-y} + 1 + e^{-x-y}$, $s = 2, b = 1, c(\alpha) = 2 - \alpha, r_H = 2, r_L = -1$. The second-order condition is satisfied since $\Omega = -e^{-x} + e^{-x-y} - e^{-x}/(1 - e^{-x}) < 0$. By solving the optimization problem, we can get $\hat{y} = ln\left[\left(1 - (1-\alpha)/2\right)\left(3\alpha - 1)/(1-\alpha)\right)\right]\left(1 - 1/(2-\alpha)\right)$ which is depicted in Figure 3. If α is lower than about 0.53, communication breaks down from REMARKS 2. The numerical result shows that while the reciprocal self-disclosure increases from about 0.53 to about 0.8, it continues to decline thereafter.

our proof appears to be consistent with the experimental results obtained by Altman (1973).

However, since our model is based on the economics tool, interpretation for the results are different from that of Altman (1973)'s: Since the payoff from the act of self-disclosure is obtained independent of the other party, the frequency (quantity) of self-disclosure does not decline as the existing level of relationship rises. In contrast, the cost of self-disclosure is a decreasing function of the existing level of relationship. Therefore, when an individual decides upon the level of self-disclosure at which the marginal benefit is the same as the marginal cost, the proportion of the overall marginal benefit accounted for by self-completion effects rises as the existing level of relationship increases. This indicates that the tacit aim of self-disclosure as the increased level of trust shifts to self-completion factors.

Therefore, when the existing level of relationship is low, as it rises, reciprocal self-disclosure increases; however, beyond a certain level, it starts to decline. This result is very consistent with the findings of Altman (1973) and Won-Doornink (1979, 1985)'s study: there is a curvilinear relationship between the stage of interpersonal relationship and the degree of reciprocity of intimate self-disclosures.

When the foundational level of intimacy is below a certain level, the risk to the receiver of his/her personal information being revealed by the sender is perceived to be high; therefore, the receiver does not reciprocate self-disclosure. Anticipating this, the sender has no incentive to self-disclose and thus, without cue communication, self-disclosure does not occur. In a situation like this, the sender engages in cue communication for a while before self-disclosure, including conversing about non-intimate topics to get the receiver to perceive the sender as trustworthy. The receiver also self-discloses only if he/she judges the sender as highly trustworthy based on the cue communication. In contrast, when a certain level of relationship exists between the two parties, the receiver reciprocates the sender's self-disclosure even if a slight risk surrounds the trustworthiness of the sender, as the benefits of self-disclosure outweigh the costs. Being aware of this, the sender directly self-discloses without cue communication, which is costly in terms of time and physical resources. This means the breakdown of cue communication at a certain level of relationship, which is depicted as a discontinuous drop from a positive value to zero. This result is

also consistent with the finding of decrease in non-intimate topics in Altman (1973).

5 Conclusion

In this paper, we explain the process of two individuals forming a trusting relationship from the perspective of self-disclosure communication. For two people to foster a trusting relationship, it is necessary for them to mutually disclose private personal information. However, because such an action is accompanied by costs and benefits, both parties decide on the optimal level of self-disclosure based on factors such as costs, the existing level of relationship, and the potential payoff from the formation of the relationship.

Self-disclosure when the existing level of relationship is below a certain level entails a high risk to the receiver that his/her own information will be revealed by the other party; therefore, the receiver does not reciprocate the sender's self-disclosure.

The higher the existing level of relationship between the two parties, the more frequently self-disclosure with deep content occurs. At the same time, there is a change in the nature of self-disclosure. In other words, as the existing level of relationship rises, there is a greater focus on the self-completion aspects of self-disclosure, such as "autocatharsis", rather than the aspect of "fostering a trusting relationship." All the behavioral trends observed in the experiments are explainable by the economics model constructed in this paper.

Furthermore, the fact that we obtained similar results with Altman (1973) even though we used very different tool, i.e., fundamental economics tool, shows the versatility of economics. It is true that many believe that assuming a rational person is unrealistic; however, this paper shows that even with rational behavior, we can explain very sensitive behavior such as self-disclosure, and its reciprocity, and developing trusting relationships. Thus, we expect that our study will stimulate more future collaborations between psychology and economics and researches beyond the academic-specific fields.

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