# Relating Facebook usage to loneliness: how intensity of Facebook usage influences loneliness between different age groups

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Abstract

This article describes a study on the effects of different forms of Facebook usage on self-indicated loneliness. We specifically look into the effects of the discrepancy between outward and inward relationship maintaining behaviour, Facebook intensity, and bonding social capital on loneliness. We performed a online survey study and analyzed the results using moderated mediation analysis. The results indicate that there are no general effects of Facebook instensity and the discrepancy between outward and inward relationship maintaining behaviours on loneliness, but there is a significant effect of bonding social capital. Additionally, the effect of Facebook intensity on loneliness varies between age groups and is nearly significant for people of young age.

*Keywords:* social networks, loneliness, well-being, bonding social capital, social media, Facebook relationship maintaining behaviour, Facebook intensity

# Relating Facebook usage to loneliness: how intensity of Facebook usage influences loneliness between different age groups

In 1993, computers were mainly the province of engineering, science, and business. By 1998, roughly one third of all U.S. households owned a personal computer; approximately 40 percent of these homes had access to the Internet (Kraut et al., 1998). Many social critics, technologists, and scholars believed that these changes and growing internet use, in particular, are transforming social and economic life (Anderson, Bikson, Law, & Mitchell, 1997; Kraemer, Dedrick, & Org, 1986). However, analysts disagree on the nature of these changes and whether the changes are for the better or the worse.

Some researchers argue that the internet is causing people to become socially isolated and separated from genuine social relationships, as they stare alone over their computers or communicate with anonymous strangers through a socially impoverished medium (Turkle, 1996). Others argue that internet leads to improved and increased amount of social relationships by freeing people from geographical constraints or isolation brought on by schedule or illness. According to them, internet allows persons to join social groups on the basis of common interests rather than convenience (Katz & Aspden, 1997; Rheingold, 1993). Arguments based on the features of technology alone did not resolve this debate.

Therefore researchers dug deeper into the social network characteristics and structures that are associated with the use of the internet. Social networks are defined as "the structure of one or more networks of relations within a system of actors" (Burt, 1982, p. 20). With the introduction of the internet, social network structures became more complex because of the difference and overlap of peoples online and offline social networks. Therefore researchers started focusing on social network sites (SNSs) like Facebook, which provides interested researchers insights in the relations of social networks due to its heavy usage patterns and technological capacities that bridge online and offline connections. Facebook provides its users the opportunity to present themselves in an online profile, view each other's profiles, and accumulate "friends" who can post comments on each other's pages. The data collected through Facebook on

social networks makes it possible to find more detailed characteristics on exactly what and how different factors influence peoples well-being.

Researcher who started unraveling and connecting social network characteristics and structures to well-being are Berkman, Glass, Brissette, and Seeman (2000), who constructed a detailed conceptual model. They concluded that social network characteristics and structures influence different health-related pathways via five psychosocial mechanisms; social support, social influence, social engagement, person-to-person contact and access to resources and material goods. When looking at the psychological pathways which construct well-being, an important pathway is not mentioned in this paper though it is an important measure for well-being and therefore critical to include (Kraut et al., 1998); loneliness.

Although loneliness is mainly associated with the older population, severe loneliness can be found in all age categories. For example, 38.7 percent of the Dutch population aged 18-34 stated to be lonely, from which 8.9 percent felt severely lonely (RIVM, 2016). The main part of the Dutch population (71 percent) acknowledges loneliness as a critical problem, from which 79 percent values talking and thinking about it (TNS NIPO, Snel, & Plantinga, 2012). Most definitions of loneliness emphasize perceived negative characteristics of relationships. For example, Young (1982) defines loneliness as the (perceived) absence of satisfying social relationships, and other researchers define loneliness as the lack of social relationships that is subjectively experienced as unpleasant (Pepelau & Perlman, 1982). In line with these definitions, researchers have attempted to link the experience of loneliness to measures of relationship quantity and quality and social network characteristics (Green, Richardson, Lago, & Schatten-Jones, 2001).

Unfortunately, loneliness also is a hotly debated topic because researchers disagree on the possible positive or negative influence of the internet and SNSs on loneliness. The influential paper of Kraut et al. (1998) found a significant positive relation between loneliness and internet use which was later disproved by Shaw and Gant (2002) who found that internet decreases loneliness. These contradicting results make it hard for

the government and for the individual users to prevent the negative effects of the use of SNSs or to stimulate using the positive characteristics of SNSs to increase well-being. Unraveling the complex and specific characteristics of online and offline social networks and their possible relation to loneliness, is necessary to come up with needed solutions based on solid argumentation's and research.

## Theory

To investigate factors which can improve psychological well-being, we selected loneliness as measurement based on the paper of Kraut et al. (1998) and its social impact. To further structure the complex nature of social networks due to the use of internet, the literature study and method focused on two categories; egocentric online and offline social network characteristics, which are measured with social network data from Facebook. Existing literature is used to come up with three different hypothesis, which combined give answer to the following main research question: *What online and offline social network characteristics improve loneliness?*

To visualize the construct of relations of these hypothesis, we made a conceptual model (see Figure 1) , which is supported with literature and tested in this research. The construction of this model is further explained in this section.

### Online social network characteristics

Social network sites (SNSs) such as such as Friendster, CyWorld, MySpace and Facebook allow people from all over the world to present themselves, articulate their own online social networks, and create or maintain connections and relations with others. One of the most popular online social network, Facebook, had 2.27 billion monthly active users in the third quarter of 2018. The number of active Facebook users had already surpassed one billion in 2012, making it the first social network ever to do so (Statista, 2018).

Multiple forms of online networking can be measured and investigated with data collected from Facebook, such as: directed communication, social information seeking and self-presentation in public or private channels.

**Directed communication.** From these four online networking forms, directed communication has multiple relations to loneliness and general well-being. Directed communication consist of targeted social interactions between a user and friend, in which one friend can directly identify the other (Burke, Marlow, & Lento, 2010). Examples of directed communications are photo tagging and messaging.

Firstly, directed communication in forms of wall posts and messages has in general been proven to be a strong predictor of relationship strength (Gilbert & Karahalios, 2009). In particular, directed interaction between pairs (such as "likes", wall posts, and comments) and consumption of friends' content (including status updates, photos, and friends' conversations with other friends) is associated with greater feelings of bonding social capital (explained below) and lower loneliness (Burke et al., 2010).

Secondly, related theories argue that online communication can influence psychological well-being specifically by helping users maintain their network of friendships (Burke & Kraut, 2016). Facebook provides an ideal platform for relationship maintenance interactions to occur quickly, with low transaction costs, and with multiple others because they provide a wide reach of messages and encourage feedback, participation, and interaction through different communication channels (Walther, 2011). These forms of directed communication called "Facebook relationship maintenance behaviours" (FRMB) are often defined as "social grooming" (Donath, 2007); activities that build trust, signal attention, and create expectations of reciprocal attention (Ellison, Vitak, Gray, & Lampe, 2014).

**Reciprocity.** Burke et al. (2010) state that a discrepancy between the reciprocal expectations of social interactions and reality (more outgoing than incoming attention), causes an increase in loneliness and content consuming. The importance of reciprocity is also mentioned by Granovetter (1982) with his theory of social ties and is also emphasizes in later theories.To apply the theory of reciprocity and investigate this specific form of directed communication with respect to loneliness, the data collection of this research distinguishes inward Facebook relational maintenance behavior (iFRMB) and outward Facebook relational maintenance behavior (oFRMB), which is further

explained in the method section. Although research suggest that there is a strong correlation between oFRMB and iFRMB, this is not yet investigated for lonely individuals (Burke, Kraut, & Marlow, 2011).Therefore we state:

*H1: More oFRMB then iFRMB has a positive effect on loneliness*

## Offline social network characteristics

**Social capital.** The offline connection of internet use is closely related to the formation and maintenance of social capital. Social capital describes the benefits one receives from one's relationships with other people (Lin, 1999). Intense Facebook use is found to be associated with distinct measures of this offline social network characteristic (Steinfield, Ellison, & Lampe, 2008) including its two subgroups; bridging and bonding social capital. These two categories describe resources embedded in different strengths and types of relationships. Bridging social capital emphasizes the informational benefits of a heterogeneous social network of weak ties (Putnam, 2000). These "bridging" ties (such as a friend of a friend) are more likely to connect different clusters within a network and thus provide access to novel information (Granovetter, 1982) and diverse perspectives. Bonding social capital is, on the other hand, connected to the emotional benefits from strong ties (Putnam, 2000). Stronger ties (close family and friends) are characterized by multiple iterative interactions and higher levels of intimacy, trust, and support (Ellison et al., 2014). Facebook networks provide excess to both strong and weak ties and is therefore related to both bridging and bonding social capital.

**Social ties.** In both definitions, one of the most important social network theories is applied, that of strong and weak social network ties. According to Granovetter (1982) the strength of interpersonal ties can be defined as: "a (probably linear) combination of the amount of time, emotional intensity, the intimacy (mutual confiding), and the reciprocal services which characterize the tie." (Granovetter, 1982, p. 1361) When combining the definition of the two social capital categories and that of social network ties to the problem of loneliness, bonding social capital can be connected to loneliness due to the associated strong ties. These strong ties with family and close

friends might provide emotional support, access to scarce resources and can also facilitate emotional aid and companionship (Wellman & Wortley, 1990). Although this seems a promising connection with loneliness, some studies still question whether the internet supplements or supplants these important strong ties (Williams, 2006). The main arguments point out that strong ties often become geographically dispersed and are unable to spend face-to-face time together(Ellison, Steinfield, & Lampe, 2011). Therefore it is important to gain a better understanding of how different uses of these sites may relate to bonding social capital.

**Personal support social capital.** To measure bonding social capital in the data collected on Facebook, the Resource Generator (RG) is used. This measurement tool uses questions to distinguishes four detailed social capital scales; I. Prestige and education related social capital, II. Political and financial skills social capital, III. Personal skills social capital, IV. Personal support social capital (Van Der Graag & Snijders, 2005). These four scales are not directly connected to the two earlier defined categories of social capital, but the scale which is most connected to the bonding social capital and therefore to loneliness is IV. Personal support social capital. The literature on bonding social capital and loneliness is therefore applied to the data of IV. Personal support social capital to answer the following associated hypothesis:

*H2: Bonding social capital has a negative effect on loneliness.*

**Facebook intensity to bonding social capital.** Bonding social capital also plays another important role in loneliness research, namely as a mediator for other factors. One of those factors is Facebook intensity. Facebook Intensity (FBI) Scale measures attitudes which refer to the emotional connectedness to Facebook (Ellison, Steinfield, & Lampe, 2007). The aim of the scale is a reliable measure of how much Facebook is integrated into the everyday activities of the given user. According to Ellison et al. (2007), Facebook intensity has a strong significant relationship with bonding social capital. Combined with hypothesis 2 (H2), this may explain why Internet use sometimes still correlates with loneliness although researchers concluded that time spent online and SNS use have little direct or indirect associations with forms

of well-being (Burke et al., 2010; Pantic et al., 2012).

**Facebook intensity to loneliness.** Research focus is increasingly moving away from variables relating to intensity of use, and is shifting towards the impact of discrete and different online activities as factors of well-being (Best, Manktelow, & Taylor, 2014). Especially with regards to loneliness, the quality of social contacts is more strongly related than the frequency of such contacts. Still, research also found significant positive relations between internet usage (hours per week) and loneliness (Kraut et al., 1998). We state that this and other correlations are a result of a full mediation of personal support social capital (bonding social capital) on the relation between Facebook intensity and loneliness. Therefore we state:

*H3: the relation between Facebook intensity and loneliness is fully mediated by personal support social capital*

**Age.** We expect age to have a great influence on these hypotheses as the experience and relationship predictors of loneliness, may vary with age (Green et al., 2001). Aside from that, the research of (Kraut et al., 1998) also shows that on almost all models tested, age is significantly related to internet hours. Lastly, age is also significantly related to bonding social capital (Burke et al., 2010), which makes it an interesting control variable. From this same research, gender is the second important control variable because it is directly influences loneliness and bonding social capital (Burke et al., 2010).

## Method

### Participants

Participants in this study included 328 adult Dutch Facebook users of which 124 identified as male, 200 identified as female, and 4 specified 'other'. The participants were between the ages of 14 and 100 ($M = 36.7$, $SD = 16.7$). Participants were required to have used Facebook at least once within the last month prior to participation.

## Materials

Our instrument included four broad types of measures and demographics which are discussed in more detail below. The demographics contained descriptive variables including gender, nationality, level of education, and age (see Table 8). Additionally, questions about the number of friends, actual friends, and time spent on Facebook were asked as proposed by Ellison et al. (2011). The four broad types of measures includes loneliness, FRMB, social capital, and Facebook intensity.

**Loneliness.** Loneliness was measured using the Three-Item Loneliness Scale (Hughes, Waite, Hawkley, & Cacioppo, 2004). This scale contains items like "How often do you feel that you lack companionship: Hardly ever, some of the time, or often?". Participants indicate their answers on a 3-point scale.

**Facebook relationship maintaining behaviours.** We distinguished two types of Facebook relationship maintaining behaviours in our measurement: inward (iFRMB) and outward (oFRMB). Where the direction indicates effort of the participant towards maintaining friends (outward), or the perceived effort of the friends towards the participant (inward).

Outward Facebook relationship maintaining behaviour is measured using the Facebook Relationship Maintenance Behavior Scale (Ellison et al., 2014). The scale contains items such as "When I see a friend or acquaintance sharing good news on Facebook, I try to respond." and "When a Facebook friend has a birthday, I try to post something on their wall.". Participants indicated their answers on a 5-point Likert scale ranging from "Strongly Disagree" to "Strongly Agree".

Inward Facebook relationship maintaining behaviour is measured using an adapted version of the Facebook Relationship Maintenance Behavior Scale (Ellison et al., 2014). The scale was adapted such that the direction was changed from outwards to inwards. For example, "I try to respond" was replaced with "my friends try to respond". The scale contains items such as "When I ask for advice on Facebook, my friends try to respond." and "When I ask a question on Facebook, friends that know the answer try to respond.", see Table 7. The participants indicated their answers on a 5-pt

Likert scale ranging from "Stringly Disagree" to "Stringly Agree".

**Social capital.** Bonding social capital was measured using a adapted version of the cumulative personal support sub-scale from the Resource Generator (Van Der Graag & Snijders, 2005).The adapted scale contains items like "Can find a temporary or permanent job for a family member" and "Can help you move homes". This sub-scale is specifically chosen because it measures the extend to which the participant can obtain support from his/her social network and is thus more closely related to strong ties instead of weak ties. The used scale is presented in Table 5.

**Facebook intensity.** Facebook intensity is measured using an adapted version of the 8-item Facebook intensity scale (Ellison et al., 2007). The scale contains items such as "How many 'friends' do you have on Facebook?" and "I am proud to tell people I'm on Facebook". One item of the original scale measured a specific population, which we adapted to measure friends in general. Some items have specific answering scales, while others use a 5-pt scale ranging from "Stringly Disagree" to "Stringly Agree". The specific structure is presented in Table 2.

## Design

The study made use of an online design. Each participant was shown the same condition. Therefore, this was an exploratory study design aimed for discovering correlations between concepts. The dependent variable used in this study is loneliness. Independent variables are the difference between outward and inward FRMB and Facebook intensity. Bonding social capital is a mediator and age is a moderator in our study.

## Procedure

Participants browsed to the online study from a link that was provided to them. Then, they were shown an informed consent form after which, if agreed, they were shown an information page with general instructions. Then, the questionnaire started and the participants provided their answers in the browser.

At the end of the questionnaire participants could indicate whether they would like to be informed on the results of the study and they were thanked for their time and effort.

In total, the study took approximately 15 minutes and 15 euros were raffled to one in every 5 participants using a lottery as a reward.

### Statistical analysis

To test the effect of Facebook intensity on loneliness we make use of moderated mediation analysis using the Baron and Kenny methodology (Baron & Kenny, 1986) and bootstrapping for bias-corrected confidence intervals. For the effect of dFRMB on loneliness we use a linear regression. Since this is a post hoc analysis, we run a power analysis to determine what effect size we are able to detect (sensitivity analysis). The statistical method used in this study are primarily multiple linear regression analyses. With the number of participants $n = 328$, an error probability of $\alpha = 0.05$, and a desired power of 0.90, we are able to find effects with effect sizes larger than $f^2 = 0.032$. Calculated using G*Power (Faul, Erdfelder, Lang, & Buchner, 2007).

## Results

This section describes the results found in the study. First, we present descriptive statistics of the variables in our study after which the results of our analyses techniques are described. Prior to the analysis participants with incomplete or unreliable data were removed. Specifically, participants with unusual high or low ages, participants that did not make it to the one but last page of the test, participants that completed the questionnaire in 7.5 minutes or less, and participants that needed more than 150 minutes to complete the test were excluded from analysis.

### Descriptive Statistics

Our participants ranged a lot on age, which we have shown in Figure A1. The education level of our participants had an approximate mean of 3 years of college ($M = 3.57$, $SD = 1.33$) (see item dem3). 98 participants were Dutch, while the rest of the

participants checked the first item on the nationality question (afghan), but probably did not took the time to find their nationality in the list.

Our users were primarily heavy internet users ($M = 4.76$, $SD = 0.52$) (see item fb1) and heavy Facebook users ($M = 5.37$, $SD = 0.90$) (see item fb4). The aggregate scaled measure of Facebook intensity, see Table 2, is normally distributed and depicted in Figure A3. We scaled the grouped variables with a distinct scaling format first separately, after which the aggregate measure was formed.

The bonding social capital of our participants is highly skewed, see Figure A2. Most participants had the highest bonding social capital and thus had access to all items related to personal support social capital on the resource generator.

The scaled difference between outwards and inwards Facebook relationship maintaining behaviours is normally distributed amongst the participants, see Figure A4.

The scaled loneliness amongst the participants follows a skewed distribution where most participants are not very lonely, see Figure A5. A large proportion (about 20%) of the participants report some loneliness and a very small proportion of participants are very lonely.

**Mediation Analysis**

To test whether the effect of Facebook intensity on loneliness is mediated by bonding social capital we conducted a moderated mediation analysis, where we moderate for age since age has a very large effect on loneliness $t(310) = -4.05$, $p < .001$ and explains 5% of the variance. Gender on the other hand has no significant effect on both bonding social capital and loneliness, $t(309) = 0.150$, $p = .88$ and $t(309) = 0.218$, $p = .83$ respectively.

First, we analyzed the moderated direct effect of Facebook intensity on loneliness. There is no significant effect $t(308) = -1.126$, $p = .261$, which could indicate that there is either a second mediator to loneliness or there is no effect of Facebook intensity on loneliness.

Then, we analyzed the moderated effects of the mediator and Facebook intensity

on loneliness. All interaction effects and the main effect of Facebook intensity are non-significant, but the main effect of bonding social capital is $t(304) = -2.219$, $p < .05$. Both regressions are depicted in Table 9.

Finally, the moderated mediation analysis using both these models is computed twice for age at 20 and age at 60 (with 10.000 bootstrap iterations).The results of age are depicted in Table 10 and Figure 2. Additionally, the complete mediation that includes all effects is depicted in Figure 3. Although the average indirect effect is not significant, the bias-corrected 95% confidence interval has an upper bound at exactly 0.00 for the age = 20 group, but includes 0 in the age = 60 group.

### Regression of dFRMB

The effect of dFRMB on loneliness is tested using a regression analysis, see Table 11. There appears to be no significant effect between dFRMB on loneliness. However, a significant effect is found of dFRMB on social information seeking, which we discuss further in the discussion section, of $t(310) = -.190$, $p < .001$.

## Discussion

In this section, unexpected results and improvements for future research are discussed.

**Results of H1.** The difference between oFRMB and iFRMB was found to have no effect on loneliness. This could be due to a correlation between oFRMB and iFRMB, as described in the literature (Burke et al., 2011). A normal distribution in the difference between oFRMB and iFRMB was found instead, as illustrated in figure A4. The difference between inbound and outbound direct communication should therefore be useful because different perspectives on this discrepancy can be compared.Burke et al. (2010) state that a discrepancy between the expectations of social interactions and reality (more outgoing than incoming attention), causes an increase in loneliness and content consuming. The increase in loneliness was not found but the sub analysis between the relation of social information seeking (another form of social networking) and this difference shows a strong significant relation. Further research should

determine if this relation could also have a direct or indirect effect on loneliness and possible mediators. Also further research is needed to distinguish the cause of the difference in FRMB (low inward with high outward or visa versa).

**Influence of measurement tool for bonding social.** The Resource Generator seems to be a good measurement tool for bonding social capital, as personal support social capital has been found to be negatively related to loneliness, just like bonding social capital (Putnam, 2000). Still other literature suggests that the Resource Generator may not be the perfect measurement tool for research on (bonding) social capital (Salisu & Hashim, 2017). They state that the Resource Generator scale suffers some methodological issues like lack validity of items and vulnerability for socially desirable answers of participants (Van Der Graag & Snijders, 2005).Also no research has been executed on the representiveness of personal support social capital for bonding social capital.

Therefore we advise to use the Personal Social Capital Scale (PCSC) in future research. Aside from an excellent performance and validity, this scale is characterized by reciprocity, resources rich and trustworthiness characteristics of social capital (Salisu & Hashim, 2017). This offers a valuable and practical instrument tool for behavioural and health researchers and is capable of measuring both bridging and bonding aspects of egocentric social capital.

**Results H3.** According to the results, there is no (mediated) effect between fbi and loneliness, even if age is taken into account as a control variable. We found age to be negatively correlated to facebook intensity, and, surprisingly, loneliness to have a strong negative correlation with age. This negative correlation is the opposite of what is expected to be found, as loneliness is mainly associated with elderly. A possible explanation is that elderly are often not regular Facebook users. The elderly who do use Facebook and are open for technology(which are represented in this participant group) have different personal characteristics which is probably also influencing the amount of offline contact. Also the distribution of ages in the sample is not representative for the Dutch population and this findings can therefore not be generalised. Further research

should look into the direct and indirect effects of age between different factors such as fbi and loneliness.

Although research suggests a relationship between fbi and bonding social capital, research by Ellison et. al, 2011 found the same results as found in this research, namely that intensity of Facebook use is not predictive of a localized measure of bonding social capital. According to them, this could be explained by the widening of the user base, as individuals outside of users' local institutional networks were included which diminished Facebook's utility as a source of social support provided by bonding social capital. Its usage changed over time to support a network of looser ties (gaining bridging privileges) which can be seen in these results.

## Conclusion

As an answer to the main research question, we found that bonding social capital can be used to reduce loneliness. As such, SNSs designers and decision makers should take deep care in designing aspects and features that can boost and maintain bonding social capital. Promoting positive interactions, such as regular directed communication with strong ties, help giving and help seeking. An example is dynamically controlling the content of strong ties (e.g. status updates, photos, comments and friends' conversations with other friends) shown on the SNS. Nowadays information of strong and weak ties is shown together on the timetables of Facebook users. If users could indicate which well-being aspect they want to improve, these timetables could be manipulated by showing more relations of stronger or weaker ties. Also extra reminders for directed communication could be generated if users frequency of likes, messages and comments to strong ties is reducing.

Also age seems to have great impact on perceived loneliness of SNS users. Therefore we advise future SNS designers to look at the expected targeted age segment of the population. For young people, who are focused on long-term goals and whose future is open, the social network may be an important information source. When we get older and the future is more limited, short-term goals may obtain higher priority

and emotional regulation may have more influence on social interaction (Green et al., 2001). Therefore, age categories should be taken into account when focused on finding solutions for loneliness.

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Table 1

*Items of the General Facebook Usage Inventory*

| Abbr. | Item | Scale |
|---|---|---|
| fb1 | How often do you access the Internet? | One to three times a month; Once a week; Several times a week; Every day; Several times a day; |
| fb2 | How many 'friends' do you have on Facebook? | Less than 100; 100-250; 250-500; 500-750; 750-1000; more than 1000; |
| fb3 | Approximately how many of your TOTAL Facebook friends do you consider actual friends? | 0-3; 4-7; 8-11; 12-15; 16-19; 20-23; more than 23; |
| fb4 | How often do you visit Facebook? | Less than once a month; One to three times a month; Once a week; Several times a week; Every day; Several times a day; |
| fb5 | In the past week, on average, approximately how long PER DAY have you spent actively using Facebook? | 0-15 minutes; 15-30 minutes; 30-60 minutes; 1-2 hours; 2 hours or more; |

*Note.* Abbr. = Abbreviation

Table 2

*Items of the Facebook intensity scale, adapted from Ellison, Steinfield, and Lampe (2007).*

| Abbr. | Item | Scale |
|---|---|---|
| fbi1 | How many 'friends' do you have on Facebook? | Less than 100; 100-250; 250-500; 500-750; 750-1000; more than 1000; |
| fbi2 | In the past week, on average, approximately how long PER DAY have you spent actively using Facebook? | 0-15 minutes; 15-30 minutes; 30-60 minutes; 1-2 hours; 2 hours or more; |
| fbi3 | Facebook is part of my everyday activity | 5-pt |
| fbi4 | I am proud to tell people I1'm on Facebook | 5-pt |
| fbi5 | Facebook has become part of my daily routine | 5-pt |
| fbi6 | I feel out of touch when I haven1't logged onto Facebook for a while | 5-pt |
| fbi7 | I feel I am part of the Facebook community | 5-pt |
| fbi8 | I would be sorry if Facebook shut down | 5-pt |

*Note.* Abbr. = Abbreviation. 5-pt indicates a 5-point Likert scale ranging from "Stringly Disagree" to "Strongly Agree".

Table 3

*Items of the Facebook Chat Inventory*

| Abbr. | "Imagine that you are talking to a good friend via Facebook chat. Please choose what best describes how intensively you would share the following types of information with him/her via Facebook chat." |
|---|---|
| fbchat_sqi1 | I open myself wholeheartly. |
| fbchat_sqi2 | I talk about how concerned I am for a particular person. |
| fbchat_sqi3 | I talk about my personal insecurities. |
| fbchat_sqi4 | I talk about the things in the past or present that I feel ashamed of. |
| fbchat_sqi5 | I talk about my life goals. |
| fbchat_sqs1 | I talk about the style of clothes I want. |
| fbchat_sqs2 | I talk about the kind of party or social gathering I like best. |
| fbchat_sqs3 | I talk about my personal standards of attractiveness about men and women. |
| fbchat_sqs4 | I talk about my interests and hobbies. |
| fbchat_sqs5 | I talk about my problems in a form of a joke. |

*Note.* Abbr. = Abbreviation. The scale used for all items is: Never, Rarely, Sometimes, Often, Always.

Table 4

*Items of the Facebook Status Update Inventory*

| Abbr. | "Imagine that you are sharing information with your good friend via Facebook Status-Update. Please choose what best describes how intensively you would share the following types of information via Facebook Status-Update." |
|---|---|
| fbstatus_sqi1 | I open myself wholeheartly. |
| fbstatus_sqi2 | I talk about how concerned I am for a particular person. |
| fbstatus_sqi3 | I talk about my personal insecurities. |
| fbstatus_sqi4 | I talk about the things in the past or present that I feel ashamed of. |
| fbstatus_sqi5 | I talk about my life goals. |
| fbstatus_sqs1 | I talk about the style of clothes I want. |
| fbstatus_sqs2 | I talk about the kind of party or social gathering I like best. |
| fbstatus_sqs3 | I talk about my personal standards of attractiveness about men and women. |
| fbstatus_sqs4 | I talk about my interests and hobbies. |
| fbstatus_sqs5 | I talk about my problems in a form of a joke. |

*Note.* Abbr. = Abbreviation. The scale used for all items is: Never, Rarely, Sometimes, Often, Always.

Table 5

*Cumulative social capital scale from resource generator items. Adapted from (Van Der Graag & Snijders, 2005)*

| Abbr. | "Here are some questions about people you may know. These people include relatives, friends and acquaintances. Do you know anyone who..." |
|---|---|
| Personal support social capital | |
| rg1 | Can find a temporary or permanent job for a family member |
| rg2 | Can give you advice about a conflict with a family member |
| rg3 | Can help you move homes |
| rg4 | Can give you a ride somewhere or lend you their vehicle in a pinch |
| rg5 | Can lend you a home improvement tool such as a ladder |

*Note.* Abbr. = Abbreviation. The scale used for all items is: Yes, No

Table 6

*Inventory for measuring Internet Behaviour*

| Abbr. | "The following items are describe communication activities on Facebook. Please reflect on your ability to perform them." |
|---|---|
| ib1_sq1 | I know which information I should and shouldn't share online. |
| ib1_sq2 | I know when I should and shouldn1't share information online. |
| ib1_sq3 | I am careful to make my comments and behaviours appropriate to the situation I find myself in Online. |
| ib1_sq4 | I know how to change who I share content with (e.g. friends, friends of friends or public). |
| ib1_sq5 | I know how to remove friends from my contact lists. |
| ib1_sq6 | I feel comfortable deciding who to follow online (e.g. on services like Twitter or Tumblr). |

*Note.* Abbr. = Abbreviation. The scale used for all items is: Not at All True of Me; Not Very True of Me; Neither True nor Untrue of Me; Mostly True of Me; Very True of Me;

Table 7

*Inventory for measuring inward Facebook Relationship Maintaining Behaviour, adapted from Ellison, Vitak, Gray, and Lampe (2014).*

| Abbr. | "The following items are concerned with how people behave towards you on Facebook. Please indicate to what extent you agree or disagree with the following statements." |
|---|---|
| frmbsis_frmb1 | When I share good news on Facebook, my friends try to respond. |
| frmbsis_frmb2 | When I share bad news on Facebook, my friends try to respond. |
| frmbsis_frmb3 | When I ask for advice on Facebook, my friends try to respond. |
| frmbsis_frmb4 | When it1's my birthday, Facebook friends try to post something on my wall. |
| frmbsis_frmb5 | When I ask a question on Facebook, friends that know the answer try to respond. |

*Note.* Abbr. = Abbreviation. The participants indicated their answers on a 5-pt Likert scale ranging from "Stringly Disagree" to "Stringly Agree".

Table 8

*Demographics questionnaire used in the study.*

| Abbr. | Item | Scale |
|---|---|---|
| dem1 | How would you describe your gender? | Male; Female: Other; |
| dem2 | What is your age? | open |
| dem3 | What is the highest level of education you have finished? | Less than high school; High school; 2 years college degree (associates); 3/4-years college degree (BA, BS); Master's degree (Ma, MS); Doctoral degree (PhD); Professional degree (MD, JD); Other; Or alternatively open format |
| dem4 | What is your nationality? | List of all nationalities; Or alternatively open format |

*Note.* Abbr. = Abbreviation

Table 9

*Regression models of the moderated mediation analysis of Facebook intensity on loneliness with bonding social capital as mediator and age as moderator.*

| *Variable* | *B* | *SE B* | *t* | *p* |
|---|---|---|---|---|
| First regression: X, Z -> M | | | | |
| (Intercept) | 0.6039308 | 0.1180649 | 5.115 | 5.52e-07 *** |
| fbi | 0.0572045 | 0.0555109 | 1.031 | 0.304 |
| age | -0.0134659 | 0.0029813 | -4.517 | 8.95e-06 *** |
| fbi*age | -0.0002068 | 0.0013957 | -0.148 | 0.882 |
| Second regression: X, M, Z -> Y | | | | |
| (Intercept) | 0.625984 | 0.146693 | 4.267 | 2.65e-05 *** |
| fbi | -0.045450 | 0.069324 | -0.656 | 0.5126 |
| sc | -0.417010 | 0.187937 | -2.219 | 0.0272 * |
| age | -0.015655 | 0.003603 | -4.345 | 1.90e-05 *** |
| fbi*sc | 0.057236 | 0.080412 | 0.712 | 0.4771 |
| fbi*age | 0.001528 | 0.001700 | 0.899 | 0.3695 |
| sc*age | 0.004940 | 0.004276 | 1.155 | 0.2488 |
| fbi*sc*age | -0.001895 | 0.001901 | -0.997 | 0.3195 |

*Note.* $M$ = mean, $SE$ = standard error, $B$ = coefficient, fbi = Facebook intensity (X), age (Z), loneliness (Y), sc = bonding social capital (M).

Table 10

*Moderated mediation analysis of Facebook intensity on loneliness with bonding social capital as mediator and age as moderator.*

| *Effect* | *Estimate* | *95% CI* | *p* |
|---|---|---|---|
| Age = 20 | | | |
| Total Effect | -0.02396 | [-0.09922, 0.05] | 0.53 |
| ACME (average) | -0.01637 | [-0.05000, 0.00] | 0.12 |
| ADE (average) | -0.00759 | [-0.08466, 0.07] | 0.83 |
| Prop. Mediated (average) | 0.68324 | [-0.83339, 25.23] | 0.55 |
| Age = 60 | | | |
| Total Effect | 0.04799 | [-0.02738, 0.13] | 0.22 |
| ACME (average) | -0.00667 | [-0.04459, 0.01] | 0.52 |
| ADE (average) | 0.05466 | [-0.02152, 0.13] | 0.16 |
| Prop. Mediated (average) | -0.13892 | [-52.16649, -0.05] | 0.65 |

*Note.* *CI* = bias-corrected confidence interval. *ACME* = average causal mediation effect, *ADE* = average direct effect. Total effect = ACME + ADE. Prop. = proportion.

Table 11

*Regression analysis of dFRMB on loneliness.*

| *Variable* | *B* | *SE B* | *t* | *p* |
|---|---|---|---|---|
| (Intercept) | 0.522646 | 0.141857 | 3.684 | 0.000271 *** |
| dfrmb | 0.117303 | 0.127738 | 0.918 | 0.359173 |
| age | -0.014300 | 0.003595 | -3.978 | 8.68e-05 *** |
| dfrmb*age | -0.001857 | 0.002904 | -0.640 | 0.522911 |

*Note.* $M$ = mean, $SE$ = standard error, $B$ = coefficient, dfrmb = difference between outward and inward Facebook relationship maintaining behaviour (X), loneliness (Y).

Table 12

*Regression analysis of dFRMB on social information seeking.*

| *Variable* | *B* | *SE B* | *t* | *p* |
|---|---|---|---|---|
| (Intercept) | 3.32945 | 0.05144 | 64.73 | < 2e-16 *** |
| dfrmb | -0.19045 | 0.04986 | -3.82 | 0.000161 *** |

*Note.* *M* = mean, *SE* = standard error, *B* = coefficient, dfrmb = difference between outward and inward Facebook relationship maintaining behaviour (X), sis = social information seeking (Y).

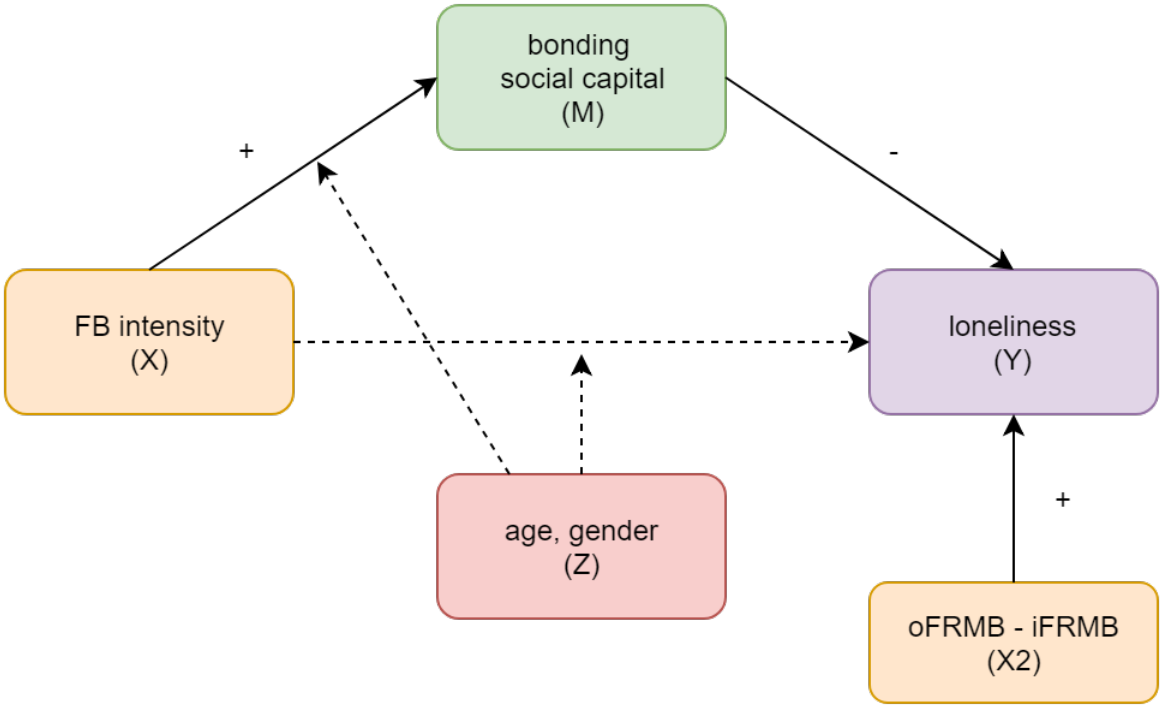


*Figure 1*. Diagram depicting the hypotheses of our study with + or - signs. Green = mediator, Orange = independent variable, purple = dependent variable, Red = moderator. FB = Facebook, o/iFRMB = outwards/inwards Facebook relationship maintaining behaviour.

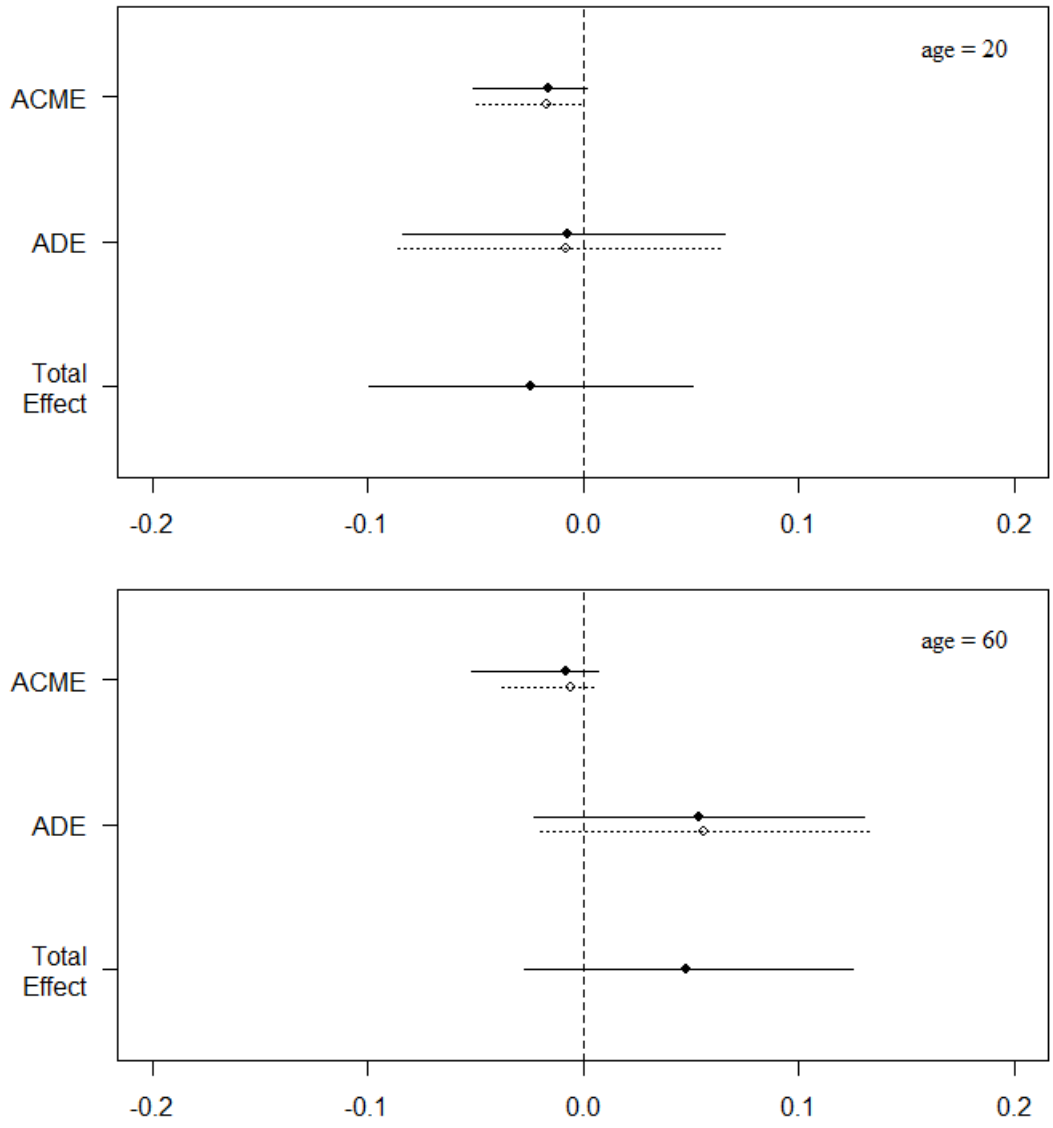


*Figure 2*. Mediation effects of Facebook intensity on loneliness with bonding social capital as mediator and age as moderator. Top: at age = 20. Bottom: at age = 60. *ACME* = average causal mediation effect, *ADE* = average direct effect. Total effect = ACME + ADE.

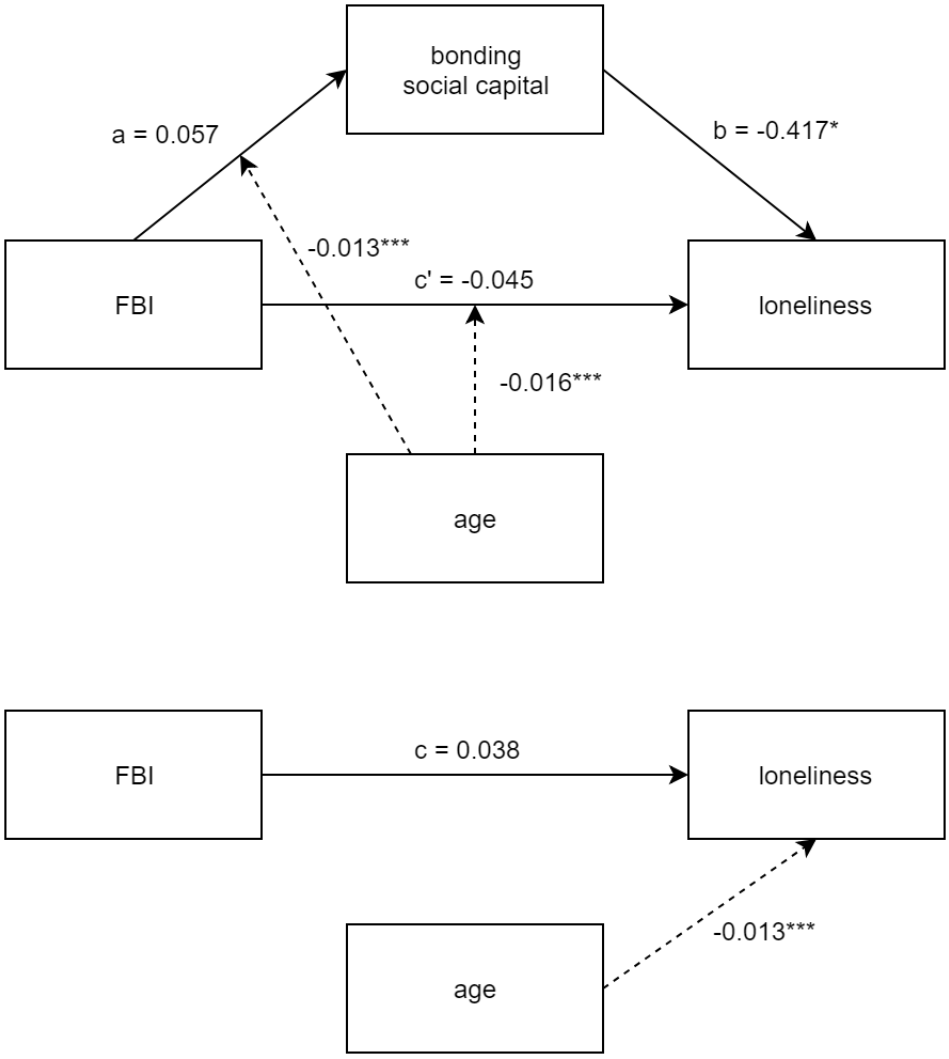


*Figure 3*. Mediation summary of Facebook intensity on loneliness with bonding social capital as mediator and age as moderator. FBI = Facebook intensity. Stars indicate significance level: * = .05, ** = .01, *** = .001

# Appendix

## Descriptives

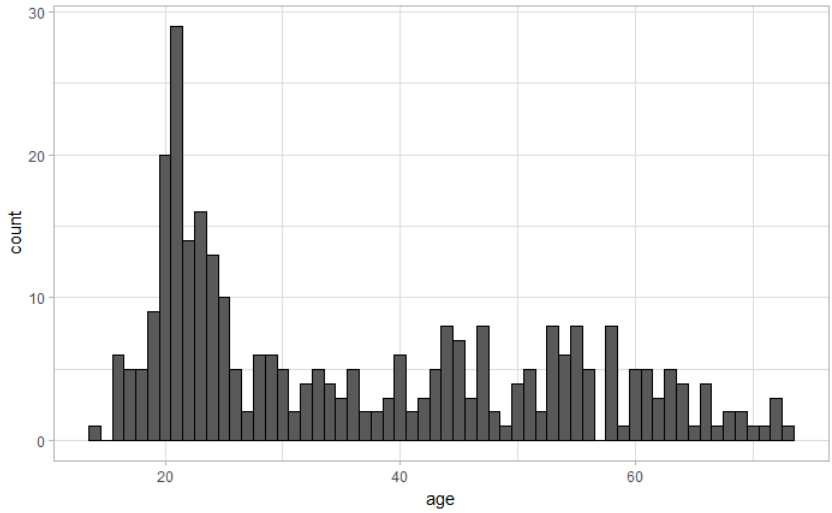


*Figure A1*. Histograp of the age of our participants

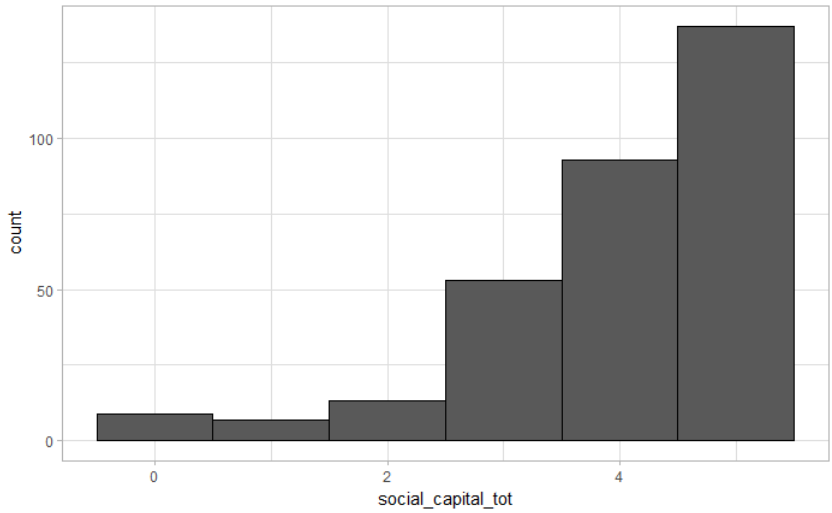


*Figure A2*. Histogram of the bonding social capital of our participants.

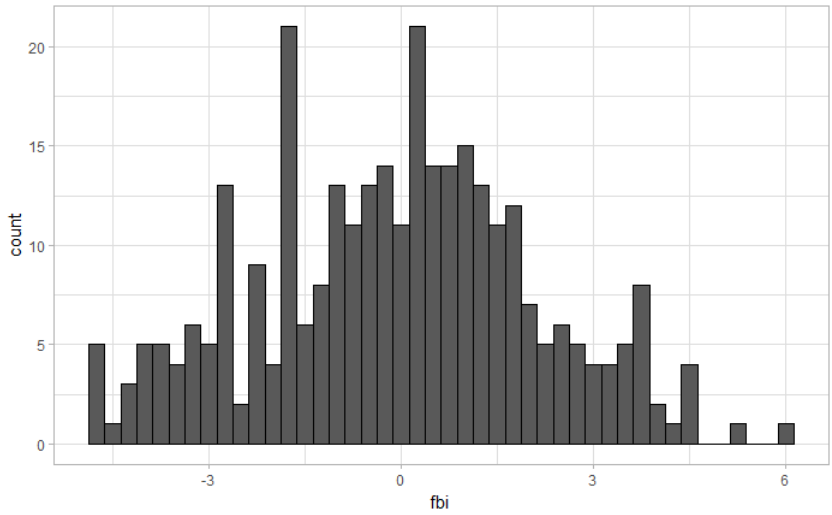


*Figure A3*. Histogram of the scaled Facebook intensity of our participants. See Table 2.

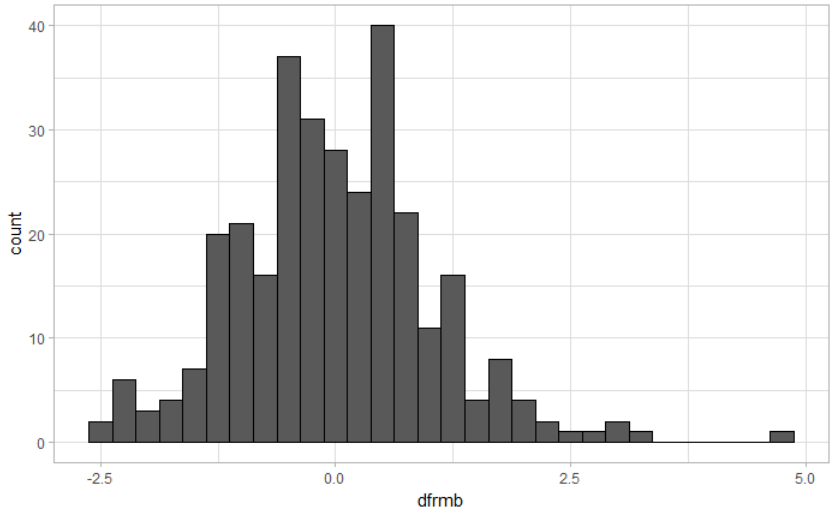


*Figure A4*. Histogram of the difference between outward and inward Facebook relationship maintaining behaviours amongst our participants.

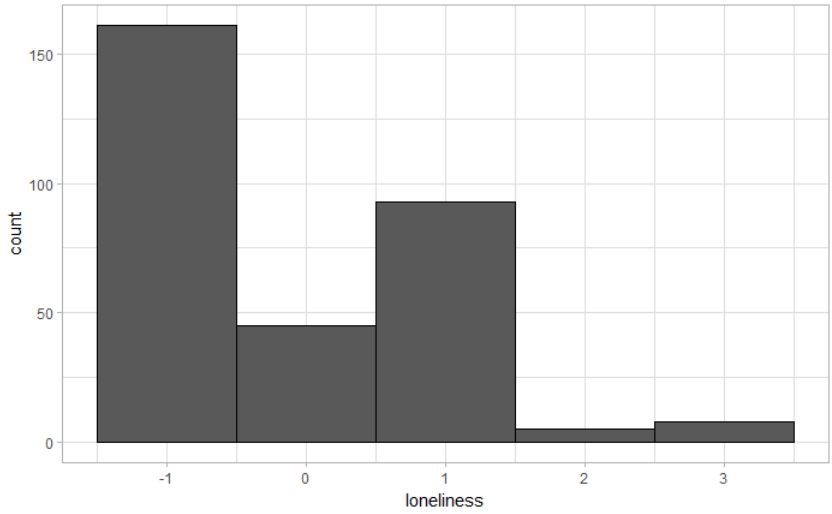


*Figure A5*. Histogram of the scaled loneliness of our participants.