The impact of communication technologies on life and relationship satisfaction

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Abstract. Previous studies have shown a relationship between the use of communications technology and well-being, particularly mediated through its effect on personal relationships. However, there is some debate over whether this effect is positive or negative. The present study explored this issue further, examining whether the effect varies depending on the type of communications technology, and the nature of the personal relationship. An online survey was conducted with 3,421 participants in three countries (Australia, UK and US). It examined the use of ten communication methods, overall satisfaction with life and satisfaction with four different kinds of relationships (close and extended family, and close and distant friends).

Results indicate that richer communication methods, which include non-verbal cues, were positively associated with both overall satisfaction with life and satisfaction with relationships. These methods included face-to-face communication, and phone and video calls. Conversely, more restricted methods, such as text messaging and instant messaging, were negatively associated with both variables. Social networking was negatively associated with overall satisfaction, but not with satisfaction with relationships. The strength of the association between a communications method and satisfaction with a relationship varied depending on the type of relationship, but whether it was positive or negative did not change.

Keywords: Communications technology; Social media; Relationships; Social connectedness; Well-being

1. Introduction

The nature of communication has changed significantly over the last few decades with the advent of the Internet and mobile communications. These communications technologies (CTs) are becoming increasingly popular with recent surveys showing that 91% of British households have mobile phones (Dutton & Blank, 2013), 83% of UK adults use the internet (Ofcom, 2014), and 73% do so every day (Office of National Statistics, 2013).

As these forms of communication become increasingly ubiquitous, it is important to examine their impact on people's lives, well-being and relationships. They have many potential benefits, enabling people to stay in touch with friends and family members across the world more easily and quickly. In line with this, several studies have indicated a positive association

between the use of these technologies and well-being and relationships (e.g. Grieve et al., 2013; Kraut et al., 2002; Wang & Wang, 2011). However, other studies have indicated detrimental effects, particularly on the strength and nature of relationships (e.g. Kraut et al., 1998; Kross et al., 2013; Shklovski et al., 2004). There is debate about the reasons for these contradictory findings, but one possibility is that the effect of communications technologies is not uniform (c.f. Best et al., 2014). The aim of the current research was to explore whether the effects vary depending on the type of communications technology, and the nature of the personal relationship.

1.1 Background: Communications technology and relationships

Some studies have examined the impact of communications technology (CT) on subjective well-being, i.e. on people's perceptions of their well-being, and their satisfaction with life (e.g. Chesley, 2005; Gross, 2004; Kraut et al., 1998; Schiffrin et al., 2010). However, well-being is a broad measure with many facets, covering issues such as standard of living, health, achievement and relationships. These individual facets are more susceptible to change than the overall measure, and more likely to be affected by factors such as the use of technology (Cummins et al., 2003; Diener et al., 2003).

Therefore, many studies have focused on the impact of CT on more specific aspects of well-being. In particular, much of the previous work has focused on its impact on relationships. This is because CT is an inherently social technology, and therefore seems likely to affect relationships in particular. This is backed up by Valkenburg and Peter (2007)'s finding that instant messaging affected well-being through the mediating variables of time with friends and quality of friendships.

There have been a large number of studies examining CTs and relationships. However, they do not all agree, with different studies giving very different (and even contradictory) findings (Best et al., 2014). There are various different theories about the effects of CTs (particularly online CTs), but they mostly fall into two main, opposing camps, as described below.

1.1.1 Negative effects

Some argue that online communication has an overall negative effect on relationships. In particular, the displacement hypothesis suggests that online communication takes time away from face-to-face communication, weakening relationships, and encouraging weak relationships at the expense of strong ones (Kraut et al., 1998).

Several studies have found evidence supporting the displacement theory. In particular, Nie and Erbring (2002) found that *"the more time people spend using the Internet, the more they lose contact with their social environment"*. A follow-up study used time diaries to identify that *"time online is largely an asocial activity that competes with, rather than complements, face-to-face social time"* (Nie et al., 2002). In addition, Shklovski et al. (2004) found that *"heavy use of the Internet is associated with reductions in the likelihood of visiting family or friends on a randomly selected day"*. Another example is Lee (2009)'s study which indicated that online communication displaces time with parents, though not with friends.

Schiffrin et al. (2010) also argue for the negative effects of online CTs. They found that people generally perceived computer-mediated communication to be less useful than face-to-face communication, and suggest that replacing face-to-face with online communication is likely to have a negative effect on relationships and well-being. In line with this, they did find an association between Internet use and reduced well-being.

Other studies have also found negative associations between particular types of online communication, well-being and relationship satisfaction (Chesley, 2005; Kross et al., 2013). Some studies further point out that some individuals (e.g., those who are lonely or have poor social skills) run the danger of developing compulsive, harmful Internet use behaviours (Kim et al., 2009; Muusses et al., 2014).

1.1.2 Positive effects

In contrast, others argue that online communication has a positive effect on relationships. In particular, the stimulation or increase hypothesis proposes that online communication builds up and augments existing social ties, thus helping to strength relationships. For example, the authors of (PEW Internet and American Life Project, 2000) said *"This survey provides clear evidence that e-mail and the Web have enhanced users' relationships with their family and friends—results that challenge the notion that the Internet contributes to isolation"*.

Several other studies have provided support for this hypothesis. For example, Valkenburg and Peter (2007) found that online communication in adolescents was positively associated with time spent with existing friends and the quality of these friendships. Similarly, Wang and Wang (2011) found that instant messaging among adolescents was mostly used with existing friends, and positively associated with well-being. They suggest: *"it may be that online communication with existing friends can promote users' interaction in offline settings, which could strengthen their closeness to friends and improve their subjective well-being"*.

More generally, several studies have found positive associations between online communication, well-being and relationships (Bessière et al., 2008; Grieve et al., 2013; Shaw & Gant, 2002). In particular, Kraut et al. (2002) followed up his earlier study (Kraut et al., 1998) that had shown negative associations and that led to him proposing the displacement hypothesis. The follow-up study indicated that many of the negative effects of online communication had dissipated, being replaced by mostly positive effects on communication, social involvement and well-being. They suggested that this may be due to a change in the nature of the Internet. In particular, as more people moved online, Internet use became less isolating. However, it should be noted that Kraut did not abandon the displacement theory entirely (c.f. Shklovski et al., 2004).

Other studies look at new relationships formed online, as well as the impact of CTs on existing relationships. They highlight that many relationships formed online can be *"real, deep and meaningful"* (McKenna et al., 2002), thus having a positive impact on life satisfaction and well-being. McKenna et al. further explain that negative associations of online communication with well-being are often based on a small percentage of the sample, with the vast majority not reporting these ill effects.

1.1.3 Reasons for the conflicting findings

There are various possible reasons for these differences in findings, including differences in methodologies, measures and robustness in the studies (c.f. Best et al., 2014). Another possible reason is that causality may have been wrongly ascribed in some cases (c.f. Nie, 2001; Shklovski et al., 2004). For example, some of the results above indicate that higher use of CTs is associated with higher well-being and better relationships. Nie (2001) argues that it is more likely that people with good social connectivity make more use of communication (including online communication) than that CT use stimulates the social connectivity.

The differences in findings may also be partly explained by different effects on different groups of people. In particular, Kraut et al. (2002)'s findings indicated that extraverts and those with good social support may benefit from Internet use, while introverts and those with less support may find it detrimental. Other findings also support this hypothesis. For example, Lee (2009) found that participants who already had strong social relationships *"were more likely to use online communication, which in turn predicted more cohesive friendships and better connectedness to school"*. Pornsakulvanich et al. (2008) also highlighted the impact of individuals' dispositions, motives and interaction behaviour on the outcomes of CT use.

Another possibility is that CT use has different effects on different kinds of relationships. For example, Lee (2009)'s study of adolescents found a negative effect of online communication on time with parents but not friends. It is possible that online communication strengthens some ties and weakens others.

Furthermore, the effect of communications technology is not uniform, with different technologies having different effects. For example, Stephanikova et al. (2009) found a negative association between time spent on "Other Internet communication" (Instant messaging, chat rooms and newsgroups) and life satisfaction, and a weaker negative association between e-mail and satisfaction. Valkenburg and Peter (2007) found that neither Instant messaging (IM) nor chat was directly related to well-being, but IM use did positively predict well-being via mediating variables. In addition, Chesley (2005) found that persistent use of cell phones (but not computers) was associated with negative work-family spillover, higher distress and lower family satisfaction. These findings indicate that some types of communications technology may strengthen relationships, while others weaken them.

It is also true that even a single technology may have different effects, depending on how it is used. For example, Valkenburg et al. (2006) found that well-being was associated with whether feedback on social networking sites was positive or negative, rather than the amount of use of the sites.

In summary, there are several possible reasons for the conflicting findings about the impact of CTs. There is some evidence that some of the conflict is caused by differences in methodologies, measures and causality attribution, as well as the differing effects of CTs on different types of people. However, there are other possible factors that have not been explored in depth. In particular, there has been little research examining the impact of CT use on different kinds of relationships, and comparing the impact of different CTs.

1.2   The current research

The current paper seeks to inform this debate by examining two areas where there has been little previous research: the impact of CT use on different kinds of relationships and the impact of different CTs. It reports on the results from an online survey examining the relationship between ten communications technologies and people's levels of satisfaction with four kinds of relationships (close and extended family, and close and distant friends), as well as overall satisfaction with life.

To help provide insight into the direction of causality, participants were also asked to rate how they felt various CTs had affected their relationships (as advocated by Nie, 2001). Although this is not definitive, it works together with the main analysis to provide a richer picture of the situation.

The survey was conducted in 2011. Changes in the use of communication technologies since then are discussed in Section 4.4.2. However, surveys conducted by the Oxford Internet Institute (Dutton & Blank, 2013) indicate that overall "patterns of use have not changed dramatically" since then, and thus the results still provide useful insight into the impact of CTs.

2.   Method

2.1   Participants

The survey was administered separately in each of three countries (Australia, the UK and the US) by a recruitment agency specific to that country. The rewards scheme for respondents differed slightly among the countries. For example, in the US, the agency worked with standard groups of respondents and offered rewards for each survey completed, whereas in the UK respondents were told that they would be entered into a draw to win one of three prizes.

In total, 3,421 participants aged 10 and over were recruited to take part in the survey (1,132 in Australia, 1,269 in the UK and 1,020 in the US)[1]. Participants aged under 18 were recruited through contact with their parents or guardians, and completed the survey with supervision.

The sampling aimed to achieve a roughly equal split between genders in each country, reflecting the demographics in each of the countries at the time. In addition, it aimed to achieve an even spread across the six age groups in each country, to ensure adequate representation from each of these different groups. Overall, 42.2% of the sample was male and 57.8% female. The age breakdown was: 10-18 years old (14.5%), 19-24 (12%), 25-34

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[1] Data was also collected in China but not included in this analysis because China is substantially different culturally, especially in the ways in which relationships are built and maintained (e.g. Gold et al, 2002). Culture also has a significant impact on responses to well-being questions (Diener et al, 2003). This paper therefore focuses on the results from Australia, the US and the UK. Descriptive results for all four countries are available in (Mieczakowski et al., 2011).

(17.8%), 35-44 (16.1%), 45-64 (25.4%), 65+ (14.1%). Sampling biases are discussed in Section 4.4.1.

2.2   Procedure

Participants were given a short description of the project and completed an appropriate consent form in the screening survey administered by the recruitment agencies. They were also given an explanation of the survey goals and their rights at the start of the survey.

The survey was conducted online in May 2011. An online survey was used because of the focus in the study on the effect of online communication technologies. The same questions were used in all countries, although there were small wording differences to account for different word usage, currencies and education systems. For example, "cell phone" was used in the US where "mobile phone" was used in the UK and Australia.

The survey was part of a larger study investigating the use and impact of modern media and technology on family life. The larger study also included a diary study and interviews with 63 families across all four countries. The results from the diary and interview study are not discussed in this paper, although they informed the questions asked in the survey. Preliminary results can be found in (Mieczakowski et al., 2011).

2.3   Measures

The survey examined participants' use of various communications technologies, their experiences of them, their level of satisfaction with various relationships and with life as a whole, and various demographic variables. This paper does not report on all the variables, but focuses on those most relevant to the impact of CT on relationships, as described below.

2.3.1   Technology use

Participants were asked how much time they spent using various methods of communication on an average weekday. The question referred to weekdays because weekday and weekend use are likely to differ, and averaging across the two might have been difficult and confusing for many participants. Weekdays were chosen because it was thought that ICT usage would likely be higher on weekdays for many individuals due to work and school commitments. Some individuals may also lean more towards having 'screen-free' time and engage in more outdoor activities at weekends. It was thus thought that weekday use may be more indicative of whether or not a participant used a technology frequently.

The list of communication methods included face-to-face communication, as well as various CTs, listed in Table 2 (in Section 2.5). Possible responses were: none, less than 1 hour, 1-3 hours, 4-6 hours, 7-9 hours, and 10+ hours. These were mapped to a scale from 0 to 5.

2.3.2   Well-being and satisfaction with relationships

Time and space constraints did not allow the inclusion of a full well-being questionnaire. Instead, the following question was included to give a rough indication of overall subjective well-being: *"Thinking about your own life and personal relationships, how satisfied are you*

with your life as a whole?" Responses were given on a scale of 0 to 10. This question has been found to have a reasonable correlation with more in-depth personal well-being measures (Cummins et al., 2003).

Participants also indicated *"the extent to which you feel happy or unhappy in your relationships with your friends and family"*. They rated four types of relationships: immediate family, extended family, close friends, and distant friends. All were rated on the same scale from 1 to 5, indicating very unhappy, unhappy, neither unhappy or happy, happy and very happy.

2.3.3 Impact of technology on relationships

Participants were also asked to indicate *"the extent to which your use of communications technologies has a positive or negative impact on your personal relationships with people"*. They rated the impact of the nine technologies in Table 2 (excluding face-to-face), on the four types of relationships in Section 2.3.2, resulting in 36 ratings. Face-to-face was not included because the question's aim was to gauge the impact of technological interventions.

Each impact was rated on the same scale from 1 to 5, indicating 1 very negative, 2 negative, 3 neither positive nor negative, 4 positive, and 5 very positive. Six was used to indicate "not applicable". For the purposes of the analysis in this paper, responses of 6 were treated as missing data.

2.3.4 Demographic variables

Various demographic data was collected including: gender, age group, ethnic background, employment status, education, and household income[2]. For each of these questions, participants selected their answers from a predefined list.

2.4 Research Questions

The study focused on the following research question:

> RQ1) How does the use of different communication methods relate to overall satisfaction and satisfaction with relationships?

The study investigated how the use of each of several communication methods was related to the satisfaction measures, and whether these relationships were positive or negative. Further, it examined whether all of the communication methods were related in the same way or if there were differences depending on the method.

A subsidiary question was:

> RQ1a) How does the use of communication methods relate to different relationships?

The study investigated how the use of communication methods was related to satisfaction with various different personal relationships, and whether they were related positively or

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[2] Questions about income were included in the survey but variations in the response scale between countries prevent inclusion of income in the current study.

negatively. It examined whether all personal relationships were associated in the same way or if there were differences depending on the type of relationship (close and extended family, and close and distant friends).

2.5 Data analysis

The study examined the associations between CT use and overall relationship satisfaction, as well as satisfaction with specific types of relationships. Therefore, an "overall satisfaction with relationships" variable was calculated based on each participant's mean response to the individual relationships variables (immediate family, extended family, close friends and distant friends). The Cronbach's alpha for the newly created variable was found to be satisfactory (0.8) and the variable was included as an outcome measure in the final analysis.

The frequency of use of each CT was measured on a scale from 0 to 5, corresponding to: none, less than 1 hour, 1-3 hours, 4-6 hours, 7-9 hours, and 10+ hours. This is clearly not an equal interval scale, but there is no evidence of non-linear relationships between the independent and dependent measures used. Therefore, it was treated as a continuous measure and included in the multiple regression analyses. Future research using more precise measures of exposure should seek to replicate the findings from this study.

Hierarchical multiple regression was used to allow us to determine whether key variables relating to the use of CTs predicted overall satisfaction and relationship satisfaction after allowing for other factors. The assumptions for regression were assessed. While a small number of univariate and multivariate outliers were identified, all cases were found to have very low leverage values and Cook's values and on that basis were retained in the final analysis. Missing data was excluded listwise. All outcome measures were found to have a normal distribution other than satisfaction with immediate family relationships. This variable was found to be negatively skewed so the variable was reflected and a square root transformation applied.

To meet the requirements for multiple regression, country, age and education were dummy coded. The final analysis included an approximately even number of participants from each country (Australia, n=1132; UK, n=1269; US, n=1020). Age was split into three levels: low (10-24 years, n=909), medium (25-44 years, n=1160) and high (45+ years, n=1352) and education was split into two levels: low (those who had completed schooling up to and including high school or trade school, n=1725) and high (those who had completed a minimum of some undergraduate university education, n=1495). Within the final sample for analysis, the mean ratings for general satisfaction and satisfaction with relationships are shown in Table 1 and the mean ratings for use of communication methods are shown in Table 2.

Table 1. Means and standard deviations on satisfaction variables (N=3421 for all).

	Mean	SD
Satisfaction with life as a whole (on a scale of 0-10)	7.06	2.10
Overall satisfaction with relationships (scale: 1-5)	3.76	0.76
Satisfaction with specific types of relationships (scale: 1-5)		

	Mean	SD
Immediate family (initial variable)	4.10	1.03
Immediate family (transformed variable)	1.34	0.35
Extended family	3.64	0.95
Close friends	3.88	0.96
Distant friends	3.46	0.90

Table 2. Means and standard deviations on time spent using each method of communication (N=3420 for all).

	Mean	SD
Face-to-face	2.38	1.24
Talking on landline phone	1.08	0.77
Talking on mobile phone	1.18	0.77
Text messaging	1.18	1.02
Social networking site	1.14	1.15
Email	1.40	0.88
Instant messenger	0.58	0.85
Video call	0.35	0.76
Blogs/forums	0.38	0.79
Online games with other players via a games console	0.33	0.84

3. Results

The Hierarchical Multiple Regression analysis aimed to determine if the amount of time spent using different communication technologies predicted satisfaction after controlling for country of residence, age, education and gender. A total of six regressions were conducted, predicting overall life satisfaction (RQ1), overall satisfaction with relationships (RQ1), and satisfaction with each of the four categories of relationships (immediate family, extended family, close friends, distant friends; RQ1a). In each regression, country was entered on step 1, age on step 2, education and gender on step 3, and communication methods variables on step 4. The results are shown in Table 3.

Table 3 also displays the standardised regression coefficients (β), and the squared semi-partial correlations (sr^2) for all variables in the final model. To interpret this table, we note that in multiple regression, the β weights indicate the slope of the regression line and the direction (positive or negative) of the relationship; this is expressed as the change in the standardised outcome measure associated with one standard deviation (SD) change in the predictor variable if all other predictor variables are held constant (Tabachnick & Fidell, 2006). The squared semi-partial correlation (sr^2) provides an indication of effect size. In Table 3, this is given as a percentage of unique variance explained by each predictor variable (Tabachnick & Fidell, 2006).

Table 3. Prediction of satisfaction variables by country, age, education, gender and use of various communication methods.

	Dependent variable											
	A		B		C		D		E		F	
	β	sr^2	β	sr^2	β	sr^2	β	sr^2	β	sr^2	β	sr^2
Australia	-.02	.03	**.07****	**.26**	-.04	.10	.03	.05	**.10*****	**.60**	.04	.07
UK	**-.08****	**.36**	.01	.01	**-.05***	**.15**	**-.05***	**.15**	**.06***	**.19**	-.02	.03
Age med	**-.08****	**.33**	**-.08****	**.29**	.02	.02	-.05	.11	**-.14*****	**.99**	-.03	.04
Age high	-.01	.00	.05	.08	-.03	.04	.02	.02	-.02	.02	**.13*****	**.63**

	A β	A sr²	B β	B sr²	C β	C sr²	D β	D sr²	E β	E sr²	F β	F sr²
Education	.01	.01	**.05****	**.23**	**-.04***	**.16**	.02	.04	**.04***	**.15**	**.05****	**.22**
Gender	.00	.00	.01	.01	-.02	.05	**-.04***	**.18**	.02	.06	**.04***	**.13**
Time spent using:												
Face-to-face	**.09*****	**.71**	**.13*****	**1.36**	**-.14*****	**1.75**	**.10*****	**.88**	**.10*****	**.90**	**.045***	**.17**
Landline phone	**.05****	**.22**	**.06****	**.24**	**-.04***	**.12**	**.08*****	**.55**	.02	.03	.03	.08
Talking on mobile phone	**.07****	**.26**	**.06***	**.17**	**-.07****	**.28**	.02	.03	.05	.11	.03	.06
Text messaging	**-.05***	**.14**	**-.05***	**.14**	**.07****	**.26**	**-.055***	**.15**	-.01	.00	-.02	.03
Social networking	**-.07****	**.26**	.04	.10	-.01	.01	**.055***	**.15**	.04	.10	.03	.06
E-mail	**.05***	**.19**	.01	.01	-.01	.01	-.01	.00	.01	.01	.02	.02
Instant messaging	**-.06****	**.22**	**-.05***	**.12**	**.07****	**.24**	-.04	.07	-.02	.01	-.02	.03
Video calls	**.10*****	**.59**	**.07****	**.28**	**-.05***	**.15**	**.07****	**.26**	**.05***	**.15**	**.05***	**.14**
Blogs/forums	-.02	.03	-.04	.10	.03	.04	**-.04***	**.12**	**-.05***	**.12**	-.01	.01
Online games+	.02	.02	-.03	.05	.04	.11	-.04	.08	-.02	.03	.01	.01
R^2	0.045		0.047		0.042		0.035		0.046		0.034	
F	9.481***		9.781***		8.761***		7.203***		9.668***		7.040***	
Adjusted R^2	0.040		0.042		0.037		0.030		0.041		0.029	
Variability accounted for	4.0%		4.2%		3.7%		3.0%		4.1%		2.9%	

Key: A = Overall satisfaction with life; B = Overall satisfaction with relationships; C = Satisfaction with immediate family relationships (note that that this variable was transformed: negative β indicates a positive association and vice-versa); D = Satisfaction with extended family relationships; E = Satisfaction with close friendships; F = Satisfaction with distant friendships; sr^2 = Percentage of unique variance

+The actual wording for this variable was "online games with other players via a games console"

All F values had parameters (16, 3203)

Significant values are in bold. Significance levels: * $p<.05$, ** $p<.01$, *** $p<.001$

3.1 Multiple regression analysis: Overall life satisfaction (RQ1)

For overall satisfaction with life, R was found to be significantly different from zero for steps 1, 2 and 4. Considering R^2 change for each significant step, country accounted for 0.6%, age for 0.5% and communication methods for 3.4% of the variation in overall satisfaction. The results after step 4 are shown in column A in Table 3. The adjusted R^2 of 0.040 indicates that 4.0% of the variability in overall satisfaction is predicted by the variables entered in the equation.

Examining the significant predictors in the final model, participants from the UK reported less overall satisfaction than those from the US (uniquely accounting for 0.36% of the variance in overall satisfaction with life) and those in the middle age group reported less overall satisfaction than those in the youngest age group (0.33%). In terms of CT use (after controlling for country, age, education and gender), greater overall satisfaction with life was associated with time spent in face-to-face communication (0.71%), talking on landline phones (0.22%), talking on mobile phones (0.26%), use of email (0.19%) and video calls (0.59%). Lower overall satisfaction was associated with time spent text messaging (0.14%), on social media websites (0.26%) and instant messaging (0.22%).

3.2 Multiple regression analysis: Overall satisfaction with relationships (RQ1)

For overall satisfaction with relationships, R was significantly different from zero for all four steps. Country accounted for 0.4%, age for 0.9%, education and gender for 0.4% and

communication methods for 3% of the variation in overall satisfaction with relationships. The results after step 4 are shown in column B in Table 3. 4.2% of the variability is predicted by the variables entered in the equation.

Examining the significant predictors, participants from Australia reported greater overall satisfaction with relationships than those from the US (uniquely accounting for 0.26% of the variance), while the middle age group reported less satisfaction than the youngest group (0.29%). In terms of CT use (after controlling for country, age, education and gender), greater satisfaction with relationships was associated with time spent in face-to-face communication (1.36%), talking on landline phones (0.24%), talking on mobile phones (0.17%) and video calls (0.28%). Lower overall satisfaction was associated with time spent text messaging (0.14%) and instant messaging (0.12%).

3.3 Multiple regression analysis: Immediate family (RQ1a)

For satisfaction with immediate family relationships, R was significantly different from zero for all four steps. Country accounted for 0.3%, age for 0.3%, education and gender for 0.4% and communication methods for 3.3% of the variation in this variable. The results after step 4 are shown in column C in Table 3. 3.7% of the variability is predicted by the variables entered in the equation.

The variable for satisfaction with immediate family relationships was negatively skewed, so the variable was reflected and a square root transformation applied. This means that a higher level of the transformed variable actually corresponds to a lower level of satisfaction. Similarly, a positive regression coefficient (β) indicates a negative association with satisfaction.

Thus, participants from the UK reported greater satisfaction with immediate family relationships than those from the US (uniquely accounting for 0.15% of the variance), and those in the higher education group reported more satisfaction than those with lower education (0.16%). In terms of CT use (after controlling for country, age, education and gender), greater satisfaction was associated with time spent in face-to-face communication (1.75%), talking on landline phones (0.12%), talking on mobile phones (0.28%) and video calls (0.15%). Lower satisfaction was associated with time spent text messaging (0.26%) and instant messaging (0.24%).

3.4 Multiple regression analysis: Extended family (RQ1a)

For satisfaction with extended family relationships, R was significantly different from zero for steps 1, 2 and 4. Country accounted for 0.6%, age for 0.3%, and communication methods for 2.5% of the variation in this variable. The results after step 4 are shown in column D in Table 3. 3.0% of the variability in satisfaction with extended family relationships is predicted by the variables entered in the equation.

Examining the significant predictors, participants from the UK reported lower satisfaction with extended family relationships than those from the US (uniquely accounting for 0.15% of

the variance), while women reported lower satisfaction than men (0.18%). In terms of CT use (after controlling for country, age, education and gender), greater satisfaction with extended family relationships was associated with time spent in face-to-face communication (0.88%), talking on landline phones (0.55%), using social networking sites (0.15%) and video calls (0.26%). Lower satisfaction was associated with time spent text messaging (0.15%) and using blogs and forums (0.12%).

3.5 Multiple regression analysis: Close friends (RQ1a)

For satisfaction with relationships with close friends, R was significantly different from zero for all four steps. Country accounted for 0.8%, age for 1.5%, education and gender for 0.3% and communication methods for 2.0% of the variation in this variable. The results after step 4 are shown in column E in Table 3. 4.1% of the variability in satisfaction with close friendships is predicted by the variables entered in the equation.

Examining the significant predictors, participants from both Australia and the UK reported higher satisfaction with their close friendships than those from the US (uniquely accounting for 0.60% and 0.19% of the variance), and those with higher levels of education also reported higher satisfaction (0.15%). Conversely, those in the middle age group reported less satisfaction than those in the youngest age group (0.99%). In terms of CT use (after controlling for country, age, education and gender), greater satisfaction with close friendships was associated with time spent in face-to-face communication (0.90%) and video calls (0.15%). Lower satisfaction was associated with time spent using blogs and forums (0.12%).

3.6 Multiple regression analysis: Distant friends (RQ1a)

For satisfaction with relationships with distant friends, R was significantly different from zero for all four steps. Country accounted for 0.4%, age for 1.5%, education and gender for 0.4% and communication methods for 1.1% of the variation in this variable. The results after step 4 are shown in column F in Table 3. 2.9% of the variability in satisfaction with distant friendships is predicted by the variables entered in the equation.

Examining the significant predictors, participants from the oldest age group reported higher satisfaction with their distant friendships than those from the youngest (uniquely accounting for 0.63% of the variance), those in the higher education group reported higher satisfaction than those with lower education (0.22%) and women reported higher satisfaction than men (0.13%). In terms of CT use (after controlling for country, age, education and gender), greater satisfaction with close friendships was associated with time spent in face-to-face communication (0.17%) and video calls (0.14%).

3.7 Participants' own ratings of the impact of CTs (RQ1a)

Participants were also asked how much impact they felt each technology had on their relationships. The means and standard deviations are shown in Table 4. Means above 3.7 are

given in bold, and means below 3.0 in italics. These cut-offs were chosen based on how the means clustered together in each column.

Table 4. Participants' ratings of the impact of various CTs on various types of relationships, from 1 (very negative) to 5 (very positive). In each cell, the mean is given first, followed by the standard deviation in brackets, with N underneath.

	Immediate Family	Extended Family	Close Friends	Distant Friends	All relationships
Talking on landline phone	**3.82 (0.92)** **3162**	**3.83 (0.88)** **3079**	**3.90 (0.87)** **3096**	**3.71 (0.88)** **2918**	**3.81 (0.76)** **2795**
Talking on mobile phone	**3.79 (0.89)** **3238**	**3.74 (0.85)** **3055**	**3.95 (0.84)** **3205**	3.66 (0.86) 2915	**3.77 (0.72)** **2804**
Text messaging	3.54 (0.92) 3042	3.53 (0.89) 2809	**3.86 (0.93)** **3009**	3.63 (0.90) 2803	3.62 (0.77) 2611
Social networking site	3.23 (1.01) 2665	3.43 (0.99) 2534	3.68 (1.01) 2662	3.67 (1.02) 2627	3.49 (0.86) 2388
Email	3.64 (0.84) 3199	3.67 (0.84) 3019	**3.77 (0.83)** **3167**	*2.79 (0.86)* *3049*	**3.71 (0.70)** **2800**
Instant messenger	3.18 (0.93) 2141	3.18 (0.90) 1985	3.40 (0.98) 2110	3.34 (0.94) 2023	3.25 (0.82) 1809
Video call	3.25 (1.04) 1948	3.21 (0.99) 1810	3.27 (1.00) 1815	3.23 (0.97) 1763	3.19 (0.88) 1611
Blogs/forums	*2.86 (0.93)* *1810*	*2.90 (0.90)* *1672*	3.00 (0.85) 1698	3.02 (0.94) 1681	*2.93 (0.83)* *1543*
Online games	*2.82 (0.96)* *1711*	*2.87 (0.91)* *1604*	3.01 (0.97) 1630	*2.99 (0.93)* *1588*	*2.91 (0.84)* *1467*

Means above 3.7 are given in bold, and means below 3.0 in italics.
For the purposes of this analysis, a response of 6 (non applicable) was counted as Missing. The "all relationships" variable was calculated as the mean of the individual relationships variables.

4. Discussion

The results indicate that communication methods used by individuals are significantly associated with their levels of satisfaction, and that different methods are associated in different ways. However, it should be noted that the amount of variance accounted for by the individual variables was generally small (less than 1% in most cases). This was expected because people's satisfaction with their whole lives and with their relationships is composed of so much more than their communication behaviour. Nevertheless, it indicates that the results should be interpreted in the context of life as a whole. Most people do not find that communication technologies alone have a drastic effect in their relationships and their happiness, although small numbers of people do develop excessive or compulsive Internet use, which can have serious consequences (Caplan, 2003; Kim et al., 2009).

4.1   The impact of different communication methods

The main research question (RQ1) was:

> How does the use of different communication methods relate to overall satisfaction and satisfaction with relationships?

The study found that different communication methods do relate to satisfaction in different ways. Some of them are associated with increased satisfaction, in agreement with the

stimulation hypothesis (Section 1.1.2), while others are associated with decreased satisfaction, in agreement with the displacement hypothesis (Section 1.1.1). This indicates that both hypotheses may hold true, for different technologies. This agrees with findings in the literature that indicate that different CTs do have different effects (e.g. Chesley, 2005; Stephanikova et al., 2009; Valkenburg & Peter, 2007).

In particular, overall satisfaction with life was positively associated with time spent in face-to-face communication, talking on landline and mobile phones, use of email and video calls. It was negatively associated with time spent text messaging, on social media websites and instant messaging. Similarly, overall satisfaction with relationships was positively associated with face-to-face communication, talking on landline and mobile phones, and video calls, and negatively associated with text messaging and instant messaging. (See Sections 3.1 and 3.2 for more details.)

4.1.1   *Face-to-face communication*

Face-to-face communication accounted for the greatest amount of variance in both overall satisfaction and satisfaction with relationships. This suggests that, although other communication technologies (CTs) have some impact, face-to-face communication is of key importance.

As discussed in Section 1.2, it is not possible in the current study to determine the direction of causality. It is possible that strong relationships produce more face-to-face communication (or that there is a mediating variable), rather than face-to-face communication strengthening relationships. However, the latter agrees with other findings. For example, in Schiffrin et al. (2010)'s study, participants rated face-to-face communication very highly for its usefulness in building interpersonal relationships, and felt that people were more likely to care about them and to provide practical support face-to-face than online. This finding also aligns with the assumption in the displacement hypothesis that relationships that are built off-line are stronger and of higher quality (Kraut et al., 1998).

With the plethora of CTs now available, it may be easy to underestimate face-to-face communication. In contrast, our results indicate that face-to-face communication is still of key importance, and suggest that it cannot necessarily be replaced with communication through other channels.

4.1.2   *Richness of communication*

The study found that talking via video calls and on landline and mobile phones was also positively associated with both overall satisfaction with life and with relationships. In contrast, all other communication methods had no or negative associations (with the exception of e-mail, which was positively associated with overall satisfaction only). In particular, text messaging and instant messaging were negatively associated with both general and relationship satisfaction.

One explanation for these findings is that richer communication methods have a more positive impact on relationships. According to Media Richness Theory, the richness of a communication method has four aspects: *"(a) the availability of instant feedback; (b) the use of multiple cues, such as physical presence, voice inflection, body gestures, and graphic symbols, and so forth; (c) the use of natural language for conveying a broad set of concepts*

and ideas; and (d) the personal focus of the medium" (Sheer & Chen, 2004). In particular, richer communication methods convey more information than just the words that are spoken (or typed). Extra cues such as body language, gesture and tone can often enable them to convey more complex and more nuanced information in the same time period.

Face-to-face communication is arguably the richest communication method. It allows instant feedback, as well as multiple cues including intonation, gesture, body language and touch, as well as words. In our study, it had the strongest positive association with satisfaction.

Phone and video calls are also rich compared to the other CTs examined, and were also positively associated with satisfaction in the current study. They allow instant feedback and convey non-textual cues, such as tone, inflection and hesitation. Video calls also carry visual cues, such as posture, gesture and movement.

In contrast, text messaging and instant messaging are much leaner methods, often offering only fairly limited amounts of text and icons. They are also limited by the user's typing speed. The study found negative associations of these methods with satisfaction.

These findings are in agreement with other studies that have shown the importance of rich communication channels (e.g. video) for tasks like negotiation where inter-personal relationships are important (e.g. Daly-Jones et al., 1998; Olson & Olson, 2000). Communication is much more than just the words spoken (or typed). Thus channels that reduce communication to merely text are much more limited, and may fail to have the positive impact on relationships that richer channels can have.

4.1.3   Social networking

One interesting finding is that the use of social networking (social media websites, such as Facebook) is associated with a reduction in overall satisfaction ($sr^2 = 0.26\%$), but is not significantly associated with overall satisfaction with relationships. In fact, it is positively associated with satisfaction with relationships with extended family.

The literature on the topic of social networking is mixed, with some finding a positive association between it and satisfaction (e.g. Grieve et al., 2013), and some a negative association (Kross et al., 2013). Others have found that the association depends on how social networking is used (Valkenburg et al., 2006).

Our study agrees with Kross et al. (2013) that there is a negative association between social networking use and overall satisfaction, although the direction of causation is uncertain. The results add to the debate by indicating that this association is not caused by an effect of social networking on relationships. It seems more likely that social media influences well-being through other mechanisms, such as increasing negative comparisons with others' lives (Chou & Edge, 2012), or encouraging unhelpful multitasking and distracting behaviour (Millard, 2012).

4.2   The impact on different relationships

The subsidiary research question (RQ1a) was:

> How does the use of communication methods relate to different relationships?

Table 3 in Section 3 describes the associations between different communication methods and satisfaction with different types of relationship. The direction of the associations and their strength are of particular relevance to this discussion. Note that the direction is given in most cases by the sign of β. The exception is the "immediate family" variable, where the direction is given by the inverse of β's sign, because the variable itself was transformed prior to the regression analysis. The strength of the association is indicated by sr^2.

4.2.1 General observations

The results indicate that whether a communication method has a positive or negative impact does not depend on the type of relationship. Table 3 shows that the direction of the association between a communication method and relationship satisfaction was consistent across all the relationship types (where a significant association existed). For example, face-to-face communication was positively associated with all relationship types.

Nevertheless, there are differences in the strength of the association between a communication method and different relationships. Furthermore, in some cases there was no significant association with satisfaction with some of the relationships. For example, text messaging was negatively associated with immediate and extended family, but this association was strongest for immediate family, and it did not have a significant association with the other relationships at all.

The impact of CTs on different types of relationships has not been examined extensively in the literature. The current study indicates that CTs may affect different relationships differently, and it is worth investigating this in more detail. However, for some types of CTs the difference only extends to the degree of the association with a consistent direction (positive or negative) across relationships. For these CTs the findings for one type of relationship may still be useful in understanding the effects on relationships as a whole.

4.2.2 Effects for particular communication methods

Some of the communication methods have a much stronger association with some types of relationship than with others.

For example, face-to-face communication is most strongly associated with satisfaction with immediate family relationships (where it accounted for 1.75% of the variance). It is less strongly associated with satisfaction with extended family and close friends (0.88% and 0.90%), and fairly weakly associated with satisfaction with distant friendships (0.17%). One possible reason for this may simply be that it is harder to spend time face-to-face with people who are further away geographically. If people in general spend little time face-to-face with distant friends, then it has little potential to make much difference to their relationships. However, another possibility is that face-to-face communication has the most impact on relationships that are close. Face-to-face communication with close family may have different characteristics than that with more distant friends. For example, when people meet casual friends face-to-face, they may be more likely to engage in surface chatter about general trivia, whereas they may be more likely to talk about personal issues, emotions and concerns with close family and friends.

Video calls are also positively associated with all types of relationships, but most strongly with extended family (0.26%) and less so for the other relationships (all around 0.15%). One

possible reason for this is that video calls may be most useful for relationships that are important to us, but geographically distant. When people are nearby, some level of face-to-face communication is possible, which may reduce the effect of video calls. Furthermore, when a relationship is not very important to people, they may not go to the effort of using video calling, or just engage in surface conversation when they do. A little work has been done looking at how people use video calls (e.g. O'Hara et al., 2006), but further research is needed, exploring in more detail who they talk with, in what circumstances and what they talk about.

Landline phones are positively associated with satisfaction with immediate and extended family, but particularly with the latter (0.55%). They are not significantly associated with satisfaction with close or distant friendships. Similarly, talking on mobile phones is only significantly associated with satisfaction with immediate family relationships (0.28%). This may be because of the ways in which phone calls on these devices are used, but more research is needed to explore this further.

Text messaging shows a negative association with family relationships (0.26% and 0.15%) but not friendships. This agrees with findings from Lee (2009) that computer use affected time spent by adolescents with their parents but not with their friends. It may be that certain kinds of CTs are commonly used during the time that would otherwise be spent with family, or in ways that disrupt family relationships.

4.3   Comparison with participants' own perceptions

Table 4 in Section 3.7 gives participants' ratings of the impact *they* felt various CTs had on different types of relationships. Face-to-face communication was not included in this question, because the question's aim was to gauge the impact of technologies. However, this means that the impact of those technologies cannot be compared directly to the impact of face-to-face.

Talking on a landline and mobile phone were rated very highly for all the relationships (most highly for most of the relationships). This provides some added support for the importance of phone calls, as noted in Section 4.1.2. It also suggests that caution should be taken when interpreting the lack of significant association between phone calls and satisfaction with friendships. Participants felt that phone calls did have a positive impact on these types of relationships. The regressions may not have been significant for other reasons. For example, the amount of time spent talking on a phone may be too low to produce significance, but even small amounts of time may be considered by participants to have a positive impact.

Text messaging was also rated very positively for close friendships (mean 3.86) and fairly positively for the other relationships. This does not match the regression findings, where text messaging was negatively associated with satisfaction with family relationships, and not significantly associated with satisfaction with friendships. Rather than text messaging disrupting family relationships, it may be the case that people with weak family relationships are using text messaging more (perhaps to communicate with other people they feel closer to). Alternatively, text messaging may actually be problematic, but participants are not aware of this. This could be a problem, leading to people not self-moderating potentially harmful behaviour.

Another CT we examined was video calls. Video calls were identified in the regressions as having a relatively strong positive association with satisfaction with all relationships. However, the participants' ratings of the effect of video calls were fairly neutral, only marginally above 3. They considered video calls to have a much lower positive impact than phone calls or text messaging, or (for most relationships) social networking sites or e-mail.

There are various possible reasons for this discrepancy. Participants may have underestimated the impact of video calls, perhaps because they were a relatively new technology. Alternatively, the direction of causality may be the other way round. For example, it may be the case that people with already good relationships tend to use video calls more often, but these calls in themselves do not improve the relationships. Another possibility is that the impact only occurs if video calls are used fairly frequently. Due to the novelty of the technology, many people may have rated its impact based on only a few experiences with it.

Blogs/forums and online games were given fairly low ratings (the lowest ratings for most of the relationships). However, the mean ratings were still all fairly close to 3 (neither positive nor negative). It should also be noted that the number of people rating these CTs was much lower (around half the sample), reflecting low rates of usage.

4.4   Limitations

4.4.1   Sampling
The sample is described in Section 2.1. It was slightly skewed, with 57.8% of the sample being female (as opposed to 50.4% in the UK population as a whole). The age distribution in the sample varied a little between countries. Overall, there was a slight over-representation in younger age groups (especially 19-24 and 25-34) compared to the distribution in the general population. The older age groups (45-64, and 65+) were correspondingly slightly under represented.

To address this, age and gender were controlled for in the models, by entering them on steps in the regression analysis before the step that looked at communication methods.

In addition, the analysis undertaken in the current study did not explore the question of whether specific communication technologies have varying impacts in different countries. Future research exploring this issue would be informative.

4.4.2   Changes since the survey
There have been some changes in the use of communication technologies since the survey was conducted in 2011. In particular, there has been substantial increase in the use of smartphones and tablets for online communication (e.g. Deloitte, 2013; Ofcom, 2014), and some increase in the use of the Internet overall, particularly among older age groups (Ofcom, 2014).

However, surveys conducted by the Oxford Internet Institute (Dutton & Blank, 2013) indicate that overall "patterns of use have not changed dramatically" among British people who use the Internet. Percentages of Internet users using e-mail, social networking sites and chat rooms remained fairly steady between 2011 and 2013, although blog use decreased, while the use of the Internet to make phone calls (VoIP) increased sharply. Twitter has also gained

greatly in popularity in the last few years, which may increase the use of the category "blogs/forums" in the questionnaire described in this paper.

It is important to take these changes into consideration when interpreting the findings of the current study. Having online communications available when on the move may make them more intrusive and result in a greater impact on relationships. This may be positive or negative depending on how they are used. Furthermore, as more people start using a technology, this may change the ways in which it is used. In particular, it may be used more to develop existing relationships rather than create new ones (e.g. Kraut et al, 2002).

Nevertheless, at a general level, our findings give an indication of the direction and scale of impact of different kinds of CTs. However, further studies are important to update this over time as the use of communications changes.

4.4.3   Other issues

The survey in this paper used self-report measures, relying on participants' recall of their use of different means of communication. This is less accurate than other methods such as diary studies (e.g. Nie et al., 2002), but enabled the collection of data from a much larger number of participants.

In addition, as a cross-sectional study, it can be hard to be sure of the directions of causation. We cannot be sure that use of a particular CT itself increases or reduces satisfaction with relationships. This is addressed throughout the discussion, and participants' ratings of impact are compared with the regression results to help with the discussion. Further work is needed to explore the reasons for the results.

The work was sponsored by British Telecom (BT). However, this was done under the banner of social responsibility, rather than to promote a particular agenda. The researchers were independent and the sponsors did not influence the course of the research. Efforts were taken to ensure impartiality. For example, the different communication technologies in the survey were examined in a consistent manner, with the same questions being asked about all of them.

5.   Conclusions

The study found that different communication technologies (CTs) are associated differently with life and relationship satisfaction, with some having positive and some negative associations. This helps to explain the discrepancies in previous studies, some of which showed that CTs improved relationships and well-being, while others indicated the opposite.

The study found that richer communication methods, which include non-verbal cues, are associated with greater life and relationship satisfaction. These include face-to-face communication, video calls and phone calls. Conversely, more restricted methods, such as text messaging and instant messaging were associated with decreased satisfaction. More work is needed to explore further the reasons for these results, but this agrees with other studies' findings on the importance of rich and natural conversation. This finding has implications for the development of CTs, highlighting the importance of conveying multiple, rich cues.

In particular, face-to-face communication was the strongest predictor of relationship satisfaction, and was positively associated with all types of relationships. This indicates that face-to-face communication is still of key importance, and suggests that care should be taken to communicate in person as well as through technology, where that is possible.

Social networking was associated with a reduction in overall satisfaction, but was not significantly associated with relationship satisfaction, except for a positive association in the case of extended family relationships. This result adds to the understanding of the impact of social networking. It indicates that potential negative effects of social networking may not be due to its effects of relationships.

The study also investigated whether communication methods affect different relationships differently. It found that the direction of the association remained consistent across relationship types (generally positive or generally negative). However, the strength of the association did vary, and some technologies were significantly associated with satisfaction with some relationships but not others. This indicates that CTs may affect different relationships differently, and it is worth investigating this in more detail.

In particular, some communication methods had a stronger association with some types of relationships than with others. For example, face-to-face communication and mobile phone calls were most strongly associated with satisfaction with immediate family relationships, while video and landline calls were most associated with satisfaction with extended family relationships. Text messaging and instant messaging had a negative association with satisfaction with family relationships, but not with friendships. The reasons for these differences are unclear. Further work is needed to explore this in more depth, investigating whether and how CTs are used differently with different groups of people.

Participants in the study were also asked for their own opinions on how various CTs affected different relationships. Their responses were not always in agreement with the regression analysis of CT use and relationship satisfaction. Further research is needed to understand the reasons for this. One possibility is that the associations from the regression analysis do not indicate causality, while another possibility is that participants may not always be aware of CT use is harmful. The latter is an important concern because it could result in participants not self-moderating potentially harmful behaviour.

Overall, this study found that different communication methods are associated differently with life and relationship satisfaction. It also found that communication methods may be associated to different extents with different types of relationships. This provides important insight for understanding the relationship between CT use and well-being, and helps to explain the conflicting findings in previous studies.

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