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Situational determinants of cognitive, affective, and compassionate empathy in naturalistic digital interactions

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ABSTRACT

Empathy is apparent in computer-mediated communication (CMC), yet little is known about the situational predictors of empathic responses when interacting digitally. We used a diary methodology to explore: (1) the degree three types of empathy (cognitive, affective, and compassionate) are experienced in students' everyday (text- and image-based) dyadic digital interactions; (2) which situational factors are important for (different types of) empathy in CMC; and (3) how empathy reported in everyday CMC affects participants' perceptions of their empathy in CMC and face-to-face (FtF) contexts. One hundred student volunteers (50 women, M_{age} = 22.57 years) completed a "digital interaction diary" for three consecutive days, yielding 1939 observations. Participants reported significantly more cognitive than affective empathy, and significantly greater affective than compassionate empathy. Several situational variables (e.g., number of communications, recipient) were related to empathy overall, while others (e.g., subject, mood) contributed to discrete contextual profiles for the empathy subtypes. Empathy reported in the diaries predicted a more favourable ratio of perceived CMC to FtF empathy, particularly for those lower in baseline trait empathy. These findings help elucidate the multidimensional experience of empathy in CMC interactions.

1. Introduction

Computer-mediated communication (CMC) is increasingly ubiquitous, yet we still have much to learn about its relationship with humans' psychological processes, which evolved over millennia in the absence of technology. Here we focus on empathy, defined as a multidimensional capacity to recognise, feel, and/or react compassionately to others' emotional states (Ekman, 2003). While some have historically demonised CMC as emotionally barren, lacking the nonverbal channels necessary for intimate interpersonal communications (e.g., Short, Williams, & Christie, 1976; Siegel, Dubrovsky, Kiesler, & McGuire, 1986), others have argued for the affiliative potential of CMC, noting a lack of evidence to concede that it is less emotionally-involved than face-to-face (FtF) communication (e.g., Derks, Fischer, & Bos, 2008; Walther, 1992, 1996). Indeed, recent analyses of social networking sites like Twitter and Facebook indicate that digital posts are often emotive (Bollen, Pepe, & Mao, 2011; Coviello et al., 2014), and people develop meaningful, empathic relationships online (Preece & Ghozati, 2001). While "digital empathy" is apparent, the situational determinants of empathy in CMC are not well understood, nor are the different empathic experiences people may have digitally. In this paper we use a naturalistic diary method to explore the state determinants of empathy in text- and image-based CMC.

1.1. Empathy

Empathy is a complex psychological phenomenon (Batson, 2009), which best describes a set of related, but fundamentally separable, emotion systems (Davis, 1983). It has been associated with a number of other psychological concepts, including sympathy or concern (Goetz, Keltner, & Simon-Thomas, 2010); perspective-taking (Lamm, Batson, & Decety, 2007); theory of mind or "mentalizing" (Hooker, Verosky, Germine, Knight, & D'Esposito, 2008); emotion recognition (Soto & Levenson, 2009), and emotion contagion (Hatfield, Rapson, & Le, 2009).

Following the emotions theorist Paul Ekman, we adopt a tripartite classification in our working definition of empathy:

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Neither empathy nor compassion is an emotion; they refer to our reactions to another person's emotions. In *cognitive* empathy we recognise what another person is feeling. In *emotional* empathy we actually feel what that person is feeling, and in *compassionate* empathy we want to help the other person deal with his situation and his emotions. We must have cognitive empathy, in order to achieve either of the other forms of empathy, but we need not have emotional empathy in order to have compassionate empathy. (Ekman, 2003, p. 180).

Thus, like Ekman, we find it useful to operationalise empathy in terms of its cognitive, affective, and compassionate correlates, for which the latter are thought to be hierarchically dependent on the former.

"Cognitive empathy", or emotion recognition (Soto & Levenson, 2009), describes the perception and (accurate) identification of others' feeling states. It is functionally separable from affective empathy (or shared feeling; Shamay-Tsoory, Aharon-Peretz, & Perry, 2009), though it may be a precursor (Ekman, 2003). Cognitive empathy has been shown to predict positive social outcomes, such as helping behaviour (Marjanovic, Struthers, & Greenglass, 2012), injustice sensitivity (Decety & Yoder, 2016), and compassion for others (Batson, Early, & Salvarani, 1997). Further, some have proposed that cognitive empathy may be more adaptive (than affective empathy) in these scenarios, for example by minimising potential distress associated with the sharing of negative emotion (Einolf, 2012). Nevertheless, cognitive empathy has a possible "dark side", facilitating manipulation and exploitation (Wai & Tiliopoulos, 2012); psychopathy, for example, may be characterised by high levels of cognitive empathy, in the absence of affective empathy and compassion (Baron-Cohen, 2011).

"Affective empathy", or emotion contagion (Hatfield et al., 2009), describes the subjective mirroring of others' feeling states. It may occur via both explicit and implicit routes (Hatfield, Cacioppo, & Rapson, 1993), with the two pathways potentially differing in their antecedents. As with cognitive empathy, affective empathy has been associated with both positive and negative outcomes. On the one hand, affective empathy has been shown to explain the link between mimicry and prosocial behaviour (Stel, van Baaren, & Vonk, 2008), facilitate social bonding (Stel & Vonk, 2010), and may be necessary to keep cognitive empathy "in-check", by allowing people to *feel* the consequences of their actions (e.g., Jolliffe & Farrington, 2006). On the other hand, distress that can result from sharing potent, negative emotions can be detrimental, leading to maladaptive outcomes, such as withdrawal and avoidance (Singer & Klimecki, 2014). While often associated with negative emotions, both cognitive and affective empathy are valence non-specific.

"Compassionate empathy", or feelings of sympathy, concern, and compassion for another (Goetz et al., 2010), is theorised to be a common, but not definite, consequence of the two other forms of empathy. Compassion is often conceptualised as a discrete prosocial affective state in its own right (Goetz et al., 2010), linked to positive outcomes such as charitable behaviour (Weng et al., 2013). Of the three types of empathic response outlined above, compassionate empathy is seen as the most socially desirable.

Empathy can be measured at both a trait (i.e., dispositional propensity; Reniers, Corcoran, Drake, Shryane, & Völlm, 2011) and state (i.e., "in-the-moment"; Shen, 2010a) level. The ability to emphasise is an individual difference factor that is thought to be relatively stable over time (Leiberg & Anders, 2006), momentary assessments of state empathy, while less commonplace, have been shown to be related to transitory phenomena, such as message persuasion (Shen, 2010b). Thus, empathy can affect (and be affected by) many aspects of our social lives, not least our day-to-day interactions, whether FtF or via CMC (Carrier, Spradlin, Bunce, & Rosen, 2015).

1.2. Empathy in CMC

Two opposing positions emerge on empathy in CMC. The first is that digital communication technology is an obstruction to affiliative interactions, and hence the occurrence of empathy. Such a perspective is reflective of what are known as "cues-filtered-out" theories (Walther & Parks, 2002). These theories propose – to varying degrees – that reduced interpersonal cues in traditional CMC (i.e., nonverbal behaviour, prosodic speech qualities etc.) reduce the information transmitted, thus resulting in more impersonal and less empathic exchanges (Walther, Loh, & Granka, 2005). Social presence theory (Short et al., 1976), for example, hypothesised that the fewer cues a system supported the less warmth and involvement users' experienced. Lack of social context cues theory (Siegel et al., 1986; Sproull & Kiesler, 1986) proposed that reduced cues in CMC produced self-focused, disinhibited, negative exchanges. Media richness theory (Daft & Lengel, 1986) argued that the interpersonal quality of exchanges depended on the cues supported, immediacy of feedback, potential for natural language, and message personalization. While these theories were formed during early CMC, some remain popular (D'Urso & Rains, 2008).

The contrary position is that CMC has the *potential* to be as personal and, in some instances, even more intimate than FtF interactions. Social information processing theory (Walther, 1992) proposed that individuals' *adapt* to communication mediums in order to develop interpersonal affinity, but that such bonds may take longer to develop in CMC than FtF (Walther & Parks, 2002). This is supported by data that suggests users compensate for the absence of nonverbal cues in textual CMC (e.g., Derks, Bos, & von Grumbkow, 2008; Walther et al., 2005). Hyperpersonal theory (Walther, 1996) was developed to account for instances of *increased* intimacy and desirability in CMC (e.g., Walther, 1995). Features unique to textual CMC, such as selective impressions, reduced inhibitions, timely construction of messages, feedback, and editing, can contribute to a more favourable interaction (Bargh, McKenna, & Fitzsimons, 2002). Thus, increased anonymity and distance in CMC can paradoxically facilitate greater empathic connections than otherwise possible (Preece, 1998), for example due to increased or more personal disclosures (Jiang, Bazarova, & Hancock, 2011; Tidwell & Walther, 2002). This is especially the case for CMC on shared experiences, themes, or interests, such as within online support communities (Caplan & Turner, 2007), which provide access to empathic relationships that may otherwise not have been physically possible.

The utility of cues-filtered-out theories has been moderated by empirical and anecdotal evidence of highly interpersonal and empathic exchanges digitally, and the development of meaningful relationships online (Preece & Ghozati, 2001). In her work on online community spaces, Jenny Preece and colleagues (Feng, Lazar, & Preece, 2004; Preece & Ghozati, 2001; Preece, 1999) catalogued an array of empathic digital exchanges and coined the term "empathic [online] communities" to describe compassionate online support forums. Indeed, there is evidence that cognitive (e.g., Hancock, Landrigan, & Silver, 2007), affective (e.g., Hancock, Gee, Ciaciaco, & Mae, 2008), and compassionate empathy (e.g., Pfeil & Zaphiris, 2007), can all occur via CMC. A study on massive emotion contagion, for example, explored the effects of rainfall on the emotional content of millions of Facebook users' status updates, and the effects of these on their friends' updates (when controlling for local precipitation) across 100 US cities, over three years (Coviello et al.,

2014). The authors estimated that a rainy day in New York contributed to an extra 1500 negative posts by local users and indirectly to approximately 700 more negative posts by friends elsewhere. Recent work also suggests that CMC can be used to build cross-cultural relationships and reduce intergroup prejudice (Walther, Hoter, Ganayem, & Shonfeld, 2015).

1.3. Situational determinants of empathy in CMC—the present research

It is apparent that "digital empathy" exists in CMC, and that technology should neither be branded as a "limitation" or "liberation" to empathy in itself (Walther, 1996). Rather, we argue that empathy in CMC is likely to depend more on *situational* factors (e.g., the recipient, topic of conversation) than fixed traits or the communication medium itself. Furthermore, it is plausible that different types of empathy (i.e., cognitive, affective, and compassionate) may have different *contextual profiles*. Work in FtF contexts suggests that a range of state factors may contribute to empathic experiences; for example, the target of one's empathy (e.g., Meyer et al., 2012), interaction topic (e.g., Pfeil & Zaphiris, 2007), and participants' mood (e.g., Silani, Lamm, Ruff, & Singer, 2013). Yet, there is scarce research on the situational determinants of empathy in CMC, let alone different types of empathy.

We used a bespoke "digital interaction diary" to explore naturalistically the state determinants of empathy in university students' CMC. Young adults are amongst the biggest users of social media and technology, hence the importance of studying CMC in this group (Duggan, Ellison, Lampe, Lenhart, & Madden, 2015). We restricted our focus largely to "first-generation" (i.e., textual) CMC to ensure a clear differentiation from FtF, but allowed for static image content. Participants completed their diaries for three consecutive weekdays, reporting on the characteristics of their digital interactions and associated empathic responses. We explored three questions:

1.3.1. Research question 1

To what extent do university students experience empathy in their everyday dyadic (text- and image-based) digital interactions?

Based on Ekman (2003) typology, affective and compassionate empathy are hierarchically dependent on cognitive empathy. Thus, we predicted that participants would experience empathy in CMC, and greater levels of cognitive empathy than affective or compassionate empathy. Further, as affective empathy can occur regardless of message valence, but compassion is primarily elicited in response to negative states, we expected to observe greater levels of affective empathy than compassion.

1.3.2. Research question 2

Which situational factors are important as predictors of cognitive, affective, and compassionate empathy in digital interactions?

Based on work in FtF contexts, we expected certain variables, such as whether the recipient was closer interpersonally to the participant (Hoffman, 2000), to be important determinants of empathic responses. However, we did not foresee their *relative* importance. We also expected some variables, such as the mood of the recipient, to emerge as a differential predictor of empathic outcomes (e.g., a sad recipient engendering more compassionate, but not necessarily cognitive or affective, empathy).

1.3.3. Research question 3

Is the empathy experienced in digital interactions related to participants' perceived degree of empathy in CMC and FtF contexts?

Participants' empathic experiences in their digital interactions may affect their perceptions of it as an empathic medium. We predicted that, when controlling for trait propensity to empathise, the amount of empathy reported in the diaries would be significantly related to participants' perceived degree of empathy in their digital and FtF interactions, but to a greater extent in the former.

2. Method

2.1. Participants

One hundred volunteers (50 women) at the host institution completed "digital interaction diaries" over three days, yielding 1939 separate observations. Participants' ages ranged from 18 to 58 ($M = 22.57$, $SD = 5.62$). They were mostly UK nationals ($n = 64$) and undergraduates ($n = 71$) studying a range of disciplines. Roughly half ($n = 52$) reported being in a romantic relationship of some form.

2.2. Materials

2.2.1. Digital interaction diary

We created a custom "digital interaction diary" to record details of interactions and participants' associated empathic responses. The diary contained instructions and templates for recording data (see Fig. 1). We chose a compact (A5) paper, rather than digital, diary in an effort to maximise ecological validity, by minimising the invasiveness of the data collection method on participants' digital interactions, and to allow participants to have access to the diary in real-time, at all times, during data collection (e.g., without an internet connection).[1]

The diary was designed to measure details about participants' digital interactions including the duration; mode (*text messaging/Snapchat/email/commenting/instant messaging*); content (*text/image/both*); device being used (*mobile phone/tablet/laptop/PC*); number of communications made (*2–10/11–20/21–30/31–40/41–50/51+*); whether the interaction was publicly viewable (*private/public*); who the recipient was (*romantic partner/friend/family member/work or university acquaintance/other*); whether the recipient was known to the participant FtF (*yes/no*); the main topic of the interaction (*work or study/social life/significant event/other*); and the main subject of the interaction (*me/them/mutual/other*). While this list was not exhaustive, we attempted to produce a task that was not too burdensome to encourage more reliable responding (Reis & Gable, 2000).

Participants' empathy in each interaction were measured using nine specially-constructed Likert items (the Measure of State Empathy [MSE]; see Measures). Finally, two 9-point pictorial scales were used to measure participants' perceptions of their own, and their partner's mood during the interaction (i.e., 1 = *highly negative*, 9 = *highly positive*). These pictorial scales are adapted portrait versions of the Self-Assessment-Manikins first developed by Lang (1980) and modified by Suk (2006).[2]

2.3. Measures

2.3.1. Trait empathy

Trait cognitive and affective empathy were measured using the

[1] Paper and digital diaries typically yield equivalent data (Green, Rafaeli, Bolger, Shrout, & Reis, 2006).

[2] The diary also included several 7-point Likert items (0 = *not at all*, 6 = *entirely*) asking about participants' perceptions of their partner's empathy and confidence in their judgments, which are not reported here.

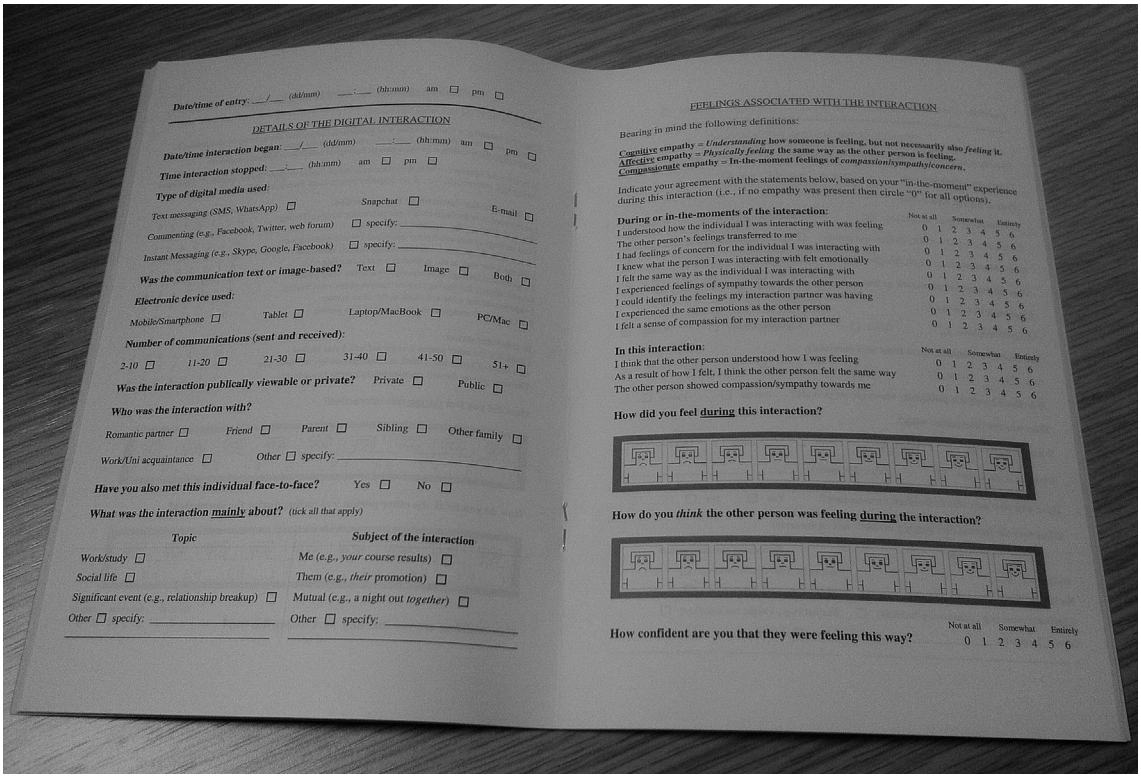

Fig. 1. Example diary entry template from the "digital interaction diary".

Questionnaire of Cognitive and Affective Empathy (QCAE; Reniers et al., 2011). For each of 31 items, participants rated their agreement on a 4-point Likert scale (1 = *strongly disagree*, 4 = *strongly agree*). Nineteen items (e.g., "I am good at predicting how someone will feel") comprise the cognitive subscale, possible scores ranged from 19 to 76. Twelve items (e.g., "people I am with have a strong influence on my mood") comprise the affective subscale, possible scores ranged from 12 to 48. The QCAE has been shown to have good internal reliability and validity (Reniers et al., 2011). Cronbach's alphas for the cognitive, $\alpha = 0.92$, affective, $\alpha = 0.80$, and total, $\alpha = 0.90$, scales in this sample were excellent.

2.3.2. State empathy

A new 9-item scale, the Measure of State Empathy (MSE) was constructed to capture our triadic operationalisation of empathy. Three 3-item Likert subscales were designed to measure state levels of cognitive, affective, and compassionate empathy based on definitions adapted from Ekman (2003): "*understanding* how someone is feeling, but not necessarily also feeling it" (cognitive); "*physically feeling* the same way as another person is feeling" (affective); and "in-the-moment feelings of *compassion, sympathy or concern*" (compassion). In order to facilitate introspective recall, participants were also given these definitions (see Fig. 1). Participants rated their agreement with each item on a 7-point Likert scale (0 = *not at all*, 6 = *entirely*). Example items for the cognitive, affective, and compassionate subscales were: "I understood how the individual I was interacting with was feeling"; "I experienced the same emotions as the other person"; and "I felt a sense of compassion for my interaction partner", respectively.

The majority of factor analytic diagnostics on the valid diary observations (after omitting errors and missing data; $k = 1831$), including the Minimum Average Partial criterion (MAP; Velicer, 1976); parallel analysis (Horn, 1965); Root Mean Square Error of Approximation (RMSEA; Steiger & Lind, 1980) and empirical Bayesian Information Criterion (eBIC; Revelle, 2014) suggested the optimal extraction of three factors. A factor analysis on the polychoric correlation matrix of the MSE, using an Oblimin rotation, produced an interpretable factor structure with the scale items loading on the hypothesised factors (see Table 1). The internal reliabilities of the cognitive, $\alpha = 0.94$, affective, $\alpha = 0.91$, compassionate, $\alpha = 0.88$, and total, $\alpha = 0.93$, MSE scales were found to be excellent.

2.3.3. Perceived digital/FtF empathy

Two 7-point Likert items (0 = *not at all*, 6 = *entirely*) were administered within a post-diary survey to measure participants' perceptions of their degree of empathy in CMC ("to what extent do you think you experience empathy in your (text and image-based) digital interactions?") and FtF ("to what extent do you think you experience empathy in your face-to-face interactions?") contexts.

2.3.4. Control variables

Primary analyses controlled for participants' demographics (i.e., gender, age, nationality [*UK*/*International*], relationship status [*yes*/*no*]) and the number of diary entries recorded. The post-diary survey also included questions about the reliability of participants' data, including if the participant had completed the diary honestly (*yes*/*no*); the extent the interactions in the diary represented their digital interactions more generally (1 = *not at all*, 7 = *entirely*); and the extent (if at all) completing the diary affected how they interacted digitally (1 = *not at all*, 7 = *entirely*). Post-hoc robustness checks on the regression models were carried out using these variables.

Table 1
Factor loadings for the Measure of State Empathy (MSE).

Scale item	Factor 1: cognitive	Factor 2: compassionate	Factor 3: affective
(1) I understood how the individual I was interacting with was feeling	**0.96**	−0.08	0.01
(4) I knew what the person I was interacting with felt emotionally	**0.86**	0.10	0.01
(7) I could identify the feelings my interaction partner was having	**0.91**	0.04	0.01
(2) The other person's feelings transferred to me	0.30	0.10	**0.53**
(5) I felt the same way as the individual I was interacting with	−0.01	−0.01	**0.96**
(8) I experienced the same emotions as the other person	0.01	0.01	**0.93**
(3) I had feelings of concern for the individual I was interacting with	0.03	**0.84**	−0.04
(6) I experienced feelings of sympathy towards the other person	0.01	**0.94**	−0.05
(9) I felt a sense of compassion for my interaction partner	−0.02	**0.81**	0.16
Proportion variance ($\Sigma = 0.83$)	0.31	0.27	0.25
Proportion explained ($\Sigma = 1$)	0.37	0.32	0.31

Note. Pattern matrix based on polychoric correlation matrix with Oblimin rotation ($k = 1831$). Salient item loadings (>0.40) are in bold. Tucker Lewis Index = 0.97; RMSEA = 0.09, 90% CI [0.08, 0.10]; empirical $\chi^2 = 11.44$.

2.4. Procedure

Ethics approval was granted by the appropriate Ethics Committee at the host research institution prior to data collection. The diary was first piloted with a smaller group of students ($N = 10$) to assess its suitability for our research questions. Participants were opportunity sampled from university email advertisements. Interested volunteers were emailed a link to an online survey where they completed informed consent, demographic questions, and the QCAE (Reniers et al., 2011). They then arranged a 10-min slot to collect their diary from the researcher, where the study instructions were explained in detail, an example diary template was discussed, and any discrepancies clarified.

We used an event-sampling methodology (Reis & Gable, 2000). Participants were asked to record details of up to 10 text- and image-based digital interactions a day, between the hours of 07:00–13:00 (morning) and 14:00–20:00 (afternoon), recording up to the first five interactions in the morning session to allow space for afternoon responses. This level of response was designed to limit burden and be simple and clear to follow, based on earlier practical discussions with a pilot focus group. Participants were asked to keep the diary with them at all times, and to complete a diary entry as soon as possible after each interaction.

A target "digital interaction" was defined as: "… any *two-way contact* with another *real* person using text and/or image-based (but not audio-visual) methods of digital communication". Participants were told that each interaction was specific to a particular person and a particular technology, and that we are interested in dyadic interactions only. Participants were asked to complete a diary entry as soon as possible when they considered the interaction to be over, and were given guidance on determining the duration of a target interaction, beginning when they *received* contact from someone and (if unsure) classed as over when they had not received any communication for more than an hour, or at the end of the respective (morning/afternoon) time window.[3]

Participants completed the diary over three weekdays and returned the diary to the researcher as soon as convenient thereafter. It was emphasised to the participants that they should respond as honestly and fully as possible, and try to behave as typically as possible in their digital interactions whilst completing the diary, recording interactions that would occur in their life as normal. Upon diary return, the participants completed a brief survey, which included questions detailed above and a re-administered QCAE (Reniers et al., 2011). The participant then sealed their diary and the survey in an envelope. All data were linked with anonymised identifiers. Participants were reimbursed £30 for their participation.

2.5. Data cleaning and analysis

Following entry, the data were cleaned.[4] Any observations that deviated significantly from the diary instructions (e.g., of a total duration greater than 360 min; involving multiple recipients etc.) were omitted. To minimise data loss, any interactions recorded outside of the prescribed time windows were retained if found to be valid in all other ways. Any errors in duration (<0) were coded as missing. This left 1849 valid diary observations.

While we allowed participants to specify qualitatively the platform used whilst commenting or instant messaging (e.g., *Facebook*, *Twitter*), due to relatively small cell sizes, these data were condensed for analyses. Furthermore, the qualitative data specifying "other" responses for recipient ($n = 87$), topic ($n = 247$), and subject ($n = 80$) of the interaction were screened and recoded into more meaningful categories wherever possible (e.g., recipient: other "lecturer" was recoded as "work/university"). The remaining "other" responses for recipient ($n = 58$) described interactions with strangers, professionals, or an acquaintance not classified as a friend (e.g., "eBay seller", "blogger met online"). The remaining "other" responses for topic ($n = 177$) included practical issues or general conversation (e.g., "bills", "general chat"). The remaining "other" responses for subject ($n = 20$) were unclassifiable.

Multilevel analysis, in the form of random intercept models, was used to control for the nested structure of the data, where diary responses were clustered within individuals. As participants' affect was highly correlated with estimations of their recipients' affect, $r = 0.75$, $p < 0.001$, recipients' affect was recoded into two binary variables, indicating whether it was lower ("− Recipient"; *yes*/*no*) or higher ("+ Recipient"; *yes*/*no*) than that of the participant. Due to the small number of image-only interactions ($k = 60$), the content of the interaction was condensed into a binary variable indicating whether an interaction contained images or not (*yes*/*no*). The baseline comparison group for all contrasts of nominal variables was designated as the most common occurrence (e.g., text messaging for mode of interaction).

[3] Full diary instructions are available from the corresponding author upon request.

[4] There were systematic mistakes to "date/time of entry" in as many of 19% of observations, where participants had erroneously written the date/time of the *start* of the interaction. Consequently, this variable was omitted.

Table 2
Descriptives of the digital interaction diary data.

	K (%)	*M*	*SD*	Range	Skew
Duration (min)	1820 (98.4)	46.87	60.88	0–360	2.29
Interaction mode	1848 (99.9)	–	–	–	–
text message: 1054 (57.0); email: 169 (9.1); comment: 140 (7.6); IM: 375 (20.3); Snapchat: 110 (6.0)					
Communication type	1680 (90.9)	–	–	–	–
text: 1267 (75.4); image: 60 (3.6); both: 353 (21.0)					
Device	1838 (99.4)	–	–	–	–
phone: 1459 (79.4); PC: 125 (6.8); laptop: 211 (11.5); tablet: 43 (2.3)					
# communications	1843 (99.7)	–	–	–	–
2–10: 1140 (61.9); 11–20: 387 (21.0); 21–30: 150 (8.1); 31–40: 79 (4.3); 41–50: 26 (1.4); 51+: 61 (3.3)					
Viewable	1694 (91.6)	–	–	–	–
private: 1574 (92.9); public: 120 (7.1)					
Recipient	1847 (99.9)	–	–	–	–
partner: 326 (17.7); family: 311 (16.8); friend: 892 (48.3); work/university: 262 (14.2); other: 56 (3.0)					
Known FtF	1725 (93.3)	–	–	–	–
yes: 1586 (91.9); no: 139 (8.1)					
Topic	1766 (95.5)	–	–	–	–
work/study: 517 (29.3); social life: 815 (46.1); sig. event: 76 (4.3); other: 177 (10.0); multiple: 181 (10.2)					
Subject	1687 (91.2)	–	–	–	–
me: 338 (20.0); them: 354 (21.0); mutual: 834 (49.4); other: 20 (1.2); multiple: 141 (8.4)					
Cognitive empathy	1842 (99.6)	10.75	5.10	0–18	−0.63
Affective empathy	1842 (99.6)	8.59	5.32	0–18	−0.11
Compassionate empathy	1837 (99.4)	6.69	5.54	0–18	0.35
Affect	1843 (99.7)	6.41	1.65	1–9	−0.42
− recipient	1842 (99.6)	–	–	–	–
yes: 460 (25.0); no: 1382 (75.0)					
+ recipient	1842 (99.6)	–	–	–	–
yes: 371 (20.1); no: 1471 (79.9)					
Valid *k* observations (%)	1849 (100)				

Note. Individual categories and their frequencies are reported below each nominal variable, with the percentage of valid cases for that category in parentheses. IM = instant messaging; # communications = number of communications; FtF = face-to-face; −/+ Recipient = recipient had lower/higher affect than the participant.

All data were analysed using R 3.2.2 (R Core Team, 2015), using packages arm (Gelman & Su, 2015), lme4 (Bates, Maechler, Bolker, & Walker, 2015), lmerTest (Kuznetsova, Brockhoff, & Christensen, 2015), moments (Komsta & Novomestky, 2015), and psych (Revelle, 2014). To normalise model residuals, the dependent variables of any models with residual skew suggesting a significantly non-normal distribution (*z*-scores > ± 1.96) were optimally power transformed prior to regression analysis, which resulted in residuals that approximated normal (skew and kurtosis z-scores < ± 1.96). Following this, to allow for comparisons within models, all continuous variables were standardised by centring and dividing by two *SD*s to put them in the same metric as binary variables (Gelman, 2008). The models were fit by maximum likelihood estimation, and missing data excluded listwise.

3. Results

3.1. To what extent do university students experience empathy in their everyday dyadic (text- and image-based) digital interactions?

The descriptive data from the digital interaction diaries are presented in Table 2. The mean number of interactions recorded across participants was 18.49 ($SD = 6.44$), with a mean duration of 46.87 min ($SD = 60.88$). Participants did experience empathy in their digital interactions (the mean of all empathy subscales was significantly different from zero at $p < 0.001$). Participants reported significantly greater levels of cognitive empathy on average than either affective, $t(1838) = 25.91$, $p < 0.001$, $d = 0.60$, or compassionate empathy, $t(1833) = 35.57$, $p < 0.001$, $d = 0.83$. In turn, compassion was experienced significantly less than affective empathy, $t(1833) = -15.59$, $p < 0.001$, $d = 0.36$. In this sample, participants were significantly more likely to report being in a positive than neutral mood in their interactions, $t(1842) = 36.69$, $p < 0.001$, $d = 0.85$. More interactions were with recipients perceived to be in a more negative (n = 460) than positive (n = 371) mood than the participant.

3.2. Which situational factors are important as predictors of cognitive, affective, and compassionate empathy in digital interactions?

3.2.1. Random intercept models

The results of the random intercept models for the empathy subtypes are presented in Table 3. Clustering at the participant level accounted for a differing amount of the variance in the three outcomes, but the majority of the variance was explained by within-person (i.e., situational) effects. The variance partition components (VPC) were VPC = 0.28, VPC = 0.32, and VPC = 0.41, for cognitive, affective, and compassionate empathy, respectively, indicating that unobserved between-person differences accounted for the most variance (approximately 41%) in compassionate empathy, and the least in cognitive empathy.

Of the trait control variables, three effects were of note. International students reported significantly more compassion than UK students, $B = 0.14$, $p < 0.05$. Age and being in a romantic relationship had borderline significant positive effects on compassionate, $B = 0.12$, $p = 0.057$, and cognitive empathy, $B = 0.08$, $p = 0.093$, respectively. None of the main effects for the trait empathy scales (cognitive or affective) were significant.

Certain situational predictors had similar effects on all three empathy types. Number of communications was significantly positively associated with cognitive, $B = 0.17$, affective, $B = 0.15$, and compassionate, $B = 0.12$, outcomes ($ps < 0.001$). Less empathy was reported in email exchanges (vs. text messaging) for cognitive, $B = -0.15$, affective, $B = -0.14$, and compassionate, $B = -0.16$, subscales ($ps < 0.01$). Recipient was important, with significantly more cognitive, $B = 0.18$, affective, $B = 0.16$, and compassionate, $B = 0.15$, empathy for partners ($ps < 0.001$); significantly greater

Table 3
Random intercept models predicting three types of state empathy.

	Cognitive empathy			Affective empathy			Compassionate empathy		
Fixed effects	*B* (*SE*)	95% CI		*B* (*SE*)	95% CI		*B* (*SE*)	95% CI	
Intercept	0.00 (0.03)	−0.06	0.06	0.01 (0.03)	−0.06	0.07	−0.02 (0.04)	−0.09	0.06
Gender	0.02 (0.05)	−0.08	0.12	0.06 (0.06)	−0.05	0.16	0.04 (0.06)	−0.09	0.17
Age	0.07 (0.05)	−0.03	0.17	0.09 (0.06)	−0.03	0.20	0.12 (0.07)†	−0.01	0.25
Nationality	0.06 (0.05)	−0.04	0.17	−0.04 (0.06)	−0.15	0.08	0.14 (0.07)*	0.01	0.27
Relationship	0.08 (0.05)†	−0.01	0.18	0.06 (0.05)	−0.05	0.16	0.01 (0.06)	−0.11	0.13
# interactions	0.02 (0.05)	−0.07	0.12	0.08 (0.05)	−0.02	0.18	0.07 (0.06)	−0.05	0.19
Trait CE	0.02 (0.05)	−0.08	0.12	−0.05 (0.05)	−0.15	0.06	−0.06 (0.06)	−0.18	0.06
Trait AE	0.06 (0.05)	−0.04	0.16	0.04 (0.05)	−0.07	0.14	0.00 (0.06)	−0.13	0.12
Duration	0.02 (0.02)	−0.03	0.06	0.02 (0.02)	−0.03	0.07	0.06 (0.02)*	0.01	0.10
# communications	0.17 (0.02)***	0.12	0.21	0.15 (0.02)***	0.10	0.20	0.12 (0.02)***	0.07	0.16
Known FtF	0.16 (0.05)**	0.06	0.26	0.18 (0.05)**	0.07	0.28	0.07 (0.05)	−0.03	0.17
Image content	0.07 (0.03)*	0.01	0.12	0.07 (0.03)*	0.01	0.12	0.01 (0.03)	−0.05	0.06
Publicly viewable	−0.17 (0.07)*	−0.29	−0.04	−0.10 (0.07)	−0.23	0.03	0.05 (0.07)	−0.08	0.18
Mode[a]									
=Email	−0.15 (0.05)**	−0.26	−0.05	−0.14 (0.05)**	−0.25	−0.04	−0.16 (0.05)**	−0.26	−0.05
=Comment	0.14 (0.07)*	0.01	0.28	0.14 (0.07)*	0.01	0.28	−0.01 (0.07)	−0.14	0.12
=IM	−0.03 (0.03)	−0.10	0.04	0.02 (0.03)	−0.05	0.08	0.01 (0.03)	−0.06	0.08
=Snapchat	0.05 (0.05)	−0.05	0.14	0.02 (0.05)	−0.08	0.12	0.01 (0.05)	−0.09	0.11
Device[b]									
=Tablet	0.02 (0.06)	−0.10	0.13	0.02 (0.06)	−0.10	0.13	0.06 (0.06)	−0.05	0.18
=Laptop	−0.03 (0.04)	−0.11	0.05	−0.03 (0.04)	−0.11	0.05	−0.01 (0.04)	−0.09	0.07
=PC	−0.01 (0.07)	−0.15	0.12	0.07 (0.07)	−0.07	0.20	−0.08 (0.07)	−0.22	0.05
Recipient[c]									
=Partner	0.18 (0.03)***	0.12	0.25	0.16 (0.03)***	0.10	0.22	0.15 (0.03)***	0.09	0.22
=Family	0.10 (0.03)**	0.04	0.16	0.11 (0.03)***	0.05	0.17	0.10 (0.03)**	0.04	0.16
=Work/university	−0.17 (0.04)***	−0.25	−0.10	−0.16 (0.04)***	−0.24	−0.09	−0.10 (0.04)*	−0.17	−0.02
=Other	−0.10 (0.07)	−0.24	0.05	−0.01 (0.07)	−0.15	0.13	−0.12 (0.07)	−0.26	0.02
Topic[d]									
=Work/study	−0.04 (0.03)	−0.09	0.02	−0.01 (0.03)	−0.06	0.05	0.01 (0.03)	−0.05	0.06
=Significant event	0.08 (0.05)	−0.02	0.18	0.15 (0.05)**	0.05	0.25	0.15 (0.05)**	0.05	0.25
=Other	−0.10 (0.04)**	−0.17	−0.03	−0.02 (0.04)	−0.10	0.05	−0.02 (0.04)	−0.09	0.05
=Multiple	0.02 (0.04)	−0.05	0.10	−0.02 (0.04)	−0.10	0.05	0.06 (0.04)	−0.02	0.14
Subject[e]									
=Me	−0.09 (0.03)**	−0.15	−0.03	−0.07 (0.03)*	−0.13	−0.01	−0.10 (0.03)**	−0.15	−0.04
=Them	0.08 (0.03)**	0.03	0.13	−0.10 (0.03)***	−0.15	−0.04	0.05 (0.03)†	−0.01	0.10
=Other	−0.04 (0.09)	−0.21	0.14	−0.05 (0.09)	−0.22	0.13	−0.15 (0.09)	−0.33	0.04
=Multiple	0.02 (0.04)	−0.07	0.10	0.01 (0.04)	−0.08	0.10	0.04 (0.04)	−0.04	0.13
Participant affect	0.21 (0.03)***	0.16	0.26	0.26 (0.03)***	0.21	0.31	−0.07 (0.03)**	−0.12	−0.02
− Recipient	0.02 (0.03)	−0.03	0.07	−0.12 (0.03)***	−0.17	−0.07	0.19 (0.03)***	0.14	0.24
+ Recipient	0.07 (0.03)*	0.01	0.13	−0.02 (0.03)	−0.07	0.04	−0.05 (0.03)	−0.10	0.01
Random effects	Var (*SD*)	*SD* 95% CI		Var (*SD*)	*SD* 95% CI		Var (*SD*)	*SD* 95% CI	
Intercept (ID)	0.04 (0.21)	0.17	0.25	0.05 (0.23)	0.19	0.27	0.07 (0.27)	0.23	0.32
Residual	0.11 (0.33)	0.32	0.35	0.11 (0.33)	0.32	0.34	0.11 (0.33)	0.32	0.34
VPC	0.28 (28%)			0.32 (32%)			0.41 (41%)		
k observations (*N*)	1236 (98)			1236 (98)			1233 (98)		
Log Likelihood	−475.05			−475.85			−482.10		

Note. All continuous variables standardised by centring and dividing by 2 *SD* to make them comparable with binary variables (Gelman, 2008). # interactions = number of interactions; CE/AE = cognitive/affective empathy; # communications = number of communications; FtF = face-to-face; IM = instant messaging; −/+ Recipient = recipient had lower/higher affect than the participant; Var = variance estimate. Nominal variable reference categories: [a]text messaging; [b]mobile phone; [c]friend; [d]social life; [e]mutual. *T*-tests use Satterthwaite approximations to degrees of freedom. $^{\dagger}p < 0.10$; $^{*}p < 0.05$; $^{**}p < 0.01$; $^{***}p < 0.001$.

cognitive, $B = 0.10$, affective, $B = 0.11$, and compassionate, $B = 0.10$, empathy for family members (*ps* < 0.01); and significantly less cognitive, $B = -0.17$, affective, $B = -0.16$, and compassionate, $B = -0.10$, empathy for work/university colleagues (vs. friends; *ps* < 0.05). Finally, all empathy types were impaired when the subject of the interaction was the participant themselves (vs. mutual), affecting cognitive, $B = -0.09$, affective, $B = -0.07$, and compassionate, $B = -0.10$, outcomes (*ps* < 0.05).

Some situational variables significantly predicted more than one empathy type, but in different ways. When the subject of the interaction was the recipient (vs. mutual), participants had significantly greater cognitive empathy, $B = 0.08$, $p < 0.01$, and borderline increased compassionate empathy, $B = 0.05$, $p = 0.078$, but significantly less affective empathy, $B = -0.10$, $p < 0.001$. Positive affect in the participant was strongly associated with greater cognitive, $B = 0.21$, and affective, $B = 0.26$, empathy, but negatively linked to compassion, $B = -0.07$ (*ps* < 0.01). Having an interaction recipient who was in a more negative mood than the participant positively predicted compassion, $B = 0.19$, but negatively predicted affective empathy, $B = -0.12$ (*ps* < 0.001).

Finally, several predictors were uniquely related to one or two types of empathy. The duration of the interaction period was significantly positively associated with compassionate empathy only, $B = 0.06$, $p < 0.05$. Knowing the interaction partner FtF significantly positively predicted cognitive, $B = 0.16$, and affective, $B = 0.18$, empathy (*ps* < 0.01), but not compassion. This pattern was the same for interactions containing images, $B = 0.07$ (cognitive), $B = 0.07$ (affective), and commenting (vs. text messaging), $B = 0.14$ (cognitive), $B = 0.14$ (affective; *ps* < 0.05). Interacting about a significant event (vs. social life) was significantly positively associated with affective, $B = 0.15$, and compassionate, $B = 0.15$, empathy (*ps* < 0.01), but not cognitive empathy. An interaction that was

Table 4
Multiple regression models predicting post-diary survey responses.

	T2 trait empathy			FtF empathy			Digital empathy			Digital/FtF empathy		
	B (*SE*)	95% CI		*B* (*SE*)	95% CI		*B* (*SE*)	95% CI		*B* (*SE*)	95% CI	
Step 1	$R^2 = 0.71$, $F(3, 96) = 79.50^{***}$			$R^2 = 0.26$, $F(3, 96) = 11.38^{***}$			$R^2 = 0.19$, $F(3, 95) = 7.23^{***}$			$R^2 = 0.07$, $F(3, 95) = 2.43^{\dagger}$		
T1 trait empathy	0.85 (0.06)***	0.74	0.96	0.41 (0.09)***	0.23	0.59	0.25 (0.10)*	0.06	0.44	0.07 (0.10)	−0.13	0.27
M state empathy	0.05 (0.06)	−0.06	0.16	0.30 (0.09)**	0.13	0.48	0.38 (0.09)***	0.19	0.56	0.25 (0.10)*	0.06	0.45
SD state empathy	−0.01 (0.06)	−0.12	0.10	0.11 (0.09)	−0.06	0.29	0.03 (0.10)	−0.16	0.22	−0.07 (0.10)	−0.27	0.13
Step 2	$\Delta R^2 = 0.00$, $F(2, 94) = 0.07$			$\Delta R^2 = 0.00$, $F(2, 94) = 0.13$			$\Delta R^2 = 0.10$, $F(2, 93) = 6.15^{**}$			$\Delta R^2 = 0.10$, $F(2, 93) = 5.33^{**}$		
T1 trait empathy	0.85 (0.06)***	0.74	0.96	0.41 (0.09)***	0.23	0.59	0.28 (0.09)	0.10	0.46	0.10 (0.10)	−0.09	0.29
M state empathy	0.05 (0.06)	−0.06	0.16	0.30 (0.09)**	0.12	0.48	0.36 (0.09)	0.18	0.54	0.24 (0.10)*	0.05	0.43
SD state empathy	−0.01 (0.06)	−0.13	0.15	0.12 (0.09)	−0.07	0.30	0.04 (0.09)	−0.14	0.22	−0.06 (0.10)	−0.26	0.13
T1 trait:*M* state empathy	0.04 (0.12)	−0.20	0.28	−0.07 (0.19)	−0.46	0.31	−0.48 (0.19)*	−0.86	−0.10	−0.51 (0.21)*	−0.92	−0.10
T1 trait:*SD* state empathy	0.02 (0.10)	−0.18	0.23	−0.07 (0.16)	−0.39	0.26	−0.48 (0.16)**	−0.80	−0.15	−0.45 (0.18)*	−0.80	−0.11
N	100			100			99[a]			99[a]		

Note. All continuous variables standardised by centring and dividing by 2 *SD* to make them comparable with binary variables (Gelman, 2008). T1 = baseline; T2 = post-diary. [a]One participant dropped due to missing data on the "digital empathy" variable. $^{\dagger}p < 0.10$; $^{*}p < 0.05$; $^{**}p < 0.01$; $^{***}p < 0.001$.

publicly viewable, $B = -0.17$, or interacting about an undefined practical or general topic (vs. social life), $B = -0.10$, significantly predicted less cognitive empathy only (*ps* < 0.05). Lastly, participants interacting with someone who was in a better mood than them positively predicted cognitive empathy alone, $B = 0.07$, $p < 0.05$.

3.2.2. Robustness checks

In a post-diary survey, participants' were quizzed (privately) about the reliability of their data. One person reported that they had responded dishonestly. On average, participants reported that their interactions in the diary were representative of their digital interactions more generally ($M = 5.22/7$, $SD = 1.09$). Twenty-six people reported that completing the diary affected how they interacted digitally to an extent ($M = 3.92/7$, $SD = 1.60$). Replicating the models in 3.2.1 but omitting the dishonest participant, those who gave a representativeness score of less than the midpoint (<4, $n = 9$), and a diary effects score of greater than the midpoint (>4, $n = 11$), resulted in only two changes at $\alpha = 0.05$. Talking about a significant event (vs. social life) now significantly predicted cognitive empathy, $B = 0.12$, and the subject of the interaction being the recipient (vs. mutual) significantly predicted compassion, $B = 0.07$ (*ps* < 0.05). Thus, the models were relatively robust to threats of honesty, representativeness, and the effects of completing a diary on participants' digital interactions.

3.3. Is the empathy experienced in digital interactions related to participants' perceived degree of empathy in CMC and FtF contexts?

Participants perceived experiencing greater empathy in FtF ($M = 5.79$, $SD = 0.91$) than (text- and image-based) digital interactions ($M = 4.31$, $SD = 1.13$), $t(98) = 14.10$, $p < 0.001$, $d = 1.42$, but these variables were significantly related, $r(97) = 0.50$, $p < 0.001$. The QCAE was highly stable over time, $r(98) = 0.84$, $p < 0.001$. Perceived empathy in CMC had a stronger relationship with trait empathy measured after, $r(97) = 0.35$, $p < 0.001$, than before, $r(97) = 0.22$, $p < 0.05$, the diary. This is a significant difference, given a QCAE retest correlation coefficient of $r = 0.84$ (Steiger, 1980), $z = 2.35$, $p < 0.05$. The relationship between perceived degree of empathy FtF and trait empathy measured before, $r(98) = 0.37$, $p < 0.001$, and after, $r(98) = 0.35$, $p < 0.001$, the diary was unchanged, $z = 0.37$, $p = 0.710$.

We estimated four hierarchical multiple regression models testing whether empathy reported in the diary predicted participants' post-diary trait empathy, perceived degree of empathy in their FtF and digital interactions, and ratio of perceived digital to FtF empathy (see Table 4). Due to the restricted sample size and potential for collinearity, overall trait empathy and state empathy (rather than their subscales) were used in these models. In step one, the outcome variables were regressed on pre-diary (T1) trait empathy and the *M* and *SD* of empathy recorded in the diary. In step two, we tested for the presence of interactions between T1 trait empathy and the two state empathy indices. Dependent variables were transformed if necessary and all variables were standardised, as described above (2.5).

In the first model, T1 trait empathy was the only significant predictor of T2 trait empathy, $B = 0.85$, $p < 0.001$. In the second, both T1 trait empathy, $B = 0.41$, and *M* state empathy, $B = 0.30$, were independent predictors of FtF empathy (*ps* < 0.01), but no other significant effects emerged. T1 trait empathy, $B = 0.25$, and *M* state empathy, $B = 0.38$, also significantly predicted digital empathy, but in addition we observed significant interactions between trait empathy and *M* state empathy, $B = -0.48$, and trait empathy and *SD* state empathy, $B = -0.48$, (*ps* < 0.05). Finally, *M* state empathy was the only significant predictor of the ratio of

digital to FtF empathy, $B = 0.25$, $p < 0.05$, but there were significant interactions between trait empathy and *M* state empathy, $B = -0.51$, and trait empathy and *SD* state empathy, $B = -0.45$ ($ps < 0.05$). The significant interactions observed in the latter models indicate that empathy reported in the diaries had a more positive effect on participants' perceived digital empathy if they were low (vs. high) in baseline (T1) trait empathy. All effects were robust to the restricted analysis described in 3.2.2, except for the product of T1 trait empathy and *SD* state empathy, which became a borderline significant predictor of digital empathy, $B = -0.37$, and the ratio of digital to FtF empathy, $B = -0.36$ ($ps < 0.10$).

4. Discussion

In this study we investigated the situational determinants of three types of empathy in students' (text- and image-based) digital interactions. First, we explored whether participants reported experiencing cognitive, affective, and compassionate empathy in CMC. In line with expectations, we found that participants reported empathy in their interactions, and the observed pattern matched our predictions that cognitive empathy would be experienced most often, followed by affective and then compassionate empathy. This result is consistent with theory suggesting that affective and compassionate empathy are dependent on cognitive empathy (e.g., Ekman, 2003). However, it does not negate that affective empathy (or indeed compassion) can occur via an implicit route, bypassing the need for conscious recognition of emotion (Neumann & Strack, 2000). This may be more likely FtF than in CMC, however, due to the nonverbal social cues underlying it (e.g., Dimberg, Thunberg, & Elmehed, 2000).

Second, we argued that the influence of situational factors on empathy in CMC has been overlooked. We present evidence that empathy in digital interactions is strongly determined by a range of situational variables, with the majority of variance in empathic responses explained by within-persons (vs. between-persons) differences. When holding all other variables constant, the number of communications in an interaction and interacting with a person who was interpersonally close (i.e., a partner or family member vs. a friend) were positively associated with all three empathy types; while using email (vs. text messaging), interacting with a person who was interpersonally remote (i.e., a work/university contact), and talking about yourself (vs. a mutual subject) negatively predicted all three types.

These findings appear consistent with the FtF literature. Longer interpersonal interactions are associated with greater empathy (e.g., Montague, Chen, Xu, Chewning, & Barrett, 2013), and it is possible that this may be more pronounced in CMC, where interpersonal connections may take longer to develop (e.g., Walther, 1992). Familiarity is known to facilitate empathy (Hoffman, 2000), with studies indicating heightened empathy for closer social others (e.g., Cialdini, Brown, Lewis, Luce, & Neuberg, 1997). The effect of familiarity may be driven by experience and social bonds, but also the prospect of increased future interactions with a familiar individual (Walther, 1994). There is evidence that email is considered a more formal interaction method than other CMC, and a less preferred medium for interpersonal and emotive communications (Haste, 2005). Finally, that a focus on the self when interacting reduces empathy is suggestive of “egoistic drift” (Hoffman, 2000), whereby a self-focused perspective reduces identification with the target and consequential empathy.

In addition to commonalities, we uncovered distinct contextual profiles for the three empathy types. Several variables heightened cognitive and affective empathy, but did not significantly predict compassion, including whether the recipient was known FtF, whether the interaction contained images, and commenting (vs. text messaging). These discrepancies could be explained by compassionate empathy being rarer in participants' interactions and only relevant in specific cases. That knowing an individual FtF is important for empathy resonates with recent neurological evidence indicating that the social suffering of known others and strangers produces distinct patterns of brain activation (Meyer et al., 2012). In accordance with cue theories of CMC, images provide another level of “media richness” that may provoke empathy (Zeeberg, 2016). Lastly, commenting on social networks is debatably a more selective process than text messaging, and people may be more likely to be discerning in what they do and do not comment on (e.g., Nasim, Ilyas, Rextin, & Nasim, 2013). For example, major news events typically attract many more comments than trivial ones. Thus, participants may have chosen to comment on things that elicited an emotive or empathic reaction. Further, to the extent that participants' comments reflected shared interests or experiences, this may have also facilitated empathic connections (Preece & Ghozati, 2001).

Talking about a significant event (vs. social life) significantly predicted affect sharing and compassion, but not cognitive empathy. This is consistent with evidence suggesting the social sharing of emotion may be moderated by the intensity of events and associated emotion (e.g., Luminet, Bouts, Delie, Manstead, & Rimé, 2000). For example, there is some evidence that emotional arousal impacts verbosity in text-based CMC (Guillory et al., 2011). However, our data suggests that emotion associated with significant events was not better *recognised* by participants (cf. the robust analysis in 3.2.2); rather, that affect sharing may share independent variance with compassion in this context.

Several predictors were important for one of the empathy types only, including the total duration, which had a positive association with compassion. If the interaction was publicly viewable and about a practical/general topic (vs. social life), less cognitive empathy was reported, while having a happier recipient positively predicted cognitive empathy. People may choose to restrict the information they disclose in perceived public (vs. private) contexts (Joinson, 2001), which may help to explain the greater cognitive empathy evident in the latter. There is evidence that positive emotions, and especially happiness, are recognised quicker and more accurately from people's expressions than negative emotions (Tracy & Robins, 2008). Further, preliminary data hints that happier participants may use more lexical cues than their negative counterparts during instant messaging (Pirzadeh & Pfaff, 2014), thus providing a mechanism for enhanced cognitive empathy in CMC with happier recipients.

Finally, certain variables predicted two or more empathic outcomes in divergent directions, allowing for the clearest separation in their contextual profiles. In particular, when the subject of the interaction was the recipient (vs. mutually relevant) this significantly enhanced cognitive empathy and compassion (albeit borderline), but impaired affective empathy, supporting the idea that affect sharing is not always a prerequisite to compassionate states (Ekman, 2003). Furthermore, participants' affect was positively associated with cognitive and affective empathy, but negatively associated with compassionate outcomes, and having a more negative recipient was positively with compassion, but impaired the synchrony of affect. These findings make intuitive sense and fit with evidence presented above (e.g., greater empathy through an “other” vs. “egoistic” focus). Moreover, they support a functional separation of the three dimensions of empathy assessed, providing evidence that the MSE is capturing the latent constructs it was designed to.

That being in a more positive affective state, and either having a

more positive recipient or not having a more negative recipient enhanced cognitive and affective empathy, respectively, is particularly interesting and may be driven by a number of factors. First, as mentioned, emotion recognition was heightened when recipients were in a more positive mood, thus, to the extent that cognitive empathy precedes affective empathy, this may explain the findings for both empathy types. Second, while research in FtF contexts hypotheses a negativity bias in emotion contagion (e.g., Rozin & Royzman, 2001), work in CMC has actually found the opposite, with positive contagion dominating (Coviello et al., 2014). Such a contradiction may be explained by the facets of hyperpersonal theory (e.g., selective presentation; Walther, 1996). For example, while there are more negative (68%) than positive emotion words (32%) in the English dictionary (Averill, 1980), a large lexical analysis of millions of Facebook posts uncovered significantly more (over double) positive than negative posts (Kramer, Guillory, & Hancock, 2014). This is consistent with our data. Third, trait positive emotion is associated with increased self-reported empathic skills (which do not necessarily translate into empathic performance; Devlin, Zaki, Ong, & Gruber, 2014).

A curious finding was the lack of the expected effects of trait empathy. While trait and state-level processes can operate orthogonally to one another (Nezlek, Schütz, Lopes, & Smith, 2007), previous work has shown trait and state empathy indices to be associated in human communication contexts (Shen, 2010a). A potential explanation for this null result is the heterogeneity within participants' interactions that may obscure any main effects of trait empathy. It is, of course, also possible that the skills necessary to empathise in textual CMC (without nonverbal cues) are qualitatively distinct from an underlying trait propensity to empathise *per se*. Finally, it could be that the null result is a methodological artefact due, for example, to the restricted sample size, relative to *k* diary observations. Nevertheless, situational factors were shown to have much stronger effects in this study.

In our final piece of analysis, we investigated whether participants' experiences of empathy recorded in the diaries affected their perceptions of their empathy in CMC and FtF contexts. A series of regression models contributed to an interesting pattern of results. When controlling for T1 trait empathy, total empathy reported in the diaries significantly predicted participants' perceived degree of empathy in FtF and, to a greater extent, digital interactions. What is more, reporting greater empathy in the diary was positively associated with a more favourable ratio of perceived digital to FtF empathy. These findings suggest that either the diaries accurately reflected participants' capacities for empathy in CMC, or that experiencing and reporting on empathy in CMC interactions while completing the diary *influenced* participants' perceived degree of empathy in CMC. While these two alternatives are unlikely to be exclusive, and warrant further longitudinal investigation, evidence for the latter emerges from a significantly greater amount of variance in T2 trait empathy being accounted for by digital empathy than in T1 trait empathy, while the amount of shared variance between trait and FtF empathy remained the same. Further, state empathy had a significant interaction with T1 trait empathy when predicting individuals' perceived digital empathy and digital/FtF empathy ratio, suggesting that the overall amount (and range) of empathy recorded in the diary had a differential effect on different types of participants, with a stronger positive effect on those who were lower in baseline (T1) trait empathy. These effects were not apparent, however, for the measure of FtF empathy.

Thus, while limited by the absence of a controlled comparison, completing a digital empathy diary may have had a context-specific effect on participants' perceptions of their degree of capacity for empathy in CMC, and particularly for those self-identifying as lower in trait empathy at baseline, before completing the diary. Indeed, monitoring one's behaviour (e.g., via a diary) can be a powerful and simple tool for initiating attitudinal and behavioural change (Michie, Johnston, Francis, Hardeman, & Eccles, 2008). It is therefore possible that, for participants identifying as low in baseline trait empathy, experiencing greater empathy in CMC increased their perceived capacity for empathy in CMC, but this directional effect is impossible to confirm with the data available.

5. Limitations

A few limitations should be acknowledged. First, the variables used in the diary were comprehensive, but not exhaustive, and, in the interests of brevity, some variables that may have explained variance in the outcomes were not included. For example, we did not collect data on the gender (or any other demographic characteristics) of the recipient (Derks, Fischer et al., 2008), neither did we model the synchronicity of communications (Nowak, Watt, & Walther, 2005), or participants' experience with CMC (Carlson & Zmud, 1999). However, some of the measures that were included in the diary can provide a degree of proxy for these omitted variables. For example, instant messaging was not found to be more empathic than text messaging, despite the former implying greater synchronicity. Nevertheless, further research could use more immersive digital methods or tools to try and capture more data and/or build on these findings. Second, establishing causal inferences is problematic. For example, while it is clear for some variables, such as mode of the interaction, that experienced empathy is more likely a product than antecedent, it is also possible that anticipated empathy influenced mode choice (Riordan & Kreuz, 2010). Nonetheless, as the first of its kind, this study was designed to be exploratory, naturalistic and ecologically valid, as a complement to controlled experimental methods, which can test the mechanisms underlying findings from this work in greater detail. Lastly, given the broad scope possible, we restricted our focus to textual and image-based CMC in this study, which necessarily restricts our findings. Future comparisons with other kinds of communicative mediums (i.e., audiovisual, FtF) using the MSE may help to expand upon these results.

6. Conclusion

There is a long standing debate over empathy and digital technology. Often CMC is demonised as impeding empathy, due to its reduced social cues (relative to FtF interactions). Such arguments are usually affixed to the qualities of the medium, with little consideration of the context or situational factors influencing digital interpersonal communication. We have shown that empathy in CMC depends significantly on situational variables, and that the contextual profile differs depending on the type of empathy being measured. Furthermore, we provide evidence that individuals' perceptions of their degree of empathy experienced in CMC (vs. FtF) contexts is associated with the amount (and range) of state empathy they report experiencing in that medium, especially when they are lower in trait empathy to begin with. Thus, there is the possibility that experiencing empathy in CMC contexts may help produce more favourable interpretations of the technology for facilitating empathy, but this interpretation requires further investigation. The current findings help us to understand how multidimensional empathy may be experienced in people's day-to-day (text and image-based) digital interactions, as complementary to other communication mediums.

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References

Averill, J. R. (1980). On the paucity of positive emotions. In K. Blankstein, P. Pliner, & J. Polivy (Eds.), *Assessment and modification of emotional behavior: Vol. 6. Advances in the study of communication and affect* (pp. 7–45). New York, NY: Plenum.

Bargh, J. A., McKenna, K. Y. A., & Fitzsimons, G. M. (2002). Can you see the real me? Activation and expression of the "true self" on the internet. *Journal of Social Issues, 58*, 33–48. http://dx.doi.org/10.1111/1540-4560.00247.

Baron-Cohen, S. (2011). *Zero degrees of empathy*. London: Penguin.

Bates, D., Maechler, M., Bolker, B. M., & Walker, S. (2015). *lme4: Linear mixed-effects models using Eigen and S4. R package version 1.1-8*. http://CRAN.R-project.org/package=lme4.

Batson, C. D. (2009). These things called empathy: Eight related but distinct phenomena. In J. Decety, & W. Ickes (Eds.), *The social neuroscience of empathy* (pp. 3–15). Cambridge, MA: MIT Press.

Batson, C. D., Early, S., & Salvarani, G. (1997). Perspective taking: Imagining how another feels versus imagining how you would feel. *Personality and Social Psychology Bulletin, 23*, 751–758. http://dx.doi.org/10.1177/0146167297237008.

Bollen, J., Pepe, A., & Mao, H. (2011). Modeling public mood and emotion: Twitter sentiment and socio-economic phenomena. In *Proceedings of the fifth international aaai conference on weblogs and social media (ICWSM 2011), 17–21 July 2011, Barcelona, Spain*. arXiv:0911.1583.

Caplan, S. E., & Turner, J. S. (2007). Bringing theory to research on computer-mediated comforting communication. *Computers in Human Behavior, 23*, 985–998. http://dx.doi.org/10.1016/j.chb.2005.08.003.

Carlson, J. R., & Zmud, R. W. (1999). Channel expansion theory and the experiential nature of media richness perceptions. *Academy of Management Journal, 42*, 153–170. http://dx.doi.org/10.2307/257090.

Carrier, L. M., Spradlin, A., Bunce, J. P., & Rosen, L. D. (2015). Virtual empathy: Positive and negative impacts of going online upon empathy in young adults. *Computers in Human Behavior, 52*, 39–48. http://dx.doi.org/10.1016/j.chb.2015.05.026.

Cialdini, R. B., Brown, S. L., Lewis, B. P., Luce, C., & Neuberg, S. L. (1997). Reinterpreting the empathy-altruism relationship: When one into one equals oneness. *Journal of Personality and Social Psychology, 73*, 481–494. http://dx.doi.org/10.1037/0022-3514.73.3.481.

Coviello, L., Sohn, Y., Kramer, A. D. I., Marlow, C., Franceschetti, M., Christakis, N. A., et al. (2014). Detecting emotional contagion in massive social networks. *PLoS One, 9*, e90315. http://dx.doi.org/10.1371/journal.pone.0090315.

Daft, R. L., & Lengel, R. H. (1986). Organizational information requirements, media richness and structural design. *Management Science, 32*, 554–571. http://dx.doi.org/10.1287/mnsc.32.5.554.

Davis, M. H. (1983). Measuring individual differences in empathy: Evidence for a multidimensional approach. *Journal of Personality and Social Psychology, 44*, 113–126. http://dx.doi.org/10.1037/0022-3514.44.1.113.

Decety, J., & Yoder, K. (2016). Empathy and motivation for justice: Cognitive empathy and concern but not emotional empathy predicts sensitivity to injustice for others. *Social Neuroscience, 11*, 1–14. http://dx.doi.org/10.1080/17470919.2015.1029593.

Derks, D., Bos, A. E., & von Grumbkow, J. (2008). Emoticons in computer-mediated communication: Social motives and social context. *Cyberpsychology and Behavior, 11*, 99–101. http://dx.doi.org/10.1089/cpb.2007.9926.

Derks, D., Fischer, A. H., & Bos, A. E. R. (2008b). The role of emotion in computer-mediated communication: A review. *Computers in Human Behavior, 24*, 766–785. http://dx.doi.org/10.1016/j.chb.2007.04.004.

Devlin, H. C., Zaki, J., Ong, D. C., & Gruber, J. (2014). Not as good as you think? Trait positive emotion is associated with increased self-reported empathy but decreased empathic performance. *PLoS One, 9*, e110470. http://dx.doi.org/10.1371/journal.pone.0110470.

Dimberg, U., Thunberg, M., & Elmehed, K. (2000). Unconscious facial reactions to emotional facial expressions. *Psychological Science, 11*, 86–879. http://dx.doi.org/10.1111/1467-9280.00221.

Duggan, M., Ellison, N. B., Lampe, C., Lenhart, A., & Madden, M. (2015). *Social media update 2014*. Washington, DC: Pew Research Centre.

D'Urso, S. C., & Rains, S. A. (2008). Examining the scope of channel expansion: A test of channel expansion theory with new and traditional communication media. *Management Communication Quarterly, 21*, 486–507. http://dx.doi.org/10.1177/0893318907313712.

Einolf, C. J. (2012). Is cognitive empathy more important than affective empathy? A response to "Who helps natural-disaster victims?". *Analyses of Social Issues and Public Policy, 12*, 268–271. http://dx.doi.org/10.1111/j.1530-2415.2012.01281.x.

Ekman, P. (2003). *Emotions revealed: Recognizing faces and feelings to improve communication and emotional life*. New York, NY: Times Books.

Feng, J., Lazar, J., & Preece, J. (2004). Empathy and online interpersonal trust: A fragile relationship. *Behaviour & Information Technology, 23*, 97–106. http://dx.doi.org/10.1080/01449290310001659240.

Gelman, A. (2008). Scaling regression inputs by dividing by two standard deviations. *Statistics in Medicine, 27*, 2865–2873. http://dx.doi.org/10.1002/sim.3107.

Gelman, A., & Su, Y. S. (2015). *Arm: Data analysis using regression and multilevel/hierarchical models. R package version 1.8-6*. http://CRAN.R-project.org/package=arm.

Goetz, J. L., Keltner, D., & Simon-Thomas, E. (2010). Compassion: An evolutionary analysis and empirical review. *Psychological Bulletin, 136*, 351–374. http://dx.doi.org/10.1037/a0018807.

Green, A. S., Rafaeli, E., Bolger, N., Shrout, P. E., & Reis, H. T. (2006). Paper or plastic: Data equivalence in paper and electronic diaries. *Psychological Methods, 11*, 87–105. http://dx.doi.org/10.1037/1082-989X.11.1.87.

Guillory, J., Spiegel, J., Drislane, M., Weiss, B., Donner, W., & Hancock, J. T. (2011). Upset now? Emotion contagion in distributed groups. In *Proceedings of the ACM conference on human factors in computing systems (CHI 2011)* (pp. 745–748). New York, NY: ACM. http://dx.doi.org/10.1145/1978942.1979049.

Hancock, J. T., Gee, K., Ciaciaco, K., & Mae, J. (2008). I'm sad you're sad: Emotional contagion in CMC. In *Proceedings of the ACM conference on computer-supported cooperative work (CSCW)*. New York, NY: ACM. http://dx.doi.org/10.1145/1460563.1460611.

Hancock, J. T., Landrigan, C., & Silver, C. (2007). Expressing emotion in text. In *Proceedings of the ACM conference on human factors in computing systems (CHI 2007)* (pp. 929–932). New York, NY: ACM. http://dx.doi.org/10.1145/1240624.1240764.

Haste, H. (2005). Joined-up texting: Mobile phones and young people. *Young Consumers, 6*, 56–67. http://dx.doi.org/10.1108/17473610510701214.

Hatfield, E., Cacioppo, J. T., & Rapson, R. L. (1993). Emotional contagion. *Current Directions in Psychological Science, 2*, 96–100. http://dx.doi.org/10.1111/1467-8721.ep10770953.

Hatfield, E., Rapson, R. L., & Le, Y. L. (2009). Emotional contagion and empathy. In J. Decety, & W. Ickes (Eds.), *The social neuroscience of empathy* (pp. 19–30). Boston, MA: MIT Press.

Hoffman, M. L. (2000). *Empathy and moral development*. New York, NY: Cambridge University Press.

Hooker, C. I., Verosky, S. C., Germine, L. T., Knight, R. T., & D'Esposito, M. (2008). Mentalizing about emotion and its relationship to empathy. *Social Cognitive and Affective Neuroscience, 3*, 204–217. http://dx.doi.org/10.1093/scan/nsn019.

Horn, J. L. (1965). A rationale and test for the number of factors in factor analysis. *Psychometrka, 30*, 179–185. http://dx.doi.org/10.1007/BF02289447.

Jiang, C. L., Bazarova, N. N., & Hancock, J. T. (2011). The disclosure-intimacy link in computer-mediated communication: An attributional extension of the hyperpersonal model. *Human Communication Research, 37*, 58–77.

Joinson, A. N. (2001). Self-disclosure in computer-mediated communication: The role of self-awareness and visual anonymity. *European Journal of Social Psychology, 31*, 177–192. http://dx.doi.org/10.1002/ejsp.36.

Jolliffe, D., & Farrington, D. P. (2006). Examining the relationship between low empathy and bullying. *Aggressive Behavior, 32*, 540–550. http://dx.doi.org/10.1002/ab.20154.

Komsta, L., & Novomestky, F. (2015). *Moments: Moments, cumulants, skewness, kurtosis and related tests. R package version 0.14*. http://CRAN.R-project.org/package=moments.

Kramer, A. D., Guillory, J. E., & Hancock, J. T. (2014). Experimental evidence of massive-scale emotional contagion through social networks. *Proceedings of the National Academy of Sciences of the United States of America, 17*, 8788–8790. http://dx.doi.org/10.1073/pnas.1320040111.

Kuznetsova, A., Brockhoff, P. B., & Christensen, R. H. B. (2015). *lmerTest: Tests mixed effects models. R package version 2.0-25*. http://CRAN.R-project.org/package=lmerTest.

Lamm, C., Batson, C. D., & Decety, J. (2007). The neural substrate of human empathy: Effects of perspective-taking and cognitive appraisal. *Journal of Cognitive Neuroscience, 19*, 42–58. http://dx.doi.org/10.1162/jocn.2007.19.1.42.

Lang, P. J. (1980). Behavioral treatment and bio-behavioral assessment: Computer applications. In J. B. Sidowski, J. H. Johnson, & T. A. Williams (Eds.), *Technology in mental health care delivery systems* (pp. 119–137). Norwood, NJ: Ablex.

Leiberg, S., & Anders, S. (2006). The multiple facets of empathy: A survey of theory and evidence. *Progress in Brain Research, 156*, 419–440. http://dx.doi.org/10.1016/S0079-6123(06)56023-6.

Luminet, O., Bouts, P., Delie, F., Manstead, A. S. R., & Rimé, B. (2000). Social sharing of emotion following exposure to a negatively valenced situation. *Cognition & Emotion, 14*, 661–688. http://dx.doi.org/10.1080/026999300501176666.

Marjanovic, Z., Struthers, C. W., & Greenglass, E. R. (2012). Who helps natural-disaster victims? Assessment of trait and situational predictors. *Analyses of Social Issues and Public Policy, 12*, 245–267. http://dx.doi.org/10.1111/j.1530-2415.2011.01262.x.

Meyer, M. L., Masten, C. L., Ma, Y., Wang, C., Shi, Z., Eisenberger, N. I., et al. (2012). Empathy for the social suffering of friends and strangers recruits distinct patterns of brain activation. *Social Cognitive and Affective Neuroscience, 8*, 446–454. http://dx.doi.org/10.1093/scan/nss019.

Michie, S., Johnston, M., Francis, J., Hardeman, W., & Eccles, M. (2008). From theory

to intervention: Mapping theoretically derived behavioural determinants to behaviour change techniques. *Applied Psychology, 57*, 660–680. http://dx.doi.org/10.1111/j.1464-0597.2008.00341.x.

Montague, E., Chen, P., Xu, J., Chewning, B., & Barrett, B. (2013). Nonverbal interpersonal interactions in clinical encounters and patient perceptions of empathy. *Journal of Participatory Medicine, 5*, e33.

Nasim, M., Ilyas, M. U., Rextin, A., & Nasim, N. (2013). On commenting behaviour of Facebook users. In *Proceedings of the 24th ACM conference on hypertext and social media (HT 2013)*. New York, NY: ACM. http://dx.doi.org/10.1145/2481492.2481513.

Neumann, R., & Strack, F. (2000). "Mood contagion": The automatic transfer of mood between persons. *Journal of Personality and Social Psychology, 79*, 211–223. http://dx.doi.org/10.1037/0022-3514.79.2.211.

Nezlek, J. B., Schütz, A., Lopes, P., & Smith, C. V. (2007). Naturally occurring variability in state empathy. In T. F. D. Farrow, & P. W. R. Woodruff (Eds.), *Empathy in mental illness* (pp. 187–200). Cambridge, UK: Cambridge University Press.

Nowak, K. L., Watt, J., & Walther, J. B. (2005). The influence of synchrony and sensory modality on the person perception process in computer-mediated groups. *Journal of Computer-Mediated Communication, 10*. http://dx.doi.org/10.1111/j.1083-6101.2005.tb00251.x.

Pfeil, U., & Zaphiris, P. (2007). Patterns of empathy in online communication. In *Proceedings of the SIGCHI conference on human factors in computing systems (CHI 2007)* (pp. 919–928). New York, NY: ACM. http://dx.doi.org/10.1145/1240624.1240763.

Pirzadeh, A., & Pfaff, M. S. (2014). How do you IM when you get emotional?. In *Proceedings of the 18th international conference on supporting group work* (pp. 243–249). New York, NY: ACM. http://dx.doi.org/10.1145/2660398.2660405.

Preece, J. (1998). Empathic communities: Reaching out across the web. *Interactions, 5*, 32–43. http://dx.doi.org/10.1145/274430.274435.

Preece, J. (1999). Empathic communities: Balancing emotional and factual communication. *Interacting With Computers: The Interdisciplinary Journal of Human-Computer Interaction, 12*, 63–77. http://dx.doi.org/10.1016/S0953-5438(98)00056-3.

Preece, J., & Ghozati, K. (2001). Observations and explorations of empathy online. In R. R. Rice, & J. E. Katz (Eds.), *The internet and health communication: Experience and expectations* (pp. 237–260). Thousand Oaks, CA: Sage Publications.

R Core Team. (2015). *R: A language and environment for statistical computing*. Vienna, Austria: R Foundation for Statistical Computing. https://www.R-project.org.

Reis, H. T., & Gable, S. L. (2000). Event-sampling and other methods for studying everyday experience. In H. T. Reis, & C. M. Judd (Eds.), *Handbook of research methods in social and personality psychology* (pp. 190–222). New York, NY: Cambridge University Press.

Reniers, R. L. E. P., Corcoran, R., Drake, R., Shryane, N. M., & Völlm, B. A. (2011). The QCAE: A questionnaire of cognitive and affective empathy. *Journal of Personality Assessment, 93*, 84–95. http://dx.doi.org/10.1080/00223891.2010.528484.

Revelle, W. (2014). *Psych: Procedures for personality and psychological research*. Evanston, Illinois, USA: Northwestern University. http://CRAN.R-project.org/package=psychVersion=1.4.5.

Riordan, M. A., & Kreuz, R. J. (2010). Emotion encoding and interpretation in computer-mediated communication: Reasons for use. *Computers in Human Behavior, 26*, 1667–1673. http://dx.doi.org/10.1016/j.chb.2010.06.015.

Rozin, P., & Royzman, E. B. (2001). Negativity bias, negativity dominance, and contagion. *Personality and Social Psychology Review, 5*, 296–320. http://dx.doi.org/10.1207/s15327957pspr0504.

Shamay-Tsoory, S. G., Aharon-Peretz, J., & Perry, D. (2009). Two systems for empathy: A double dissociation between emotional and cognitive empathy in inferior frontal gyrus versus ventromedial prefrontal lesions. *Brain, 132*, 617–627. http://dx.doi.org/10.1093/brain/awn279.

Shen, L. (2010a). On a scale of state empathy during message processing. *Western Journal of Communication, 74*, 504–524. http://dx.doi.org/10.1080/10570314.2010.512278.

Shen, L. (2010b). Mitigating psychological reactance: The role of message-induce empathy in persusasion. *Human Communication Research, 36*, 397–422. http://dx.doi.org/10.1111/j.1468-2958.2010.01381.x.

Short, J. A., Williams, E., & Christie, B. (1976). *The social psychology of telecommunications*. London, UK: Wiley.

Siegel, J., Dubrovsky, V., Kiesler, S., & McGuire, T. W. (1986). Group processes in computer-mediated communication. *Organizational Behavior and Human Decision Processes, 37*, 157–187. http://dx.doi.org/10.1016/0749-5978(86)90050-6.

Silani, G., Lamm, C., Ruff, C. C., & Singer, T. (2013). Right supramarginal gyrus is crucial to overcome emotional egocentricity bias in social judgments. *Journal of Neuroscience, 33*, 15466–15476. http://dx.doi.org/10.1523/jneurosci.1488-13.2013.

Singer, T., & Klimecki, O. M. (2014). Empathy and compassion. *Current Biology, 24*, R875–R878. http://dx.doi.org/10.1016/j.cub.2014.06.054.

Soto, J. A., & Levenson, R. W. (2009). Emotion recognition across cultures: The influence of ethnicity on empathic accuracy and physiological linkage. *Emotion, 9*, 874–884. http://dx.doi.org/10.1037/a0017399.

Sproull, L., & Kiesler, S. (1986). Reducing social context cues: Electronic mail in organizational communication. *Management Science, 32*, 1492–1512. http://dx.doi.org/10.1287/mnsc.32.11.1492.

Steiger, J. H. (1980). Tests for comparing elements of a correlation matrix. *Psychological Bulletin, 87*, 245–251. http://dx.doi.org/10.1037/0033-2909.87.2.245.

Steiger, J. H., & Lind, J. C. (1980). Statistically based tests for the number of factors. In *Paper presented at the annual spring meeting of the Psychometric Society, Iowa City, IA*.

Stel, M., van Baaren, R. B., & Vonk, R. (2008). Effects of mimicking: Acting prosocially by being emotionally moved. *European Journal of Social Psychology, 38*, 965–976. http://dx.doi.org/10.1002/ejsp.472.

Stel, M., & Vonk, R. (2010). Mimicry in social interaction: Benefits for mimickers, mimickees, and their interaction. *British Journal of Psychology, 101*, 311–323. http://dx.doi.org/10.1348/000712609X465424.

Suk, H. (2006). *Color and emotion – a study on the affective judgment across media and in relation to visual stimuli*. Unpublished dissertation: University of Mannheim.

Tidwell, L. C., & Walther, J. B. (2002). Computer-mediated communication effects on disclosure, impressions, and interpersonal evaluations: Getting to know one another a bit at a time. *Human Communication Research, 28*, 317–348. http://dx.doi.org/10.1111/j.1468-2958.2002.tb00811.x.

Tracy, J. L., & Robins, R. W. (2008). The automaticity of emotion recognition. *Emotion, 8*, 81–95. http://dx.doi.org/10.1037/1528-3542.8.1.81.

Velicer, W. F. (1976). Determining the number of components from the matrix of partial correlations. *Psychometrika, 41*, 321–327. http://dx.doi.org/10.1007/bf02293557.

Wai, M., & Tiliopoulos, N. (2012). The affective and cognitive empathic nature of the dark triad of personality. *Personality and Individual Differences, 52*, 794–799. http://dx.doi.org/10.1016/j.paid.2012.01.008.

Walther, J. B. (1992). Interpersonal effects in computer-mediated interaction: A relational perspective. *Communication Research, 19*, 52–90. http://dx.doi.org/10.1177/009365092019001003.

Walther, J. B. (1994). Interpersonal effects in computer-mediated interaction: A relational perspective. *Communication Research, 19*, 52–90. http://dx.doi.org/10.1177/009365092019001003.

Walther, J. B. (1995). Relational aspects of computer-mediated communication: Experimental observations over time. *Organization Science, 6*, 186–203. http://dx.doi.org/10.1287/orsc.6.2.186.

Walther, J. B. (1996). Computer-mediated communication: Impersonal, interpersonal, and hyperpersonal interaction. *Communication Research, 23*, 3–43. http://dx.doi.org/10.1177/009365096023001001.

Walther, J. B., Hoter, E., Ganayem, A., & Shonfeld, M. (2015). Computer-mediated communication and the reduction of prejudice: A controlled longitudinal field experiment among Jews and Arabs in Israel. *Computers in Human Behavior, 52*, 550–558. http://dx.doi.org/10.1016/j.chb.2014.08.004.

Walther, J. B., Loh, T., & Granka, L. (2005). Let me count the ways: The interchange of verbal and nonverbal cues in computer-mediated and face-to-face affinity. *Journal of Language and Social Psychology, 24*, 36–65. http://dx.doi.org/10.1177/0261927X04273036.

Walther, J. B., & Parks, M. R. (2002). Cues filtered out, cues filtered in: Computer-mediated communication and relationships. In M. L. Knapp, & J. A. Daly (Eds.), *Handbook of interpersonal communication* (3rd ed., pp. 529–563). Thousand Oaks, CA: Sage.

Weng, H. Y., Fox, A. S., Shackman, A. J., Stodola, D. E., Caldwell, J. Z. K., Olson, M. C., et al. (2013). Compassion training alters altruism and neural responses to suffering. *Psychological Science, 24*, 1171–1180. http://dx.doi.org/10.1177/0956797612469537.

Zeeberg, A. (2016, January 06). *How images trigger empathy*. The Atlantic. http://www.theatlantic.com.