ORIGINAL ARTICLE

The Effects of Instant Messaging on the Quality of Adolescents' Existing Friendships: A Longitudinal Study

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Recent studies suggest that instant messaging (IM) is positively related to the quality of adolescents' existing friendships. However, most of these studies were based on cross-sectional correlational data. In addition, most studies have focused on direct effects of IM on the quality of friendships without exploring mediating variables that may explain these effects. The aim of this study was to fill these two lacunae in the literature. We hypothesized that IM, which is mostly used to communicate with existing friends, stimulates the quality of friendships, via its potential to stimulate intimate online self-disclosure. A sample of 812 Dutch adolescents between 10 and 17 years of age were surveyed twice within a 6-month interval. IM had a positive longitudinal effect on the quality of adolescents' existing friendships. This direct positive effect could be explained entirely by adolescents' tendency to disclose intimate information online.

Since the second half of the 1990s, a growing number of studies have focused on the uses, functions, and consequences of online communication technologies such as e-mail and instant messaging (IM). These studies can be subdivided into three broad categories. A first category focuses on the uses and functions of online communication technologies for adolescents and adults (Boase, Horrigan, Wellman, & Rainie, 2006; Boneva, Quinn, Kraut, Kiesler, & Shklovski, 2006; Bryant, Sanders-Jackson, & Smallwood, 2006; Grinter & Palen, 2002; Gross, 2004; Howard, Rainie, & Jones, 2001; Lenhart & Madden, 2007; Lenhart, Madden & Hitlin, 2005; Stafford, Kline, & Dimmick, 1999). These studies have found, for example, that e-mail and IM are predominantly used for the maintenance of existing social relationships, both among adolescents (Boneva et al., 2006; Grinter & Palen, 2002; Gross, 2004)—who primarily use IM—and among adults (Boase et al., 2006; Stafford et al., 1999)—who primarily use e-mail.

A second category of studies has focused primarily on detecting differences in the quality of online friendships (i.e., friendships that were created online) and offline

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friendships (i.e., friendships that were created in a face-to-face setting). These studies have been conducted among adolescents (Mesch & Talmud, 2006, 2007) and adults (Chan & Cheng, 2004; Cummings, Butler, & Kraut, 2002; Parks & Floyd, 1996; Parks & Roberts, 1998). They have demonstrated that online friendships are generally perceived as lower in quality than offline friendships. However, this perceived lower quality usually improves significantly over time and becomes comparable to that of offline friendships when the online friendship lasts for more than 1 year (Chan & Cheng, 2004). Moreover, adolescents and adults who have many offline friends also seem to create online friendships more easily (Kobayashi et al., 2000; Matei & Ball-Rokeach, 2001), which suggests that online friendships do not develop at the expense of offline friendships.

A third and final category of studies, to which our study belongs, aims to investigate the consequences of different types of Internet use for the quantity and/or quality of existing friendships or other social relationships. Unlike the studies in the previous category, the studies in this category address the causal relationship between (types of) Internet use and various outcome variables. Some of these studies reported negative consequences of (types of) Internet use for the quantity and/or quality of existing friendships or relationships (Kraut et al., 1998; Mesch, 2001; Nie & Erbring, 2000). Some others reported no significant effects (Bryant et al., 2006; Gross, 2004). However, the great majority reported positive effects of (types of) Internet use on the quantity and/or quality of existing friendships or relationships (Boase et al., 2006; Boneva et al., 2006; Howard et al., 2001; Hu, Wood, Smith, & Westbrook, 2004; Katz, Rice, & Aspden, 2001; Kraut et al., 2002; Valkenburg & Peter, 2007a, 2007b, 2007c).

However, although the majority of Internet-effects studies seem to point toward positive effects, this research is still characterized by three shortcomings. First, most conclusions about the consequences of Internet use for the quality of existing friendships are based on correlational studies. These studies cannot give a decisive answer about the direction of the relationship between (types of) Internet use and the quantity and/or quality of friendships. They cannot rule out the possibility that people with higher quality friendships more often turn to the Internet to communicate with these friends. Therefore, the first aim of this study was to investigate the causal direction of the relationship between online communication and the quality of existing relationships. Our study involves a two-wave panel study among 812 Dutch adolescents and investigates the longer-term relationships between adolescents' IM use and the quality of their existing friendships.

A second shortcoming in earlier research on the effects of (types of) Internet use and existing friendships is that the independent variable Internet use has been theoretically underspecified. Several studies have treated Internet use as a one-dimensional concept, operationalized by weekly or daily time spent on the Internet (e.g., Kraut et al., 1998, 2002). In our view, it is theoretically problematic to investigate the effects of time spent on the Internet on the quality of existing friendships because a large proportion of the time spent on the Internet is not social. The consequences of Internet use for the quality of existing friendships can only be

adequately investigated when Internet use pertains to communication with existing friends. Therefore, the second aim of this study was to investigate the consequences of a communication technology that is preeminently used to maintain existing friendships: IM. IM is currently not only a staple of adolescents' communication with existing friends (Lenhart et al., 2005) but it is also often used to share personal information with these friends (Boneva et al., 2006; Grinter & Palen, 2002; Gross, 2004; Schouten, Valkenburg, & Peter, 2007). Therefore, if there is an online communication technology that is to influence adolescents' existing friendships, it should be IM.

A third and final shortcoming is that most studies have investigated direct relationships between (types of) Internet use and one or more dependent variables, such as social involvement or the quality of existing friendships. Hardly any study has hypothesized on possible mediating variables that may explain a stimulating effect of (types of) Internet use on the quality of adolescents' friendships. However, several scholars have pointed to the fact that there is no such thing as a direct impact of Internet use (e.g., Matei & Ball-Rokeach, 2001). Instead, we need to specify what the mechanisms are that may underlie the Internet–friendship relationship. Therefore, the third and final aim of our study was to fill this gap in the literature and to investigate a potentially valid explanation for the positive Internet–friendship relationships that have been found in earlier studies.

An Internet-enhanced intimate self-disclosure hypothesis
We hypothesize that the positive relationships between different types of Internet communication and the quality of existing friendships that have been found in earlier studies can be entirely accounted for by Internet-enhanced intimate self-disclosure. We label our hypothesis the Internet-enhanced intimate self-disclosure hypothesis. Intimate self-disclosure is defined as disclosing intimate information about the self (Derlega, Metts, Petronio, & Margulis, 1993). It refers to verbal communication about personal topics that are typically not easily disclosed, such as one's worries, fears, secrets, and embarrassing experiences (Derlega et al., 1993). Some early theories on self-disclosure (e.g., Altman & Taylor, 1973; Jourard, 1971) suggest that self-disclosure is synonymous with feelings of closeness or a close relationship. However, more recent theories assume that, although self-disclosure can contribute to relationship development and maintenance, it is not equivalent to feelings of closeness or having a close relationship (Buhrmester & Prager, 1995; Derlega et al., 1993). After all, we can feel close to a person whom we hardly know and we can feel distant to a person whom we know very well (Derlega et al., 1993).

Our Internet-enhanced self-disclosure hypothesis may be a valid hypothesis to explain the effects of IM use on the quality of friendships because self-disclosure is not only positively related to our independent variable (IM use) but also to our dependent variable (the quality of adolescents' existing friendships). As to the relationship between IM use and intimate online self-disclosure, a series of experimental and survey studies have shown that computer-mediated communication (CMC) in general and IM use in particular stimulate intimate self-disclosure (e.g., Bargh,

McKenna, & Fitzsimons, 2002; Hu et al., 2004; Joinson, 2001; Leung, 2002; Schouten et al., 2007; Tidwell & Walther, 2002). The finding that CMC enhances intimate self-disclosure is one of the most consistent outcomes in CMC research.

The Internet-enhanced intimate self-disclosure is often explained with Walther's (1996) hyperpersonal communication theory. According to this theory, CMC is typically characterized by reduced visual, auditory, and contextual cues, such as social status cues. One important consequence of CMC's reduced cues is that CMC interactants become less concerned about how others perceive them and thus they feel fewer inhibitions in disclosing themselves (e.g., Joinson, 2001). Another plausible consequence of CMC's reduced cues is that the range of possible uncertainty reduction strategies (Berger & Calabrese, 1975) is limited. In face-to-face settings, one can reduce uncertainty about a communication partner in many different ways, including observing the partner and asking others about him or her. However, in CMC, the range of uncertainty reduction strategies is often confined to interactive strategies, such as direct questioning and self-disclosure. Although these direct strategies may be regarded impolite in face-to-face settings, in CMC they may be more accepted and, as a result, more frequently used (Tidwell & Walther, 2002).

As to the relationship between self-disclosure and the quality of friendships, there is initial evidence from the Internet-effects literature that intimate online self-disclosure stimulates online friendship formation (McKenna, Green, & Gleason, 2002; Peter, Valkenburg, & Schouten, 2005) and the closeness of existing friendships (Valkenburg & Peter, 2007a). Furthermore, there is ample evidence from interpersonal and relational communication research that intimate face-to-face self-disclosure is a main predictor of the quality of existing friendships, both among adults and adolescents (e.g., Altman & Taylor, 1973; Buhrmester & Prager, 1995; Derlega & Grzelak, 1979; Derlega et al., 1993). One of the main functions of intimate self-disclosure is the promotion of closeness in relationships (Buhrmester & Prager, 1995; Derlega & Grzelak, 1979; Duck, 2007). Adolescents in particular often identify the mutual disclosure of intimate topics as a central characteristic of high-quality friendships (Buhrmester & Prager, 1995). Based on these earlier theories and research findings, it is plausible to assume that intimate online self-disclosure stimulates the quality of adolescents' existing friendships.

However, if IM use enhances intimate online self-disclosure and if this intimate online self-disclosure results in higher quality relationships, then intimate online self-disclosure could, logically, mediate (and thus explain) the relationship between IM use and the quality of existing friendships. This is exactly what our Internet-enhanced intimate self-disclosure hypothesis assumes.

Selfdisclosure and friendships in adolescence

Our Internet-enhanced intimate self-disclosure hypothesis is based on the earlier finding that adolescents primarily use IM to communicate with their existing friends (e.g., Lenhart et al., 2005; Valkenburg & Peter, 2007c). Our hypothesis assumes that adolescents' IM use results in enhanced intimate self-disclosure, which in turn leads

to higher quality existing friendships. Our study focuses on preadolescents and adolescents between 10 and 17 years of age. In this developmental stage, both self-disclosure and friendship maintenance are more acute than in any other developmental life stage (Buhrmester & Prager, 1995). A key developmental task in the transition from childhood to adolescence is the distancing from parents and the development of a new adult identity in interaction with peers (Steinberg & Morris, 2001). This process may create insecurities and tensions in adolescents because many new rules of the adult world have to be learned and practiced (Collins & Laursen, 2000). An important way to reduce these insecurities and tensions is the formation and maintenance of close friendships.

However, the development and maintenance of friendships require sophisticated communication and self-disclosure skills. Modern theories of self-disclosure agree that self-disclosure is inherently functional. It either brings benefit to or addresses some concern of the discloser (Derlega & Grzelak, 1979). Based on a functional analysis of Derlega and Grzelak (1979), Buhrmester and Prager (1995) have identified five functions of self-disclosure for adolescents: (a) receiving social validation, (b) gaining social control, (c) achieving self-clarification, (d) exercising self-expression, and (e) enhancing relationship development.

Several earlier studies have demonstrated that adolescents often use IM to disclose intimate information (e.g., Boneva et al. 2006; Grinter & Palen, 2002). One third of adolescents even seem to prefer IM to face-to-face settings for intimate self-disclosure (Schouten et al., 2007). As discussed, on the one hand, adolescents are characterized by an enhanced need for self-disclosure. On the other hand, their face-to-face self-disclosure is sometimes confined because they are not yet independent enough to freely move around and meet with peers after school (Boneva et al., 2006). In addition, adolescents can be extremely self-conscious and shy (Elkind & Bowen, 1979). They may feel awkward to self-disclose in face-to-face settings and, therefore, may like to turn to a 'protected' environment such as IM for self-disclosure (Peter et al., 2005). These factors seem to be the paramount reason for their massive attraction to IM. Therefore, if there is a stage in life in which it is important to investigate relationships between IM use, self-disclosure, and friendship maintenance, it is most probably adolescence.

However, preadolescence and adolescence cover a sizeable period during which important developmental changes occur. Older adolescents' friendships are typically closer than those of preadolescents and early adolescents (Buhrmester & Furman, 1987). During preadolescence, exchanging intimacy gains significance, but it is not until adolescence that intimacy and emotional support are essential in friendships (Aboud & Mendelson, 1996; Damon, 1977). In addition, levels of face-to-face self-disclosure are lower in middle adolescence (14–15 years) than in early and late adolescence. In middle adolescence, concern about interpersonal identity peaks, which may enhance difficulties in self-disclosure (e.g., Hargie, Sounders, & Dickson, 1994). In conclusion, because age may be related to both self-disclosure and the quality of friendships in adolescence, the validity of our Internet-enhanced self-disclosure

hypothesis may differ for pre-, early, and middle adolescents. Therefore, we will investigate whether our Internet-enhanced intimate self-disclosure hypothesis holds for different developmental groups.

Method

Sample

This longitudinal study is based on a sample of 812 Dutch adolescents between 10 and 17 years of age (50% girls; 50% boys). The adolescents were surveyed on two occasions, with a half-year interval. Sampling and fieldwork were done by Qrius, a market research company in Amsterdam, the Netherlands. Respondents were recruited from an existing online panel managed by Qrius. Qrius had sampled the respondents in all parts of the Netherlands, partly via e-mail invitations, and partly through respondents' social networks. The gender, age, and education level of our sample did not deviate from official statistics in the Netherlands (Central Bureau of Statistics, 2005). Prior to the implementation of the survey, institutional approval, parental consent, and adolescents' informed consent were obtained. Adolescents were notified that the study would be about the Internet, emotions, and friendships and that they could stop participation at any time they wished.

In the first data wave, which took place in May and June 2006, 1,158 adolescents were surveyed. During the second data wave, which took place in November and December 2006, 70% of the adolescents participated again. Three hundred forty-six adolescents (30%) were lost, partly because they left the online panel, partly because they failed to return the questionnaire or a completed questionnaire. Respondents were reminded twice by e-mail, once by surface mail, and were finally offered an extra bonus of 5 Euro, in addition to the 3 Euro that they received for filling in the questionnaires. Despite these measures, the attrition rate could not be further reduced.

We checked whether the adolescents who did not complete the second survey systematically differed from those who did. Boys did not drop out more often than girls did, $F(1, 1,157) = 0.01$, $p = .97$. Neither did we find significant differences in the educational levels of those who dropped out and those who did not, $F(1, 1,157) = 0.31$, $p = .58$. Adolescents who had dropped out were somewhat older ($M = 14.01$, $SD = 2.22$) than those who remained in the panel ($M = 13.47$, $SD = 2.29$; $F(1, 1,157) = 13.47$, $p < .001$). However, in the second wave, respondents were still equally distributed across the age groups: 10-to 11-year-olds: 26%; 12- to 13-year-olds: 24%; 14- to 15-year-olds: 26%; 16- to 17-year-olds: 25%.

Measures

IM use

We measured adolescents' IM use with four questions: (a) "On *weekdays* (Monday through Friday), how many days do you usually use IM?" (b) "On the *weekdays* (Monday through Friday) that you use IM, how long do you then usually use it?"

(c) "On *weekends* (Saturday and Sunday), how many days do you usually use IM?" The response options for the latter question were: 1 (*Only on Saturday*); 2 (*Only on Sunday*); and 3 (*On both days*); and 4 (*I do not use IM on weekends*). If respondents selected response options 1 to 3 in the question on IM weekend use, they were asked the following question for Saturday and/or Sunday: (d) "On a Saturday (a Sunday), how long do you usually use IM?" Respondents' IM use per week was calculated by multiplying the number of days per week that they used IM (range 0 through 7) by the number of minutes that they used it on each day ($M = 569.94$; $SD = 577.95$ at Time 1; $M = 583.57$, $SD = 718.78$ at Time 2).

Online communication with existing friends
We asked respondents how often they used IM to talk with their existing friends: "When you use IM, how often do you IM with friends whom you know from your offline environment?" Response categories ranged from 1 (*Never*) to 5 (*Always*) ($M = 4.38$; $SD = 0.85$ at Time 1; $M = 4.35$, $SD = 0.86$ at Time 2).

Intimate online self-disclosure
Our measure was based on earlier scales that include items to measure intimate self-disclosure (Jourard, 1971; Miller, Berg, & Archer, 1983). Our measure has been successfully used in an earlier Dutch study on online self-disclosure (Schouten et al., 2007) in which it led to an excellent reliability. Respondents were asked: "When you are using IM on the Internet, how much do you usually tell about. . . ." ". . . . (1) your personal feelings," ". . . . (2) the things you are worried about," ". . . . (3) your secrets," ". . . .(4) being in love," ". . . . (5) moments in your life you are ashamed of." Items were measured on a 5-point scale ranging from 1 (*I tell nothing about this*) to 5 (*I tell everything about this*). In both data waves, the five items loaded on one factor, which explained 67% of the variance at Time 1, and 65% of the variance at Time 2. Cronbach's alpha was .87 at Time 1 and .87 at Time 2 ($M = 2.22$; $SD = 0.75$ at Time 1; $M = 2.29$, $SD = 0.71$ at Time 2).

Quality of friendships
The quality of existing friendships was measured with the relationship satisfaction (three items), approval (three items), and support (three items) subscales of the Network of Relationship Inventory—Revised (Buhrmester, 2002), which is an adjusted version of Furman and Buhrmester's (1985) Network of Relationship Inventory. We asked respondents to think of the friends they know from their offline environment, for example, from school and their neighborhood. Items were: "How often are you happy with these friends?" "How much do you like the way things are between you and these friends?" "How satisfied are you with your relationships with these friends?" "How often do these friends praise you?" "How often are these friends proud of you?" "How often do these friends like the things you do?" "How often do you turn to these friends for advice?" "How often do you turn to these friends for support when you have a problem?" and "How often do these friends cheer you up when you are a bit sad?" Response options ranged from 1 (*never*) to 5 (*always*).

A factor analysis showed that the three factors identified by Buhrmester could not be retraced. In both waves, all nine items loaded highly on one factor, which explained 58% of the variance at Time 1 and 55% of the variance at Time 2. For both waves, the nine items were averaged to form a quality of friendship scale. Cronbach's alpha was .91 at Time 1 and .89 at Time 2 ($M = 3.51$; $SD = 0.62$ at Time 1; $M = 3.49$, $SD = 0.57$ at Time 2).

Data Analysis

Crosslagged panel model
The first aim of this study was to investigate the causal direction of the longitudinal relationships between online communication and the quality of existing relationships. These relationships will be analyzed in a crosslagged panel model (Figure 1). The two-way arrow A in Figure 1 represents the covariance between IM use at Time 1 and the quality of existing friendships at Time 1. Arrows B and C represent the stability of both IM use and the quality of existing friendships from Time 1 to Time 2. The two crosslagged arrows represent the two potential causal longitudinal relationships between IM use and the quality of adolescents' existing friendships.

Explanatory causal model
Our Internet-enhanced intimate self-disclosure hypothesis was investigated through the model presented in Figure 2, in which the intervening variable intimate online self-disclosure was added to the crosslagged panel model. Our hypothesis assumes that IM use at Time 1 has a positive influence on intimate online self-disclosure at Time 2 (Arrow H2A; the first part of our hypothesis). Furthermore, it assumes that intimate online self-disclosure at Time 2, in turn, affects the quality of friendships at Time 2 (Arrow H2B; the second part of our hypothesis). Finally, the Internet-enhanced intimate self-disclosure hypothesis predicts that the direct relationship
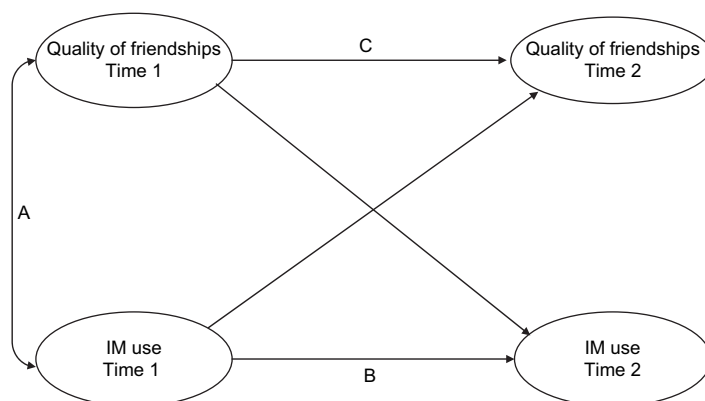

Figure 1 Hypothesized crosslagged model on the relationship between instant messaging use and the quality of existing friendships.
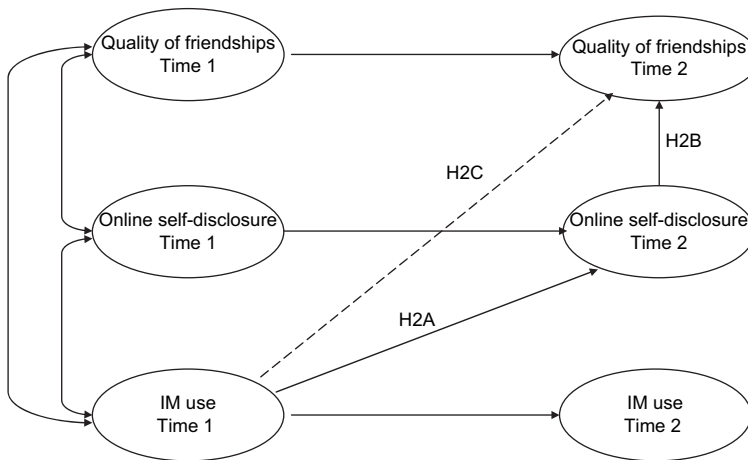
Figure 2 Hypothesized explanatory model on the relationship between instant messaging use, intimate online self-disclosure, and the quality of existing friendships.

between IM use at Time 1 and the quality of existing friendships at Time 2 will not be significant (dashed arrow H2C) due to the inclusion of the mediator intimate online self-disclosure in the model.

Results

Descriptive Statistics
In the first wave, respondents reported using IM on average 1 hour 22 minutes per day (*SD* 1 hour 23 minutes). In the second wave, they reported using IM on average 1 hour 23 minutes per day (*SD* 1 hour 43 minutes). In both waves, nearly all respondents (96.9% at Time 1 and 95.8% at Time 2) indicated that they "often" to "always" used IM to communicate with existing friends.

Zero-Order Correlations
Table 1 provides the zero-order correlation matrix of the variables included in the models in Figures 1 and 2. The correlations are presented for both waves. As Table 1 shows, IM use is positively related to intimate online self-disclosure at Time 1 and Time 2. IM at Time 1 is not significantly related to the quality of existing friendships at Time 1, but it is significantly related to the quality of existing friendships at Time 2. Intimate online self-disclosure is positively related to the quality of existing friendships both at Time 1 and Time 2.

Testing the Hypothesized Models
The hypothesized models (Figures 1 and 2) were tested with structural equation modeling (SEM) using AMOS 7.0. All variables in our models represented latent

Table 1 Zero-Order Correlations Among all Variables in the Model

	IM Use		Online Self-Disclosure		Quality of Friendships	
	Time 1	Time 2	Time 1	Time 2	Time 1	Time 2
IM use						
Time 1	—					
Time 2	.55***	—				
Online self-disclosure						
Time 1	.19***	.14**	—			
Time 2	.17***	.18***	.52**	—		
Quality of friendships						
Time 1	.05	.03	.20***	.17***	—	
Time 2	.08*	.04	.19***	.20***	.54***	—

Note: Instant messaging (IM) use represents the average weekly time in minutes that adolescents spend with IM. Online self-disclosure is the extent to which adolescents talk about intimate topics when using IM (1 = *I tell nothing about this*; 5 = *I tell everything about this*). Quality of friendships reflects adolescents' perceived quality of their existing friendships.
*$p < .05$. **$p < .01$. ***$p < .001$ (two-tailed).

variables, which were estimated from one or two manifest indicators. The latent construct IM use was estimated from the manifest additive scale to measure adolescents' IM use. The loading of the manifest indicator IM use on the latent construct was set to 1, and its error variance to 0 (Kenny, 2002). For intimate online self-disclosure and the quality of existing friendships, 2-item parcels served as indicators. These item parcels were created using a procedure suggested by Russell, Kahn, Spoth, and Altmaier (1998). First, we factor analyzed the items meant to measure each variable. Based on the sizes of the factor loadings, we alternately assigned each item to the first or second item parcel.

Maximum likelihood was the estimation method to test the fit of our model. We used two indices to evaluate the fit of our models: the root mean square error of approximation (RMSEA) and the comparative fit index (CFI). Particularly in the case of large samples, these indices are considered informative criteria in SEM (Byrne, 2001). A good model fit is expressed in an RMSEA value close to .06 and a CFI value close to .95 (Byrne, 2001). For conventional reasons, we also report the chi-square value. A good model fit is indicated by a *non*significant chi-square value. However, in the case of large samples, the chi-square test is often unreliable because it seriously underestimates the model fit (Byrne, 2001).

Crosslagged panel model
Our hypothesized model as presented in Figure 1 fit the data well, $\chi^2(6, N = 812) = 16.32$, $p = .012$, CFI = .997, RMSEA = .046 (90% confidence interval [CI]: 0.020–0.074). The relationship between IM use at Time 1 and the quality of existing friendships at Time 2 was significant ($\beta = .06$, $p < .05$, one-tailed). The path from the

quality of friendships at Time 1 to IM use at Time 2 was not significant ($\beta = .01$, $p = .80$). This latter path was also not significant when we modeled only the reverse causal arrow.

Explanatory model
The explanatory model as presented in Figure 2 (without the dashed arrow) fit the data well, $\chi^2(29, N = 812) = 113.92$, $p < .001$, CFI = .983, RMSEA = .060 (90% CI: 0.049–0.072). Figure 3 shows the final observed model. In agreement with the first part of our mediation hypothesis, the relationship between IM use at Time 1 and intimate online self-disclosure at Time 2 was significant ($\beta = .06$, $p < .05$). In agreement with the second part of our mediation hypothesis, intimate online self-disclosure at Time 2 was positively related to the quality of existing friendships at Time 2 ($\beta = .11$, $p < .001$). The independent and mediator variables accounted for 33% of the variance of the quality of existing friendships.
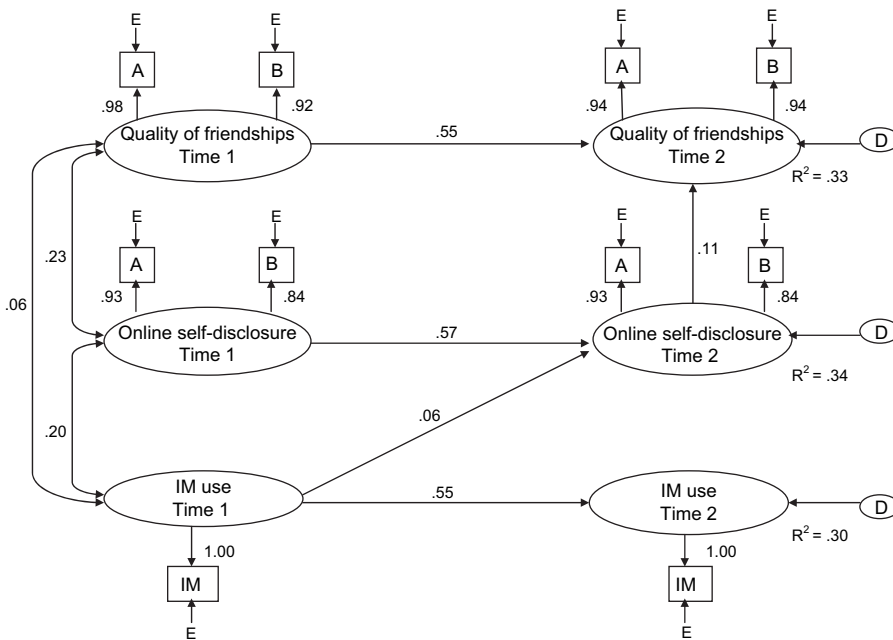

Figure 3 Observed structural model on the relationship between instant messaging use, intimate online self-disclosure, and the quality of existing friendships.

Note: Latent variables are represented by ovals. Indicator variables are represented by rectangles; A and B = first and second parcel of observed items from which the latent constructs are estimated; E = error term of observed variables; D = disturbance term of latent variables. All coefficients are correlations or beta coefficients that are significant at least at $p < .05$ (two-tailed).

To test the robustness of our model, we conducted three additional analyses. First, to rigorously investigate the causal direction of our explanatory hypotheses, we also investigated a model in which intimate online self-disclosure at Time 1 (rather than at Time 2) was related to the quality of friendships at Time 2. This model also fit the data well, $\chi^2(29, N = 812) = 119.59$, $p < .001$, CFI = .982, RMSEA = .062 (90% CI: 0.051–0.074). The influence of intimate online self-disclosure at Time 1 on the quality of friendships at Time 2 was significant ($\beta = .08$, $p < .05$).

Second, the significant relationship between intimate online self-disclosure and the quality of offline friendships may be due to a functional similarity between the friendship quality items measuring support (e.g., how often do you turn to your friends for support when you have a problem?) and the items measuring intimate online self-disclosure (e.g., how much do you usually tell about the things you are worried about?). To investigate this possibility, we reran our model without the items measuring social and emotional support. This model also fit the data satisfactorily, $\chi^2(29, N = 812) = 143.44$, $p < .001$, CFI = .976, RMSEA = .070 (90% CI: 0.059–0.081). The relationship between IM use at Time 1 and online intimate self-disclosure at Time 2 remained the same (i.e., $\beta = .06$, $p < .05$). The relationship between intimate online self-disclosure at Time 2 and the quality of existing friendships at Time 2 decreased from $\beta = .11$ to $\beta = .06$ but remained significant at $p < .05$ (one-tailed).

Finally, we investigated reverse relationships between IM use, intimate online self-disclosure, and the quality of friendships. To do so, we modeled two extra paths in our explanatory model as presented in Figure 2: one from intimate online self-disclosure at Time 1 to IM use at Time 2, and another from the quality of friendships at Time 1 to intimate online self-disclosure at Time 2. Intimate online self-disclosure at Time 1 did not significantly predict IM use at Time 2 ($\beta = .04$, $p = .19$). The quality of existing friendships at Time 1 did predict intimate online self-disclosure at Time 2 ($\beta = .07$, $p < .05$), which indicates that the longitudinal relationship between intimate online self-disclosure and the quality of friendship is reciprocal rather than unidirectional. This reciprocal relationship is theoretically plausible (e.g., Buhrmester & Prager, 1995) and does not reduce the validity of our Internet-enhanced intimate self-disclosure hypothesis. The coefficients of the hypothesized paths did not change when the reversed paths were included in the model.

Testing the Validity of the Mediator Intimate Online Self-Disclosure

Hypotheses H2A, H2B, and H2C in Figure 2 stated that intimate online self-disclosure would mediate the relationship between IM use at Time 1 and the quality of existing friendships at Time 2. We first used a SEM approach to test whether the effect of IM use at Time 1 on the quality of friendships at Time 2 was mediated by intimate online self-disclosure. A SEM approach to mediation is similar to Baron and Kenny's (1986) causal steps approach in two respects. First, it also tests whether the independent variable (IM use) influences the mediating variable (intimate online self-disclosure; H2A), and whether the mediator, in turn, influences the dependent variable (quality of

existing friendships; H2B). Second, it also tests whether the influence of the independent variable on the dependent variable disappears when the mediating variable is included (H2C).

In our SEM causal steps approach, we tested a nested model under two conditions: When the direct path from IM use at Time 1 to the quality of existing friendships at Time 2 was constrained to 0 and when it was allowed to vary. Mediation is warranted if the model with the constrained path does not improve the model's fit because, in that case, the direct path from IM use at Time 1 to the quality of friendships at Time 2 is not significant. Our results showed that the model containing the constrained path did not lead to a significant chi-square change, $\chi^2(1, N = 812) = 1.46, p = .23$, $\text{TLI}_{\text{change}} = -.001$. This meant that the effect of adolescents' IM use on the quality of their existing friendships was entirely mediated by intimate online self-disclosure.

We subsequently performed a formal significance test of the indirect effect using a bootstrap procedure suggested by Preacher and Hayes (2004). In this bootstrap procedure, a computer generates a series of samples of size n (where n is the original sample size) from the data. In each bootstrap sample, the indirect effect is computed. A CI for the indirect effect is then computed across all the bootstrap samples. If this CI includes 0, the indirect effect is nonsignificant; if it does not include 0, the indirect effect is significant.

We used the bootstrap procedure (1,000 samples, $N = 812$) to generate a 95% bias-corrected and accelerated CI for the indirect effect of adolescents' IM use at Time 1 on the quality of their friendships at Time 2. As expected and in agreement with our crosslagged panel model, the effect of IM use at Time 1 on the quality of existing friendships at Time 2 was significant, $B = .0402$, $SE = .0205$, $t = 1.96$, $p < .05$. However, when the mediator intimate online self-disclosure was included in the model, this effect disappeared, $B = .0284$, $SE = .0206$, $t = 1.38$, $p = .17$.

The indirect effect of IM use at Time 1 on the quality of existing friendships at Time 2 through intimate online self-disclosure at Time 2 was significant: $B = .0118$, $SE = .005$, $t = 2.36$, $p < .05$. The 95% bias-corrected and accelerated CI for this indirect effect was estimated to lie between 0.0044 and 0.0226. Because 0 is not in this confidence interval, it is safe to conclude that the indirect effect was significantly different from 0 at $p < .05$ (see Preacher & Hayes, 2004 for a detailed explanation of this procedure).

Developmental Differences

To investigate whether our Internet-enhanced intimate self-disclosure hypothesis held for all age groups, we performed a multiple group analysis with age as the grouping variable (10- to 11- vs. 12- to 13- vs. 14- to 15- vs. 16- to 17-year-olds). The unconstrained model for the three age groups yielded a good fit, $\chi^2(116, N = 812) = 455.67$, $p < .001$, CFI = .983, RMSEA = .030 (90% CI: 0.027–0.033). Constraining both the measurement weights and the structural weights did not lead to

a significant chi-square change, $\chi^2(27, N = 812) = 0.00$, $p = 1.00$. This suggests that the model held for preadolescents, early adolescents, and middle adolescents.

Discussion

The first aim of this study was to investigate the longitudinal relationships between IM use and the quality of adolescents' existing friendships. With the exception of the studies by Kraut et al. (1998, 2002), our study is the first Internet-effects study that has applied a more rigorous longitudinal design. We found that virtually all adolescents use IM to communicate with their existing friends. IM use increased the quality of existing friendships, whereas the quality of friendships did not influence IM use. These results suggest that the positive relationships found in earlier research cannot be explained with the argument that adolescents with high-quality friendships more often turn to IM. Rather, our results suggest that adolescents seem to use IM successfully to satisfy one of their most vital developmental needs: the maintenance of existing friendships.

The second aim of our study was to investigate the validity of our Internet-enhanced intimate self-disclosure hypothesis. The majority of earlier research has focused on direct effects of Internet use on social involvement variables, without hypothesizing on possible mediating variables that may explain these effects. Our study was designed to investigate one potential process that may underlie the positive effects that have been found in earlier studies: intimate online self-disclosure.

Our Internet-enhanced intimate self-disclosure hypothesis assumed that IM use would stimulate adolescents to disclose themselves intimately on the Internet. This enhanced intimate online self-disclosure would in turn stimulate the quality of their existing friendships. All assumptions of our Internet-enhanced self-disclosure hypothesis were supported. Intimate online self-disclosure proved to be a valid explanation for the positive effect of IM use on the quality of existing friendships. IM apparently enables adolescents to talk about more intimate topics with their friends than they do in offline settings, which, in turn, enhances the quality of their friendships.

Since the advent of the Internet, both survey and experimental CMC research has demonstrated that online communication enhances intimate online self-disclosure. However, in these effects studies, self-disclosure was usually conceptualized as a dependent variable. Our study is one of the first in which self-disclosure was conceptualized as a mediating variable. We used both earlier CMC theories and interpersonal communication theories about self-disclosure to hypothesize about the consequences of online self-disclosure for adolescents' existing friendships. Such an approach, in which CMC and Internet-effects theories are integrated with interpersonal communication theories, has been underutilized in earlier research on the social consequences of the Internet. Not only does such an approach advance beyond simple main effects accounts of Internet use, it also leads to more adequate models

that help us understand the underlying parameters that explain the Internet–social development relationship.

We found a reciprocal relationship between intimate online self-disclosure and the quality of existing friendships. This result suggests an Internet-induced 'close-get-closer' effect: Adolescents who disclose more online develop higher quality friendships, and these same adolescents are in turn more inclined to disclose to these friends. Such reinforcing spiral effects have recently been discussed in the communication literature (Slater, 2007). Outcomes of a particular media use often reinforce this media use, particularly when these outcomes are related to personal or social identity (Slater, 2007). This reciprocal effect also fits in modern conceptions of relationship development, in which self-disclosure and relationship development are seen as mutually constituting each other (e.g., Duck, 2007).

Limitations of the Present Study and Suggestions for Future Research

This study has demonstrated positive effects of adolescents' online communication on the quality of their friendships. However, we focused on a technology—IM—that favors communication with existing friends. We asked adolescents how much they disclosed *while using IM*. Because virtually all adolescents use IM to communicate with their existing friends, self-disclosure via IM inherently means self-disclosure to existing friends. Future researchers should realize that our positive longitudinal effects may hold only for IM use and not necessarily for other types of Internet use. For example, Valkenburg and Peter (2007c) did not find any positive effects of adolescents' use of chat (in public chatrooms) on the quality of their existing friendships. Unlike IM, chat is often used to talk to strangers, and, as a result, self-disclosure via chat inherently involves other target persons. It is important for future research to differentiate between different uses of online communication technologies, as there is a risk of finding unjust effects when this is not done.

We hypothesized that intimate online self-disclosure would act as a mediator between IM use and the quality of existing friendships. We selected intimate self-disclosure as a mediator because earlier literature indicated that this variable is related to both IM use and the quality of friendships. However, it is possible that other communication or psychological processes, such as understanding, investment, liking, uncertainty management, breadth of interaction, and commitment shape or account for potential social effects of the Internet. We hope that our study will inspire future researchers to pay attention to other potential mediators that may explain the social consequences of the Internet. Future research should also be designed to compare the validity of our hypothesis with that of other explanatory hypotheses.

We have demonstrated that the positive effect of IM can be attributed to enhanced intimate online self-disclosure. However, it must be noted that the same liberating or disinhibiting mechanisms of online communication, which have led to the positive outcomes in our study, can also have many negative effects, such as flaming, online harassment, and cyberbullying. Our study must not be

misunderstood as an apotheosis of the Internet. There is definitely a need for more research to identify the conditions under which adolescents may experience potential adverse effects of different forms of online communication and how they can be educated about such effects.

Acknowledgments

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Los Efectos de los Mensajes Instantáneos sobre La Calidad de las Amistades Existentes de los Adolescentes: Un Studio Longitudinal

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Resumen

Estudios recientes sugieren que el envío de Mensajes Instantáneos (IM) está positivamente relacionado con la calidad de las amistades existentes de los adolescentes. Sin embargo, muchos de estos estudios están basados en los datos transversales correlacionados. Además muchos de estos estudios se han enfocado en los efectos directos de IM sobre la calidad de las amistades sin explorar las variables mediadoras que pueden explicar esos efectos. El objetivo de este estudio fue completar estos dos vacios en la literatura. Hipotetizamos que IM, que es mayormente usado para comunicar entre amigos existentes, estimula la calidad de la amistad, a través de su potencial para estimular la revelación personal íntima online. Una muestra de 812 adolescentes Holandeses entre 10 y 17 años de edad fue encuestada dos veces dentro de un intervalo de 6-meses. IM tuvo un efecto longitudinal positivo sobre la calidad de las amistades existentes de los adolescentes. Este efecto positivo directo puede ser explicado completamente por la tendencia de los adolescentes a revelar información íntima online.

即时通讯对青少年现有友谊质量的影响：一份纵向研究

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摘要

最近的研究表明，即时通讯（IM）对青少年现有的友谊质量起积极的作用。但此类研究大部分是基于横向和关联性的数据。此外，大部分的研究着眼于 IM 对友谊质量的直接影响，而未探讨也许能解释这些影响的中介因素。本研究旨在填补先前研究中的这两个空白。我们假设 IM 有激发亲密性和**即时**自我表露的潜力，来加强与现有朋友的联系，并促进友谊的质量。我们在 6 个月内对 812 个 10 到 17 岁的荷兰青少年进行了问卷调查。我们发现 IM 对青少年友谊质量有积极而纵向的影响。青少年**即时**表露隐秘信息的倾向可完全解释上述直接、积极的影响。

대 청소년들의 친구간 우정의 질에있어 인스턴트 메시지의 효과: 종단연구

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요약

최근의 연구들은 인스턴트 메시지 (IM)가 10대 청소년들의 우정의 질에 긍정적으로 연계되어 있다는 것을 보여주고 있다. 그러나, 대부분의 이들 연구들은 횡단상관관계 자료에 근거한 것 들이다. 게다가 대부분의 연구들은 이러한 효과들을 설명할 수도 있는 중재변수들에 대한 연구없이 우정의 질에 대한 IM의 직접적인 효과에만 중점을 두어왔다. 본 연구의 목표는 기존의 연구에서의 이러한 두가지 부족한 점에 대한 보완에 중점을 두고있다. 본 연구는 현재의 친구들과 이야기 하기 위해 가장 자주 사용하는 IM이 친밀한 온라인 자기 정보공개를 자극하려는 잠재성을 통해 우정의 질을 자극하려 한다고 가정하였다. 모두 10세부터 17세까지의 812명의 네덜란드인을 대상으로 6개월간격을 두고 두번의 조사가 단행되었다. IM은 10대 청소년들의 우정의 질에 대한 긍정적인 종단효과를 보여주었다. 이러한 직접적인 긍정적인 효과는 친밀한 정보 온라인을 공개하려는 10대 청소년들의 경향에 의해 설명되어질 수도 있는 것이다.