

# Well-Being After the Virginia Tech Mass Murder: The Relative Effectiveness of Face-to-Face and Virtual Interactions in Providing Support to Survivors

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## Abstract

Acts of mass violence such as terrorist attacks or school shootings victimize more than those directly involved. Witness to these acts and members of the attacked community are at risk for increased levels of PTSD, depression, and other forms of mental distress. Research has clearly established that social support is critically important for recovering from such traumatic events (Galea et al. 2002; Johnson, North, & Smith, 2005; Ruzek et al, 2007) as being imbedded in a strong private network of friends and family can provide the emotional support survivors need to effectively cope with the tragedy (Hawdon and Ryan 2011). Given the increased use of e-mail, text messaging, and social networking sites among youth (Hinchcliffe & Gavin, 2009), it is likely that survivors of mass violence use technology to communicate with the members of their private networks (Dutta-Bergman, 2004). However, it is unclear if this “virtual interaction” can be as effective as face-to-face interaction in providing the needed support. Our research addresses this question using data collected after the 2007 mass murder of 32 people at Virginia Tech. Using data collected from 543 Virginia Tech students, we predict levels of emotional and behavioral well-being five months after the shootings. Our central independent variables include measures of how frequently the students communicated with their friends and families in the week following the tragedy and if these communications were in person or “virtual.” Results indicate that face-to-face interaction significantly improved well-being; however, interacting with friends and family members through e-mail, text messaging, or some form of online communication was unrelated to well-being. Our findings highlight the importance of face-to-face interactions after acts of mass violence.

## Keywords

PTSD/TBI, anxiety disorders, and other diagnoses, depression, substance abuse, consequences of trauma, survey, quantitative methods, types of research, human-caused, sources of trauma

On the morning of April 16, 2007, a Virginia Tech senior entered an on-campus dormitory and murdered two students. Approximately 2 hr later, the student entered a classroom building, murdered an additional 30 people, and wounded 17 others. The Virginia Tech tragedy, to date the deadliest school shooting in American history, stunned the university community. Many survivors turned to technology to inform friends and family that they were alright, get information about their friends' well-being, or to simply get up-to-date information about the tragedy that struck their campus (see Eberhardt, 2007; Mastrodicasa, 2008). As the immediate threat passed, a somber sense of disbelief quickly engulfed the community as students, staff, faculty members, and local residents tried to make sense of the events. As is common after tragedies, survivors turned to their friends and family for support. Yet, unlike most tragedies that preceded the Virginia Tech shootings, many of the traumatized and grieving community members used virtual media to talk to their loved ones.

Research has clearly established that social support is critically important for recovering from such traumatic events (Galea et al., 2002; Johnson, North, & Smith, 2002). Given the increased use of e-mail, text messaging, and social networking sites among youth (Hinchcliffe & Gavin, 2009; Lehtonvirta & Räsänen, 2010; Räsänen & Kouvo, 2007), it is unsurprising that survivors of the Virginia Tech school shooting used technology to communicate with the members of their private networks (see Eberhardt, 2007). However, it is unclear whether this virtual interaction was as effective as

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face-to-face interaction in providing the needed support. Our research addresses this question using data collected from 543 Virginia Tech students after the Virginia Tech shootings.

## Theoretical Background

The relationship between social support and individual health is well established (Granello, 2001; Kawachi & Berkman, 2001; Ryan, Hughes, & Hawdon, 1998; Savage & Russell, 2005; Smith & Christakis, 2008). Those embedded in strong social networks are more likely to receive the social support, instrumental support, and sense of attachment that promotes a sense of well-being (see Berkman, Glass, Brissette, & Seeman, 2000, for a discussion of the pathways linking social networks to health outcomes). Social support, in turn, provides positive affect, predictability in one's life, and a sense self-worth (Cohen & Wills, 1985). It is therefore not surprising that researchers have found that social support is inversely related to the onset of posttraumatic stress disorder (PTSD) and other mental health problems after traumatic events (Galea et al., 2002; Galea, Nandi, & Vlahov, 2005; Johnson et al., 2002; Ruzek et al., 2007; van Ommeren, Shekhar, & Benedetto, 2005; Vernberg, La Greca, Silverman, & Prinstein, 1996; Walsh, 2007). Although the social support-well-being relationship is well established, there is little research investigating whether this relationship holds when the support is provided through virtual means rather than face-to-face contact. The lack of research in this area is in part due to the relative newness of the technology that can be used to provide support such as e-mail, text messaging, video messaging, and social networking sites. Despite this lack of research, however, we can deduce possible hypotheses regarding the use of virtual communication as a source of support and well-being after tragedies.

In general, the buffering model (see Cohen, 2004; Cohen & Willis, 1985; Dalgard, Bjork, & Tambs, 1995; Kawachi & Berkman, 2001) applies to the Virginia Tech tragedy. According to this model, stress arises when one considers a situation as threatening and lacks an appropriate coping response. That is, stressful situations occur when one believes it is important to respond but an appropriate response is not immediately available (Cohen & Willis, 1985). The Virginia Tech tragedy was undoubtedly an acute stressor (see Ryan & Hawdon, 2008, for a discussion of how a response to the tragedy was expected, but people were unsure of what the appropriate response was). A stressful event such as a school shooting can adversely affect victims' mental health by promoting maladaptive coping strategies and possibly activating physiological responses that lead to distress. Social support can protect individuals from these adverse effects by mitigating the stressor, making the stressor seem less important, or promoting effective coping strategies (Cohen, 2004). There are several types of support that can protect individuals from stress. Emotional support is communicating to a

stressed person that he or she is valued and accepted despite the difficulties the stressful event creates. Informational support is helping a stressed individual to define, understand, and ultimately cope with the stress-inducing event. Social companionship provides contact with others, distracts the person, and facilitates a positive mood. Finally, providing material resources or instrumental support may help reduce stress by resolving instrumental problems such as financial problems or time management issues (Cohen, 2004; Cohen & Willis, 1985).

In the case of the Virginia Tech shootings, it would seem that those experiencing this stressful event would benefit most from emotional support, informational support, and companionship. These forms of support are largely dependent on communication (as opposed to instrumental support, which is more dependent on providing tangible resources). At first glance, there is little reason to believe that these communication-based supports could not be adequately provided via technology-mediated sources. Since cell phones, texting devices, instant messaging, social networking sites, video conferencing, and even e-mail can provide instantaneous or near instantaneous response, communication in the virtual world is as real-time as face-to-face communication. In fact, virtual communication is probably a better source of certain types of support than is face-to-face communication. For example, informational support—where accurate information about the event is valuable currency—would be facilitated by web-based communication since the supporter could easily access up-to-date information from news sources, social media sites, and other citizen journalists. Therefore, one could predict that virtual communication would be as effective in buffering stress as face-to-face communication.

However, research on stress-reducing benefits of social support indicates that the adverse effects of trauma are greatly reduced if victims receive comfort, reassurance, and a sense of safety from those they trust. This support from others who those in need trust counteracts the feelings of insecurity, helplessness, and meaninglessness that the victimized often experience (Walsh, 2007). The importance of trusting those who are providing the support may limit the buffering effectiveness of virtual communication. A number of studies of online communities report that in-person interaction creates stronger ties and more trust among group members than do online communication, at least initially (e.g., Hlebec, Manfreda, & Vehovar, 2006; Lafontaine, Rosen, & Hendrickson, 2010; Matzat, 2010; Wilson, Straus, & McEvily, 2006). At least among those involved in business, virtual communication cannot replace face-to-face interaction in adding a human touch to relationships (Chen & Wellman, 2009). The relative lack of trust in virtual relationships may be because the members of larger social networks are typically less emotionally close than are the members of smaller networks (Roberts, Dunbar, Pollet, & Kuppens, 2009), and internet networks typically have more friends, and therefore weaker ties, than do networks based on face-to-face interaction (Hlebec et al., 2006; Uslaner, 2004).

Moreover, face-to-face interaction is superior to virtual interaction in fostering the encompassing (vs. specific) knowledge of the others upon which bonding depends (Etzioni & Etzioni, 1999). Therefore, virtual communication may impede the development of the trust upon which effective stress buffering depends. If this is true, one would predict that virtual communication would not be as effective as face-to-face interaction in preserving mental well-being after a tragedy.

Yet, the relative lack of trust in online communities may not have posed a problem for providing support after the Virginia Tech tragedy. First, the Virginia Tech tragedy was the first mass tragedy that primarily affected the net generation. Virginia Tech students in 2007 were very familiar with virtual modes of communication, and this familiarity became quickly apparent after the tragedy. For example, within hours after the shootings, students created several Facebook groups to memorialize the victims that ranged in size from several dozen to more than 300,000. Facebook also served to convey information about the incident as students posted links to online news stories and individuals updated their pages to let others know they were safe. Most important for our purpose, within a day of the shootings, more than 5,000 Virginia Tech students and alumni joined the Facebook group VT Unite, which offered students a place to grieve and express condolences (Read, 2007a). Thus, Facebook and other modes of virtual communication were frequently used for friends, near and far, to offer support (Eberhardt, 2007; Read, 2007a, 2007b). The fact that virtual communication is an everyday part of life for most young people (see Carnevale, 2006; Hinchcliffe & Gavin, 2009; Lehdonvirta & Räsänen, 2010) and is an expected and frequently used means of communication during and after crisis (Dutta-Bergman, 2004; Eberhardt, 2007; Kavanaugh, Sheetz, Quek, & Joon Kim, 2010; Mastrodicasa, 2008; Palen, Vieweg, Liu, & Hughes, 2009) may counteract the trust-reducing influence of virtual communications.

Indeed, a recent study of youthful online-community users from the United Kingdom, Spain, and Japan found that the youth identify as strongly with their online communities as they did with their families, and they had a stronger allegiance to their online friends than with their offline recreational groups (Lehdonvirta & Räsänen, 2010). Finally, although internet users have slightly wider social circles than nonusers, their virtual communications are primarily with people they know (Uslaner, 2004), so the internet is an additional means by which people who already are connected to other people can communicate (Katz & Aspden, 1998; also see Dutta-Bergman, 2004). This appears to be what happened on the day of the Virginia Tech shootings. Based on a sample of Virginia Tech students, Kavanaugh and her associates found that students frequently used technology-based means of communication. More than 80% of surveyed students used e-mail, 70% used text messaging, 60% used Facebook or other social networking sites, and 95% used cell phones. Of these communications, more than half were to

family members and an additional 25% were to close friends (Kavanaugh et al., 2010). Thus, the students primarily talked to those they knew and knew well; that is, they communicated with strong ties.

Consequently, there are logical reasons to predict that virtual communication would not serve the same stress-buffering functions as face-to-face interactions do. Yet there are also reasons to predict that virtual communication could have been as effective as face-to-face interactions in providing stress-buffering support after the Virginia Tech tragedy. We now turn to an analysis of Virginia Tech students to determine which prediction is accurate.

## Methods

We use ordinary least squares (OLS) regression conducted on a sample of 460 Virginia Tech students to determine whether virtual means of communication were as effective as face-to-face communication in protecting their well-being after the 2007 tragedy that occurred on campus. We predict the students' emotional and behavioral well-being 5 months after the tragedy. Our central independent variables include measures of how frequently the students communicated with their friends and families in the week following the tragedy and whether these communications were in person or virtual.

## Sample

We use data collected from a web-based survey of Virginia Tech students. All students have e-mail accounts that they are required by the university to routinely check; thus, this population is unusually accessible through the internet, and the typical problem associated with web surveys of coverage error and sampling bias is not a serious issue. In fact, web-based surveys are likely superior to traditional phone surveys because many students rely solely on cell phones (see Witte & Howard, 2002, for a discussion of the representativeness of web-based samples).

After the tragedy, the Virginia Tech Center for Survey Research randomly selected 2,000 undergraduate students from those enrolled in the fall of 2007.<sup>1</sup> Dillman's (1999) strategies were followed to maximize response rates. The survey was completed within 6 months of the tragedy, and data collection ended on October 1, 2007. In total, 626 students completed the survey (total response rates of 31.3%). Although the response rate is relatively low, the sample is representative of all ethnic categories and with respect to the distribution of students across the university's eight colleges. As is common in surveys, women are overrepresented in the sample, so we conduct the analysis using weighted data to correct for this oversampling.

## Measures

Our dependent variable is the students' emotional and behavioral well-being. To measure student well-being, we

use items from the *DSM* screener for depression (see Centers for Disease Control & Prevention [CDC], 1998) and from Weinberger and Schwartz's (1990) Emotional and Psychological Distress Scale. In addition, we use an item regarding respondents' self-reported levels of productivity at work or school. In total, we use nine items to assess well-being. Three items, "I am the kind of person who has a lot of fun," and "I am not very sure of myself," and "I often feel lonely," were 5-point Likert-type items with response options ranging from *strongly agree* to *strongly disagree*. With the other six items, respondents were asked whether they felt or experienced a given mood or behavior *often*, *sometimes*, *rarely*, or *never*. The moods and behaviors included (a) feel very sad; (b) feel grouchy, irritable, or in a bad mood; (c) feel like not eating or overeating; (d) have difficulty sleeping; (e) have difficulty concentrating on work; and (f) feel like they are less productive at doing their daily activities than they would like to be. All of the items were coded so high scores indicated high levels of well-being. Although we had initially planned to analyze these items as three separate concepts, the high interitem correlation among the nine items suggested they were tapping aspects of the same phenomena. We therefore combined the items into a single measure. The composite measure had a Cronbach's alpha of .765.

Our central independent variables are the extent to which students talked to friends and family members in the week following the tragedy and whether these conversations occurred in person or through some virtual medium (online, text messaging). Respondents were asked about the conversations they had during the week following the tragedy, and the responses ranged from 1 (*no conversations that week*) to 5 (*several conversations each day that week*). Respondents were asked about the number of conversations they had with family members and the number of conversations they had with friends. These variables were combined to provide a measure of overall support. Next, respondents were asked how many of their conversations in the week following the tragedy were in-person or through some virtual medium (i.e., online, text messaging, e-mail). These responses ranged from 0 (*none of them*) to 3 (*all of them*). We use these four variables (family in-person conversations, family virtual conversations, friend in-person conversations, and friend virtual conversations) to determine whether the mode of conversation influences well-being.

The stress-buffering model acknowledges that social integration influences well-being in ways that do not necessarily involve social support during stressful events (see Cohen, 2004; Cohen & Wills, 1985; Dalgard et al., 1995). That is, those who are embedded in strong social networks do not have the same need for social support to cope with tragedies as do those who are less well integrated since the well-integrated typically exhibit high levels of well-being even when stressors are combined with relative weak social support. Because of this, we include a measure of social

solidarity in our model. Our measure taps the extent to which respondents' felt they are part of the Virginia Tech community. We measure solidarity using six items: (a) "I am proud to be a member of the Virginia Tech community," (b) "I trust the students at Virginia Tech," (c) "I trust the faculty at Virginia Tech," (d) "I trust the staff at Virginia Tech," (e) "I feel I am a part of the Virginia Tech community," and (f) "People at Virginia Tech share the same values." All items responses are 5-point Likert-type scales with response options ranging from 1 (*strongly disagree*) to 5 (*strongly agree*), and the index ranged from 6 to 30. These items display high levels of reliability with the alpha reliability coefficient measuring .803.

Previous research (Cicognani et al., 2008; Hagerty, Williams, Coyne, & Early, 1996; Hawdon & Ryan, 2011; Hawdon, Ryan, & Mobley, 2000; Peterson & Reid, 2003; Peterson, Speer, & McMillan, 2008) indicates that participating in community-level activities promotes a sense of belonging to the community. We therefore control for how frequently the respondents engaged in community activities in the week following the tragedy. Respondents were asked how frequently they participated in sports or games on a community team. The responses ranged from 1 (*not at all*) to 5 (*several times a day*).

Finally, we control for a number of factors that can influence perceptions of community solidarity, including the demographic factors of race (white versus non-white, with white as the reference category) and gender (female is the reference category). We also control for the number of years the respondent has been at Virginia Tech<sup>2</sup> and whether they knew one of the tragedy's victims (not knowing a victim is the reference category). We also include in the model whether the respondent saw a professional counselor in the week after the tragedy (not seeing a counselor is the reference category). Descriptive statistics of all of the variables in the analysis are reported in the Appendix A.

## Results

The bivariate correlations among the variables are presented in Table 1. Looking first at these correlations, the amount of social support, as measured by the number of conversations about the tragedy the respondents had with their friends and family during the week following the shootings, is positively related to well-being ( $r = .228, p < .01$ ). The number of in-person conversations respondents had with family ( $r = .127, p < .01$ ), the number of virtual conversations they had with friends ( $r = .125, p < .01$ ), being integrated into the community ( $r = .252, p < .01$ ), and participating in community sporting events ( $r = .176, p < .01$ ) also positively correlate with well-being. Seeing a professional counselor is inversely related to well-being ( $r = -.099, p < .05$ ). None of the other variables are significantly related to well-being at the bivariate level. Most notably, the number of virtual conversations respondents had with family members and the number of in-person conversations they had with friends are not significantly related to well-being.

**Table 1.** Bivariate Correlations

	Well-Being	Conversations	Family In-person	Family Online	Friends In-person	Friends Text	Solidarity	Sports	Years at VT	Know Victim	Ethnic Female	Ethnic Minority
Well being	1											
Conversations with family and friends	.228**	1										
Number of in-person family conversation	.127**	.123**	1									
Number of family conversations online	.067	.089*	-.176**	1								
Number of friend conversations in person	-.002	.092*	.089*	.030	1							
Number of friend conversations on text	.125**	.143**	-.049*	-.039	-.521**	1						
Social solidarity	.252**	.245**	.026	.066	.109*	.000	1					
Played on community team after the tragedy	.176**	.051	-.009	.035	.119**	.022	.048	1				
Years at Virginia Tech	.000	.037	-.062	.058	.064	-.017	-.105*	-.064	1			
Did you know any of the victims?	-.083	.076	.052	.033	.043	.007	.049	.027	-.015	1		
Female	-.076	.179**	.026	.083	-.029	.066	.130**	-.081	.003	.043	1	
Ethnic minority	.006	-.083	.094*	-.136**	-.062	.063	-.097*	.019	-.070	-.046	-.012	1
Did you see a professional counselor after the tragedy?	-.099*	.098*	-.062	.088*	.003	-.005	-.064	.033	-.015	.090*	.004	-.011

Note: *N* = 543.

\**p* < .05 \*\**p* < .01

**Table 2.** Regression Analysis of Well-Being

	Model 1: Base Model	Model 2: In-person Communications	Model 3: Virtual Communications	Model 4: Full Model
Overall social support	0.917*** (4.97)	0.878*** (4.76)	0.876*** (4.70)	0.768*** (4.08)
Social solidarity	0.343*** (5.11)	0.353*** (5.29)	0.340*** (5.06)	0.346*** (5.21)
Participation on community team	0.676*** (3.77)	0.725*** (4.05)	0.677*** (3.77)	0.677*** (3.77)
Years at Virginia Tech	0.033 (0.62)	0.047 (0.89)	0.033 (0.63)	0.040 (0.76)
Knew a victim of the tragedy	-0.900* (-2.47)	-0.926* (-2.56)	-0.890* (-2.44)	-0.960* (-2.67)
Female	-1.133** (-3.05)	-1.171** (-3.18)	-1.192** (-3.20)	-1.246** (-3.39)
Ethnic minority	0.617 (1.11)	0.302 (0.54)	0.692 (1.24)	0.351 (0.63)
Saw professional counselor after tragedy	-1.555** (-2.79)	-1.446** (-2.61)	-1.586** (-2.84)	-1.465** (-2.65)
Number of in-person conversations with family		0.565** (2.67)		0.658*** (3.07)
Number of in-person conversations with friends		-0.444 (-1.79)		-0.115 (-0.39)
Number of virtual conversations with family			0.275 (1.10)	0.503* (2.04)
Number of virtual conversations with friends			0.359 (1.21)	0.636* (2.15)
Constant	17.00*** (8.88)	17.01*** (8.88)	16.57*** (8.58)	15.56*** (7.83)
<i>R</i> <sup>2</sup> , Model <i>F</i>	0.157, 12.51***	0.174, 11.18***	0.162, 10.35***	0.186, 10.12***

Notes: *n* = 543; unstandardized coefficients are shown; *t* values in parentheses.

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

Moving to the multivariate analysis, Table 2 reports the results of four OLS regressions. The first column of Table 2 is the results of regressing well-being on our measure of

overall support and the control variables. The second column reports the findings when the number of in-person conversations respondents had with family and friends are added to

the base model, and the third column presents the results when virtual conversations with family and friends are added to the base model. Finally, the full model is presented in the fourth column.

The base model accounts for 15.7% of the variance in well-being. Being integrated into the community ( $b = 0.343$ ,  $\beta = .214$ ,  $p < .001$ ) and overall support ( $b = 0.917$ ,  $\beta = .208$ ,  $p < .001$ ) are the best predictors of well-being, and both of these factors increase well-being. Similarly, playing on a community sports team following the tragedy increases well-being ( $b = 0.676$ ,  $\beta = .151$ ,  $p < .001$ ). Women have lower levels of well-being than men do ( $b = -1.13$ ,  $\beta = -.124$ ;  $p = .002$ ), and knowing one of the victims ( $b = -0.900$ ,  $\beta = -.099$ ,  $p = .014$ ) and seeing a professional counselor within a week of the tragedy ( $b = -1.56$ ,  $\beta = -.112$ ,  $p = .005$ ) are inversely related to well-being. Race and the number of years the respondent was at Virginia Tech are unrelated to well-being.

When we add the number of in-person conversations respondents had, the model explains 17.4% of the variance in well-being. The number of in-person conversations respondents had with family members increases well-being ( $b = 0.565$ ,  $\beta = .108$ ,  $p = .008$ ). Interestingly, the number of in-person conversations respondents had with friends decreases well-being ( $b = -0.444$ ,  $\beta = -.072$ ); however, this predictor is significantly only using liberal levels of significance ( $p = .072$ ). The influence of the other factors on well-being is similar to those reported in the base model.

Adding virtual communications to the base model has little effect on the model. The explained variance increases from 15.7% to only 16.2%; however, the  $F$  test for this change indicates it is a significant improvement in the model,  $F(df = 2, 533) = 4.26$ ,  $p = .015$ . Neither virtually communicating with friends nor family members is significantly related to well-being in this model ( $p = .228$  and  $.272$ , respectively). The other variables in the third model remain related to well-being in the same fashion as in the first model.

Finally, we move to the full model as reported in the fourth column of Table 2, which explains 18.6% of the variance in well-being. In the full model, the number of in-person conversations with family members ( $b = 0.658$ ,  $\beta = .125$ ,  $p = .002$ ) and the number of virtual conversations with family members ( $b = 0.503$ ,  $\beta = .083$ ,  $p = .042$ ) are significantly and positively related to well-being. Similarly, having virtual conversations with friends also significantly improves the respondent's well-being ( $b = 0.636$ ,  $\beta = .102$ ,  $p = .032$ ). Interestingly, although the virtual conversation variables fail to achieve statistical significance when they are added to the base model, both of these variables are significant predictors in the full model. The number of in-person conversations with friends that respondents had in the week following the tragedy is unrelated to well-being ( $p = .695$ ). As in base model, overall support ( $b = 0.768$ ,  $\beta = .175$ ,  $p < .001$ ), being integrated into the community ( $b = 0.346$ ,  $\beta = .216$ ,  $p < .001$ ),

and playing community sports ( $b = 0.677$ ,  $\beta = .152$ ,  $p < .001$ ) significantly increase well-being. Knowing a victim ( $b = -0.960$ ,  $\beta = -.106$ ,  $p = .008$ ), being female ( $b = -1.25$ ,  $\beta = -.137$ ,  $p = .001$ ), and seeing a professional counselor ( $b = -1.47$ ,  $\beta = -.106$ ,  $p = .008$ ) significantly decrease well-being. Race and number of years being at Virginia Tech are unrelated to well-being.

## Discussion

Since the tragic events of April 16, 2007 primarily affected college students, it is unsurprising that many used cell phones, text messaging, e-mail, and social media sites to communicate with friends and family members. It is also unsurprising that a significant number of students continued to use these technologies to discuss the event in the week following the tragedy. We analyze whether this virtual communication was as effective in buffering the acute stress these students experienced as face-to-face interactions were. Some of the results were anticipated; however, some of the results were unexpected.

First, the stress-buffering model (Cohen, 2005; Cohen & Willis, 1985) received considerable support from this research. Face-to-face interactions with family members significantly improve well-being. Of the four styles of communication included in the analysis (face-to-face with family, face-to-face with friends, virtual with family, and virtual with friends), face-to-face communication with family members produced the strongest effect on well-being. This finding was expected and offers additional evidence to the large body of literature that argues that those experiencing a traumatic event benefit from support. Second, being imbedded in a community, measured here with an index of social solidarity, promotes well-being. Again, this finding was anticipated and confirms that those who are members of a strong social network fair better after tragic events than do those who lack social ties. Third, engaging in community-level events after traumatic events promotes recovery. This finding also supports existing research (Hawdon & Ryan, 2011). Finally, interacting with friends and family members through e-mail, text messaging, or some form of online communication was related to well-being. This finding suggests that stress-buffering support can be delivered virtually. It is likely that the type of support those experiencing the acute stress of the Virginia Tech tragedy needed is dependent on communication as opposed to the delivery of some tangible resource; therefore, the means through which the supporting communication is delivered may not be critically important for that communication to be effective. It is also likely that this effect is amplified when those using the technology are youth who are very familiar and comfortable with virtual communication.

Although the above findings confirm existing research and theoretic predictions, additional findings were unanticipated and raise several issues. Although communicating

with family and friends through technology-based means promotes well-being, this positive effect only emerges when other factors are held constant. Looking at the bivariate and partial correlations, it appears that face-to-face interactions with family members and friends suppress the effect of technology. There is a clear relationship between face-to-face interactions with family members and well-being, both at the bivariate and multivariate level. However, there is an inverse relationship between communicating with friends and family members face-to-face and communicating with friends and family members virtually. Thus, the more students texted their friends, the less likely they were to talk to their family members face to face. Although texting their friends promoted their well-being, the relative lack of face-to-face contact with their family members impeded recovery. This finding highlights the importance of face-to-face interactions with family members after acts of mass violence. Although communicating with friends and family members through technology-based means is beneficial, it can become counterproductive if it distracts from face-to-face communication with family members. Virtual communication apparently cannot replace face-to-face contact as a means of support; it can, however, effectively supplement it.

It is also interesting that face-to-face communication with friends was not a significant predictor of well-being. Moreover, the relationship, though not statistically significant, was inverse. Face-to-face communication with friends appears to be less beneficial than communicating with them through text messaging, e-mail, or a social networking site. In fact, at least for this sample of participants, face-to-face communication with friends was detrimental to their well-being.

There are some plausible reasons for this. First, since many students left campus during the week following the tragedy, it is possible that their closest friends were unavailable for face-to-face interaction. As a result, these students likely kept in touch, exchanged information, and provided comforting through virtual means. The friends with whom they interacted face-to-face may have not been their closest, most trusted friends. Second, since the virtual world is a part of these students' everyday life, they are more used to conveying aspects of their private life than those less familiar with technology-based information may feel comfortable divulging over e-mail, text messages, or on a public-access site such as Facebook. Third, it is possible that face-to-face interactions with friends were ineffective because their fellow students had also experienced the trauma. Fellow victims are likely not the best source of support, especially in terms of distracting the person's attention from the event and helping him or her maintain a positive mood. It is possible that students who interacted with other students may have dwelled on the event and created a negative mood of victimization instead of a positive mood of support. Conversely, family members, most of whom were not present on campus to experience the acute stressor, would be in a better position

to offer emotional support and companionship that distracts the victim's attention from the event. Unfortunately, we lack the data to establish which of these possible explanations or any other explanation is correct. Nevertheless, the finding that face-to-face interactions with friends did not reduce stress (and, in fact, may have increased it) is interesting and deserving of further investigation.

In addition to lacking the data to address the above finding, our study has other limitations. First, we asked respondents to estimate the number of conversations about the event that they had in the week following the event. Since these are retrospective data, there are likely errors in the respondents' recollections. We can only hope that the degree to which some respondents overestimated their conversations is offset by those who underestimate their conversations and that the over- or under-representation is not systematically related to any of explanatory variables. Second, we asked about the frequency of the respondents' conversations but not the explicit content of these conversations. Although the questions asked respondents to report the approximate number of times they discussed the events of April 16, we did not probe deeper into the tone, content, and frame of these conversations. Although some conversations were probably comforting, others may have been extremely upsetting. Again, we are unable to distinguish between these types of conversations with the available data. Although these factors limit our confidence in generalizing our findings, we believe the research provides valuable insights. Still, this research should be considered exploratory.

## Conclusion

The students affected by the Virginia Tech tragedy experienced an acute stressor. As previous research indicates, severely acute stressors such as a mass shooting are related to mental and physical health problems among the survivors. Our research adds to the large body of literature that indicates those who are imbedded in a strong social network and those who receive stress-buffering support are far less likely to experience mental and physical problems. Although the literature is full of examples of how support can buffer trauma victims from the consequences of acute stress, little research has investigated whether the stress-buffering support victims need can be delivered through technology-based means of communication instead of face-to-face interactions. Given the widespread use of virtual communication devices and techniques, our research begins to address this important question.

Stress-buffering support appears to be best received through face-to-face interaction. Virtual interactions, though beneficial, are not sufficient. Provided virtual interactions occur with other face-to-face interactions, virtual interactions are effective at promoting the survivors' well-being. When stressed by an acute stressor such as violence, youth need support, especially if they are not imbedded in a strong

social network. Although our findings indicate that virtual interaction is not sufficient at providing support, it is better than receiving no support at all. Thus, after a serious crisis, parents, friends, consolers, aid workers, and other concerned citizens working with the traumatized should encourage the victims to reach out to their friends and family using any means possible. Yet, especially with members of the net generation for whom virtual communication is part of their daily lives, we should be careful to not allow virtual interactions to impede face-to-face interactions. Virtual interactions are not as effective as face-to-face interactions in providing stress-buffering support and promoting well-being; therefore, texting, e-mail, IM, and social networking sites can supplement, not replace, old fashion human contact.

## Appendix A

### Descriptive Statistics

	Mean	Standard Deviation
Emotional and behavioral well-being	26.497	4.544
Social support	-0.119	1.037
Solidarity	27.506	2.838
Participation on community team	1.688	1.018
Years at Virginia Tech	3.070	3.468
Knew a victim of the tragedy	0.470	0.500
Female	0.471	0.499
Ethnic minority	0.122	0.328
Saw professional counselor after tragedy	0.125	0.331
Number of in-person conversations with family	0.720	0.866
Number of in-person conversations with friends	1.736	0.742
Number of virtual conversations with family	0.824	0.750
Number of virtual conversations with family	1.125	0.730

*N* = 543.

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### Notes

1. We did not conduct a power analysis prior to collecting the data. The university was concerned that researchers interested in studying the tragedy could potentially burden the student population. To protect students, the university created an oversight committee to review all surveys related to the tragedy. The committee decided that the Center for Survey Research would oversee all sampling procedures and ensure that students would not be asked to complete more than two surveys related to the tragedy. As a result, the number of students we could contact was predetermined. With that said, the sample had a power of 0.898 for detecting a small effect size ( $r^2 = .05$ ) at a .01 alpha (see Lenth, 2009, for the calculation procedures for correlational studies).
2. We do not include age in the analysis because it is highly correlated ( $r = .648$ ) with years at Virginia Tech. Including both variables in the model produces elevated variance inflation factor (VIF) statistics and a condition index of 44.92. We ran models including only age, only years at Virginia Tech, and both variables. Neither of these variables was statistically significant in any model, and the substantive results were identical across the three models. We therefore decided to avoid the possible problems with multicollinearity and include only years the student had attended Virginia Tech.

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