The Impact of Social Presence on Feelings of Closeness in Personal Relationships

ANONYMOUS FOR REVIEW

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Any interactive communication system can support personal relationships by facilitating a welcome and timely presence of an absent person in the mind of the other. This paper presents a consideration of how short term feelings, as experienced during acts of communication, relate to a relationship's longer term feelings towards one another. Through a 21-day study with 63 participants, we report ratings of Closeness and Social Presence as evidence that links the two concepts as temporally distinct aspects of emotional connectedness. Such a relationship is useful as by relating Social Presence to Closeness we can demonstrate that by creating technologies which help to create emotionally significant experiences during acts of communication we are supporting the relationship in a more meaningful, long-term fashion by supporting feelings of Closeness. This assists the HCI community by clarifying how Social Presence and Closeness can be used as phenomenological concepts to assess communication devices designed to support inter-personal relationships.

1. INTRODUCTION

At some point in their lives, large numbers of people have to suffer periods of separation from the people they care about most. In these circumstances, communication technologies cease to be tools of convenience but assume a new meaning: they are social life-lines for sustaining personally meaningful relationships. Even if people get to meet at the beginning and end of the day, messages and conversations can serve to maintain relational bonds despite hectic lifestyles. Both distance and co-located relationships rely on communication technologies to remain connected with one another.

HCI has long concerned itself with investigating domestic communication, analysing existing routines (Romero et al., 2007), looking at how particular information, such as location data, is shared (Neustaedter et al., 2006) and how particular technologies are used within the home (Kirk et al., 2010; Tee et al., 2009). These investigations attempt to produce an understanding of existing practices and desires such that new technologies can be optimized for supporting social connections. Many innovative domestic technologies have been proposed (e.g. (Chen et al., 2006; Hindus et al., 2001; Itoh et al., 2002; Kaye, 2006; Sellen et al., 2006)) with varying levels of attention to their conception of connectedness and, in consequence, the evaluation of the technology's impact. Much of the work published within the HCI community focusses upon the design of these technologies, with many evaluations carried out as an afterthought (if carried out at all). For example, (Chen et al., 2006; Hindus et al., 2001; Bonanni et al., 2006) do not present an evaluation at all.

One reason why these evaluations may not be commonly carried out is a lack of theoretical understanding as to how

various interpersonal phenomenological concepts operate within interpersonal relationships.

Qualitative analysis is essential for understanding how interpersonal relationships are enacted through communication technologies in particular contexts. Many evaluations depend exclusively on qualitative data. Whilst such analyses are very important, evaluating communication technologies relies on a mixed-methods approach. For example, if SMS technology was investigated, it is easy to believe that people would report that they liked the non-intrusive, low-effort nature of the technology. While significant, such comments gloss over SMS's lack of ability to connect it's users in an emotionally significant way (Gooch and Watts, 2011). Quantitative data enables interpretation of the things that people say and do in specific settings, giving an opportunity to assess and compare technologies. To best interpret qualitative data, you need to understand how the results are to be interpreted in a wider range of settings.

There are a range of phenomenological concepts which could be used as lenses through which we could examine communication technologies and interpersonal relationships. Taking a social perspective, concepts such as Closeness (Adams et al., 2001; Berscheid et al., 1989), empathy (Baron-Cohen and Wheelwright, 2004; Cramer, 2003; Preece and Ghozati, 2001), emotional awareness (Brave and Nass, 2003; Neese, 1990; Ekman, 1994))and intimacy (Macky et al., 2000; Argyle and Dean, 1965) could all be used. Each of these have a distinct, nuanced definition which is not necessarily understood by participants. For example, with regards to the differences between closeness and intimacy, (Parks and Floyd, 1996) undertook a self-report survey with 270 college students who were asked "what does being 'close' in this friendship mean to you?' and 'In what ways, if any, does closeness differ in your same- and opposite-sex (platonic) friendships?" alongside "whether they would use the term 'intimate' to describe their target friendships" (Parks and Floyd, 1996, p. 91). They report three different relationships between closeness and intimacy; around half of their participants appeared to view them as equivalent, a quarter reporting that intimacy implied either a romantic/sexual component and the remaining quarter arguing that intimacy implied a more intense close relationship. However, whereas intimacy is somewhat ambiguous in terms of particular encounters or the status of a relationship, closeness reflects a more enduring understanding of how an individual thinks about their personal relationship with another. These different accounts indicates that using 'Closeness' as one of our lenses will account for the longer-term concept of relational connection which has a familiar informal meaning.

Taking a technological perspective, there are various Computer Mediated Communication (CMC) theories which we could use to understand the communication technology aspect of our investigation. Daft and Lengel's Media Richness Theory was developed from early short-term laboratory-based research on mediated communication, following evidence that crudely categorized media on the basis of the 'number of cues' they contain. The 'richness' of any CMC technology was associated with a simply summative model of cues by channel and assumed to be directly proportional to their capacity for creating a sense of connectedness (Daft and Lengel, 1986). However, this generalized 'sum of cues' view cannot adequately account for relational phenomena such as hyperpersonal communication (Walther and Burgoon, 1992; Walther, 1996). As both the range of CMC opportunities have expanded and the degree to which technologies have become embedded in situations outside of work, so the relational significance of the communication media has become ever more exposed. Walther proposed his own theory, that of Social Information Processing (SIP), to address the relational dynamic that can be generated through CMC usage.

The SIP position on CMC technologies is that people can learn and create new nuances in the forms of expression at their disposal, given the constraints of the media, to construct relationships that are as profound as those mediated by face-to-face communication. Although mediated communications technically embed fewer cues than face-to-face communication, given sufficient time mediated relationships may demonstrate the same relational dimensions and traits as face-to-face relationships (Walther, 1992). The SIP theory is limited by the fact that it suggests that particular characteristics inherent in the design of any communication technology are relatively unimportant, given sufficient time to adapt to the available media and develop the relationship. For a detailed review of these and other CMC theories, see (Whittaker, 2003). Media Richness theory and SIP prioritise the importance of technology in different ways, arguing that they are either of primary importance to interpersonal communication, or of minor importance in the context of interpersonal relationships. By comparison, Social Presence has developed as a more nuanced concept which reflects the role of communication media in supporting mutual understanding without disregarding the social aspects of communication. We decided that such a concept will account for the short-term concept of relational connection during an act of communication.

Within this paper we will focus on the two phenomenological concepts we have identified as being important within the field of inter-personal communication; Social Presence and Closeness.

1.1. Social Presence

One of the key concepts in communication research is Social Presence (SP) (Short et al., 1976). By reaching into the world of human experience, it has promoted elements of the communication technology design problem beyond considerations of clarity and efficiency. Social Presence is formally defined as "the degree of salience of the other person in the interaction and the consequent salience of the inter-personal relationship" (Short et al., 1976, p. 65) and is a phenomenological construct owing to "whole constellations of cues" (Short et al., 1976, p. 157). Thus we treat SP in technologically mediated personal relationships as something constructed in the mind of an individual whilst interacting with the representations the other has crafted with the communication medium. That is, through their use of the medium and, critically, given each individual's understanding of the status of their ongoing relationship, the distant other performs actions that evoke a sense of themselves for their loved-one. SP functions by highlighting the relationship with the other person in the mind of each interlocutor through the acts of communication they share. In the context of personal relationships, we argue that SP corresponds to the level of emotional connectedness to have been engendered in each act of communication. That is, Social Presence is a short term feeling which is only experienced during an act of communication. SP, as a concept, has often been used in the world of HCI but is rarely explicated (e.g. (Barden et al., 2012; Counts and Fellheimer, 2004; Kang et al., 2008)).

In the context of personal relationships, a sense of SP is not guaranteed simply by the notional "richness" of a medium as was once thought (e.g. (Bradner and Mark, 2001; Connell et al., 2001; Daft and Lengel, 1986; Shih and Swan, 2005; Walther and Burgoon, 1992; Walther, 1996)). Although we acknowledge that technical affordances can shape the sense of Social Presence, as much past research has shown, it is not the focus of this paper. We want to extend our consideration of Social Presence beyond communication media and towards personal aspects. As Biocca and Harms state, "social presence cannot really be conceptualized as a fixed property of medium. Rather it is best conceptualized as a property of individual perceptions of mediated others, that likely fluctuates during interactions, tasks, and individual differences" (Biocca and Harms, 2002). For example, Connell et al. examined the social perception of personalities and intentions and the projection of authority in the workplace. They found that the use of the telephone was associated with stronger feelings of SP than face-to-face communications, and Instant Messaging with weaker feelings of SP (Connell et al., 2001). They argued that SP is generated during a conversation to an extent that is jointly permitted by the task (in this case centrally concerned with social relations) and the freedom of expression of the medium.

This is important because it shifts the concept of interest away from communication media per se and towards considering the communicative act more holistically. The consequence is then that the design and use of communication media must be constrained by an appreciation of the type of relationship that they enable. Key among these are the distance factor (co-located or long-distance) and whether the relationship is familial, social or romantic. There has previously been no consideration of how these different relationship types and distances can impact upon feelings of Social Presence. Such information is essential in order to use Social Presence as a measure of success when evaluating novel communication devices as it would assist in the interpretation of the SP scores.

1.2. Closeness

Closeness has a familiar informal meaning. It has also been the subject of extensive research in social psychology and so can be considered in a more technical sense and in a manner that is quite distinct from the Social Presence construct. Although it has been operationalised in a number of different ways, it is widely accepted as being affected by the frequency of Contact, diversity of Contact and the strength of Contact between two individuals. This indicates the communication is an important aspect of our understanding of Closeness as a phenomenological concept.

There are three key elements that underpin the various operationalisations of Closeness. The first is that it is an inherent property of interpersonal relationships, being used to distinguish between different types of relationships (Dunbar, 2010). The second is that communication acts are acknowledged to influence feelings of Closeness (Altman and Taylor, 1973). Finally, Closeness is a longer-term relational concept than Social Presence: "social bonds do not grow and then stabilize forever. Some reach plateaus and then grow further; others become undesirable and either break-up or revert to an earlier level of intimacy of exchange" (Altman and Taylor, 1973, p. 4). All friends, at some point, started off as being strangers; unfortunately, some will also finish up that way. Measurements of Closeness have been demonstrated to be predictive of the break-up of romantic couples (Berscheid et al., 1989). We can thus consider Closeness to be a feeling of emotional connection which is experienced over a long period of time and which is relatively static. We reiterate that this conceptualisation is generally accepted by the field.

Within this paper we define Closeness in terms of interdependence (Adams et al., 2001; Berscheid et al., 1989; Kelley et al., 1983) and self-disclosure (Aron et al., 1992; Golish, 2000; Sedikides et al., 1999). This definition considers Closeness in terms of how much an individual depends on the other person and how much they are willing to disclose to them. Such an operationalisation assess feelings of Closeness in terms of how much of an individual is preserved outside of the relationship. This operationalisation is generally measured using the IOS scale (Agnew et al., 2004; Aron et al., 1992).

1.3.   Proposed Model

It is important to note that Closeness can be characterised as both a relationship *type* and a relational *state*. Within this paper we conceptualise Closeness as a relational state, a feeling that occurs and dissipates within the context of some relationship. We hypothesise that feelings of Social Presence can predict these transient feelings of Closeness.

We hypothesise that Social Presence ratings can predict ratings of Closeness. We argue that each act of communication has an impact, to the extent that it generates a sense of Social Presence, on the longer-term feeling of Closeness. We hypothesise that within a given relationship communicative acts with high levels of SP increase feelings of Closeness and acts with low levels of Social Presence decrease feelings of Closeness. This corresponds with the concept of Closeness as a relational quality where Closeness is in some way a longer-term feeling of the same phenomenon as Social Presence.

We also recognise that Social Presence and Closeness can be linked through the concept of Closeness as a relationship type. We would expect that relationships which can be characterised as being 'close' would be predisposed towards stronger feelings of Social Presence due to the pre-existing emotional bond between the interlocutors. For example, we would expect a dating relationship to be predisposed to have higher levels of Social Presence than a friendship. We do not focus on such a connection within this paper.

The hypothesised relationship between SP and Closeness is interesting from a theoretical perspective and useful from a practical perspective. Relating SP to Closeness helps broaden our understanding of both concepts in the context of personal relationships. By relating the two concepts to each other, we can demonstrate that by creating technologies that help to create emotionally significant experiences during acts of communication, designers have the potential to help support personal relationships in a more meaningful, long-term fashion. Practically, our model encourages the use of SP as a measurement technique within a Closeness context. If technologies can be associated with high or low levels of SP, then we can make plausible claims about the technology's impact on the relationship's feelings of Closeness, and subsequently the state of the relationship more generally.

In this paper, we present a joint analysis of Closeness and SP ratings and their role in personal relationships. Our data were provided by people in established relationships over an extended period, and for whom separation figured in their lives. We have two main research questions. The first relates to what factors can predict feelings of SP, focussing on communication media, relationship type and relationship distance. The second question relates to what factors can predict feelings of Closeness, focussing on SP ratings, relationship type and relationship distance. We use our quantitative data to contrast the self-reported experiences of people in different types of personal relationship (partner, friend, sibling or parent-child). This builds on preliminary work that attempted to explain the basic dynamic with a small dataset (Gooch and Watts, 2011) and improve on an initial analysis of the full dataset (Gooch and Watts, 2013).

2.   METHODOLOGY

Our research questions are based in an area of human activities where experimental investigation has little advantage as a methodological technique. There is so much context surrounding each communicative act that isolating them in a lab setting is unlikely to be revealing. Furthermore, an experimental setting would likely be too artificial to reflect the true communication practices of participants whilst introducing unwanted influences due to the unfamiliar setting. The relational sphere of human activity is, furthermore, largely about subjective meanings, attitudes and feelings rather than transparent communication activity. Such a position is supported by other work in this area (e.g. (Sedikides et al., 1999)).

Having discounted laboratory studies we are left with those techniques which can be used in the ecologically valid setting of people's homes. These include diary studies, questionnaires and interviews, the benefits and drawbacks of which are well known (Lazar et al., 2010).

Suited to probing participants to gather a deep understanding, interviews can thus gather data which is otherwise difficult to obtain. Follow-up questions can be used to pursue themes which arise during the interview. Interviews can also be exploratory; it is not necessary to need to know what you are looking for before the start of the interview. In the context of what we are investigating, interviews suffer from 3 major shortcomings. First of all, the interview occurs at a time which is distinct from the phenomenon of interest, that is an act of communication between them and a partner. Additionally, interviews tend

to be based around a small number of participants due to the resources required to conduct and analyse a large number of interviews. This limits the statistical analysis which could be performed. Finally, interviews are not suited to collecting data over time. This is problematic when attempting to determine the relationship between two phenomenological concepts which are temporally distinct. Determining the relationship between Social Presence and Closeness would be difficult through an interview study.

In many ways, questionnaires are the antithesis of interviews. Questionnaires allow data to be collected from a large number of people at relatively low cost. This is extremely useful when trying to gather a broad overview of a particular concept. However, similar to interviews, questionnaires tend to be completed sometime after the event under consideration occurred. Again, the temporal nature of our investigation makes questionnaires an unsuitable data collection technique.

Diary studies share some of the drawbacks of questionnaires; participants don't tend to reflect and produce deeply analytical data and can fail to complete sufficient entries. Additionally diary studies require a substantial commitment of time and effort from participants which is difficult to balance against gathering meaningful data. Furthermore diary studies do not supply any contextual information which might assist in analysing the data collected. However, diaries do allow us to collect data in a naturalistic setting which is also temporally valid, that is data which is collected close to the phenomenon under consideration. Diary studies are also necessary for gathering data which changes over time.

Given the importance to our investigation of collecting temporally valid data over time, we chose to construct a diary-based study (21 day recording period) around self-report activity from people who we asked to reflect on their communications with 'a person you feel close to'. Such an approach gathers data in an ecologically meaningful fashion, ensuring that the study is embedded within the complexities of our participants' relationships.

The study required participants to keep two different diaries, each using a different sampling method. As we want to investigate changes in Closeness over time, and Closeness is conceptualized as a slow-changing feeling, we adopted a periodic self-report method. This first diary was completed early in the morning every day and consisted of a single measure of Closeness. This was known as the Daily Diary.

The second diary was event-based; it was completed each time the participant had communication with their partner – this was called the Contact Diary. Participants were asked to complete their diary as soon after a communication event as was practical. Each entry recorded basic information about the communicative act including the method of communication and a measure of SP. Participants also noted the date and time, length of contact and and who initiated and ended the contact but we do not report this data in this paper as it's analysis did not reveal any meaningful results. Participants were instructed to use their own judgement as to what a 'single' act of communication was. In brief, our data shows an act as being either a single synchronous act of communication (e.g. a telephone call) or a succession of asynchronous messages on the same topic (e.g. a series of SMS messages).

The measure of Closeness made use of the IOS scale (see Figure 1, and (Agnew et al., 2004; Aron et al., 1992)), a well-used measure of inter-personal Closeness. This operates in a manner akin to a graphical Likert scale, in that participants are asked to express their reaction to a question on a seven-point scale but each point on the scale is represented by an image rather than a number in a linear sequence. The question in IOS is 'Please circle the picture below which best describes your relationship with your [type] partner'. IOS represents points on this scale as seven pairs of circles, each labelled 'self' and 'other'. At one extreme – corresponding to 'not at all close' – shows self and other as two circles that abut to one another but do not intersect. At the other extreme, the circles overlap almost completely, the non-intersecting portions thus representing only a small fraction of the individual selves preserved outside of the relationship. The five other points in between thus vary in the degree to which respondents are able to express their relationship in terms of the proportion of themselves that is comprised of the other. Each score was thus between 1 (minimum Closeness) and 7 (maximum Closeness). As a graphical rather than text-based scale, it reflects similar concerns to those that motivated the development of the Self Assessment Manikin to evaluate affective experience (Bradley and Lang, 2002).

A major issue with SP is selecting a measure because researchers have adapted a wide variety of instruments (van Baren and IJsselsteijn, 2004). It is difficult to compare results between studies without standardisation: each questionnaire might be exposing different aspects of the intended phenomenon or miss it altogether. Not all questionnaire details are published and many suffer from reliability/validity issues (van Baren and IJsselsteijn, 2004). Additionally, the questionnaires can be extremely long (Networked Minds (Biocca and Harms, 2002) contains 40 questions) or so focused on a specific technology that they are not readily transferable into different studies.

Short, Williams and Christie's semantic differential scales do not suffer this shortcoming. They contain nine diametrically opposed adjectives (see Table 1) (Short et al., 1976). Ratings are made on a seven point Likert
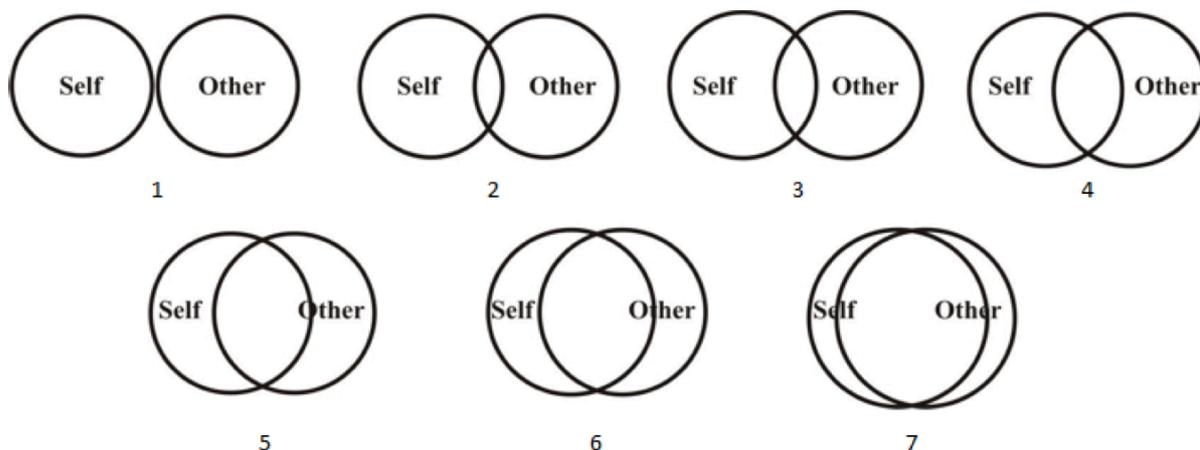
Figure 1. The IOS Closeness Measure

scale from -3 (near one adjective) through to +3 (near the other adjective).

	3	2	1	0	1	2	3	
Impersonal								Personal
Cold								Warm
Ugly								Beautiful
Small								Large
Insensitive								Sensitive
Colourless								Colourful
Unsociable								Sociable
Closed								Open
Passive								Active

Table 1. The Semantic Differentials Measure of Social Presence

The traditional meaning of the differentials focuses on the medium (e.g. 'Skype VOIP is impersonal vs. personal') and so are implicit in the way they evoke the sense of the other person (Biocca et al., 2003). The scales' use of nine pairs means that the burden of completing the SP ratings is small – an important element of a longitudinal study that seeks to record assessment close to the relevant event. There is a shortcoming in that the measure assesses the communication medium rather than the act of communication, conflicting with our conceptualisation of SP as being a property of the interpersonal relationship. However, we are aware of no measures that assess Social Presence as being unconnected to the communication medium, nor do we argue that the medium has no role to play in understanding Social Presence. Furthermore, our instructions to the participants stated that "...there are

then 9 items where you have to indicate which word best describes the contact (and by how much)", highlighting that they were reporting on the contact as a whole rather than just the communication medium. As such, we are satisfied that the measure is suitable for use with regards to our conceptualisation of Social Presence. The ranking for each individual score is summed to provide an overall assessment of a participant's experience of Social Presence. As there are nine semantic differential items the maximum score was thus $9 \times 7 = 63$ and the minimum was $9 \times 1 = 9$. Both the Semantics Differentials measure and the IoS scale are standard measuring techniques within their respective fields.

Participants were asked to keep the diaries continuously for a period of 21 days.

Data collected with longitudinal self-report studies represent a particular perspective on every-day phenomena. People may self censor, confabulate and forget to report or miss relevant episodes. The risk of these was minimised by making the diary entry requirements as short as possible such that the effort required to fill them in was minimised. Beyond that, the limitations of the methodology must be acknowledged.

Participants were recruited through emails and posters on a British university campus. The range of relationships included lovers, friends, parents and siblings. Table 2 shows the breakdown of participants by relationship type and relationship distance. 63 people took part in the study. Participants received no incentive for taking part in the study.

Relation-ship Type	Number of Partici-pants	Number of Same-City Relation-ships	Number of Distant Relation-ships
Partner	16	6	10
Friend	16	7	9
Sibling	11	1	10
Parent	20	2	18

Table 2. Number of participants by separation and relationship

3. RESULTS AND ANALYSIS

Our 63 participants returned a total of 988 Contact Diary entries, each comprising of a set of Semantic Differential ratings of SP for that particular contact episode and short descriptions of who was involved, what they discussed and who initiated and ended the exchange. 63 Daily Diaries were returned, each comprising a single IOS rating to reflect their feeling about the other person at the start of each day. This results in 1323 individual Daily Closeness ratings. Two participant's diaries were rejected as each measure was consistently rated at it's maximum. Both participants were reporting on their long-distance romantic relationships. This was deemed as being indicative of a lack of reflection and as such likely to negatively impact the validity of any statistical test which used this data. After data cleaning, we are analysing 956 contact reports and 1281 Daily Closeness ratings. Our data set contains more Daily Closeness reports than contact reports as some participants, particularly in non-romantic relationships, did not contact their partner every day. Although this could be perceived as a weakness, we highlight it as a strength as it accurately reflects our participants actual communication routines.

The mean number of Contact Diary entries returned by our participants was 14.5, SD was 10.6, median 13.0. The maximum for any one individual was 58, the minimum was 0. Perhaps unsurprisingly, there was considerable variation between relationship type and distance (see Table 3). An initial interpretation of this data shows that romantic partners tend to communicate more often than other relationship types and that co-located people communicate more than people living at a distance. Table 4 breaks down the number of communication acts by communication media, indicating how many times each relationship type used each communication media.

Before discussing our results in any depth, we first consider the statistical validity of any tests we perform on the data we have collected.

3.1. Statistical Validity

Our 956 contact reports and 1281 Daily Closeness ratings represent our entire data sample. It is necessary to describe some of the features of this data set in order to establish the most appropriate statistical test to use to analyse any variation within the data. The first feature to note is that the study design results in a data set which is inherently repeatedly measuring the same people. In addition to this repetition of recording, the data is also hierarchical (Nezlek, 2001, 2003). We have ratings from multiple people, reporting on multiple days, each of which can contain multiple acts of communication. Our variety of variables are measured across these different levels – importantly, relationship type and relationship distance are at a person level, ratings of Closeness are at a daily level and finally ratings of SP and type of communication media are at a the level of a single act of communication. The lack of independence between our contact reports, as well as the differing levels at which our data is measured, will have to be accounted for in any statistical test.

Our first research question refers to what factors can predict participants' SP ratings. Although the SP scale is ordinal, the high number of categories the variable can take (between 9 and 63), means that an ordinal regression would not be appropriate. We can instead assume that the SP scale resembles a continuous distribution (Pasta, 2009). This means that we can analyse this question using a repeated measures linear regression. There are four assumptions to meet to make such a regression valid[1] (Nay, 2012; Cohen et al., 2003). These assumptions are met by our data.

Our second research question refers to whether SP ratings (or other factors) can predict feelings of Closeness. The Closeness scale is an ordinal measure with a low number of categories. This means that a repeated measures ordinal logistic regression is appropriate. The assumptions of this test are met by our data.

In terms of judging which model is chosen for each of our research questions, we decided to utilise a data-driven approach rather than one chosen on the basis of theory. The main objectives of this paper are to explore the connection between Social Presence and Closeness. Although we have drawn on theories that indicate that a connection is likely, our assessment is that the best way to assess such theories is through a data-driven approach.

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[1]The assumptions are:

(i) linearity of the relationship between dependent and independent variables
(ii) independence of the errors (no serial correlation)
(iii) homoscedasticity (constant variance) of the errors
(iv) normality of the error distribution

Relationship Type	Mean Number of Contact Entries (*SD*)	Mean Number of Same-City Contact Entries (*SD*)	Mean Number of Distant Contact Entries (*SD*)
Partner	25.1 *(13.1)*	30.8 *(13.9)*	20.8 *(11.5)*
Friend	14.8 *(5.3)*	16.4 *(5.5)*	13.6 *(5.0)*
Sibling	6.3 *(2.7)*	7.0 *(-)*	6.2 *(2.9)*
Parent	11.3 *(8.7)*	14.5 *(2.1)*	10.9 *(9.1)*

Table 3. Number of Contact Diary entries by distance and relationship

Communication Media	Total	Partner	Friend	Sibling	Parent
Face to Face	216	96	81	8	31
SMS	258	114	64	19	61
Telephone	208	109	12	19	68
IM	65	10	43	9	3
Email	98	18	25	10	45
Skype (voice only)	79	43	20	3	13
Skype (with video)	19	1	3	1	14
Card	1	0	0	0	1
Letter	3	0	0	1	2
Facebook	9	0	8	1	0

Table 4. Number of uses of each communication media by relationship type

3.2. Which factors can predict participants' SP ratings?

Our first research question refers to whether relationship type, relationship distance and communication media can predict participant's Contact SP ratings. We've already discussed how a repeated measures linear regression is suitable to analyse these questions.

It is possible to construct multiple models of linear regression that use different combinations of the parameters to predict the response variable. In our case, the response variable is Social Presence and the predictor parameters are relationship type, relationship distance and communication media. After considering how the different parameters can be used to model the Social Presence score, and a measure of how closely the model fits the data (the Corrected Quasi Likelihood under Independence Model Criterion), a model was selected as having the lowest score, indicating that the model predicts more of the variation in the data set and illustrate different facets of our research question. This model considers relationship type × relationship distance alongside Communication Media. This allows us to consider the impact of these two factors independently

of one another. What this means is that we can assess the impact of communication media independently from the impact of relationship type × relationship distance.

Table 5 shows the results of this model. There are some interesting things to consider within this model. Firstly, all communication media are rated as being significantly lower than Face to Face communication, indicating the importance of this form of communication in personal relationships. Many prior investigations have contrasted communication media through SP ratings in laboratory experiments. Our data, taken from a longitudinal setting, show similar differences. Although there remains much debate as to whether face-to-face is the 'gold-standard' of communication, our data firmly indicates that it is the most effective means of generating strong feelings of Social Presence amongst interlocutors.

Deepening our analysis, there appears to be a division between a set of high SP technologies (namely Telephones and both versions of Skype) and a set of low SP technologies (namely SMS, IM, Email and Facebook). Although all of these technologies predict lower SP scores than face to face, they vary in how much lower their predicted SP score is.

Parameter	B	Std. Error	95% Wald Confidence Interval		Hypothesis Test		
			Lower	Upper	Wald Chi-Square	df	sig
(Intercept)	51.93	1.49	49.00	54.86	1208.56	1	0.001
Friend x Distant	4.37	2.20	0.05	8.68	3.93	1	0.047
Friend x Co-located	1.11	2.19	-3.17	5.40	0.26	1	0.611
Sibling x Distant	0.01	2.08	-4.07	4.08	0.00	1	0.998
Sibling x Co-located	-5.12	1.29	-7.64	-2.60	15.84	1	0.001
Parent x Distant	1.85	1.70	-1.48	5.19	1.20	1	0.275
Parent x Co-located	-3.38	5.32	-13.82	7.05	0.40	1	0.525
Partner x Distant	5.01	2.06	0.97	9.05	5.90	1	0.015
Partner x Co-Located	Comparison category						
SMS	-10.07	1.15	-12.32	-7.83	77.14	1	0.001
Telephone	-6.87	1.29	-9.41	-4.34	28.35	1	0.001
IM	-10.54	1.35	-13.18	-7.90	61.20	1	0.001
Email	-10.70	1.72	-14.07	-7.33	38.68	1	0.001
Skype (with video)	-5.38	1.56	-8.43	-2.33	11.93	1	0.001
Skype (voice only)	-7.08	1.29	-9.61	-4.54	29.94	1	0.001
Facebook	-13.93	2.69	-19.19	-8.65	26.80	1	0.001
Letter	-7.38	1.96	-11.21	-3.54	14.23	1	0.001
Card	-5.23	1.26	-7.70	-2.77	17.27	1	0.001
MMS	-17.56	1.34	-20.19	-14.93	170.88	1	0.001
Face to Face	Comparison category						

Table 5. Parameter Estimates from the first repeated measures linear regression model

One of the reasons for analysing the impact of communication media on SP was to analyse what set of facets of a communication system could have an impact on the feeling of SP during an act of communication. However the distinction between these two sets of technologies is difficult to determine. The high SP set contains technologies that use an element of people's person-hood (predominantly their voice) whereas the low SP set does not contain such personal elements. By person-hood we mean technologies that utilise an aspect of an individual which is unique to them, such as their voice (on the telephone) or their face (on video-conferencing). All of the low SP technologies are text based. Additionally, the majority of the low SP technologies (excepting IM) are asynchronous whereas all of the high SP technologies are synchronous. As a final observation, all of the high SP technologies produce acts of communication that are fleeting while the low SP technologies involve the exchange of more 'realised' or permanent messages. This analysis of media characteristics is not a huge contribution, merely highlighting that our results are consistent with prior research.

Three relationships were found to statistically predict different SP scores to co-located partners. Co-located siblings are predicted to have a lower SP score than co-located partners. This might be expected, given that partners require more emotionally meaningful communication in order to sustain their relationship (Stafford, 2010) which we assume is closer than sibling relationships (Dunbar, 2010).

Of most interest is the fact that distant partners are predicted to have a significantly higher SP score than co-located partners. This is perhaps unsurprising; in distant relationships communication technologies are the primary means of communication. This is likely to increase the emotional meaning of these technologies compared to co-located relationships. Similarly, the limited opportunities for face to face communication in distant relationships is likely to increase its meaning when it does occur.

It is harder to explain the higher SP score predicted for distant friends. Two possible interpretations are as follows. The first concerns the nature of the friendship. Most friendships are made when the friends are co-located. It is feasible that many of these relationships

only became distant when our participants moved away to University. If that is the case, it is plausible that our participants are trying to maintain the bond of their co-located relationship through the use of communication technologies – this would account for the high level of SP they experienced during their acts of communication.

An alternative interpretation is based on a similar interpretation as to the high SP score of distant partners. In any distant friendship, communication technologies are the primary means of communication. Distant friends are still predicted to have a lower SP score than distant lovers. It could be that the simple act of being apart imbues technologies with more importance, overriding the lesser degree of closeness typically experienced between friends compared to partners. This could explain why distant friends are predicted to report higher levels of SP than co-located partners but not as high as distant partners. However, friendship relationships are not the focus of this paper and the study provides no data to assess such a claim.

Having examined the relationship between communication technologies and a sense of Social Presence, we now move on to consider whether this feeling of Social Presence can predict feelings of Closeness.

3.3.   Which factors can predict participants' Daily Closeness ratings?

Our second research question asks whether SP (as realised during acts of communication and recorded in the Contact Diary) can predict the longer term feeling of Closeness (as measured through the Daily Diaries). We have already established that a repeated measures ordinal logistic regression is suitable to analyse which factors can predict participant's Daily Closeness ratings.

The first task is to establish which factors to use within the model. We have four main interests – whether relationship distance, relationship type, communication media and SP scores can predict levels of Closeness.

Our measure of SP can take 63 values; being an ordinal variable, this means we have 63 potential levels to predict against. This is too many to draw any meaningful data from the regression. Instead we group the SP ratings into one of three levels: low = < 30, mid = 31 – 49 and high = 50 – 63 ratings.

There are a number of possible ways of combining our parameters to predict levels of Closeness. After testing all of the possibilities, we found that no model containing communication media as a parameter converged. This suggests that communication media are not strong predictors of Closeness ratings. This could be interpreted as evidence that Closeness operates over a longer period of time than single acts of communication, as we argued earlier.

We selected Social Presence with relationship type x relationship distance as the model underlying our regression test. This model fits the criteria of being statistically significant, a model which converges and which is meaningful to interpret.

The regression model indicates that both relationship x distance (wald chi-square(7) = 15.718, p = 0.001) and SP level (wald chi-square(2) = 28.256, p < 0.001) are significant predictors of Daily Closeness ratings. Table 6 shows the details of the regression model.

The grouping of the SP ratings into three levels assumes that the threshold values of 30 and 50 correspond to ratings that are below or above points of neutrality. To demonstrate the robustness of our analysis, we re-grouped the SP ratings into one of three levels with different thresholds: low = < 40, mid = 41 – 54 and high = 55 – 63. The regression model also indicates that both relationship x distance (wald chi-square(7) = 88.528, p < 0.001) and SP level (wald chi-square(2) = 38.012, p < 0.001) are significant predictors of Daily Closeness ratings. Due to space constraints, the details of this model are not presented here but the details of the second model are effectively indistinguishable from the first model in terms of the significance of parameters contributing to the model.

Five factors were significant predictors of Daily Closeness scores, three relationship type x relationship distance and both SP groupings.

Taking the Social Presence data first; both mid and low SP scores predict a lower level of Closeness than high SP scores. Additionally, low SP scores predict a lower Closeness score than mid SP scores. This corresponds to the relationship between SP and Closeness that we proposed earlier. Our data supports our argument that each act of communication has an impact, to the extent that it generates a sense of SP, on the longer-term feeling of Closeness.

It is worth reiterating why this is of importance. The relationship between SP and Closeness indicates that through creating technologies that help to create emotionally significant experiences during acts of communication, designers have the potential to help support personal relationships in a more meaningful, long-term fashion. Furthermore, creating new technologies is easier than changing social structures or impacting relationships in other ways. If technologies can be associated with high or low levels of SP, then we can make plausible claims about the technology's impact on the relationship's feelings of Closeness, and subsequently the state of the relationship more generally. As SP has a positive association with Closeness, we have further validation for our argument that Social Presence is a suitable concept to use as an evaluation measure when considering how to support inter-personal relationships.

Parameter	B	Std. Error	95% Wald Confidence Interval		Hypothesis Test			Exp(b)	95% Wald Confidence Interval Exp(B)	
			Lower	Upper	Wald Chi-Square	df	sig		Lower	Upper
Friend x Distant	-1.22	0.49	-2.17	-0.26	6.18	1	0.013	0.296	0.11	0.77
Friend x Co-located	-0.49	0.52	-1.50	0.52	0.89	1	0.344	0.613	0.22	1.69
Sibling x Distant	-0.98	0.56	-2.08	0.12	3.07	1	0.080	0.374	0.13	1.12
Sibling x Co-located	0.65	0.31	0.03	1.27	4.28	1	0.039	1.915	1.03	3.55
Parent x Distant	0.23	0.46	-0.67	1.14	0.26	1	0.610	1.263	0.51	3.11
Parent x Co-located	-1.27	0.59	-2.42	-0.12	4.72	1	0.030	0.280	0.09	0.88
Partner x Distant	0.12	0.54	-0.94	1.18	0.05	1	0.829	1.122	0.39	3.23
Partner x Co-Located	Comparison category									
Low SP Score	-1.21	0.40	-1.99	-0.43	9.24	1	0.002	0.299	0.14	0.65
Mid SP Score	-0.91	0.17	-1.25	-0.57	28.15	1	0.001	0.403	0.29	0.56
High SP Score	Comparison category									

Table 6. Parameter Estimates from the repeated measures ordinal logistic regression

Turning our attention to the relational qualities; distant friends, co-located siblings and co-located parents were all significantly different to the comparison group of co-located partners. Co-located parents and distant friends both predict a lower Closeness level than co-located partners whereas co-located siblings predict a *higher* level of Closeness than co-located partners. These results are difficult to interpret; they do not correspond that well to existing theories of the determination of Closeness by relationship type (e.g. (Dunbar, 2010)). Although the data displays a difference for some interactions between relationship type and distance, the pattern is not consistent, nor do those significant interactions follow a clear pattern. We would anticipate that co-located partners would have the highest ratings of Closeness, hence selecting it as the comparison category. It is then unsurprising that other relationships, namely distant friends and co-located parents, predict significantly lower Closeness ratings. It is harder to explain the significantly higher prediction of Closeness by co-located siblings. The most straightforward interpretation is simply that the single participant reporting on their co-located sibling felt closer than the co-located partners who participated in this study.

An alternative interpretation is based around certain characteristics of our selected population of students. Unlike those in later life, most students' intimate relationships have not existed for very long. On average, our participants' partner relationships had only existed for around 3.5 years. In comparison, our participants' sibling relationships had existed for the majority of our participant's lives, on average around 22 years. Distinct

from parental relationships, siblings grow up together, share experiences and progress through life at the same rate, experiencing similar changes and rites of passages. This could create an intense sibling bond that is stronger than a weaker partner relationship where the partners have not grown together. This balance is likely to shift depending on the age of participants – couples that have been together for 20 years have gone through a similar process of experiencing life together and one would expect that bond to be stronger than couples who have dated for a few years.

A final interpretation is based on the fact that each participant only reported on a single relationship. Therefore we do not know the relationship status of our participants regarding the relationship types that each participant was not reporting on. It is possible that those participants reporting on their co-located siblings did not, or had never had, an intimate partner. In those circumstances, their sibling would remain in their 'inner circle' of Close relationships, must likely consisting of their nuclear family. Such an interpretation is impossible to investigate with the data set we have. This could be compounded by self-selection bias; people who have chosen to report on their communication habits with the sibling when asked to report on 'a person you feel close to' may have an unusually close relationship with their sibling.

4. DISCUSSION

The most notable finding from our data is the broad correspondence we have found between Social

Presence and Closeness ratings. Social Presence scores are predictive of feelings of Closeness. This is an important finding as it broadens our understanding of Social Presence; the instantaneous impact of Social Presence during a communication act impacts upon the longer-term feeling of Closeness between the people in the relationship. It could be argued that this increases the significance of Social Presence as it has an impact beyond the communication act it is associated with. Our analysis cannot provide answers to some of the more nuanced questions as to how this association between SP and Closeness works. For example, is it that people who are already close tend to use highly socially present technologies and when they don't they feel particularly distant? Or is it the opposite, that people who are not generally close get a 'burst' of closeness when they happen to communicate using more socially present technologies? Or nether or both? We have not got the data to answer such questions and leave them open as potential elements of further work.

As well as being theoretically interesting, our findings also have the potential to be used in the design of communication technologies aimed at supporting personal relationships. We have found that SP and Closeness are interrelated relationally significant concepts. As we discussed earlier, new communication technologies have to be assessed to gauge whether they are having an impact upon the users' relationships. The connection between SP and Closeness gives researchers the ability to assess these relationships using a quantitative framework that relates single acts of communication to the long-term sustenance of the relationship.

However, our data also raises the fascinating finding that the selection of media does not appear to predict feelings of Closeness, indicating that technology may not matter as much as issues surrounding the relationship. This suggests that people can feel close to other people, and maintain that feeling, regardless of the communication technologies they use. This finding fits with existing theories of communication in personal relationships, particularly hyperpersonal communication (Walther, 1996). This could be interpreted as meaning that researchers should not attempt to create technologies that increase feelings of Closeness but focus on maximising the sense of Social Presence experienced during use of the technology. This would subsequently lead to highly Socially Present technologies that we would predict would make interlocutors feel closer to one another.

Beyond assessment, we suggest that the relationship between SP and Closeness can be used as a design resource. Both SP and Closeness appear to have a part to play in sustaining personal relationships, each reflecting aspects of the relationship as it develops over time. We argue that designers should choose a particular phenomenon as the method of impacting the relationship; if they are interested in the in-the-moment feeling of using the technology, designers should focus on supporting feelings of SP. Conversely, Closeness is sometimes more relevant as a concept which is not necessarily about a single act of communication but supporting the relationship in a broader fashion. Thieme's 'Lover's Box' would be a good example of this whereby lovers exchange meaningful digital gifts (Thieme et al., 2011). Although not strictly speaking communication, the technology remains relationally significant through increasing the sense of Closeness. In comparison, technologies such as HomeNote focus on improving the act of communication through creating a sense of Social Presence (Sellen et al., 2006).

It is important to consider possible artefacts in our analysis. Data collected with longitudinal self-report studies represent a particular perspective on every-day phenomena. People may self censor, confabulate and forget to report or miss relevant episodes. The risk of these was minimised by making the diary entries as short as possible such that the effort required to fill them in was minimised. That distant relationships were found to be have higher SP scores than same-city ones could be explained by having relatively incomplete data on same-city communications. However, this difference is in accordance with our point of departure: for distance relationships, communication media are vital for sustaining the relationship.

5. CONCLUSIONS & FURTHER WORK

In this paper we have presented an understanding of how Social Presence and Closeness operate together within personal relationships. We proposed a relationship whereby Social Presence, as realised within individual acts of communication has an impact on longer-term feelings of Closeness. Data from 64 participants in a 21-day diary study were analysed and the tests provide some supporting evidence that our hypothesis is correct. Specifically we found that relationship type × relationship distance and Communication Media predict ratings of Social Presence. We also established that relationship type × relationship distance and Social Presence scores predict ratings of Closeness.

The main contribution of this paper is thus presenting a theoretical framework through which quantitative evaluations of communication technologies within interpersonal relationships can be carried out. If a given communication technology is evaluated and found to be associated with high levels of Social Presence, our data indicates that said communication technology would also support the relationship through increasing feelings of Closeness.

Although we have found some evidence to support our model of SP and Closeness, there are two key areas of further work. The first is related to better understanding SP. Emotion is typically described in terms of valence (i.e. positive or negative) and intensity (i.e. strength of feeling). Thus far we have treated high levels of SP as a uniformly positive contribution to a communication experience. It is unclear whether the concept of SP works this way in a relational setting. Some types of relational encounter, such as a heated argument, might be highly Socially Present in terms of intensity but very negative in terms of the relationship.

The second area of future work is to improve our understanding of the model as a whole. We have limited data here; finding a causal link between SP and Closeness and attempting to test our hypothesis with more data from more types of relationships could help inform our model. Refined statistical treatments of ratings data are possible that factor events as well as days into the treatment of relationship time. We have not considered how frequency interacts with the intensity of experiences. Above all, this paper has discussed only the statistical relatedness of ratings data. An insight into the phenomenological meaning of an association between enduring Closeness and Social Presence in-the-moment cannot be revealed in this way. In other work, we have attempted to expose some of the qualitative dimensions of mediated relationships with an inductive thematic approach to the content of communications (Gooch and Watts, 2013). However, triangulation across these paradigms of research is anything but a trivial matter and so represents a significant methodological challenge for future research. Our model thus far only consists of SP and Closeness - we are interested in whether an even longer-term factor, such as Relational Satisfaction, could fit into the model we have proposed. Such work would make our model even more useful for researchers interested in supporting personally meaningful relationships.

Our analysis of our second research question is limited by the fact that each of our participants only reported on a single relationship. It is interesting to consider what we could establish if we had collected data from each participant on multiple relationship types and distances. Firstly it would assist us when attempting to interpret the results of our analyses with regards to which factors can predict feelings of Social Presence and Closeness. Secondly, it would also allow us to compare across individuals to establish how Social Presence and Closeness operate across a single person's relationships. For example, it is likely that people who have high Social Presence and high Closeness with regards to their partner may be predisposed towards having high Social Presence and high Closeness in their other relationships. Perhaps people who are very close to their siblings tend to be less close to their friends. Such an argument treats the phenomena of Social Presence and Closeness as relational types rather than relational states (as we discussed in the introduction of this paper). An investigation of this nature could provide us with data which helps us to better understand the role communication media play in supporting interpersonal relationships. Furthermore, such an approach would also be suitable for investigating how various personality traits (such as empathy or emotional awareness) interact with Social Presence and Closeness across a individual's various relationships. Such an investigation would improve our understanding of the model as a whole and we leave it as a piece of further work.

In this paper, we have not considered how frequency interacts with the intensity of experiences, nor factored out positive and negative encounters from our contact data. Clearly, even for people who care deeply about one another, harsh words are exchanged from time to time. It would be interesting to consider how media play into the restoration of positive communications after disagreements. Furthermore, the range of familiar media, for all the advantages they offer to ground experiential studies, cannot inform design-focused activities that draw on a richer set of interactions. Research is needed that explores how parts of our intimately familiar world can connect with new technical possibilities, whilst respecting the emotional and aesthetic significance of personally important objects. This is necessary to reveal how interactions between SP and Closeness unfold, and present new opportunities to sustain the relationships that really matter.

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