Social Media Use and Friendship Closeness in Adolescents' Daily Lives:

An Experience Sampling Study

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Abstract

The formation and maintenance of friendship closeness is an important developmental task in adolescence. In order to obtain insight in real-time processes that may underly the development of friendship closeness in middle adolescence, this preregistered experience sampling study [ESM] investigated the effects of social media use on friendship closeness. The study was conducted among 387 adolescents (54% girls, M_{age} = 14.11 years; 96% Dutch) from different educational tracks (44% lower prevocational secondary educational; 31% intermediate general secondary education; 26% academic preparatory education). Adolescents reported six times per day for three weeks on their Instagram, WhatsApp, and Snapchat use in the previous hour and their momentary experiences of friendship closeness (126 assessments; 34,930 observations). Multi-level analyses revealed positive between-person associations of friendship closeness with general WhatsApp use and Instagram use with close friends. In contrast, at the within-person level, we found small negative overall associations of general WhatsApp use and Instagram use (with and without close friends) with friendship closeness. However, there was large heterogeneity in the person-specific effect sizes of the within-person associations of social media use with friendship closeness. For example, person-specific effect sizes of the association of Instagram use with close friends with friendship closeness ranged from β = -.745 to β = +.697. These results underline the importance of acknowledging person-specific effects in developmental and media effect theories.

Keywords: Adolescence, Ambulatory Assessment, Diary, Friendship Quality, Social Network Site Use (SNS use), Individual Differences.

Social Media Use and Friendship Closeness in Adolescents' Daily Lives:

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The formation and maintenance of close friendships is an important developmental task in adolescence (Berndt, 2002). Close friendships are characterized by supportiveness, accessibility, and responsiveness, and fulfill adolescents' need for intimacy (Armsden & Greenberg, 1987; Furman & Buhrmester, 1985; Sullivan, 1953). Until one to two decades ago, friendships were predominantly maintained through face-to-face interactions, but nowadays, virtually all adolescents use social media on a daily basis to connect with their friends (Rideout & Robb, 2018; van Driel et al., 2019). As friendship closeness in adolescence contributes to a successful psychosocial development later in live, previous studies have started to examine whether the development of friendship closeness could be promoted through social media use (Nesi et al., 2018; Yau & Reich, 2018). By now, several empirical studies (e.g., Antheunis et al., 2014; Rousseau et al., 2019) and at least four reviews (Nesi et al., 2018; Uhls et al., 2017; Valkenburg & Peter, 2011; Yau & Reich, 2018) have examined the association between social media use and friendship closeness among adolescents. Overall, this work suggests that different types of social media use are related to higher levels of friendship closeness (e.g., intensity of Hyves use, Antheunis et al., 2014; Facebook relationship maintenance behavior, Rousseau et al., 2019; duration of instant messaging, Valkenburg & Peter, 2007; Valkenburg & Peter, 2009a).

Although researchers seem to agree that social media use can benefit friendship closeness, three pressing questions that arise from the literature are yet to be answered. The first question pertains to real-time processes that may underly the development of friendship closeness (Granic, 2005). Previous longitudinal studies have shown that adolescents' social media use is related to friendship closeness across relatively long time intervals of 6 months (Rousseau et al., 2019; Valkenburg & Peter, 2009a). However, as adolescents use social

media throughout the day to share their current thoughts and feelings with close friends (Rideout & Robb, 2018), social media use may also be related to friendship closeness across smaller time intervals of weeks, days, or even hours (Kahlow et al., 2020). According to dynamic system theories of adolescent development, these short-term, momentary fluctuations in friendship closeness may shape longer-term developmental change in well-being and social relationships (Granic, 2005; Hinde, 1997). Therefore, it is important to understand to what extent these momentary fluctuations are induced by adolescents' social media use. As such, the first aim of this study was to investigate in-the-moment co-fluctuations of social media use and friendship closeness in adolescents' daily lives.

A second unanswered question is whether it is interaction with close friends that drives the effect of social media use on friendship closeness. Most studies have investigated how the frequency or intensity of social media use predicts friendship closeness (Antheunis et al., 2014; Lee, 2009; Valkenburg & Peter, 2007, 2009a) without discerning whether this social media use concerned interactions with friends. As interactions with friends are the building blocks of friendship closeness (Hartup, 1996), adolescents may experience higher levels of momentary friendship closeness after using social media *with* close friends than after using social media *without* close friends (Yau & Reich, 2018). Hence, the second aim of this study was to test this hypothesis by examining how friendship closeness is related to occasions when social media is used to interact *with* close friends versus occasions when social media is used *without* close friends. Social media use *without* close friends included all occasions on which adolescents had used social media to interact with non-close-friends, such as peers, parents, and strangers, as well as all occasions on which they had used social media without interacting with anyone.

A third and final unanswered question is whether different social media platforms yield different effects on friendship closeness. Most previous research has focused on the

effects of one social media platform on friendship closeness (e.g., MSN, Hyves or Facebook; Antheunis et al., 2014; Lee, 2009; Rousseau et al., 2019; Valkenburg & Peter, 2007, 2009a). However, today's adolescents use multiple social media platforms in functionally complementary ways (van Driel et al., 2019; Waterloo et al., 2017) and use some platforms more frequently to communicate with their friends than others. Therefore, the third aim of this study was to investigate the differential effects of the three most popular social media among Dutch adolescents (i.e., Instagram, WhatsApp, and Snapchat; van Driel et al., 2019) on friendship closeness.

To get insight in the association of Instagram, WhatsApp, and Snapchat use with adolescents' momentary friendship closeness, we conducted a preregistered experience sampling method (ESM) study. This study was conducted among 387 middle adolescents whom we surveyed 6 times a day for three weeks. In order to be able to compare the findings of our study with the findings of previous research (Antheunis et al., 2014; Rousseau et al., 2019), we first investigated the associations of general social media use with friendship closeness, before we examined the associations of social media use *with* versus *without* close friends and friendship closeness. We focused on middle adolescence (13-15 years), as this is the period in which friends become more supportive and important, adolescents start to spend more time with friends, and start to value physical and emotional intimacy in these friendships (De Goede et al., 2009; Sullivan, 1953). Middle adolescents may therefore be particularly attracted to social media, because social media provide them the opportunity to stay in touch with their friends near constantly and stimulate the exchange of intimate information (Nesi et al., 2018; Uhls et al., 2017), which are both key driving forces of adolescents' friendship formation and maintenance (Furman & Buhrmester, 1985).

Momentary Social Media use and Momentary Friendship Closeness

Most previous research has focused on the effects of (mostly) older social media

platforms on friendship closeness (e.g., MSN, Hyves or Facebook; Antheunis et al., 2014; Lee, 2009; Rousseau et al., 2019; Valkenburg & Peter, 2007, 2009a). Many of the affordances of these older social media platforms are comparable to more recent ones (boyd, 2014), and, as a result, these studies may at least partly inform us about how today's adolescents' social media use may be related to their friendship closeness. For example, MSN is comparable to WhatsApp and parts of Snapchat, as all of these platforms are mostly used for more private and direct forms of interaction, whereas both Facebook and Hyves are comparable to Instagram, as all of these platforms are mainly used for public forms of communication such as posts, likes, and comments (Valkenburg & Piotrowski, 2017).

Previous research on social media use and friendship closeness has often been informed by the *stimulation hypothesis*. This hypothesis proposes that due to the reduction of social cues in social media interactions, adolescents may become less concerned about how others perceive them (Valkenburg & Peter, 2009a). Accordingly, they may feel more comfortable to self-disclose intimate information via social media with their close friends than via offline conversations, which, in turn, stimulates the closeness of these friendships (Trepte et al., 2018; Valkenburg & Peter, 2009a; Yau & Reich, 2018). The stimulation hypothesis received support in different types of studies: Cross-sectional studies showed that adolescents who spent more time on social media than their peers experienced higher levels of friendship closeness (e.g., intensity of Hyves use, Antheunis et al., 2014; frequency of using e-mail/chat room/instant messaging, Lee, 2009; time spent on chatting/instant messaging, Valkenburg & Peter, 2007). In addition, longitudinal studies found that adolescents who spent more time on messaging (Valkenburg & Peter, 2009a) and who displayed higher rates of Facebook relationship maintenance behavior (e.g., commenting on a friend's post, Rousseau et al., 2019) than their peers showed higher levels of friendship closeness six months later.

These previous studies have typically used trait-like measures of friendship closeness, such as the Peer Attachment Inventory (Armsden & Greenberg, 1987) or the Network of Relationships Inventory (Furman & Buhrmester, 1985). Such trait measures tap into relatively stable global perceptions of friendship closeness based on adolescents' general perception of their friendship across multiple weeks or months. Research among college students has shown that in addition to trait-like levels of friendship closeness, persons may also experience state-like levels of friendship closeness that are context-dependent and fluctuate throughout the day (Bayer et al., 2016; Kahlow et al., 2020), suggesting that social media use may also trigger momentary changes in feelings of friendship closeness within a person.

Different theories, including the transformation framework (Nesi et al., 2018), explain that social media use may be related to momentary fluctuations in friendship closeness due to the accessibility affordance of social media (e.g., boyd, 2011; Moreno & Uhls, 2019). Adolescents have countless possibilities to communicate and stay in touch with their close friends via social media, regardless of whether they are at home, at school, or in the sports club. In fact, many social media platforms explicitly prompt their users to share their current thoughts, feelings, and experiences with their friends and, by doing so, invite immediate support or positive feedback from these friends (Bayer et al., 2016; Waterloo et al., 2017). Never before have adolescents had the opportunity to share so many in-the-moment experiences with their close friends. And never before have they had the opportunity to receive so much immediate positive feedback and emotional support from these friends when sharing their experiences (Bayer et al., 2016; Kahlow et al., 2020; Yau & Reich, 2018).

Positive feedback and emotional support from peers are among the most important building blocks of friendship closeness (Rousseau et al., 2019). As adolescents' social media use predominantly leads to positive feedback from peers (Koutamanis et al., 2015; van Driel

et al., 2019) and negative friendship interactions are scarce (De Goede et al., 2009), it is likely that for most adolescents (but not for all), social media interactions with their friends enhance momentary feelings of friendship closeness (Ellison et al., 2014; Rousseau et al., 2019). This assumption received support from a study by Kahlow et al. (2020), which found that young adults who sent more text or voice messages via Snapchat than their peers on one day, experienced higher levels of relational closeness the next day. Moreover, descriptive survey studies have shown that the majority of adolescents believe that social media use enriches existing friendships, because it enables them to easily keep up with their friends on a daily basis (Pew Research Center, 2018; Rideout & Robb, 2018) and helps them to understand their friends' feelings and daily lives (Lenhart, 2015). Thus, based on the idea that adolescents predominantly use social media to interact with their friends (Valkenburg & Peter, 2009a; van Driel et al., 2019), it is plausible that social media use stimulates friendship closeness in daily life.

In the present study, we aimed to examine whether the positive *between*-person association between social media use and friendship closeness that has been found in previous studies also exists at a shorter time span and operates similarly at the *within*-person momentary level. That is, if we are interested in knowing whether social media use actually *stimulates* closeness to existing friends, we need to disentangle social media-induced fluctuations in friendship closeness within single adolescents from social media-induced differences in friendship closeness *between* adolescents (Beyens et al., 2020; Prinstein et al., 2020). We assessed adolescents' levels of social media use and friendship closeness across 126 momentary assessments. By averaging these momentary assessments, we were able to obtain a general measure of friendship closeness and social media use across a three-week period. We hypothesized that adolescents who used social media more frequently across the three weeks would also experience higher average levels of friendship closeness than

adolescents who used social media less frequently (i.e., positive between-person level association, H1a). And we expected that adolescents would experience higher levels of friendship closeness after using social media in the previous hour as compared to when they had not used social media (i.e., positive within-person level association; H1b).

Social Media Use With Close Friends

In the early days of the Internet, online social interactions were limited to small groups of early adopters, who mainly interacted with strangers online, but since the introduction of the newer generation social media like Instagram, Snapchat, and WhatsApp, adolescents use social media predominantly to maintain existing relationships (Rideout & Robb, 2018; Valkenburg & Peter, 2009b; van Driel et al., 2019). It is no surprise, then, that many previous social media effect studies on friendship closeness have conceptualized time spent with social media or online relationship maintenance behavior as a proxy for time spent with close friends via social media. Even though the stimulation hypothesis proposes that interactions with close friends drive the effect of social media use on friendship closeness, this assumption has not been tested directly.

Research on messaging suggests that online communication is only positively related to friendship closeness when it is used for communication with peers whom adolescents know in real life, but not when it is used for communication with strangers (Valkenburg & Peter, 2007; Wang et al., 2011). Some other studies found that especially social types of communication, such as Facebook relationship maintenance behaviors or one-on-one communication, are positively related to friendship closeness and tie strength (Burke & Kraut, 2014; Rousseau et al., 2019; Wang et al., 2014). However, these social communication activities did not exclusively pertain to close friends, but also to parents, peers, acquaintances, and even strangers they met online. In line with the social displacement hypothesis (Kraut et al., 1998), one may expect that especially on occasions when social

media is used *without* close friends, it may displace the time adolescents spend on face-to-face interactions with their close friends and reduce friendship closeness. Although this idea is not unequivocally supported (see e.g., Dienlin et al., 2017; Hall et al., 2019), there are some recent studies among (young) adults suggesting that digital media use may be at the expense of face-to-face contact with close friends (e.g., Facebook use, Allcott et al., 2020; smartphone use, Verduyn et al., 2020; ICT use, Vilhelmson et al., 2018). Moreover, 40% of the adolescents confirm this idea, because they believe that social media take away time that they could otherwise have spent with their close friends in real life (Rideout & Robb, 2018).

Based on the assumption that friendship closeness may be enhanced via social media use through online interaction with close friends, we hypothesized that adolescents who had been more frequently in touch with close friends via social media across the three weeks would experience higher average levels of friendship closeness than adolescents who had been less frequently in touch with close friends (i.e., positive between-person level association, H2a). In addition, based on the social displacement hypothesis, we expected that adolescents would experience higher levels of friendship closeness after using social media *with* their close friends in the previous hour as compared to using social media *without* close friends (i.e., positive within-person level association, H2b).

Different Platforms, Differential Effects

Adolescents use different social media in functionally complementary ways, and each of these platforms may therefore be related to friendship closeness in a unique way (Phua et al., 2017; Waterloo et al., 2017). Instagram is mainly used for positive self-presentation to a large audience, which is a type of social media use that may be unrelated to friendship closeness (Burke & Kraut, 2014; McEwan et al., 2018; Waterloo et al., 2017). In contrast, WhatsApp and Snapchat are mainly used to privately communicate with close others such as friends (Vaterlaus et al., 2016; Waterloo et al., 2017). Due to the private nature of WhatsApp

and Snapchat, adolescents also share more ludic content and intimate information with their friends via these platforms than via Instagram (Boczkowski et al., 2018; Moreno & Uhls, 2019; van Driel et al., 2019; Vaterlaus et al., 2016; Waterloo et al., 2017). As humor and intimate self-disclosure play an important role in friendship maintenance (Martin & Ford, 2018; Trepte et al., 2018), we hypothesized that WhatsApp and Snapchat use would be more strongly positively associated with friendship closeness than Instagram use, both at the between-person (H3a) and within-person level (H3b).

Method

Sample Characteristics

This preregistered study (https://osf.io/7vszj) was part of a larger project on adolescents' social media use and psychosocial functioning. The present study used data from the first experience sampling method (ESM) wave of this project. The sample consisted of 387 students (54% girls) with a mean age of 14.11 years (*SD* = .69). Students were enrolled in different educational tracks: 44% were in lower prevocational secondary education (VMBO), 31% in intermediate general secondary education (HAVO), and 26% in academic preparatory education (VWO). Of all participants, 96% was born in The Netherlands and self-identified as Dutch, 2% was born in another European country, and 2% in a country outside Europe. The sample was a fairly accurate representation of this specific area in the Netherlands in terms of educational level and ethnic background (Statistics Netherlands, 2020).

Procedure

Sample Recruitment and Selection

The research project titled "*Longitudinal research on adolescents' social media use and well-being*" (2019-YME-11162) has been approved by the Ethics Review Board of the Faculty of Social and Behavioral Sciences of the University of Amsterdam. A priori power analyses for our main project (power .80; within-person effect size of .07, α = .05, see

https://osf.io/ar4vm/) indicated that a sample size of 300 participants would be needed. We took potential attrition and the consent rates of two earlier studies into account (i.e., 46% in Dietvorst et al., 2018 & 42% in Beyens et al., 2020). We invited 745 students from a large school in the Netherlands (i.e., all students in Grade 8 and 9) to participate in our study. Of these students, 400 received active parental consent to participate in the first ESM wave of the project and 388 provided informed consent themselves. One participant withdrew from this study before the start of the first ESM wave, which resulted in a final sample of 387 participants.

Baseline Session

In November 2019, students participated in a classroom baseline session in which the researchers informed them about all stages of the study and assured them that their answers would be anonymized and treated in a confidential way. During this instruction session, students completed a baseline survey in which we asked them to indicate their number of close friends and to provide a definition of close friendships. They were also asked to install the Ethica Data app on their own phone that was used to complete the ESM surveys. At the end of the baseline session, students completed an initial survey on their social media use via the Ethica app. In this initial Ethica survey, we asked them to indicate which social media platforms they used more than once a week, on which we based the subsequent personalized ESM questionnaires. Three researchers were present to answer adolescents' questions and to help them with the installation of the app.

ESM Surveys

The ESM study took part in the three weeks following upon the baseline session, in December 2019. Through the Ethica app, adolescents were prompted six times per day to fill out a survey of approximately 2 minutes (23 items). Adolescents received one additional closed question at the beginning of each day and an additional open question at the end of

each day. Adolescents only received questions about their usage of Instagram, WhatsApp, and Snapchat if they indicated on the initial Ethica survey that they used these platforms more than once a week. Adolescents who used any of these platforms less frequently, received questions about their usage of other social media platforms (i.e., YouTube or gaming) or other activities. In total, adolescents received 126 surveys.

Sampling Scheme

Following recent guidelines for designing ESM studies among adolescents (van Roekel et al., 2019) and based on Beyens et al. (2020), a semi-random sampling scheme was chosen. This avoided structural patterns in friendship closeness, while taking into account that adolescents were only allowed to use their phone during break time when they were at school. At weekdays, adolescents received one notification before school time, two notifications during the school breaks, and three notifications after school time. At weekend days, they received one notification in the morning, three notifications in the afternoon, and two notifications in the evening. The response time windows were adjusted to the time of the day to take travel time to school and individual differences in evening rituals into account. Adolescents had to respond within a time window of 60 minutes for the first morning surveys, 120 minutes for the last evening surveys, and 30 minutes for all other surveys. Adolescents received automatic reminders within 5 to 10 minutes after each ESM notification. The exact notification scheme can be found on OSF (https://osf.io/tbdjq/).

Monitoring Plan and Incentives

During the study, we sent direct messages to the adolescents to check whether we could help with any technical issues and to motivate them to fill out as many questionnaires as possible. Adolescents received a financial compensation of €0.30 for each completed questionnaire. In addition, each day, we raffled off 4 times €25,- among all adolescents who completed all six surveys the previous day.

Compliance

We sent a total number of 48,762 surveys. However, due to some unforeseen technical issues, 862 surveys (1.77%) were not received by the students. Accordingly, adolescents received 47,900 surveys, of which 34,930 (73%) were completed, resulting in a good compliance rate in comparison with other ESM studies among adolescents (van Roekel et al., 2019). On average, adolescents completed 90.26 out of 126 surveys ($SD = 23.84$).

Measures

Friendship Closeness

In line with previous research (Bayer et al., 2016; Lee, 2009), we measured friendship closeness with a single item: "How close to your close friends do you feel right now?". Adolescents responded on a 7-point scale, ranging from 1 "not at all" to 7 "completely", with 4 "a little" as midpoint. We specifically focused on close friends to ensure that adolescents did not consider all their social media connections as friends. Adolescents in this sample defined close friends as peers with whom they spend time and have fun, who provide support and whom they can trust and count on, with whom they feel at ease to disclose intimate personal information, and with whom they can be their authentic self. These characteristics are in line with the definition of friendship by Armsden and Greenberg (1987) and align with the social provisions that characterize friendship (Furman & Buhrmester, 1985). On average, adolescents had 8.76 close friends ($SD = 6.19$).

Social Media Use

We measured the most popular activities adolescents engaged in on Instagram, WhatsApp, and Snapchat. These activities were selected based on a recent national survey by van Driel et al. (2019). We asked adolescents to indicate how much time they had spent in the previous hour using Instagram (3 items: viewing posts/stories of others; reading direct messages; sending direct messages), WhatsApp (2 items: reading direct messages; sending

direct messages), and Snapchat (5 items: viewing stories of others; viewing snaps; sending snaps; reading direct messages; sending direct messages). Adolescents responded on a scale with answer categories ranging from 0 to 60 minutes with 1-minute intervals. We did not measure active public use of Instagram and Snapchat (e.g., posting a picture or story), because a recent survey study showed that these activities do not occur frequently enough to be assessed multiple times per day (van Driel et al., 2019).

Social Media Use with Close Friends

Social media use with close friends was measured with one question that asked whether adolescents had been in touch with their close friends in the previous hour. The multiple answer options were: yes, …. via Instagram, via WhatsApp, via Snapchat, face-to-face, in another way, or no. Before the start of the study, we conducted interviews with 34 adolescents to become familiar with their jargon and their uses of different social media platforms. From these interviews we learned that adolescents use the Dutch translation of "being in touch" to refer to directed, targeted communication.

Indices

Instagram/WhatsApp/Snapchat use. Based on the social media use measure and social media use with close friends measure, we created a dummy per platform for each assessment (e.g., 0 = no Instagram use; 1 = Instagram use). If adolescents reported that they had been in touch with close friends via a certain platform according to the "social media use with close friends" measure (e.g., because they may have used the video chat function), but did not report using this social media platform according to the "social media use" measure, we coded their response on the social media use variable as 1 (instead of 0). We also computed the person mean of each dummy variable, which reflects the proportion of occasions during which participants used a particular platform (e.g., a person mean of .70 indicates that an adolescent used Instagram at 70% of all occasions). Within-person

correlations between the specific social media activities belonging to one platform ranged

from $r = .56$ to .84. Between-person correlations between the specific social media activities

belonging to one platform ranged from $r = .86$ to 1.00. These strong correlations confirm that

the social media activity items can be grouped together to compute one dummy variable per

platform.

Social Media Use With and Without Close Friends. Per assessment we created

dummy variables for social media use *with* close friends: 0 = no

Instagram/WhatsApp/Snapchat use *with* close friends; 1 = Instagram/WhatsApp/Snapchat use

with close friends). We also created the person mean of each dummy variable (e.g., a person

mean of .70 indicates that an adolescent used Instagram *with* close friends at 70% of all

occasions). A similar procedure was used to create a dummy variable and for

Instagram/WhatsApp/Snapchat use *without* close friends (0 = no Instagram/WhatsApp/

Snapchat use *without* close friends; 1 = Instagram/WhatsApp/Snapchat use *without* close

friends) and the person means of these dummy variables. These dummy-coded variables

allowed for the comparison of occasions when adolescents used media with and without close

friends, as well as occasions when they did not use any social media at all.

Statistical Analyses

Unless indicated otherwise, we exactly followed our preregistered analysis plan

(https://osf.io/7vszj) and examined associations of Instagram, Snapchat, and WhatsApp use

with friendship closeness by means of multi-level modelling in M*plus* 8.4 (Muthén &

Muthén, 2017). We ran two-level models in which the repeated momentary ESM assessments

(level 1) were nested within adolescents (level 2). To avoid multicollinearity (see Supplement

1), the three platforms were analyzed in three separate sets of analyses. We estimated four

models per platform. In all models, we person-mean centered all categorical and continuous

within-person variables (Level 1) to control for between-person effects (Wang & Maxwell,

2015). Between-person variables were grand-mean centered (Level 2).

For each platform, in Model 1 (the intercept only model), we determined the relative amount of within-person and between-person variance (i.e., intraclass correlation). In Model 2 (the reference model), we added two fixed covariates to the model, *Weekday vs. Weekend day* (Level 1) and *notification number of the day* (Level 1), to detrend the data. This is helpful to interpret within-person associations as correlated fluctuations beyond other changes in social media use and friendship closeness (Wang & Maxwell, 2015). In Model 3 (fixed effects model), we determined the within-person and between-person associations of social media use with friendship closeness, by adding the fixed within-person effect of Instagram/WhatsApp/Snapchat use (Level 1) and the between-person effect of adolescents' average level of Instagram/WhatsApp/Snapchat use across the three weeks (Level 2).

Finally, in Model 4, we determined the within-person and between-person associations of Instagram/WhatsApp/Snapchat use *with* and *without* close friends with friendship closeness. For the ease of interpretation, we used an alternative specification of the preregistered model. Specifically, we estimated the within-person fixed effects of Instagram/WhatsApp/Snapchat use *with* close friends and *without* close friends with two Level 1 dummy variables (Dummy 1: 0 = no Instagram/ WhatsApp/Snapchat use *with* friends; 1 = Instagram/WhatsApp/Snapchat use *with* close friends; Dummy 2: 0 = no Instagram/WhatsApp/Snapchat use *without* close friends, 1 = Instagram/WhatsApp/Snapchat use *without* close friends; Level 1). At the between-person level, we estimated the associations of adolescents' average level of Instagram/WhatsApp/Snapchat *with* close friends and *without* close friends across the three weeks (Level 2). As this alternative specification of Model 4 resulted in an identical overall model fit as the preregistered Model 4 in which we aimed to include the *general* social media use variables instead of the social media use *without* close friends variables, Model 3 remained nested in Model 4 (see

Supplement 14 for the results of the original preregistered models).

Nested models were compared by the likelihood ratio test, Akaike's Information Criteria (AIC) and Bayesian Information Criteria (BIC) (Hox et al., 2018). We preregistered that model comparison would show an improvement in model fit if the AIC and BIC values were at least 3 points lower than the reference model or if the likelihood ratio test was significant ($p < .05$) (Raftery, 1995). We interpreted the fixed effects if at least one of these inference criteria suggested a better fit. When p values were smaller than .05, we considered the fixed effects as significant and interpreted the effect sizes. In order to determine differences between platforms (H3a & H3b), standardized effects were compared.

As an assumption check, we examined whether residuals were normally distributed according to the procedure of Hox et al. (2018). Histograms and QQ-plots revealed that all residuals were fairly normally distributed (see Supplement 2). As the assumptions were met, we tested our models in M*plus* 8.4 by using the maximum likelihood estimation method. The Multi-level analyses allowed us to include all available assessments on which all items were reported.

Data and Materials Availability

The preregistration of the hypotheses, design, sampling and analysis plan (https://osf.io/7vszj) and the analysis scripts used for this paper (https://osf.io/v3u42/) are available online on the Open Science Framework. The anonymous data set has been published on Figshare (Pouwels et al., 2020).

Results

Descriptive Statistics and Correlations

In total, 345 adolescents (89%) used Instagram at least once a week, 375 (97%) used WhatsApp, and 285 (73%) used Snapchat at least once a week. Descriptive statistics in Table 1 show that adolescents used Snapchat at 61% of the assessments, followed by Instagram

(56%), and WhatsApp (53%). In about half of all occasions during which adolescents used

Snapchat or Instagram, they had been in touch with their friends via these platforms.

WhatsApp was used less frequently for being in touch with close friends; only during 23% of

all occasions when adolescents had used WhatsApp. Of all participants, 23% had never been

in touch with their friends via WhatsApp, as opposed to 4% via Snapchat and 1% via

Instagram. Thus, although WhatsApp was used by the largest group of participants, they used

WhatsApp relatively less frequently with close friends than Instagram and Snapchat.

As Table 1 shows, within-person and between-person correlations had an opposing

sign. At the between-person level we found *positive* correlations between friendship

closeness and Instagram use with close friends and WhatsApp use. Adolescents who had used

Instagram with close friends and WhatsApp more frequently than their peers throughout the

three weeks experienced higher levels of friendship closeness across the three weeks than

their peers. At the within-person level, however, friendship closeness was significantly

negatively correlated with Instagram use, Instagram use with close friends, and WhatsApp

use. Hence, adolescents felt less close to their friends after they had used Instagram or

WhatsApp in the previous hour. As these associations reflect zero-order within-person

correlations, we conducted multi-level analyses to test our hypotheses.

Associations of Friendship Closeness with Social Media Use

A full overview of each model can be found in Supplement 3 to 6. A summary of the

main findings is presented in Table 2. Table 3 presents a statistical overview of the main

findings of Model 3 and 4.

Intercept-Only Model

The intercept-only model (Model 1) without predictors revealed an intra-class

correlation (ICC) of .41. Hence, whereas 41% of the variance in friendship closeness was due

to stable differences between adolescents, 59% was due to within-person over-time

fluctuations in adolescents' individual scores around their own means. This ICC confirms

that our sampling scheme of six assessments a day yielded sufficient within-person variance

in friendship closeness for conducting multi-level analyses.

Reference Model

Next, we estimated our reference model (Model 2) to check for potential time trends

in the data. Adolescents experienced higher levels of friendship closeness on weekdays than

in the weekend (β = .184 to .195, p < .001) and they experienced higher levels of friendship

closeness at the beginning than at the end of the day (β= -.059 to -.072, p < .001). As both

predictors were significant, Model 2 served as reference model to which the social media use

models were compared.

Social Media Use Models

Instagram Use. Model 3 revealed no between-person association (H1a): Adolescents'

average level of Instagram use across the three weeks was unrelated to their mean level of

friendship closeness across the same period. In contrast, a very small significant negative

within-person effect of Instagram use on momentary experiences of friendship closeness was

revealed (β = -.058, p < .001; H1b). That is, adolescents felt less close to their friends after

they had used Instagram in the previous hour.

In Model 4, we determined the relative effects of Instagram use with and without

close friends (H2, Model 4). At the within-person level, this model showed that the very

small negative effect of Instagram use on momentary friendship closeness pertained to both

Instagram use *with* close friends (β = -.069, p < .001, H2b) and Instagram use *without* close

friends

(β = -.047, p = .002, H2b). Adolescents felt less close to their friends after using Instagram in

the past hour than when they did not use Instagram, regardless of whether they used

Instagram *with* or *without* close friends. At the between-person level, we found an association

with an opposite sign for Instagram use *with* close friends (β = +.171, *p* = .002; H2a, Model 4), which indicated that adolescents who had been in touch more frequently with their close friends via Instagram across the three weeks felt, on average, closer to their friends than adolescents who had been in touch less frequently with close friends via Instagram. The average level of Instagram use *without* close friends was unrelated to mean levels of friendship closeness.

WhatsApp Use. We found that WhatsApp use was *positively* related to mean levels of friendship closeness at the between-person level (β = +.104, *p* = .044; H1a, Model 3), but very weakly *negatively* related to momentary experiences of friendship closeness at the within-person level (β = -.027, *p* = .030; H1b, Model 3). This indicates that adolescents who used WhatsApp more frequently across the three weeks felt, on average, closer to their friends than adolescents who used WhatsApp less frequently. But adolescents felt less close after they used WhatsApp in the previous hour, compared to not using it at all.

The model fit did not significantly improve by including WhatsApp use with close friends in the model (H2b & H2a, Model 4). Thus, the positive between-person and negative within-person associations of WhatsApp use with friendship closeness did not depend on whether or not adolescents used WhatsApp with their friends.

Snapchat Use. The model fit of the Snapchat model was not significantly better than the reference model (Model 3). This indicates that Snapchat use was unrelated to adolescents' average (between-person level, H1b) and momentary (within-person level, H1a) level of friendship closeness.

The fit of the Snapchat use *with* close friends model (Model 4) was significantly better than the Snapchat use model according to the likelihood ratio test, but not according to the AIC and BIC criteria. We did not find any significant fixed effects. Thus, regardless of whether Snapchat was used *with* or *without* close friends, Snapchat use was not associated

with adolescents' average (between-person level, H2b) and momentary (within-person level, H2a) level of friendship closeness.

Comparison of Platforms

Looking at differences between platforms, at the between-person level (H3b), we found moderately strong positive significant associations of friendship closeness with Instagram use with close friends (β = .171) and general WhatsApp use (β = .104), but not for Snapchat use. In contrast, at the within-person level (H3a), friendship closeness was significantly negatively related to Instagram use (β = -.058) and WhatsApp use (β = -.027). Comparison of effect sizes suggests that the associations were the strongest for Instagram, both at the between-person and within-person level.

Sensitivity Analyses

We conducted several preregistered sensitivity analyses that shed light on the robustness of the results against alternative specifications of the sample and research models. Specifically, we examined models in which (a) all three platforms were included together, and (b) 8 participants with potentially untrustworthy answer patterns were excluded. In addition to the preregistered sensitivity analyses, we also estimated a model in which we omitted occasions with discrepancies between social media use with close friends and general social media use (i.e., occasions on which adolescents used a platform with close friends, even though they indicated that they spent 0 minutes using that platform). The findings of these models are available in Supplement 7 to 9, respectively. The general conclusion is that the findings were most robust for Instagram.

Exploratory Analyses

We conducted three additional sets of exploratory analyses. As preregistered, we first examined whether the within-person effects of Instagram use *without* close friends and WhatsApp use remained significant after controlling for the carry-over effect of friendship

closeness two hours prior to each assessment. A full overview of the model specifications and main outcomes of these analyses can be found in Supplement 10 to 13. Dynamic Structural Equation Modelling [DSEM] revealed that, again, findings were most robust for Instagram. The effects of Instagram use *with* and *without* close friends on friendship closeness remained significant after controlling for the two-hour lagged effect of friendship closeness, $b = -.088$, 95% CI [-.133, -.042], $\beta = -.024$ and $b = -.054$, 95% CI [-.096, -.010], $\beta = -.015$, respectively. Thus, Instagram use *with* and *without* close friends did not only co-fluctuate with friendship closeness, but also predicted subsequent changes in friendship closeness. For WhatsApp use, we no longer found a significant within-person effect on friendship closeness.

Second, we examined whether there was heterogeneity between adolescents in the within-person effects of social media use on friendship closeness. The fixed effect models pointed at very small average within-person effect sizes. One explanation for such small effects may be that effects were diluted across a heterogeneous sample of adolescents with different susceptibilities to the effects of social media use (Beyens et al., 2020; Valkenburg & Peter, 2013). In order to model such heterogeneity, we added random effects to our multi-level analyses. Random effect models pointed at significant variance around the slopes and indicated that there was significant heterogeneity between adolescents in the strength and direction of the association of friendship closeness with Instagram, WhatsApp and Snapchat use (see Supplement 4 to 6). This heterogeneity was confirmed by DSEM analyses with random slopes (see Supplement 10 to 13). Figure 1 presents the range of the person-specific associations of Instagram use (top histogram), Instagram use with close friends (bottom left histogram), and Instagram use without close friends (bottom right histogram). The y-axis represents the number of participants and the x-axis the standardized person-specific effect sizes. As Figure 1 shows, for all three variables we found a large heterogeneity in person-specific within-person associations with friendship closeness. For Instagram use, the

standardized person-specific effect sizes ranged from -.565 to +.449, for Instagram use *with*

close friends from -.745 to +.697, and for Instagram use *without* close friends they ranged

from -.649 to +.454.

Third, in addition to the preregistered exploratory analyses, we explored potential

gender differences, given that several large-scale studies have demonstrated that media

effects may differ between boys and girls (Kelly et al., 2018; Thorisdottir et al., 2019;

Twenge et al., 2020). We did not find a main effect of gender on friendship closeness at the

between-person level, indicating that boys and girls did not differ in their average level of

friendship closeness. The associations between Instagram, WhatsApp or Snapchat use and

friendship closeness at the between-person level were not moderated by gender. However, we

found a significant cross-level interaction. The within-person association of WhatsApp use

with friendship closeness was moderated by gender ($b = .123$, $p = .028$), but the associations

of Instagram and Snapchat use with friendship closeness were not. Simple effect analyses

showed that the within-person association of WhatsApp use with friendship closeness was

significantly negative among boys ($b = -.098$, $p = .040$), and non-significant among girls ($b = .024$, $p = .465$).

Discussion

The development of close friendships is an important task in adolescence. In order to

get insight in real-time processes that may underly the development of friendship closeness

(Granic, 2005), this study investigated the role of social media use in adolescents' friendship

closeness in their daily lives. Using experience sampling data with 34,930 observations of

387 participants, we demonstrated that adolescents who used WhatsApp and Instagram with

close friends more often than their peers experienced higher levels of friendship closeness.

These positive between-person associations were not replicated at the within-person level.

Instead, we found small negative within-person associations between general WhatsApp use

and Instagram use and friendship closeness. Thus, overall, the stimulation hypothesis was not supported at the within-person level. However, post-hoc analyses indicated sizeable individual differences in adolescents' susceptibility to the effects of social media use on friendship closeness.

Adolescents' Social Media use and Friendship Closeness in Their Daily Lives

Previous research consistently found positive between-person associations of social media use with friendship closeness (e.g., Antheunis et al., 2014; Rousseau et al., 2019). These earlier studies examined the between-person association between adolescents' social media use and their general assessment of the closeness of their friendships. In the present study, we examined these between-person associations by aggregating adolescents' real-time, momentary experiences of friendship closeness across three weeks, which generally greatly reduces the recall bias in estimating the level of social media use (Griffioen et al., 2020; Underwood et al., 2018). Despite this difference in approach, we were able to replicate the positive between-person association, but only for WhatsApp use: Adolescents who used WhatsApp more frequently experienced higher average levels of friendship closeness as compared to their peers who used WhatsApp less often. Although the associations for general Instagram and Snapchat use with friendship closeness were also positive, they fell below significance. As a result, our first hypothesis (H1a) was partially supported.

Although at first sight the positive between-person association appears to suggest that the *stimulation* hypothesis was supported, several scholars have highlighted the importance of disentangling within-person effects of social media from between-person associations, as conclusions about processes within single individuals cannot be drawn from between-person differences (Coyne et al., 2020; Keijsers & van Roekel, 2019; Prinstein et al., 2020). In order to investigate whether social media use actually *stimulates* friendship closeness in adolescents' daily lives, we examined the within-person associations of Instagram,

WhatsApp, and Snapchat use with friendship closeness. Contrary to the stimulation hypothesis and our own hypothesis (H1b), we found either nonsignificant or very small negative within-person associations. Thus, on average, adolescents did *not* experience higher levels of friendship closeness after using social media use in the previous hour. This finding is in line with other social media effects studies, which found only very small effects of social media at the within-person level (Coyne et al., 2020; Orben et al., 2019). However, it should be noted that our additional analyses, as presented in Figure 1, showed a striking heterogeneity in these effects. In fact, while the average within-person effect of Instagram use was very small (β = -.058), the person-specific within-person effect sizes ranged from β = -.565 to β = +.449.

Friendship Closeness and Social Media use With Versus Without Close Friends

We further extended previous research by showing that the effects of Instagram use did depend on whether adolescents used Instagram with or without close friends. As expected in H2a, we found quite strong positive between-person associations of Instagram use with friendship closeness that pertained to social media use *with* close friends (β = .171). Moreover, as expected, adolescents' Instagram use *without* close friends was unrelated to friendship closeness at the between-person level.

In contrast to the between-person associations and our hypothesis (H2b), at the within-person level we did find a significant, but small, negative within-person association between Instagram use *with* and *without* close friends and friendship closeness. While this may indicate that using Instagram may be linked with feeling less close to one's close friends, it is important to consider that the sizes of the within-person associations were very small, and appeared to mask individual differences in effect sizes (Beyens et al., 2020). That is, we found strong heterogeneity in the within-person effect sizes of Instagram use with and without close friends, ranging from strongly negative (β = -.745) to strongly positive (β =

+.697). Although a more extensive analysis of the person-to-person differences in susceptibility to the effects of social media use on friendship closeness was beyond the scope of this study, our findings do suggest that there is a group of adolescents for whom the stimulation hypothesis holds. However, because there is also a group of adolescents for whom social media use is negatively related to friendship closeness, these effects may cancel each other out, resulting in small average within-person associations between Instagram use with and without close friends and friendship closeness.

We have two potential explanations as to why some adolescents may experience small decreases in friendship closeness as a result of Instagram use per se or Instagram use *with* or *without* close friends. A first explanation may lie in the constant accessibility of social media. Adolescents have created expectations regarding online friendship maintenance that may temporarily decrease friendship closeness if they are not met. For example, adolescents may have created the expectation that their friends will always be available to provide feedback on their social media posts (Nesi et al., 2018). Accordingly, they may feel stressed or concerned about their friendships if they do not receive immediate or enough (positive) comments or likes from their close friends on these posts (Beyens et al., 2016; Yau & Reich, 2018), which could lead to momentary decreases in their assessment of friendship closeness. Moreover, as adolescents often use social media to publicly display their friendships to others by posting pictures with close friends, they may sometimes be exposed to social media posts of friends at events they are not invited to, which may enhance feelings of social exclusion (Nesi et al., 2018; Rideout & Robb, 2018).

A second explanation may be that for some adolescents Instagram use without close friends displaces the time they spend on face-to-face interaction with their close friends (Kraut et al., 1998; Verduyn et al., 2020). Even when adolescents spend time with their close friends, social media may be at the expense of quality time with close friends, as adolescents

and their friends have been found to frustrate each other by using their phones while they are hanging out together (Rideout & Robb, 2018). Such media multi-tasking during conversations has been found to be related to lower socioemotional functioning (van der Schuur et al., 2015), and may account for the small social-media induced decreases in friendship closeness among some adolescents (Nesi et al., 2018).

Different Platforms Yield Differential Effects

The findings of this study confirmed the idea that adolescents use different social media platforms in complementary ways (Phua et al., 2017; Vermeulen et al., 2018; Waterloo et al., 2017), although the pattern of platform differences was the opposite of what we had expected. Whereas we expected that WhatsApp and Snapchat use would be more strongly positively related to friendship closeness than Instagram use (H3a and H3b), the most robust and strongest effects were found for Instagram. This may perhaps be due to the fact that adolescents' use of social media rapidly changes over time. Although WhatsApp was the most popular platform among adolescents in this study, only in 12% of the occasions it was used to communicate with close friends. A recent Dutch survey study revealed that WhatsApp is used not only to send direct messages to (close) friends, but also to parents and acquaintances (van Driel et al., 2019). Although Snapchat was used more frequently with close friends than WhatsApp, the effects for Snapchat may have been non-significant because adolescents may not remember the content of their snap messages and consider them as relatively meaningless, as has been shown in a study among young adults (Bayer et al., 2016).

Contrary to our expectations, Instagram seems to play the largest role in communicating with close friends and, thus, friendship closeness. Today's adolescents often have multiple Instagram accounts (van Driel et al., 2019): Besides a real Instagram account (RINSTA) many adolescents have a fake Instagram account (FINSTA) that is used to connect

with close friends. Research among college students showed that a FINSTA is used to provide friends daily updates and to make them laugh (Kang & Wei, 2020). As humor and intimate self-disclosure are strongly related to friendship closeness (Martin & Ford, 2018; Trepte et al., 2018), the use of FINSTA's may explain why we found the strongest effects for Instagram.

Strengths, Limitations, and Implications for Future Research

To the best of our knowledge, this preregistered study is (among) the first to assess whether social media use and friendship closeness are linked in adolescents' daily lives. The study had a high compliance rate (one of the most important markers of the quality of an ESM study; van Roekel et al, 2019), resulting in a total number of 34,930 assessments. Moreover, we used an ecologically valid measure of social media use that minimized recall bias (Larson, 2019), by asking adolescents to report on their social media use in the previous hour. In addition, this study provided further evidence for the more general idea that between-person and within-person processes are distinct processes, which need to be distinguished in (social) media effect studies (Coyne et al., 2020; Orben et al., 2019; Prinstein et al., 2020). Finally, the present study revealed that it is important for future studies to disentangle online interactions with close friends from other online interactions, because at the between-person level, these different types of interactions may have opposite effects on adolescents' friendship closeness.

Despite its strengths, this study also has several limitations. First, as this study specifically focused on close friendships, findings cannot be directly generalized to other types of friendships or friendships in general. Second, this study incorporated a rather narrow measure of social media use with close friends that did not distinguish between different types of social media use with close friends (e.g., liking a friends' post, direct messaging). Third, this study did not take the valence or quality of online interactions with friends into

account. The present study therefore could not obtain insight into the *circumstances* under which social media use enhances and decreases friendship closeness. Insight in this question could be obtained by assessing the type, valence, and content of social media interactions with close friends (i.e., humor, self-disclosed intimate information, support, conflicts, cyberbullying, or misunderstanding) (Nesi et al., 2018; Yau & Reich, 2018). As the majority of adolescents predominantly have positive experiences with close friends via social media (Koutamanis et al., 2015; van Driel et al., 2019), this question could only be addressed in a targeted sample of adolescents who have both positive and negative experiences with close friends.

Another important open question is *how many* adolescents experience positive or negative effects of social media use on real-time experiences of friendship closeness. This study already provided a first glimpse of potential heterogeneity in these effects, as our sensitivity analyses pointed at large variance around within-person effects. A recent ESM study on the effects of adolescents' social media use on well-being demonstrated strong person-specific susceptibilities to these effects (Beyens et al., 2020). Beyens et al. showed that 46% of the adolescents felt happier after using social media, while 10% felt less happy. Answering the question for how many adolescents social media use affects their friendship closeness in positive or negative ways would provide indispensable insight into who benefits from social media use in terms of friendship closeness and who does not.

A person-specific approach provides the opportunity to obtain insight into *who* these adolescents are in terms of trait-level characteristics. This study provided initial insights in potential trait differences in terms of gender, by revealing that a negative within-person association of WhatsApp use with friendship closeness only holds for boys. However, even after including gender as trait-like moderator, there still was a large portion of unexplained variance, suggesting that besides gender, there may be other trait variables that explain

heterogeneity. In order to get a more complete overview of the characteristics of adolescents who benefit from social media use in terms of friendship closeness and who do not, investigation of a combination of different trait variables is warranted. Based on results of previous between-person studies, it may be interesting to investigate the moderating role of trait levels of friendship quality, social anxiety, and social competence (Nesi et al., 2018; Yau & Reich, 2020).

While the current study already provided unique insights in the short-term Instagram-induced changes in momentary levels of friendship closeness, an important avenue for future research is to investigate the long-term effects of Instagram-induced decreases or increases in momentary levels of friendship closeness. The within-person associations that we found in this study were based on just one hour of social media use. Yet, these within-person effects may accumulate over time and result in long-term social-media induced development of friendship closeness. This accumulation, however, does not necessarily follow the logic of a linear system, as short-term and long-term effects may be opposing in magnitude or even sign (e.g., Keijsers & van Roekel, 2019; Lerner & Lerner, 2019; Smith & Thelen, 2003). Perhaps, through socio-emotional non-linear feedback loops, short-term negative effects of social media use upon experienced friendships may motivate youths to invest more in their friendships, leading to longer term positive effects and positive between-person associations of social media use and friendship closeness. Future research, for instance using measurement burst designs (Nesselroade, 1991), could provide more insight in the effect of short-term daily mechanisms on longer-term developmental change.

The findings of the present study shed light on the public debate on the effects of social media use. Many people have concerns about the potential negative impact of social media use on adolescents' socioemotional well-being. The present study revealed that virtually all adolescents had been in touch with their friends via social media throughout the

day. Whereas spending time on social media was linked with very small negative momentary associations with friendship closeness, we did not find negative associations between the average time spent with social media and average levels friendship closeness. Those adolescents who used Instagram most frequently to interact with close friends even experienced the highest levels of friendship closeness in their daily lives. As our findings pointed at sizeable individual differences in adolescents' susceptibility to the effects of social media use on friendship closeness, we found preliminary evidence for the idea that social media use may be harmful for some youths and beneficial for others. Future research is needed to examine for which adolescents and under which circumstances social media use stimulates friendship closeness, and for whom and when social media decreases friendship closeness.

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Table 1

Descriptive Statistics and Within-Person and Between-Person Correlations of Social Media Use with Friendship Closeness

	Descriptive Statistics				Correlations Friendship Closeness	
	n	*o*	*M*[a]	*SD*	Within-person	Between-person
Friendship Closeness	387	34,930	4.48	1.30	--	--
Social media use						
Instagram	345	31,658	.56	.25	-.03***	+.10
WhatsApp	375	34,068	.53	.25	-.02**	+.12*
Snapchat	285	26,479	.61	.27	-.01	+.04
Social media use *with* close friends						
Instagram	345	31,658	.29	.22	-.03***	+.19***
WhatsApp	375	34,068	.12	.20	-.01	+.07
Snapchat use	285	26,479	.31	.27	.00	+.10
Social media use *without* close friends						
Instagram	345	31,658	.28	.20	-.01	-.09
WhatsApp	375	34,068	.41	.22	-.01*	+.07
Snapchat	285	26,479	.30	.20	.00	-.07

Note. n = number of participants that reported on each variable; *o* = total number of occasions on which participants reported on each variable.

[a]Means reflect the average of person mean scores. For social media use, person mean scores reflect the proportion of occasions during which participants used a particular platform (e.g., adolescents used Instagram during 56% of the occasions).

* $p < .05$; ** $p < .01$; *** $p < .001$.

Table 2

Summary of the Main Outcomes of the Multi-Level Analyses

	Friendship Closeness	
	Within-person	Between-person
	β	β
Social media use		
Instagram	-.058***	+.082
WhatsApp	-.027*	+.104*
Snapchat	-.001	+.035
Social media use *with* close friends		
Instagram	-.069***	+.171**
WhatsApp	-.037	+.082
Snapchat	+.009	+.090
Social media use *without* close friends		
Instagram	-.047**	-.055
WhatsApp	-.025	+.095
Snapchat	-.009	-.073

Note. β = standardized effects using STDY for the categorical within-person variables and STDYX for the continuous between-person variables. Significance was based on two-sided *p*-values of the unstandardized effects.

* *p* < .05; ** *p* < .01; *** *p* < .001.

Table 3

Predicting Friendship Closeness From Social Media use at the Within-Person and Between-Person Level.

	Instagram [IN]				WhatsApp [WA]				Snapchat [SN]			
	$n = 345 * t_{average} = 91.762$				$n = 375 * t_{average} = 90,848$				$n = 285 * t_{average} = 92,909$			
	$o = 31,658$				$o = 34,068$				$o = 26,479$			
MODEL 3 - Social Media use	b	SE	p	β	b	SE	p	β	b	SE	p	β
Within-person												
IN/WA/SN use vs. no use$_{t0*}$	-.087	.020	<.001	**-.058**	-.041	.019	.030	**-.027**	-.002	.023	.940	-.001
Between-person												
Average IN/WA/SN use	+.419	.276	.129	+.082	+.542	.269	.044	**+.104**	+.157	.269	.559	+.035
Fit indices												
Likelihood Ratio Test	$\chi2(2) = 21.604$		$p < .001$		$\chi2(2) = 8.740$		$p = .006$		$\chi2(2) = .348$		$p = .420$	
AIC	117169.827				126932.689				97265.941			
BIC	117228.367				126991.742				97323.229			
MODEL 4 - Social Media use With vs. Without Close Friends												
Within-person												
IN/WA/SN use *with* friends vs. no use$_{t0*}$	-.104	.024	<.001	**-.069**	-.057	.034	.090	-.037	+.014	.028	.616	+.009
IN/WA/SN use *without* friends vs. no use$_{t0*}$	-.072	.023	.002	**-.047**	-.038	.020	.053	-.025	-.013	.025	.614	-.009
Between-person												
Average IN/WA/SN use *with* friends	.970	.318	.002	**+.171**	+.525	.348	.131	+.082	+.416	.292	.154	+.090
Average IN/WA/SN use *without* friends	-.345	.355	.332	-.055	+.555	.319	.082	+.095	-.440	.381	.249	-.073
Fit indices												
Likelihood Ratio Test	$\chi2(2) = 12.556$		$p = < .001$		$\chi2(2) = .320$		$p = .426$		$\chi2(2) = 5.726$		$p = .029$	
AIC	117161.262				126936.370				97264.214			
BIC	117236.527				127012.295				97337.871			

Note. In all models, we controlled for weekday vs. weekend day and Nth notification number of the day. Social media use predictors were dummy coded (0 = no use of IN/WA/SN; 1 = use of IN/WA/SN). Significant effects are displayed in bold. n = number of participants, t = average number of assessments per participant, o = number of observations, b = unstandardized effect; SE = standard error; p = two-sided p-value; β = standardized effect using STDY for the categorical within-person variables and STDYX for the continuous between-person variables.

Figure 1

Distribution of the Person-Specific Effect Sizes of the Association of Closeness to Friends With Instagram use (Top Histogram), Instagram Use With Close Friends (Bottom Left Histogram), and Instagram Use Without Close Friends (Bottom Right Histogram).
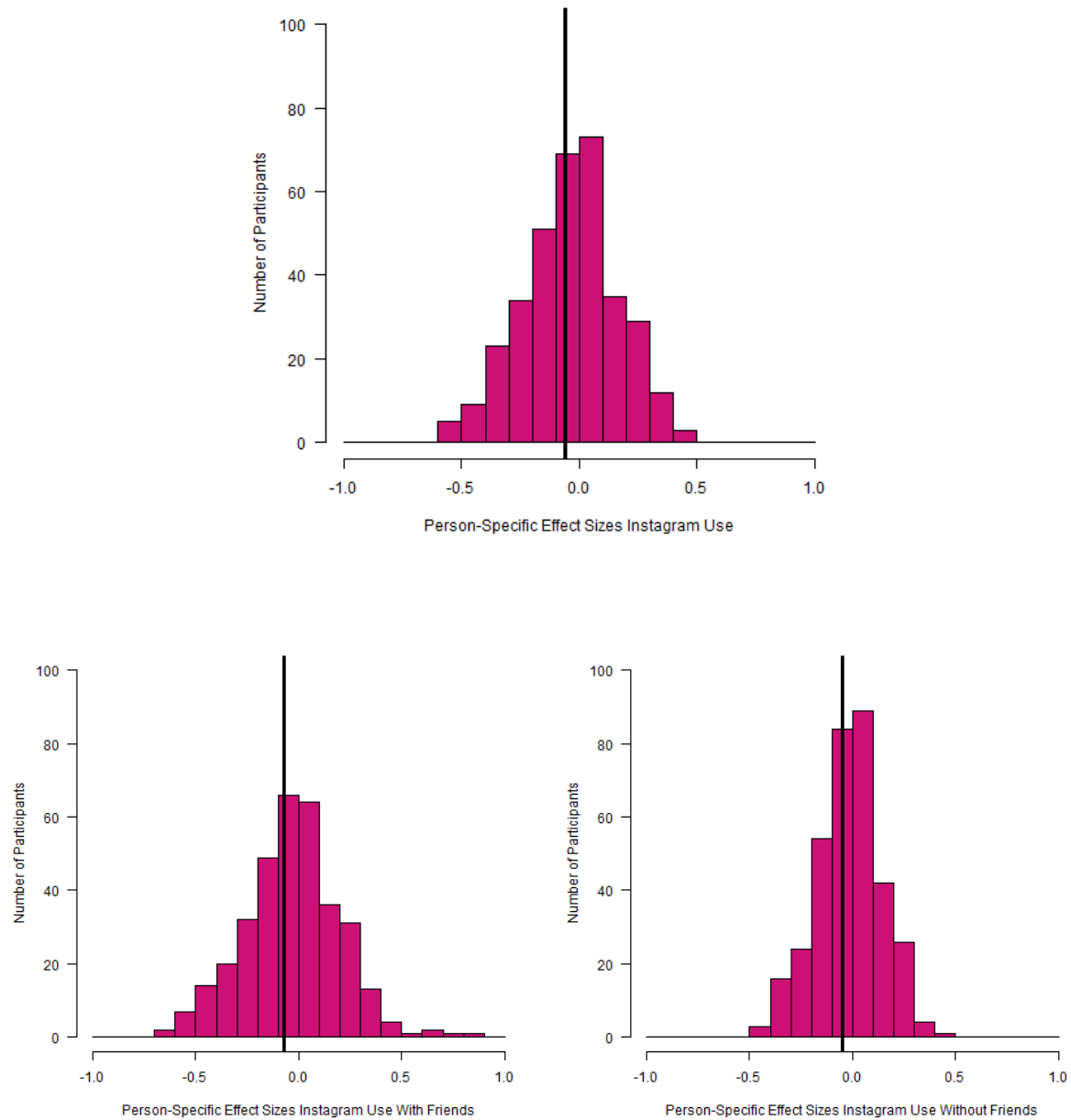
Note. The vertical black lines represent the mean of these person-specific effect sizes.