

# Effects of Duration and Laughter on Subjective Happiness Within Different Modes of Communication

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*Media naturalness theory and social information processing theory make competing predictions regarding the effectiveness of different modes of communication at creating and maintaining emotionally intense social relationships. We explored how the duration of interaction and the form of laughter influenced happiness in communication modes with different levels of media naturalness. Forty-one participants completed a 14-day contact diary, recording interactions across face-to-face, Skype, telephone, instant messaging, texting, and e-mail/social network sites. Increases in duration of interaction positively predicted happiness only for face-to-face interactions, offering partial support for the media naturalness hypothesis. Laughter positively predicted happiness in all but one of the communication modes, with real and symbolic laughter having similar effects, a result consistent with the social information processing theory.*

**Key words:** Social relationships, face-to-face interaction, computer-mediated communication, happiness, laughter, media naturalness theory, social information processing theory

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On average, we spend about 20% of each day socializing with others, predominantly through face-to-face (FTF) conversations (Dunbar, 1998). As time is an inelastic resource (Nie, 2001), this allocation is rather restrictive, and appears to constrain the size of social networks to a small numbers of intimates (~15) and a limited number of social partners (~150; Roberts, 2010). However, computer-mediated communication (CMC), which here we use to include both computer-mediated and telephone communication, offers alternative means of managing social relationships that might relax the constraints on FTF interactions and thus widen users' social horizons (Dunbar, 2008; Kock, 2005; Pollet, Roberts, & Dunbar, 2011). The extent to which CMC functions to relax these constraints on the number of social relationships an individual can maintain is partly determined by the effectiveness of different modes of CMC at building and maintaining emotionally intense relationships, i.e. at bonding social relationships together

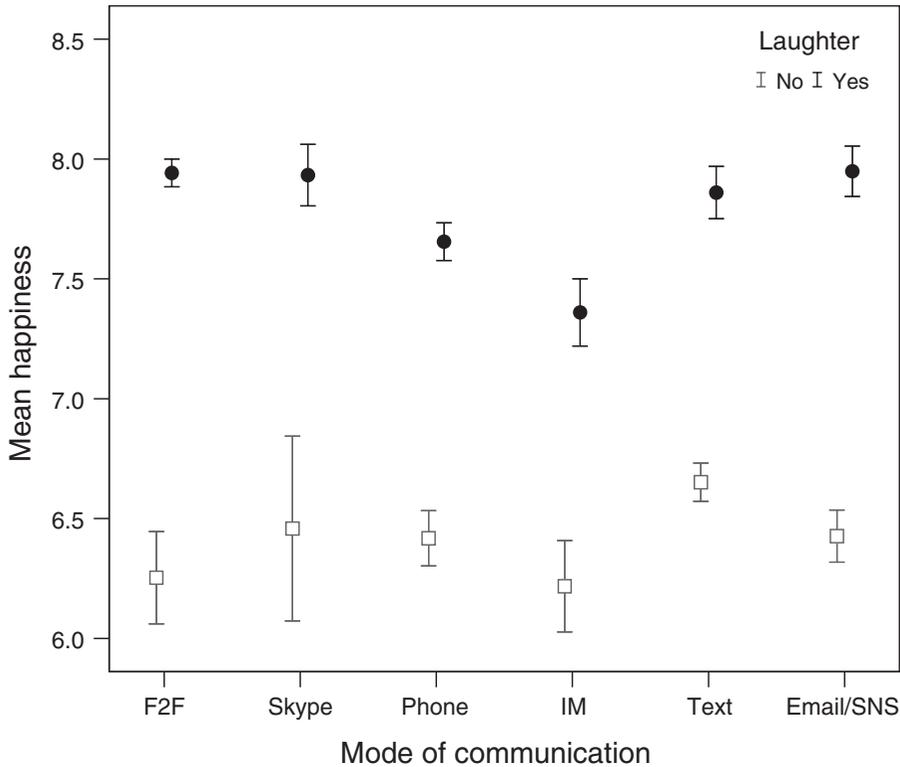
(Pollet et al., 2011). In this study, we used the level of happiness felt after the interaction as a proximate measure of this effectiveness at social bonding. We examined how the duration of the interaction, and the form of laughter during the interaction (real vs. symbolic), mediated happiness felt after the interaction within six communication modes: FTF, Skype videoconferencing, telephone, instant messaging (IM), mobile phone text messaging (texts), and e-mail/social networking site messages (e-mail/SNS).

Due to the distinct properties of CMC, the experience and outcome of an electronically mediated social interaction can diverge from an analogous FTF interaction (Kock, 2005). Whilst CMC technologies enable interaction across long distances and can reduce time constraints due to asynchrony, they lack important physical, visual, and auditory social cues present in FTF interaction (Daft & Lengel, 1986; Kock, 2005). Media richness theory (Daft & Lengel, 1986) proposes that communication media can be arranged in a hierarchy of richness, based on their ability to carry multiple communicative cues (e.g. facial expressions and voice intonations), provide instant feedback, support the use of language variety and allow for the personalization of messages. Rational and effective users should therefore choose the richest media available if the task is equivocal and lean media if the task is less equivocal and early research found that high performing managers are indeed better at matching the task demands to the richness of media (Daft, Lengel, & Trevino, 1987). However, people often choose lean media even for equivocal tasks, and use of lean media can result in the same or even better outcomes than if rich media were used (Kock, 2005; Walther, 1996).

Kock (2005, 2009) argues that the notion of 'richness' is not merely dependent on the properties of the mode of communication, but also depends on the biological characteristics of communicators. Kock suggests that since our hominin ancestors communicated primarily FTF, evolutionary pressures are likely to have led to the development of a brain, facial expressions, body language, and sounds designed for FTF, as other forms of communication are too recent to have shaped brain evolution. Thus the 'naturalness' of communication modes is determined by the extent to which they possess five properties of FTF communication: collocation; synchronicity of communication flow; and the capacity to express and perceive facial expressions, body language, and speech. The 'media naturalness hypothesis' postulates that, if all else is equal, a reduction in the naturalness of a communication mode is associated with enhanced cognitive effort, enhanced communication ambiguity, and diminished physiological arousal (Kock, 2005). It is these variables, rather than media choice or task outcome quality, that are the focus of media naturalness theory.

In terms of theoretical predictions, there are at least two important differences between media richness and media naturalness theory. First, whereas media richness theory places FTF at the top of a continuum of richness (see Fig. 1, Daft et al., 1987), media naturalness theory places FTF at the centre of a continuum. Any CMC that allows for the exchange of less (e.g. texts) or more (e.g. group support decision systems) communicative stimuli per unit time than FTF are predicted to pose cognitive obstacles to communication – thus in media naturalness theory, a mode can be *too* rich. Second, and most relevantly for this study, media naturalness theory proposes a 'speech imperative proposition.' Given the prominence of language in human communication and the evolutionary costs of linguistic faculties, speech should be especially meaningful in determining the naturalness of a communication mode (Kock, 2005). Thus modes of communication that support speech (FTF, Skype and telephone) should involve much less cognitive effort, involve less ambiguity, and result in greater physiological arousal than those that do not support speech (IM, text, and e-mail/SNS), even if these modes may allow for synchronicity of communication. This specific focus on the importance of speech is not present in media richness theory.

There is some evidence in support of media naturalness theory – for instance participants who completed a collaborative task in electronic chat conditions, as compared to FTF and teleconferencing



**Figure 1** Mean (and standard error) happiness ratings for social interactions across six communication modes when laughter did (filled circular markers) or did not (open square markers) occur. Real laughter was recorded for face-to-face (FTF), Skype, and telephone; symbolic laughter was recorded for instant messaging (IM), text messaging (text), and e-mail/social network site messaging (e-mail/SNS). Happiness was measured using the Interaction Feelings Scale (IFS), with 10 indicating “Extremely happy.”

conditions, perceived more mental demand, more temporal demand and higher levels of effort and frustration (Graetz, Boyle, Kimble, Thompson, & Garloch, 1998). Further, FTF communication has been found to surpass e-mail in terms of self-reported usefulness and psychological closeness (Cummings, Butler, & Kraut, 2002); FTF communication is associated with more positive social experiences than CMC (Schiffirin, Edelman, Falkenstern, & Stewart, 2010). Thus interaction through more natural communication modes may elicit more positive affect (Kock, 2005) and these modes may therefore be better tools for building and maintaining emotionally intense social relationships (Cummings et al., 2002; Pollet et al., 2011).

However, a social information processing perspective (Walther, 1992) assumes that people are driven to develop social relationships and CMC can be effective in developing interpersonal relationships, albeit at a slower pace than FTF due to the limited nonverbal cues available. Further, users have the potential to adapt their communication style to the property of the mode, and thus to an extent overcome the limitations of CMC. Walther (1996) argues that due to a combination of idealized perception on the part of the receiver, optimised self-presentation on the part of the sender and reduced nonverbal cues

(which are commonly not under conscious control), use of CMC can lead to enhanced self-disclosure and 'hyperpersonal communication' that is more "socially desirable than we tend to experience in parallel FtF interactions" (Walther, 1996, p. 17).

Again, there is some evidence to support these arguments. Participants interacting via CMC, rather than FtF, showed a greater proportion of direct and intimate uncertainty reduction behaviours and this resulted in judgments of greater conversational effectiveness by CMC partners (Tidwell & Walther, 2002). Along similar lines, the 'Internet-enhanced self-disclosure hypothesis' (Valkenburg & Peter, 2009) proposes that online communication, as compared to FtF communication, leads to greater self-disclosure and therefore to higher quality social relationships (for a review of research in this area, see Valkenburg & Peter, 2009).

Thus, the first issue we focus on is how the mode of communication affects the relationship between the duration of the interaction and the happiness felt after the interaction.

The media naturalness hypothesis (Kock, 2005) suggests that if FtF and other communication modes with visual and vocal cues (Skype) or just vocal cues (telephone) are effective at building strong relationships, then the longer the duration of the interaction, the more positive affect there should be. Put simply, a 30-minute chat with a friend will be more satisfying (and thus produce higher happiness ratings) than a 5-minute chat. In contrast, the duration of the interaction in less natural communication modes (IM, texts, and e-mail/SNS) should *not* be correlated with happiness, as these communication modes involve more cognitive effort, more communication ambiguity, and less physiological arousal. However, according to the alternative view that CMC can be effective at building strong relationships (Valkenburg & Peter, 2009; Walther, 1992, 1996), the relationship between duration and happiness should hold across all modes of communication – so a 30-minute IM chat should be more satisfying than a 5-minute IM chat.

The second key issue this paper addresses is the role of real and symbolic laughter in mediating happiness felt after the interaction. Laughter plays a central role in regulating social relationships (Provine, 1996), and Dunbar (2004) has argued that the absolute amount of time spent communicating with others might be less instrumental to social relationships than whether or not laughter occurs during the interaction. Laughter is tightly intertwined with linguistic communication (Dunbar, 2004; Provine, 1996) and a form of synchronization known as the 'punctuation effect' structures the dynamics of laughter (Provine, 1996). Further, laughter is systematically connected to elevated positive affect and prosocial behaviour (Provine, 1996) and heightens pain thresholds in experimental settings and natural communal interactions, suggesting that it augments endorphin levels in the central nervous system (Dunbar et al., in press). Genuine (or Duchenne) laughter, which involves muscle movements not just around the mouth but also around the eyes, raises positive affect and diminishes negative affect (Keltner & Bonanno, 1997). Thus, laughter may bolster human relationships through infusing communication with positive affect (Dunbar, 2004).

Given the role of laughter in social bonding, how is this signal mediated by CMC technologies? Research suggests that there are inherent differences in the way that FtF interaction and CMC transmit affective meaning (Derks, Fischer & Boss, 2008b; Walther & D'Addario, 2001). Provine, Spencer, & Mandell (2007) note that while telephone communication lacks visual cues, the auditory dimension is still "socially potent, generating smiles and laughs in remote individuals who can *hear but not see* their conversant" (p. 299; original emphasis).

The ability to convey emotion and laughter, however, is a more complex issue for 'symbolic communication' in text-based modes, due to the absence of FtF nonverbal cues and the fact that symbolic communication is voluntary and intentional (Derks, Bos, & von Grumbkow, 2008a; Derks et al., 2008b; Provine et al., 2007; Walther, Loh & Granka, 2005). Therefore, we may expect real laughter and symbolic laughter to have quite different effects, and there is some evidence that emoticons are

not effective at communicating affect in CMC. For example, Walther and D'Addario (2001) found that emoticons, compared to the written text, had little influence on how text-based messages were understood. However Morkes, Kernal, and Nass (1999) demonstrated that participants who received humorous textual comments from their partner during a CMC interaction liked their partner more, and laughed and smiled more during the interaction. Other researchers have also found that use of emoticons can elicit positive affect, and that emoticons are used in a similar way to laughter (Derks et al., 2008a; Provine et al., 2007; Walther et al., 2005). Thus, whilst the media naturalness hypothesis would predict that only real laughter would be related to happiness after the interaction, this body of research suggests that symbolic laughter may also be predicted to have an effect on levels of happiness after the interaction.

Overall, whilst there has been much research in the area of how the properties of CMC affect social interaction, many of the studies have been based around strangers interacting in a laboratory setting via different modes of communication. Whilst this approach offers a high degree of experimental control and has significantly advanced the field, like most laboratory-based experiments it has limited external validity in terms of understanding how people use CMC in their everyday lives, not just to exchange practical information but to service and maintain their social relationships. Questionnaire approaches have a higher level of external validity, but have thus far focused on a limited number of communication modes (Cummings et al., 2002; Schiffrin et al., 2010), and the accuracy of participants' recall of specific instances of communication is known to be relatively low (Bernard, Killworth, & Sailer, 1982). Detailed contact diaries kept over a number of days allow for more precise measurement of the details of each interaction, have a high degree of external validity, and limit the problem of accurate recall of specific events (Fu, 2007). In this study, we therefore used a 14-day contact diary study to explore how duration of the interaction and form of laughter mediated happiness within six communication modes in order of decreasing media naturalness: FTF, Skype, telephone, IM, texts, and e-mail/SNS. As far as we are aware, this is the first time that the effectiveness of a wide range of communication modes at social bonding (as measured by happiness after the interaction) has been assessed as the participants use these modes in their everyday lives.

Building on the media naturalness hypothesis, and specifically the speech imperative proposition (Kock, 2005), we hypothesised that a reduction in media naturalness would result in more cognitive effort, more communication ambiguity, and less physiological arousal. These effects should correspond to lower happiness ratings. Thus, the impact of the duration of the interaction on the happiness ratings should vary by communication mode.

*Hypothesis 1:* The duration of interaction in more natural communication modes with auditory cues (i.e., FTF, Skype, and telephone) will positively predict feelings of happiness,

but duration will not predict happiness for less natural communication modes without auditory cues (i.e., IM, texts, and e-mail/SNS).

Whilst real laughter plays a crucial role in regulating social interaction and acts as a potent 'bonding mechanism' (Dunbar et al., in press; Provine, 1996), the research reviewed above suggests that symbolic laughter expressed via emoticons (e.g., 😊) and laughter indicators in text (e.g., "LOL" for laugh-out-loud) can be effective at generating positive affect in CMC. Thus, we predicted that both real and symbolic laughter would mediate happiness levels.

*Hypothesis 2:* Within all communication modes, participants will experience more

happiness after social interactions when laughter (either real or symbolic) occurs than when laughter does not occur.

## Methods

### Participants

Forty-one participants, 16 men ( $M_{age} = 24.9$  years,  $SD = 2.92$  years, age range: 22–33 years) and 25 women ( $M_{age} = 24.2$  years,  $SD = 2.18$  years, age range: 21–30 years) completed 14-day contact diaries. All participants were postgraduate students at the University of Oxford. Participants classified their romantic relationship status as single ( $N = 15$ ), or in a relationship ( $N = 26$ ). Participant ethnicities were coded as White ( $N = 34$ ), Asian/Pacific Islander ( $N = 2$ ), South Asian ( $N = 2$ ), Hispanic/Latin American ( $N = 1$ ), and Mixed/Other ( $N = 2$ ). Participants were volunteers recruited from personal networks and mass e-mail requests and were informed that they would be entered into a raffle upon completion of the study, where they could win one of three gift vouchers to Amazon (£30, £20, and £10).

### Social Contacts Questionnaire

Question 1 asked participants to list the initials of people they would *'seek advice, support, or help from in times of severe emotional or financial crisis.'* This question has previously been used to identify network members to whom the participants feel very emotionally close (Roberts & Dunbar, 2011). From this initial list of individuals, participants then selected up to five network members with whom they had the most frequent interaction 2 weeks prior to the study (Question 2). In this manner, participants selected network members whom they were emotionally close to *and* with whom they were likely to interact with during the period of the contact diary. Participants then provided information about their relationship to the selected network members (family, friend or romantic partner) and perceived emotional closeness to the network member on a 1–10 Likert scale.

### Contact Diary

Participants completed a daily interaction log about all social interactions with these selected network members over six communication modes: FTF, Skype or other videoconferencing programs using video and voice, telephone, IM, texts, and e-mail/SNS. Messages exchanged by e-mail and SNS were combined, as in this study we were interested in direct communication rather than more passive browsing of SNS sites. For each communication mode with each network member, participants answered questions about duration, happiness, interaction atmosphere, and laughter.

Participants recorded approximately how many minutes they spent interacting with a particular network member that day over each communication mode. For text-based modes, this constituted the time they spent reading and writing IM, text messages, and e-mail/SNS messages. To assess happiness, the participants were asked: *"For each communication mode, indicate how happy or unhappy you felt today after a single interaction or after the average of all interactions with [Person X] over that specific medium."* This question was adapted from the Happiness Measures (HM) scale, an established well-being scale (Fordyce, 1988). Participants answered the happiness question using an 11-point "Interaction Feelings Scale" (IFS), spanning from 0 = "Extremely unhappy" to 10 = "Extremely happy," with the anchor points based on Fordyce (1988).

Participants were also asked to provide an "Interaction Atmosphere Rating" (IAR), with the following prompt: *"For each communication mode, rate the average interaction atmosphere today with*

[Person X] (i.e., the nature/tenor of the interaction(s)).” This question controlled for the content of social interactions and was adopted from a similar question in a diary study (Fu, 2007). Participant instructions clarified that IAR could be the nature or tenor of a single interaction or the average of all interactions with a given individual over a specific communication mode on a given day. Participants reported IAR using the 5-point “Interaction Atmosphere Scale” (IAS), spanning from 1 = “Very unpleasant” to 5 = “Very pleasant.” These anchor points were based on Fu’s (2007) sample contact diary.

For each communication mode with each network member, participants were also asked whether they laughed (for FTF, Skype, and telephone) or whether they expressed laughter (for IM, texts, and e-mail/SNS). This was a Yes/No response. Participants were asked to record “genuine laughter.” This was an attempt to encourage the recording of Duchenne laughter for the three modes containing vocal cues. Participants were also asked to record “symbolic laughter” for the three text-based modes. This was defined as “*phrases specifically indicating laughter (e.g., ‘LOL,’ ‘Haha,’ etc.) or any type of smiling/laughing emoticon (e.g., 😊).*” While the term symbolic laughter may have been used elsewhere to apply to different phenomena, in this study the term was constructed to extend beyond emoticons and to account for the capacities of both textual messages and emoticons to convey characteristics of emotion and laughter (Derks et al., 2008a; Morkes et al., 1999; Provine et al., 2007; Walther et al., 2005). Participant instructions emphasised that symbolic laughter should only be recorded if the participant sent laughter phrases and/or smiling/laughing emoticons to network members during interactions.

Laughter is inherently social (Provine, 1996). Therefore, additional instructions clarified that all forms of laughter must be both produced by the participant and recognized by network members (e.g., if one genuinely laughs out loud while reading a text message but does not respond to the interaction partner, then this kind of interaction should not be recorded).

## Procedure

Participants first completed a ~40-minute in person interview, during which they filed in the questionnaire, and were given instructions on how to complete the contact diary. During the recording period, participants filled out one daily interaction log each evening. The contact diary study spanned 14 days, as communication patterns across two weeks generally mirror communication patterns across nine months (Eagle, Pentland & Lazer, 2009). The sample did not have to be 14 consecutive days, but participants were strongly encouraged to do so if they could. Participants were sent daily reminder e-mails. At the end of data collection, all 41 participants were simultaneously debriefed via e-mail about raffle results and the purpose of the study.

## Statistical Analysis

Following Cummings, Lee, and Kraut (2006), separate multilevel models were generated for each communication mode (Table 1). Each model was a three-level model, where the interactions over 14 days at Level 1 were nested within the network members at Level 2, which in turn were nested within participants at Level 3. Raw happiness ratings constituted the outcome variable in each model. The predictor variables in each model broadly consisted of time budgets (i.e., minutes), interaction atmosphere (i.e., IAS rating), occurrence of laughter (i.e., laughter or no laughter), and network member relationship type (i.e., family member, friend, or romantic partner). Relationship type was included in the models because the identity of network members can influence both experiences with communication modes (Carlson & Zmud, 1999) and patterns of sociality (Roberts & Dunbar, 2010, 2011). Details of the specification of the model, power analysis, and calculation of the effect size – the proportional reduction in variance (PRV) – are provided in the Electronic Supplementary Material (ESM).

**Table 1** Fixed effect estimates for multilevel regression models predicting happiness (IFS rating) from duration of interaction (mins), interaction atmosphere (IAS rating), occurrence of laughter (laughter or no laughter), and network member relationship type (family, friend, or romantic partner).

Model number and communication mode	Model 1 FTF	Model 2 Skype	Model 3 Telephone	Model 4 IM	Model 5 Text messages	Model 6 E-mail/SNS messages
<i>Fixed Effects</i>						
Intercept	7.10 (0.19)***	7.55 (0.38)***	6.78 (0.15)***	6.42 (0.17)***	6.72 (0.10)***	6.62 (0.15)***
Participant mean Mins	0.12 (0.09)	0.10 (0.09)	-0.01 (0.07)	-0.11 (0.08)	0.08 (0.08)	0.06 (0.09)
Participant mean IAS	0.61 (0.07)***	0.78 (0.10)***	0.41 (0.08)***	1.17 (0.09)***	0.76 (0.08)***	0.58 (0.08)***
Mins <sup>a</sup>	<b>0.41 (0.19)*</b>	<b>-0.09 (0.10)</b>	<b>-0.07 (0.10)</b>	<b>-0.06 (0.20)</b>	<b>-0.09 (0.08)</b>	<b>0.20 (0.10)</b>
IAS <sup>a</sup>	0.73 (0.04)***	0.80 (0.10)***	0.86 (0.06)***	0.86 (0.08)***	0.73 (0.05)***	0.67 (0.07)***
<b>Laughter</b>	<b>0.73 (0.17)***</b>	<b>0.30 (0.28)</b>	<b>0.61 (0.13)***</b>	<b>0.58 (0.18)**</b>	<b>0.44 (0.13)**</b>	<b>0.83 (0.14)***</b>
Mins X laughter	-0.34 (0.19)	†	0.05 (0.12)	0.01 (0.21)	0.15 (0.11)	-0.09 (0.13)
Friend vs. romantic partner	0.34 (0.18)	-0.09 (0.33)	0.22 (0.18)	0.60 (0.19)**	0.42 (0.15)**	0.003 (0.24)
Friend vs. family member	-0.15 (0.26)	0.09 (0.32)	-0.09 (0.17)	0.41 (0.20)*	0.01 (0.18)	0.10 (0.19)
<i>Covariance</i>						
Variance of residuals	0.91 (0.05)***	1.29 (0.17)***	1.53 (0.10)***	1.04 (0.11)***	1.17 (0.08)***	1.08 (0.10)***
Variance of intercepts	0.24 (0.06)***	0.02 (0.09)	0.22 (0.08)**	0.04 (0.06)	0.17 (0.06)**	0.39 (0.12)**

\*Note. Table displays parameter estimates (and standard errors). Effects in bold refer to Hypotheses 1 and 2. <sup>a</sup> Group-mean centred. † Value could not be computed due to lack of cases for interaction effect.

†\* $p < .05$ . \*\* $p < .01$ . \*\*\* $p < .001$ .

## Results

### Descriptive Statistics

The mean $\pm$ SD number of network members named in response to Question 1 was 9.54 $\pm$ 3.49. One of the participants only named four network members in response to Question 1 and thus recorded their interactions with these four network members. The remaining 40 participants named five or more network members, and thus recorded interactions with the five network members they identified in Question 2. The 204 network members selected by participants had a mean $\pm$ SD emotional closeness of 8.10 $\pm$ 1.45 and consisted of 70 family members, 107 friends, and 27 romantic partners. Since participants recorded interactions for 14 days, this ultimately yielded 2,856 contact entries, each consisting of interaction information with a network member across up to six communication modes for any particular day. The contact diary data are hierarchical (days clustered within network members clustered within participants). However, for illustrative convenience, Tables S1, S2, S3, and S4 in the ESM provide general descriptive statistics of raw scores for time budgets, happiness, interaction atmosphere, and laughter collapsed across participants, network members, and days of interaction.

### Duration of Interaction and Happiness (Hypothesis 1)

Duration of the interaction was a significant positive predictor of happiness for FTF, suggesting that increases in time dedicated to FTF interaction (relative to participants' mean time budgets) increased happiness (Table 1). The PRV for duration was 0.037 indicating that the inclusion of duration in the model accounted for a 3.7% reduction in the Level 1 variance. However, duration did not significantly predict happiness for other communication modes, although it did approach significance in a positive direction for e-mail/SNS messages ( $p = .052$ ). Thus, Hypothesis 1 was only partly supported: As hypothesised, increases in time dedicated to FTF interaction positively predicted happiness, and did not predict happiness for IM, text messages, and e-mail/SNS messages. However, contrary to predictions, time dedicated to Skype and telephone did not positively predict happiness.

### Laughter and Happiness (Hypothesis 2)

The occurrence of real laughter was a significant positive predictor of happiness for FTF (PRV = 0.29) and telephone (PRV = 0.17), and the occurrence of symbolic laughter was a significant positive predictor of happiness for IM (PRV = 0.07), text messages (PRV = 0.09), and e-mail/SNS (PRV = 0.15; Table 1, Figure 1). However, real laughter did not significantly predict happiness for Skype, though happiness tended to be higher when real laughter occurred. Therefore, Hypothesis 2 was largely supported; participants tended to experience more happiness after social interactions when real or symbolic laughter occurred.

The interaction between duration and the occurrence of laughter did not significantly predict happiness for any communication mode (Table 1). Therefore, increases in the duration of the interaction were not more likely to predict happiness when laughter occurred than when laughter did not occur.

### Control Variables

In addition to predictors relevant to hypotheses, each model also contained control variables to account for the effects of average time budgets, interaction atmosphere, and network member relationship type. The participant mean duration was not a significant predictor of happiness for any communication mode. The mean IAS rating, and the interaction IAS rating, were both significant positive predictors of happiness for all communication modes. Overall, the two relationship type variables had little effect

on predictions of happiness. For IM, social interactions with romantic partners and family members significantly increased happiness compared to friends. For text messages, social interactions with romantic partners significantly increased happiness compared to friends.

## Discussion

This contact diary study explored how the duration of interaction and the form of laughter influenced happiness within six communication modes with different levels of media naturalness. Hypothesis 1 was only partially supported. Whilst the duration of the interaction for FTF positively predicted happiness, there was no effect of duration on happiness for the other modes, including those CMC modes that included auditory cues (Skype and telephone). Results showed robust support for Hypothesis 2. Within all communication modes, except for Skype, participants experienced more happiness when laughter (real or symbolic) occurred than when laughter did not occur. Whether the network member was a family relation, a friend, or a romantic partner had little effect on happiness within communication modes. This suggests that the observed patterns may be general principles that apply across all social relationships, rather than specific to particular types of relationships. Furthermore, the nature of social interactions (i.e., variation in interaction atmosphere), the participants' overall average duration of interaction and overall interaction atmosphere per communication mode were controlled for in all the multilevel models.

Increases in the duration of communication events predicted happiness only for FTF interaction, providing some support for media naturalness theory (Kock, 2005). However, the results did not support a specific aspect of media naturalness theory - the 'speech imperative proposition' (Kock, 2005). Despite Skype and phone allowing for synchronous communication with voice, there was no effect of duration on happiness in these modes, suggesting FTF communication might be qualitatively different from all other forms of communication. Subtle nonverbal facial and bodily cues play a central role in regulating communication (Pentland, 2008), and it may be that these cues are less readily available on Skype or by telephone, leading to a decrease in the sense of connection with the communication partner, as compared to FTF. It should be noted that whilst both simulation studies and a post hoc power analysis (see ESM for details) revealed that the sample size in this study was sufficient to detect a medium effect, the reduction in variance associated with including duration in the FTF model was relatively small (3.7%), compared to the reduction in variance associated with including laughter in the models (7% to 29% across five modes). Thus the findings on the effect of duration on happiness in FTF interactions should be treated as preliminary until replicated in future studies.

The occurrence of laughter positively predicted happiness within five of the communication modes, broadly confirming Hypothesis 2. Thus, overall, laughter emerged as more critical to interactions conducted over CMC than the duration of communication. This is consistent with the argument that pure time spent participating in linguistic communication may be less instrumental to social relationships than whether or not laughter occurs (Dunbar, 2004). Further, both real and symbolic laughter enhanced happiness within communication modes. This pattern of results concurs with previous research suggesting that laughter in both its real and symbolic forms (Provine et al., 2007) promotes positive affect and prosocial behaviour (Dunbar et al., in press; Keltner & Bonanno, 1997; Walther et al., 2005). This raises the question as to how these similar effects on happiness may emerge, given the differences between natural and symbolic communication (Kock, 2005; Provine et al., 2007).

Kock (2009) has previously argued that in order to fully explain how people interact via CMC, media naturalness theory should be synthesized with channel expansion theory. Channel expansion theory builds on social information processing theory (Walther, 1992), but proposes that media perceptions

are not just influenced by the mere use of communication modes, but by the cultivation of 'knowledge-building experiences' in the form of experience with a CMC tool, the topic of communication, the organizational context, and the interaction partners (Carlson & Zmud, 1999). With reference to e-mail use, smiling emoticons, and humour/irony, Carlson and Zmud (1999) suggest that e-mail users with experience in the four domains outlined above may be adept at accurately interpreting a wide variety of cues in e-mail messages. Therefore, whilst the results of this study on the effect of duration on happiness are broadly consistent with media naturalness theory, the results for laughter are more supportive of social information processing theory and channel expansion theory, suggesting that humans are capable of adjusting aspects of natural communication, like laughter, to yield expressive capacities even within the constraints of text-based CMC (Derks, et al., 2008b; Provine et al., 2007; Walther, 1992).

There is strong evidence to show that laughter heightens pain thresholds and the most likely explanation for this effect is that laughter increases endorphin levels in the central nervous system (Dunbar et al., in press). Endorphin release promotes feelings of wellbeing and relaxation, and thus the relationship between real laughter and happiness felt after the interactions in FTF, Skype, and telephone communication may be due to endorphin release. This endorphin release may be an important part of the underexplored "physiological arousal" specified in the media naturalness hypothesis. Whether symbolic laughter in CMC also results in the release of endorphins, or whether it has effects on happiness that are not mediated by endorphin release, is a promising avenue of future research, given that endorphin release can be measured relatively simply through a pain threshold test (Cohen, Ejsmond-Frey, Knight, & Dunbar, 2010; Dunbar et al., in press).

As with all diary research, the current study is limited by recall bias and sampling procedures (Fu, 2007). However, diary procedures can gather detailed information about specific instances of interaction rather than summarizing across many events over long time periods, as is usually the case in cross-sectional research (Fu, 2007). With respect to sampling, all participants were postgraduate students at the same university, and while the sample was cross-cultural in terms of country of origin, it remains unclear how results from this sample would generalize to other populations (Fu, 2007; Henrich, Heine, & Norenzayan, 2010).

Further, the diary methods did not allow for control over the nature of the interaction, or the target of the interaction, over different modes. The interpersonal goals and motives of interactants can have a large effect on both the nature of interaction that takes place over CMC, and the impression interactants form of each other (Walther, van der Heide, Tong, Carr, & Atkin, 2010). It may be that participants interacted FTF with people they were closest to, thus explaining why duration of interaction was related to happiness for FTF but not for the other modes. However, by asking the participants who they would turn to in times of severe crisis, we specifically targeted network members with whom the participants had emotionally close relationships and this prompt typically elicits a small number of immediate family and very close friends (Roberts, 2010). Thus the communication across all modes occurred with people with whom the participants had emotionally close relationships.

A final potential limitation is that the content of the interaction was not standardized across modes, and we did not gather detailed information about the nature of this content. Detailed analysis of the content of text-based exchanges can reveal important information about the nature and emotional tenor of that interaction (Morkes et al., 1999; Tidwell & Walther, 2002). Using the time diary method employed in the current study, the respondent burden would be too high for participants to manually record the details of each exchange, and the best way to access this information in future studies may be to utilise the electronic records of the participants' text-based communication (e-mails, IM, texts) alongside more subjective information on the nature of the interaction (e.g., Gilbert & Karahalios, 2009).

Ultimately there is always a trade-off between a laboratory-based, experimental design with high internal validity in which these types of variables can be strictly controlled but the external validity may be lower, and observational, survey or time-diary designs with higher external validity but limited control over all the variables (Tebes, 2000). This tension is especially important if the focus of research is on how different communication modes are used to build and maintain relationships between friends and family in everyday life, rather than on communication between strangers or in the workplace. The best way to distinguish between competing theories may be if a consistent set of results can be found using a variety of methods, as results from a single study using a single method are unlikely to be conclusive.

The finding that increases in the duration of an interaction predicted happiness only for FTF interaction raises two questions: is colocation necessary to sustain social bonds, and if so, what qualities of colocation are crucial? Derks et al. (2008b) argue that future research should target the lack of 'emotional embodiment' in CMC. Touch and physical interaction serve essential functions in social relationship maintenance among both humans and primates (Dunbar, 2010), and there is some evidence that the addition of tactile and kinaesthetic stimuli to CMC may elevate the sense of connection with the communication partner (Haans & IJsselsteijn, 2006). Future research should thus target the distinction between actual (i.e., FTF) and virtual colocation (e.g., videoconferencing technologies, tactile stimuli) to ascertain whether CMC technologies can ever maintain social relationships as successfully as FTF interaction (Derks et al., 2008b; Kock, 2009).

In conclusion, for FTF communication, duration significantly predicted happiness, suggesting that the absolute duration of FTF interaction plays a crucial role in building and maintaining emotionally intense relationships. This partially supports media naturalness theory in emphasising the qualitatively different nature of FTF interaction, although the lack of effect of duration on happiness for Skype and telephone undermines the speech imperative proposition aspect of media naturalness theory and suggests that colocation, rather than speech and/or visual access, may be the critical variable. In contrast, laughter predicted happiness across five of the six modes, indicating that both real and symbolic laughter may play similar roles in mediating social interaction and that laughter, rather than duration of the interaction, may be the most important factor in determining the affective nature of the interaction for all modes except FTF.

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