The Co-Development of Extraversion and Friendships: Bonding and Behavioral Mechanisms in
Friendship Networks

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Author Note

We embrace the values of openness and transparency in science (Schönbrodt, Maier, Heene, & Zehetleitner, 2015; osf.io/4dvkw). We therefore follow the 21-word solution (Simmons, Nelson, & Simonsohn, 2012), or refer to complete project documentations in the OSF. We furthermore publish all raw data necessary to reproduce reported results and provide scripts for all data analyses reported in this manuscript for Sample 1 (see osf.io/f7ty9) and all scripts and output files for Sample 2.

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Abstract

Empirical evidence suggests that people select friends whose extraversion is similar to their own (selection effects). However, little is known about whether friends influence extraversion development (influence effects) and about the interaction mechanisms that underlie friendship selection and influence effects. We examined whether selection and influence effects explain similarity in extraversion between friends in two independent samples. Similarity in extraversion predicted a higher likelihood of friendship selection across four years in Sample 1 ($n = 1,698$; $M_{\text{age}} = 22.72$, $SD = 2.99$; 49% female) and across a period of 16 weeks in Sample 2 ($n = 131$; $M_{\text{age}} = 21.34$, $SD = 3.95$; 77% female). Friends' extraversion predicted increases in young adults' extraversion in both samples. In Sample 2, we examined the interaction mechanisms underlying these selection and influence effects by combining event-based experience-sampling network dynamics with diary data on friendship network and extraversion dynamics. Findings showed that (a) similarity in extraversion predicted positive interaction quality changes and (b) positive interaction quality predicted friendship selection (bonding mechanism). In the same sample, (I) friends' extraversion predicted friends' sociable behavior changes, (II) friends' sociable behavior predicted young adults' sociable behavior changes, and (III) young adults' sociable behavior predicted extraversion changes (behavioral mimicry mechanism). These findings provide unique insight into interaction mechanisms underlying longitudinal links between friendships and extraversion.

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The Co-Development of Extraversion and Friendships: Bonding and Behavioral Interaction Mechanisms in Friendship Networks

A longstanding tradition of personality and social psychology research has aimed at understanding why people have relationships with others who are like them (e.g., Byrne, 1971; Kandel, 1978b; Newcomb, Bukowski, & Bagwell, 1999). Most studies focus on personality effects on social relationships, with an increasing number of studies showing that people choose friends and romantic partners with similar personality traits (e.g., Asendorpf & Wilpers, 1998; Cuperman & Ickes, 2009; Morry, Kito, Martens, Marchylo, & Stevens, 2005; Selfhout et al., 2010). Reverse effects of social relationships on personality have received less attention. Dynamic models of personality development, however, stress that people's social relations shape their personality as well (Caspi, Elder, & Bem, 1987; Emmons, Diener, & Larsen, 1986; Neyer & Asendorpf, 2001; Reitz, Zimmermann, Hutteman, Specht, & Neyer, 2014; Roberts & Robins, 2004). More specifically, several scholars have suggested that personality traits may be reinforced within friendships, so that friends become more alike in their personality traits over time (e.g., Caspi & Roberts, 2001; Nelson, Thorne, & Shapiro, 2011; Reitz et al., 2014; Thorne, 1987). This raises intriguing questions: Do we choose friends who are similar to us in personality traits (selection effects), do we become like them in these traits (influence effects), or both? And, if we find evidence for both, what mechanisms are responsible for explaining how people select and influence their friends' personality?

To address these questions, we examined two independent samples of longitudinal data on friendship networks and the personality trait extraversion across four years in Sample 1 ($n = 1,698$) and across a period of 16 weeks in Sample 2 ($n = 131$) using a Stochastic Actor-Oriented Model (SAOM; Snijders, 2001; Snijders, Steglich, & Schweinberger, 2007; Snijders, Van de Bunt, & Steglich, 2010; Steglich, Snijders, & Pearson, 2010). This approach is flexible and useful

for understanding friendship selection and influence effects, because these two effects can be simultaneously modeled and underlying mechanisms that explain selection and influence can be empirically examined (for recent discussions, see Veenstra, Dijkstra, Steglich, & Van Zalk, 2013; Wölfer, Faber, & Hewstone, 2015). We focus on extraversion, or the tendency to participate in and enjoy social interactions (Ashton & Lee, 2007), a trait that is, by definition, socially anchored. Extraversion has been most extensively studied in the domain of peer relations and friendship and predicts selecting more friends (e.g., Asendorpf & Wilpers, 1998; Neyer & Asendorpf, 2001; Selfhout et al., 2010). Further, introverts tend to prefer introverts as friends, and extraverts tend to prefer extraverts as friends (Nelson et al., 2011; Peter, Valkenburg, & Schouten, 2005; Selfhout et al., 2010; Van Zalk & Denissen, 2015). Nevertheless, research has just begun to explore what happens after friendships are formed between persons with similar levels of extraversion. We aimed to go beyond prior studies focusing on to what extent similarity in extraversion predicts friendship selection (i.e., compared to other personality traits; see for example Selfhout et al., 2010) and additionally examine whether friends influence extraversion, so that friends become more similar in extraversion over time. Thus, the first aim of the current studies was to examine friendship selection (i.e., to what extent does similarity in extraversion predict friendship choices) together with friendship influence (i.e., to what extent does friends' extraversion predict extraversion changes) to explain friendship similarity in extraversion.

The second aim was to examine the underlying interaction mechanisms that explain how similarity in extraversion predicts friendship selection, and how friends influence extraversion development. We hypothesized that two distinct interaction mechanisms, namely *relationship bonding* (i.e., positive interaction quality) and *behavioral mimicry* (i.e., friends mimicking sociable behavior) within everyday interaction networks explain friendship selection and influence, respectively. To capture these interaction mechanisms in everyday interactions

between participants, we used additional event-based experience-sampling data from the second sample to estimate longitudinal network dynamics of interaction quality between interaction partners and sociable behavior in interactions between friends. We modeled dynamics of these two experience sampling networks together with friendship networks and extraversion in one model (i.e., three networks and the personality trait extraversion). We examined to what extent (a) similarity in extraversion predicted positive interaction quality changes; (b) positive interaction quality predicted friendship selection (cross-network effects from interaction quality network on friendship network dynamics). We also examined to what extent (I) friends' extraversion predicted friends' sociable behavior changes; (II) friends' sociable behavior predicted young adults' sociable behavior changes (i.e., reciprocity in sociable behavior dynamics); (III) young adults' sociable behavior predicted extraversion changes.

Dynamic Extraversion and Friendship Networks: The Interplay of Selection and Influence

Given that personality traits are relatively enduring and broad dispositions, it is perhaps unsurprising that most longitudinal studies have focused on how people choose friends with similar extraversion. Friendships are defined as voluntary and socially rewarding relationships (Aboud & Mendelsohn, 1996; Bukowski & Newcomb, 1984; Lazarsfeld & Merton, 1954; Newcomb et al., 1999). One of the most widely studied social relationship principles is that of homophily (Lazarsfeld & Merton, 1954; McPherson, Smith-Lovin, & Cook, 2001), also known as *friendship selection* (Kandel, 1978b): People choose friends who are similar to them in demographical background, values, attitudes, emotions, and personality traits. Indeed, a series of longitudinal studies shows that, during acquaintanceship, people tend to select friends who are similar to them in extraversion (Peter et al., 2005; Selfhout, Branje, Raaijmakers, & Meeus, 2007; Selfhout et al., 2010; Van Zalk & Denissen, 2015). For example, Van Zalk and Denissen (2015) found that unacquainted early adolescents and early adults selected friends with similar levels of

extraversion in three different samples. Thus, part of the answer as to why friends may be similar in extraversion seems to lie in personality-based effects on friendship selection: People select friends who are similar to them in extraversion.

Although there is relatively consistent support for friendship selection as an explanation for friendship similarity in extraversion, less attention has been devoted to friendship influence as an alternative explanation for this similarity. In the context of the current study, friendship influence concerns friends' extraversion changing targets' extraversion over time. Dynamic theories of personality development emphasize that social contexts and relations may affect dispositional traits, changing these dispositions over time (Caspi et al., 1987; Emmons et al., 1986; Roberts & Robins, 2004). Whereas introverted friends may reinforce each other's introverted tendencies (e.g., being socially reclusive), extraverted friends may reinforce each other's extraverted tendencies (e.g., being outgoing and sociable; Nelson et al. (2011) provide more examples). To our knowledge, it has not been examined yet whether friends influence each other's extraversion development, despite the recent emphasis on bi-directional influences between personality and social relationships (Back, 2015; Caspi & Roberts, 2001; Wrzus & Roberts, 2017). Therefore, we aimed to examine to what extent young adults choose friends who are similar to them in extraversion (i.e., friendship selection) and to simultaneously examine to what extent friends' extraversion changes young adults' extraversion (i.e., friendship influence). To examine the dynamic links between extraversion and social relationship development, we focused on young adulthood, a period when both extraversion and friendships change (e.g., Hutteman, Hennecke, Orth, Reitz, & Specht, 2014; Roberts, Caspi, & Moffitt, 2001).

Going Beyond Selection and Influence Effects: Underlying Interaction Mechanisms

The number of studies examining both selection and influence to explain relationship similarity in other characteristics than personality has increased rapidly. Network studies have

typically examined whether these effects are at work to explain similarity in a range of domains, including emotions and cognitive attributions (Delvaux, Meeussen, & Mesquita, 2016; Schaefer, Kornienko, & Fox, 2011), political attitudes and behaviors (Dahl & Van Zalk, 2014; Van Zalk, Kerr, Van Zalk, & Stattin, 2014), and antisocial behaviors (e.g., Burk, Steglich, & Snijders, 2007). Nevertheless, the cogs and wheels of *how* these network effects might work and what specific mechanisms may explain them remain understudied (see Veenstra et al., 2013). Recent work on network dynamics has called for a greater emphasis on studying underlying mechanisms embedded within social interactions that explain long-term changes in more general attitudes, feelings, behaviors, and personality traits (Veenstra et al., 2013; Wölfer et al., 2015). The vast majority of network studies use data across relatively long-term intervals (e.g., annual measurements) and subsequently show that, across these intervals, people choose friends who are similar to them in a domain and also that friends become more similar in that domain over time. What is missing from these studies is empirical evidence for *interaction mechanisms* happening during actual social interaction that explain how these effects unfold. We used the term interaction mechanisms as state-level changes referring to situation-specific and concrete interpersonal perceptions and behaviors occurring between interaction partners (Back, 2015; Back et al., 2011; Geukes, Van Zalk, & Back, 2017). These interaction mechanisms may explain how people choose their social partners and how their social partners influence them (see Back et al., 2011).

In a similar vein, recent work on the social consequences of personality (e.g., Back & Vazire, 2015) as well as on personality development (e.g., Geukes, Van Zalk, et al., 2017; Geukes, Van Zalk, & Back, 2018) has placed a large emphasis on the need to consider situation-specific interaction mechanisms when trying to understand relationship and personality changes. These accounts refer to repeated state-like interaction behaviors within specific social contexts

that, over time, may lead to personality and social relationship changes (see also Baumert et al., 2017). According to several models, most notably the PERSOC model (Back et al., 2011) and the TESSERA framework (Wrzus & Roberts, 2017), sequences of state-like experiences and behaviors constitute interaction mechanisms, which underlie personality changes (see also the Integrative State Process Model; Geukes et al., 2018). According to the PERSOC model (Back et al., 2011), personality and social relationships are interconnected through circumscribed social interaction units, consisting of dynamic relations between behavioral states (including how people behave within a specific social encounter) and momentary interpersonal perceptions (such as perceptions of liking and exclusion in that encounter). As these temporary states develop into repeated sequences, behavioral habits as well as social and self-related mental representations are created over time, which are assumed to influence dispositional personality tendencies and social relationship quality and stability. Thus, following recent work on social consequences of personality and personality development (e.g., Back et al., 2011; Baumert et al., 2017) as well as heeding the call of network studies in general (e.g., Veenstra et al., 2013), we focus on repeated social interaction mechanisms embedded within social contexts, potentially driving friendships and personality development. We distinguish between two broad classes of interaction mechanisms: Bonding interaction mechanisms (i.e., the experience of closeness or intimacy among social interaction partners) and behavioral interaction mechanisms (i.e., how social partners behave during interactions).

Bonding Interaction Mechanisms in Networks Underlie Selection Effects

Bonding interaction mechanisms in social networks can be seen as the glue that holds relationships together. They concern dyadic intimacy or closeness experienced by the social interaction partners during relationship formation between these interaction partners. One example of this concerns the perceptions of interaction quality, or how positive the interaction

partner(s) experience(s) the interaction. We suggest that bonding interaction mechanisms are particularly relevant for explaining how relationships are formed and maintained. In the context of similarity, Uncertainty Reduction Theory (Berger & Calabrese, 1975; Ramirez, 2009) holds that similarity between interaction partners diminishes uncertainty and therefore enhances interaction quality, which, in turn, leads to relationship formation. In a similar vein, the reinforcement-affect hypothesis (Byrne & Nelson, 1965; Clore & Byrne, 1974) suggests that similarity will increase positive affect between partners, leading to a more positive and pleasurable interaction than between dissimilar partners. Similar to the Uncertainty Reduction Theory, the reinforcement-affect hypothesis holds that positive interaction quality will stimulate relationship formation between similar partners.

Thus, a set of related theoretical frameworks emphasizes the importance of interaction quality as a mechanism to explain how similarity affects relationship formation, including friendship selection. Prior empirical studies have studied unacquainted and just-acquainted freshmen over time and found support for the idea that increased interaction quality explained similarity in extraversion effects on friendship selection (Selfhout, Denissen, Branje, & Meeus, 2009; Van Zalk & Denissen, 2015). Among unacquainted freshmen dyads, two prior studies showed that similarity in extraversion predicted intensity of interactions (Selfhout et al., 2009) and social interaction quality (Van Zalk & Denissen, 2015), which, in turn, predicted a higher likelihood of friendship selection.

Based on existing theoretical frameworks and prior empirical findings, we expect that (A) higher similarity in extraversion would predict positive interaction changes (i.e., either participants changing a less positive interaction into a more positive interaction over time or participants maintaining their already positive interaction over time); and that (B) positive interaction quality between participants, in turn, would predict friendship selection (i.e.,

participants forming a new friendship or maintaining a friendship).

Behavioral Interaction Mechanisms in Networks Underlie Influence Effects

We suggest that behavioral interaction mechanisms explain friendship influence effects within formed relationships. One such behavioral mechanism connected to personality development is behavioral mimicry (Kurzius & Borkenau, 2015; Lakin & Chartrand, 2003; Mauersberger, Blaison, Kafetsios, Kessler, & Hess, 2015; Salazar Kämpf et al., 2018), referring to the tendency of social partners to imitate each other's behaviors. We suggest that by mimicking interaction partner's sociable behaviors, rather than more reclusive behaviors, dyadic partners increase in extraversion over time. In contrast, mimicking reclusive behaviors may increase introversion. Thus, we propose that people tend to mimic those behaviors that fit their dispositions, goals, and attitudes more than other behaviors (See also Lakin & Chartrand, 2003; Smith-Genthôs, Reich, Lakin, & Casa de Calvo, 2015, for a similar argumentation). Behavioral mimicry is suggested to occur when personality traits are similar between interaction partners. When individuals interact with friends who are similarly extraverted and mimic their friends' sociable behavior, they may then change their extraversion self-perceptions accordingly. We focused on other-rated sociable behavior (i.e., the target's sociable behavior as observed by the interaction partner) to avoid shared observer bias. We expected that (I) friends' extraversion predicts friends' sociable behavior changes, (II) friends' sociable behavior predicts target individuals' sociable behavior changes, and (III) target persons' sociable behavior predicts target persons' extraversion changes.

Empirical findings on behavioral mimicry in dyadic relationships, and particularly their connection to specific personality traits, are rare. One study suggested that mimicry of social interaction behaviors is a distinctive reciprocal and dyadic relationship attribute and found little evidence for the idea that one interaction partner specifically drives social mimicry (Salazar

Kämpf et al., 2018). Using Social Relations Models, the authors demonstrated that variance in social mimicry was mostly explained by the unique relationship between interaction partners, not by one partner (i.e., Actor or Partner effects). However, these authors did not specifically examine mimicry in sociable behavior, or its connection to personality. Kurzius and Borkenau (2015) showed that specific personality traits predict specific patterns of behavioral mimicry during interactions between unacquainted persons. For example, participants reacted with agreeable behaviors (e.g., nodding and smiling) when dyadic partners' agreeableness was high, and with negative behaviors (e.g., head-shaking and shrugging) when dyadic partners' dominance was high. These prior studies indicate that behavioral mimicry may be elicited by dyadic partners' specific traits, yet these studies did not examine whether behavioral mimicry, in turn, predicted personality trait changes.

To our knowledge, only one study examined how high levels of social partners' extraversion in particular may lead to reinforcement of sociable behavior. Building on the Self-Reinforcement Theory of Personality, Nelson et al. (2011) suggested that mutual reinforcement within friendships is particularly present when dyadic partners have similar personality traits. Mutual reinforcement refers to social partners socially reinforcing (e.g., via smiles, verbal encouragement) specific behaviors which match their own personality traits. For example, their findings indicated that, whereas introverted friends reinforced each other's tendencies to be socially reclusive, extraverted friends reinforced each other's tendencies to be socially inclusive, to have high energy during conversations, and to talk frequently. Based on this reasoning and these prior findings, we suggest that friends influence each other's extraversion over time, because friends with similar extraversion adopt and further reinforce sociable behaviors during social interactions.

The Current Studies

The current studies aim to fill the existing gap of knowledge concerning why friends tend to be similar in extraversion by using a social network approach (Snijders et al., 2010; Udehn & Van Zalk, 2002). More specifically, when people select friends who are similar to them in extraversion, they may – willingly or unwillingly – set the conditions for further reinforcing their outgoing and sociable dispositions. Consistent with this perspective, dynamic theories of personality development emphasize that people actively choose and change environments that reinforce their dispositional traits, changing these dispositions over time (Caspi et al., 1987; Emmons et al., 1986; Roberts & Robins, 2004). Selection and influence are considered as two sides of the same coin: Both need to be simultaneously considered to explain friendship similarity in personality. Thus, the first aim of this study was to examine to what extent selection and influence effects jointly explain similarity in friendship networks. To address this, we used two distinct longitudinal social network samples of young adults in two different countries and estimated a Stochastic Actor-Oriented Model (Snijders et al., 2010) to examine how *both* friendship selection and influence explain similarity in extraversion. We examined short-term (Sample 2; 16 weeks) and long-term (Sample 1, four years) selection and influence effects to gain insight into the temporal stability of these effects. In so doing, we aimed to better understand whether and how friends influence extraversion development.

The second aim of this study was to empirically examine one model that targeted the co-development of extraversion and friendships via selection and influence effects, while at the same time examining interaction mechanisms that underlie these selection and influence effects. We simultaneously examined in one model (a) the co-development of extraversion and friendship, by studying selection and influence effects, and (b) two underlying interaction mechanisms that explain these effects. Figure 1 presents a conceptual overview of the two interaction mechanisms we hypothesized to operate in friendship networks. We show six hypothetical stages, three for

selection effects and three for influence effects, to demonstrate how specific interaction mechanisms underlie these effects. The first mechanism concerns a bonding interaction mechanism, namely perceived quality during social interactions between to-be friends (i.e., people who change from not being friends to being friends at a later measurement; see the top of Figure 1). We suggest that persons who are more similar in extraversion experience more positive interaction quality than persons who are less similar in extraversion (in Figure 1, the changes shown from Stage 1a to 1b). Positive interaction quality, in turn, leads to a higher likelihood of friendship selection between persons with similar extraversion (changes shown from Stage 1b to 1c). Thus, positive interaction quality is suggested as a mechanism explaining why people select friends with similar extraversion.

The second interaction mechanism is behavioral mimicry, which is suggested to be an important behavioral mechanism through which friends influence extraversion (see the bottom of Figure 1). Friends with similar levels of extraversion are suggested to mutually reinforce their sociable behavior during dyadic interactions, leading to sociable behavior changes (changes from Stage 2a to Stage 2b). Sociable behavior, in turn, is suggested to result in extraversion changes (changes from Stage 2b to 2c). Thus, we examined two interaction mechanisms: Bonding, as indicated by positive interaction quality changes, and behavioral mimicry, as indicated by mimicry of sociable behavior changes. Both interaction mechanisms were examined in Sample 2.

Method

We used two independent samples (Sample 1 and Sample 2) to examine the first aim of this study, namely, to what extent selection and influence effects jointly explain similarity in extraversion in friendship networks. In both samples, longitudinal panel data were collected on friendship networks and extraversion for young adults. In Sample 1, we used randomly selected young adults who were followed across a four-year period with three biannual waves of

measurement, whose reciprocal friendship information was optimized by using a snowball procedure (i.e., up to three friends, who were not already participating as target participants, were invited to participate per wave). In Sample 2, a complete friendship network of newly acquainted psychology freshmen was followed across 16 weeks with four waves. In Sample 2, we used unlimited friendship nominations with a network boundary (i.e., only other freshmen of psychology could be nominated as friends). We then examined one model in each sample in which similarity in extraversion was used to predict friendship dynamics (i.e., friendship selection), while at the same time, friends' extraversion was used to predict extraversion dynamics (i.e., friendship influence).

The second objective concerned our conceptual model (see Figure 1), where we hypothesized that bonding and behavioral mimicry interaction mechanisms within everyday situations explain friendship selection and influence. We only used Sample 2, as here we additionally collected event-based experience sampling data on everyday interactions between participants, and combined these data with longitudinal panel data on friendship networks and extraversion.

All sampling procedures and materials of Sample 1 were approved by the Swedish Central Ethical Review Board, Örebro University (Title: "Evaluation of the tolerance project: how to reduce prejudice?"; Project number 2013/298). Procedures for Sample 2 were approved by the German Research Foundation (BA 3731/6-1), the Research Ethics Committees of the University of Münster, and University of Mainz (Title: "The longitudinal course of narcissists' reputations: A developmental social interaction approach"; no project numbers ascribed).

Sample 1

In Sample 1, we examined selection and influence effects covering a four-year period with three biannual waves. All R-scripts and output files can be found on the OSF page <https://osf.io/f7ty9/>. Data are available upon request by contacting the main author.¹

Sample. Participants comprised of two randomly selected cohorts (24 and 26-year-olds) and their friends from a mid-sized Swedish city that was nationally representative regarding population density, income level, and unemployment rate. See Appendix 1 for a detailed overview of the sample sizes. Questionnaires were filled out by target participants and their friends on three waves with two-year intervals, respectively. Data from Sample 1 have not been used in prior publications.

Sampling procedure. We targeted a random selection of young adults from two cohorts to fill out questionnaires, then subsequently used the snow-ball technique (Coleman, 1958; Frank & Snijders, 1994; Goodman, 1961; Kerr, Stattin, & Kiesner, 2007; Spreen, 1992). The snow-ball technique aims to maximize reciprocal information from both the target adolescent and the friends they nominated and to increase the sample size (see Kerr et al., 2007; Kiesner, Kerr, & Stattin, 2004; Munoz, Kerr, & Besic, 2008; Van Zalk et al., 2014 for a detailed account of the same procedure in different samples). Our final sample was therefore constructed in three steps: (a) Randomly sending target participants from two cohorts invitation letters and questionnaires via post and asking them to nominate up to eight friends (target sample); (b) Identifying nominated friends who already participated in the target sample (target sample friends); (c) Inviting a maximum of three friends nominated by the target participants, who were not yet themselves in the target sample as participants (non-target sample friends), by sending them the same invitation letters and questionnaires as the target participants received. These three steps were repeated in the same identical way at each of the three waves of measurement, regardless of whether nominated friends had already participated or not at prior waves (i.e., old and new

friends could participate at each wave; prior wave information was ignored). We explain each of these three steps and their consequences in detail in Appendix 1. The final sample consisted of the combination of the 1,199 target sample (both (a) and (b) combined) and the 499 non-target sample friends (c), resulting in a total of 1,698 participants (see Appendix 1; $M_{\text{age}} = 22.72$ years, $SD = 2.99$, 49% female). In sum, all participants fulfilled two criteria: (1) They had at least one wave of data with extraversion scores; and (2) they had at least one wave of data where they were either nominating a friend, and/or being nominated as a friend.

Measures.

Friendship nominations. At each wave, participants were asked to write down the names of a maximum of eight of their friends via a friendship nomination questionnaire used in other studies (e.g., Kiesner et al., 2004; Van Zalk, Kerr, Branje, Stattin, & Meeus, 2010). Specifically, they were asked to write the names, gender, age, and address of their friends.

Extraversion measure. Participants filled out the Swedish translation of the 44-item Big Five Inventory (BFI; Ekehammar, Akrami, Gylje, & Zakrisson, 2004). We used the eight extraversion items of the BFI. Participants rated each of the eight items on a five-point Likert scale (1 = “Strongly disagree” to 5 = “Strongly agree”). We calculated an average across the eight items for each participant. Cronbach’s alphas were .88, .91, and .89 for the first, second, and third wave of measurement, respectively.

Sample 2

We used Sample 2 to replicate findings from Sample 1, by collecting data on extraversion and friendship networks across short time intervals (i.e., four waves across approximately one semester at a German university, namely sixteen weeks). In addition, we used Sample 2 to address the second aim of our study, which was to examine whether bonding interaction

mechanisms (i.e., interaction quality changes) and behavioral mimicry interaction mechanisms (i.e., sociable behavior changes) underlie the co-development of extraversion and friendship.

Sample. Participants were 131 psychology freshmen ($M_{\text{age}} = 21.34$, $SD = 3.95$; 77% female) from the CONNECT Study (see Geukes, Breil, Hutteman, Nestler, Kfner, Back, 2019; see also <https://osf.io/2pmcr/> for an overview of all materials and procedures). Anonymized data, R-scripts, and output files based on the CONNECT data used in the current study can be found under <https://osf.io/f7ty9/>. Some of the variables used in this manuscript (extraversion, sociable behavior, and friendship nominations) have been considered in prior publications based on the CONNECT data, either as predictor, control, validation, and/or as outcome variables (Breil et al., 2019; Geukes et al., 2019; Geukes, Nestler, Hutteman, Dfner, et al., 2017; Geukes, Nestler, Hutteman, Kfner, & Back, 2017; Human, Carlson, Geukes, Nestler, & Back, in press; Weber, Geukes, Leckelt, & Back, in press). Despite this partial overlap in the use of some variables, the current study is the first in which selection and influence effects underlying extraversion similarity in friendship networks were examined. A complete list of prior publications based on the CONNECT data, including information on the respective focal research question, can be found on the OSF page <https://osf.io/z94j2/>.

Sampling and Procedures. All psychology freshmen starting their first year at the University of Mnster, Germany, in October 2012 ($n = 138$) were invited to participate via email. They were asked to come to an introductory session one week before the start of the semester. A total of 131 participants agreed to participate (participation rate: 95%). The students received an incentive in the form of course credit, monetary compensation (up to 100 Euro for the participation during the first semester), participation in a lottery for a variety of gift vouchers, and individual feedback on their personality and personality development (i.e., provided after the end of the study in 2013).

In the current study, we used data from two sources of the CONNECT project: A time-based online diary and an event-based smartphone survey (see Table 1 for details). These assessments were realized throughout participants' first semester, namely during the period from October 2012 to January 2013.

The purpose of the time-based online diary was to get repeated measures of social relationships and personality judgments at regular time intervals. We selected only those waves of the time-based assessment at which extraversion and friendship were assessed and ensured that both assessments fell into the considered four event-based assessment waves, respectively (see Table 1).

The purpose of the event-based assessment was to obtain repeated information on real-life interpersonal interactions to be able to examine bonding and behavioral mimicry interaction mechanisms. This was done in five weeks during the first semester. These roughly corresponded to the 1st week, 2nd week, 3rd week (all October 2012), 8th week (December 2012), and 15th week (January 2013) of the semester (see Table 1). To meaningfully relate the event-based assessments to the time-based assessments, we aggregated the 2nd week and 3rd week to better match the timing of the time-based assessment, creating a total of four waves. For this study, we used the measures on interaction quality and sociable behavior of the event-based smartphone survey as indicators of the bonding and the behavioral interaction mechanisms, respectively. Within the four waves of event-based assessments, participants were asked to fill out a smartphone-based survey after they had interactions with one or more other participants (i.e., fellow students of their cohort). These interactions were defined as “an encounter with one or more people that lasts for at least five minutes and in which one responds to the behavior of the other persons”. Thus, the event-based assessments covered various periods, which were as closely matched as possible to the timing of friendships and extraversion measures. Nevertheless, as multiple interactions

between the same persons were possible within one period, we averaged ratings towards the same interaction partner within that period for the analyses.

Measures.

Friendship measure. In the time-based online diary, participants were presented with pictures of all other participants and asked to select those pictures of others whom they considered their friends (“This person is a friend of mine...”), resulting in a dichotomous variable with 1 = “friend” and 0 = “non-friend”. Importantly, no limitations were given to the number of friendship nominations. In the current study, the friendship nomination measure correlated positively and significantly with perceived relationship satisfaction (rated on a scale from 0 = very unsatisfied to 10 = very satisfied; $r_{pb} > .478, p < .001$), perceived relationship importance (rated on a scale from 0 = not important to 10 = very important; $r_{pb} > .613, p < .001$), and perceived emotional support (“In case of emotional troubles, I can...” rated on a scale from 0 = “never turn to this person” to 10 = “always turn to this person”; $r_{pb} > .522, p < .001$). We concluded that our friendship measure was a valid indicator of other perceived relationship quality indicators.

Extraversion measure. In the time-based online diary, participants rated themselves on extraversion on a scale from 0 = “extraverted, enthusiastic” to 10 = “reserved, quiet”, a validated short-scale for extraversion (Denissen, Geenen, Selfhout, & Van Aken, 2008; John, Donahue, & Kentle, 1991; John, Naumann, & Soto, 2008; John & Srivastava, 1999). We recoded this measure in our analyses (see Analysis Strategy), so that higher scores reflected more extraversion.

Interaction quality. The first mechanism concerned a bonding mechanism, measured by perceived interaction quality in social interactions. Within the event-based smartphone-survey, participants were asked to rate how they perceived the interaction quality with their interaction partners on a scale from 1 to 7, with 1 = “positive” and 7 = “negative”. We dichotomized

interaction quality values to obtain network adjacency matrices (see Analysis Strategy for details).

Sociable behavior. The second mechanism concerned a behavioral mimicry mechanism, measured by sociable behavior. Within the event-based smartphone data, participants rated their own and interaction partner's sociable behavior on a scale from 1 to 7, with 1 = "sociable" and 7 = "reclusive". In the current study, we used other-rated sociable behavior (i.e., how the interaction partner judged a participant's sociable behavior) to avoid shared observer bias. Nevertheless, we replicated our findings using self-reports on sociable behavior and we dichotomized sociable behavior values to obtain network adjacency matrices (see Analysis Strategy for details).

Analysis Strategy

To examine to what extent friendship selection and influence explain similarity in extraversion found in friendship networks, we estimated selection and influence effects in a Stochastic Actor-Oriented Modeling (SAOM) with the R-package *RSiena* (Snijders, 2001; Snijders et al., 2010). The relevant R-script is available in an OSF project (<https://osf.io/f7ty9/>) and is labeled "Model Main Analyses in R Tables 3, 4, and 5". In the next subsections, we provide an overview of the model specifications and assumptions, network data characteristics, and the effects included in our models to examine our research aims.

Model specifications and assumptions. We summarize basic model specifications to introduce readers unfamiliar with longitudinal network modeling and data requirements (discussed in detail by Snijders et al., 2010). We only offer a general introduction, specifically applied to the data used for the current studies. We refer to prior work (e.g., Huisman & Snijders, 2003; Snijders et al., 2007; Steglich, Snijders, & West, 2006; Wasserman & Faust, 1994) that has addressed these assumptions in more detail.

The SAOM framework offers the possibility of simultaneously examining effects on friendship network changes (i.e., selection effects (a), also called *network dynamics*; see Snijders et al., 2010) and effects on extraversion changes (i.e., influence effects (b), also referred to as “*behavioral dynamics*”) using a Markov-chain continuous time process. The simultaneous estimation of (a) selection and (b) influence is important to our research objectives, because we aim to examine how *both* friendship selection and influence explain friendship similarity in extraversion. Two identical RSiena models (one for Sample 1, one for Sample 2) were estimated to examine selection and influence effects that explain friendship similarity in extraversion. To address our second research aim, we estimated a third model in Sample 2. With this third model, we examined whether network dynamics of interaction quality explain selection effects, and whether network dynamics of sociable behavior explain influence effects.

We considered to what extent SAOM assumptions (discussed in detail by Snijders et al., 2010) applied to the data used for the current studies. Here, we present only a brief discussion of the three most relevant assumptions: (I) Time underlying friendship network and extraversion changes is assumed to be continuous, and these continuous changes can be estimated by discrete waves of measurement (i.e., three waves for Sample 1, four waves for Sample 2); (II) A Markov process is assumed to underlie continuous longitudinal changes, meaning that earlier states of a variable (e.g., the friendships network at a certain time) probabilistically predict the next state of that same variable (e.g., the likelihood of changes in the friendship network at a subsequent time), an assumption often used for social network models (e.g., Snijders et al., 2007; Wasserman & Faust, 1994); (III) Between the observation moments, the dependent variables (i.e., networks and extraversion) are assumed to change in small unobserved steps. At each moment of change, one participant changes either one outgoing network tie (i.e., friendship, sociable behavior, and/or interaction quality), or his/her extraversion.

Effects estimated with RSiena can be seen as multinomial logistic regression effects for ordered dependent outcomes (i.e., influence effects on extraversion in our study) and categorical logistic regression effects for binary outcomes (i.e., selection effects on friendship, sociable behavior, and interaction quality networks; Snijders et al., 2010). Friendship selection effects represent the probability that a specific participant will form or maintain a friendship to another specific participant. If an effect is positive and significant, then, at higher values of the predictor, there is a higher probability of a participant to form or maintain a friendship compared to not forming and not maintaining a friendship to that participant. For example, our expectation was that similarity in extraversion between two participants would predict a higher likelihood of friendship selection between these two participants, meaning we expected a positive and significant effect of similarity in extraversion on friendship selection. The same interpretations apply for effects on the dependent networks interaction quality and sociable behavior. Effects of friendship influence represent the probability that a specific participant will increase in extraversion relative to him- or herself compared to not changing. If an effect is positive and significant, then, at higher values of the predictor, there is a higher probability of a participant to increase in extraversion compared to not changing in extraversion. We examined the two-sided significance of effects by dividing the effect estimate by its standard error (Ripley, Snijders, Boda, Voros, & Preciado, 2018).

We followed model specification recommendations according to Snijders and colleagues (e.g., Snijders et al., 2007; Snijders et al., 2010; Steglich et al., 2010; Van de Bunt, Van Duijn, & Snijders, 1999). We proceeded by including the effects that were of theoretical interest for the research questions, and five network effects. We decided to include five network effects recommended from prior network studies (Ripley et al., 2018): Outdegree, reciprocity, GWESP-FF, transitive triplets, and the interaction between reciprocity and transitive triplets (Block,

2015). Network effects were included (a) because their exclusion, when estimating friendship changes, leads to biases in effect estimates (Snijders et al., 2007; these network interdependencies are explained in detail in the Result section "Selection and Extraversion") and (b) because a series of prior studies on friendship networks showed that, when modeling friendship network changes, these effects significantly explain friendship network changes and, therefore, represent important confounding effects (e.g., Block & Grund, 2014; DeLay, Ha, Van Ryzin, Winter, & Dishion, 2016; Van de Bunt et al., 1999; Van Zalk et al., 2010; Van Zalk et al., 2014; Veenstra et al., 2013). We refer to the Result section for specific interpretations of each effect and the model fit section for how we assessed their model fit to the data.

Network data. Next, we specify in a step-by-step fashion how we restructured the data into network adjacency matrices. For details on network data using RSiena, see the RSiena Manual (Ripley et al., 2018). To enhance interpretation of these adjacency matrices, we use a hypothetical example of Klara, Maya, and Terry.

Friendship network data. For Sample 1, three adjacency matrices were specified for the 1,698 participants (i.e., 1,698 by 1,698 cells per matrix, one matrix for each of the three waves). For Sample 2, four adjacency matrices were specified for the 131 participants (i.e., 131 by 131 cells per matrix, one matrix for each of the four waves). The rows in each matrix were used to show whether Klara_{*i*} (called *ego*) nominated Maya_{*j*} (called *alter*) as a friend. If ego Klara_{*i*} nominated alter Maya_{*j*} as a friend (an example of an outgoing friendship tie), then a value of 1 was coded in the cell_{*ij*}. In contrast, if ego Klara_{*i*} did not nominate alter Maya_{*j*} as a friend (i.e., a non-nomination), then a value of 0 was coded in the cell_{*ij*}.

By using the columns of the matrices, we could also use these same matrices to examine whether alters nominated egos (incoming friendship ties). If alter Maya_{*j*} nominated ego Klara_{*i*} as a friend, a 1 was coded in the cell_{*ji*}. If alter Maya_{*j*} did not nominate ego Klara_{*i*} as a friend, a 0 was

coded in the cell $_{ji}$. Finally, by using the full matrices (i.e., both sides of the diagonal), we could include each participant as an ego *and* an alter; in our example, this means that Maya $_i$ was also an ego $_i$ and *her* outgoing friendships to alters (e.g., alter Klara $_j$) were shown in the rows, and her incoming friendships from alters were shown in the columns. Please note that since our data are interchangeable, we only use ego and alter here to enhance the interpretation for some of our effects (i.e., where the direction of nomination is relevant); in our analyses, Maya and Klara are both ego *and* alter.

In Sample 1, there was a maximum of eight outgoing nominations possible per participant (i.e., a maximum of eight values of 1 per row; see Table 2). Although each participant could nominate only a maximum of eight other participants, that same participant could hypothetically be nominated by *all* other participants (i.e., we did not restrict the maximum number of incoming friendship nominations). This means that the number of incoming nominations could theoretically range beyond eight; We found a maximum of nine incoming nominations in Sample 1. For Sample 2, friendship nominations were unlimited, meaning that a maximum of 131 nominations per row and column were possible (see Table 3 for more information).

Missings were handled separately from a non-nomination (following the missing estimation procedure as explained by Ripley et al., 2018). If an ego did not participate at a specific wave, the entire row for ego was coded with missing values (*NAs*). If an alter was absent at a specific wave, the entire column for alter was coded with missing values (*NAs*). See the Missing Data section for how these missings were handled in our analyses.

In sum, we created matrices representing friendship networks, one for each wave, in which each cell $_{ij}$ provided dyadic information on friendships, namely showing either the presence of a friendship nomination (coded 1), a non-nomination (coded 0), or a missing value (coded *NA*).

Interaction quality network data. In our theoretical model, we expected that interaction quality changes explained selection effects. In Sample 2, we therefore specified four (i.e., one for each wave) adjacency matrices. Using the same procedure as described above for friendship networks, we created one matrix at each wave in which each cell_{ij} provided dyadic information on interaction quality. Because we were interested in the difference between positive versus less positive interaction quality and the range of interaction quality values was large (values ranged from 1 = “positive” to 7 = “negative”; RSiena (Ripley et al., 2018) can only handle a limited number of ordered network values), we dichotomized the interaction quality values. We contrasted positive interaction quality (i.e., scores 1 and 2 on a scale from 1 = “positive” to 7 = “negative” were recoded into the value 1) versus less positive interaction quality (i.e., other scores on the same scale were recoded into the value 0). A missing value was treated separately (coded NA: see section on Missing data below). In the same R-script, we explored additional analyses in which we treated interaction quality scores as a varying (i.e., changing over time) dyadic covariate to predict friendship changes (but, in that case, we could not examine predictor effects on interaction quality; see Ripley, et al., 2018). Thus, we modeled interaction quality changes by estimating network dynamics of positive interaction ties (i.e., ego changing from a less positive interaction to a positive interaction with alter, or ego maintaining a positive interaction with alter over time).

Sociable behavior network data. We additionally expected that mimicry of sociable behavior explained influence effects. We created one matrix for each wave (i.e., four matrices), in which each cell_{ij} provided dyadic information on sociable behavior. We used the same procedure as described above for interaction quality, with one major difference: Sociable behavior was *only* coded when participants were friends at that specific wave, because we suggested mimicry of sociable behavior to underlie friendship influence. This means that when a 0 was coded in the

friendship network, then a 0 was coded in the sociable behavior network. For one specific wave, given that ego_i selected alter_j as a friend (i.e., cell_{ij} was coded with a one in that wave's friendship network), we entered information of sociable behavior between pairs of participants.

For the same reasons as explained above for interaction quality, we dichotomized the sociable behavior values. We contrasted sociable behavior (i.e., scores 1 and 2 on a scale from 1 = "sociable" to 7 = "reclusive" were recoded into the value 1) versus less sociable behavior (i.e., other scores on the same scale were recoded into the value 0). A missing value was treated separately (coded *NA*: see section on Missing data below). Thus, we modeled sociable behavior changes by estimating network dynamics of other-reported sociable behavior ties (i.e., exclusively for friendships; alter reporting that ego changed from less sociable behavior to more sociable behavior, or alter reporting that ego maintained sociable behavior over time).

Selection effects. For selection effects, we examined how participants' attributes (i.e., how similar Klara is to Maya in extraversion) predicted friendship selection (e.g., Klara and Maya, who are not friends yet, become friends at a later point in time). Higher similarity in extraversion, therefore, indicated a greater degree of similarity between ego and alter on extraversion, and we expected that higher similarity in extraversion would predict a higher likelihood of friendship selection compared to lower similarity in extraversion. We controlled for participants' own (i.e., ego extraversion) and their friends' (i.e., alter extraversion) extraversion effects on friendship selection.

Influence effects. For effects on the second dependent variable, extraversion changes, we expected friends' extraversion to predict extraversion changes. We therefore estimated an *average alter* effect on extraversion changes. This refers to higher average scores of friends' extraversion (so the average across all nominated alters) at a prior time of measurement predicting the target's (ego's) extraversion changes. We expected a positive average alter

extraversion effect, which would mean that a higher average friends' extraversion predicted a higher likelihood of increased ego's extraversion. We controlled for the number of incoming and outgoing friendship network ties when predicting these changes (*indegree* and *outdegree*, respectively; see Snijders, 2010). *Linear shape* and *quadratic shape* represent the basic tendency of the behavior (i.e., how participants score on extraversion) in our model. A significant and positive linear shape would indicate that participants tend to have high scores of extraversion (i.e., on average, participants score higher than the midpoint on the scale of extraversion); conversely, a significant and negative effect would indicate that participants tend to score low on extraversion (i.e., on average, participants score lower than the midpoint on the scale of extraversion). A quadratic effect is the quadratic term of the linear effect (i.e., the linear effect interacting with the linear effect), and, depending on the linear effect, could represent either accelerated preference (i.e., positive quadratic effects) or decelerated preference (i.e., negative quadratic effects) for extraversion. Thus, we examined to what extent friends' extraversion predicted ego's extraversion changes, controlling for participants' basic tendencies toward extraversion (i.e., whether a person was more or less extraverted).

Interaction mechanisms underlying selection and influence effects. For Sample 2 ($n = 131$), we estimated a second model to examine the underlying interaction mechanisms bonding and behavioral mimicry. Changes in these two interaction mechanisms were modeled as network dynamics. Effects between networks (i.e., interaction quality network predicting friendship selection dynamics) were modeled using cross-network effects (Ripley et al., 2018; Snijders et al., 2010). Within the same model, we examined how the sociable behavior network predicted changes in extraversion. We followed the recommended procedure as used in prior network studies addressing underlying interaction mechanisms with continuous time modeling (De la Haye, Robins, Mohr, & Wilson, 2013; Van Zalk et al., 2010; Veenstra et al., 2013). Specifically,

we simultaneously estimated in one single model (a) to what extent the predictor predicted interaction mechanism changes, and (b) to what extent the interaction mechanism predicted outcome changes, while (c) controlling for predictor effects on outcome changes. Support for underlying continuous interaction mechanisms is found when (a) and (b) are significant ($p < .05$) while controlling for (c). Note that this procedure is similar to those used in other continuous time-modeling approaches that do not use network data . However, additional characteristics of network data (e.g., high interdependence of scores due to network structures, which are dealt with by modeling network effects, see Result section under “Extraversion and Selection” for details) do not allow these other approaches to be applied here. Importantly, conventional mediation inference statistics (e.g., Sobel’s test; bootstrapping indirect effects in Structural Equation Modeling) cannot be applied in continuous time modeling. For example, one issue with these conventional mediation techniques is that they assume discrete time ordering underlying the effects and are thus dependent on the specific time-lag chosen, which does not fit assumptions underlying continuous time modeling approaches (such as SAOM). We, therefore, decided to deliberately avoid the term mediation, and instead focus on underlying interaction mechanisms.

Selection interaction mechanism: Bonding. As we expected that a bonding mechanism, measured by interaction quality, underlies effects of similarity in extraversion on friendship selection (see the upper parts of Figures 1 and 2), we added a third (i.e., next to friendship and extraversion changes) dependent variable: Interaction quality changes. Using this third dependent variable, we examined to what extent similarity in extraversion predicted interaction quality changes (i.e., effect labeled A in Figure 2), and to what extent interaction quality predicted friendship selection (i.e., effect labeled B in Figure 2). If both effects A and B are positive and significant, support was found for interaction quality as underlying mechanism for selection effects.

Influence interaction mechanism: Behavioral mimicry. For the behavioral mimicry mechanism, measured by reciprocity of sociable behavior in interactions between friends, to underlie friendship influence (see the lower parts of Figures 1 and 2), we added a fourth dependent variable: Sociable behavior changes. We expected to find three additional effects. First, we expected that alters' extraversion would predict alters' sociable behavior changes (effect labeled "I" in Figure 2). Second, we expected that alters' sociable behavior predicted ego's sociable behavior changes, so that ego and alters would reciprocate each other's behavior over time (i.e., behavioral mimicry; effect labeled "II" in Figure 2). Third, ego's sociable behavior was expected to predict ego's extraversion changes (effect labeled "III" in Figure 2). All three effects I-III need to be positive and significant to support the idea that friends influence extraversion via behavioral mimicry in sociable behavior.

Missing data. In our analyses for both samples, we used the carry-forward procedure (see Huisman & Snijders, 2003). In the carry-forward procedure, missing data is imputed by using data from the prior wave to the subsequent wave (e.g., if Terry had missing data on Wave 2 on extraversion but Terry had an extraversion score at Wave 1, Terry's extraversion score at Wave 1 was used for Terry's extraversion score at Wave 2). Missing data in the friendship networks within waves in both samples was lower than 10%. Participants also had missing data within waves and/or between two waves of measurements on extraversion (< 15%), and for Sample 2, interaction quality (< 18%), and sociable behavior (21%). In Sample 1, a total of 89 persons (5% of $N = 1,698$) dropped out from the first to the last wave. In Sample 2, a total of 8 persons (6% of $N = 131$) dropped out between Wave 1 and Wave 4. Nevertheless, as all persons provided data on at least one wave of measurement, we included all participants in our analyses. We compared the carry-forward procedure with a missing data estimation procedure, referred to as composition change, in which the missing scores are weighed and estimated based on all available information

from each wave (for more details, see §4.3.3 Ripley et al., 2018). When comparing the estimates obtained in the carry-forward procedure to estimates obtained in the composition change procedure, changes in effect estimates ($\Delta\hat{\beta} < .001$) and p -values ($\Delta p < .0001$) were small. We reported our results with the carry-forward procedure in all findings below.

Goodness of Fit. We assessed goodness of fit (in all models and for each of the two datasets separately) following the procedure described in the RSiena Manual (Ripley, et al, 2018). Specifically, this method consists of a comparison between (a) the auxiliary statistics, which represent the observed network parameters (e.g., the *observed* number of outdegrees), and (b) the simulated networks, which represent the estimated network parameters (e.g., the *estimated* number of outdegrees). The auxiliary (a) and (b) simulated network parameters are visually shown together in one plot for specific parameters (e.g., outdegree) and compared by using a violin plot with confidence intervals (Hintze & Nelson, 1998). We estimated the model with a high ($n = 5000$; Ripley, et al., 2018) number of iterations. Next, we used the first estimation of results to estimate the model repeatedly again (using the “PrevAns=” command) with a total of five estimation rounds.

Results

Descriptives

Table 2 shows descriptive information and correlations between extraversion and friendship degree measures across waves for Sample 1. Table 3 shows the same information for Sample 2. Friendship degree refers to the number of outgoing (i.e., ego nominates alter as friend) and incoming (i.e., alter nominates ego as friend) nominations and was consistently positively associated with extraversion within waves. Thus, in both samples, these findings indicate that extraverted individuals have more friends than introverted individuals. Correlations for

extraversion between waves were all significant ($p < .001$) and ranged from medium to high in both samples. Correlations for friendship degree between waves were all significant ($p < .001$) and were high in both samples. The average degree was higher in Sample 2 than in Sample 1, which may reflect, in part, the different methodologies we used in each sample to assess friendships (i.e., a maximum of 8 friends per participant in Sample 1, and a maximum of 131 friends in Sample 2).

Extraversion and Selection

The findings regarding selection and influence of extraversion for Sample 1 and Sample 2 are shown in Table 4 under *selection*. All models showed good convergence (t -ratios for convergence were $< .01$ for all effects in all models). As expected, similarity in extraversion positively and significantly predicted subsequent friendship selection in both samples. We controlled for main effects of extraversion, namely the ego extraversion effect (e.g., ego Klara's extraversion predicts ego Klara's outgoing friendship nominations) and the alter extraversion effect (e.g., alter Maya's extraversion predicts ego Klara's incoming friendship nominations).

As expected, the five network effects (labeled 1-5 below) were all significant ($p < .05$; see Table 4). Results showed a negative and significant (1) outdegree effect, which shows the basic tendency to form and maintain friendships and is the basic intercept when modeling network changes. Furthermore, (2) reciprocity was positive and significant, which showed participants' preference to reciprocate friendships. Additionally, we found two effects, which jointly represent participants forming triadic friendships with the friends of their friends, or clustering (Block, 2015). Results showed that the (3) Geometrically Weighted Edgewise Shared Partners (GWESP-FF; e.g., the more *indirect* friendships Klara has with Maya via other friends, such as via friendships with alters Terry and Roger, the more likely Klara nominated Maya directly as a friend) and the (4) transitive triplets effect (e.g., if ego Klara nominates alter Maya, and alter

Maya nominates alter Terry, then it is more likely that ego Klara directly nominates alter Terry) were positive and significant. Finally, (5) the interaction between reciprocity and transitivity was negative and significant, which showed a participant's reduced tendency to reciprocate dyadic friendships within triads (i.e., "groups") than outside of triads (Block, 2015).

Extraversion and Influence

In the same model as discussed above, we examined friendship influence by considering how the alters' (i.e., friends') average extraversion predicted ego's extraversion changes. Findings are shown in Table 4 under *influence*. Consistent with our expectations, alter's average levels of extraversion predicted ego's extraversion changes. The effect was positive and significant, showing that higher average levels of friends' extraversion predicted a higher likelihood of increases in extraversion. Thus, this effect indicated that when Klara's friends' extraversion was higher than Maya's friends' extraversion, Klara's extraversion was more likely to increase than Maya's extraversion. We controlled for incoming and outgoing friendship nominations, meaning that this influence effect was found regardless of whether extraverted participants received more nominations and nominated more alters. Both the linear and quadratic effects were not significant in the models, showing no specific preference for higher or lower scores in extraversion. Thus, we found support for friends' influence on extraversion.²

Selection Interaction Mechanism: Bonding

Table 5 shows the results for the model in which we added two new dependent variables to the prior model to test for bonding and behavioral mimicry interaction mechanisms, respectively: Interaction quality network and sociable behavior network dynamics. These two variables were operationalized as networks in order to capture the specific dyadic interaction between ego and alter. Results for the relevant effects are also summarized in Figure 2 using the same labels.

The relevant effects for the first mechanism were labeled A (i.e., similarity in extraversion effects on interaction quality changes) and B (i.e., interaction quality effects on friendship selection) in both Table 5 and Figure 2. As expected, we found a positive effect of similarity in extraversion on interaction quality changes (effect A; column labeled “Interaction Mechanism I: Interaction Quality”, in the row labeled “Similarity extraversion” in Table 5). Specifically, this effect indicated that, when comparing the interaction dyad Klara and Maya to the interaction dyad Klara and Terry, and the former dyad was more similar in extraversion than the latter dyad, there was a higher likelihood for Klara and Maya of changing a less positive interaction into a more positive interaction over time, or maintaining their interaction quality over time, than for Klara and Terry.

Furthermore, interaction quality positively predicted the likelihood of friendship selection (effect B; column labeled “Friendship Network”, in the row labeled “Interaction quality outdegree” in Table 5). Specifically, this effect indicated that when Klara perceived more interaction quality with Maya than with Terry, there was a higher likelihood of friendship selection between Klara and Maya than between Klara and Terry. Thus, in line with the proposed bonding mechanism, positive interaction quality seems to explain similarity in extraversion effects on friendship selection.³

Influence Interaction Mechanism: Behavioral Mimicry

Table 5 also shows whether sociable behavior changes explained effects of alters’ extraversion on ego’s extraversion. We examined to what extent (I) alters’ extraversion predicted alters’ sociable behavior changes, (II) alters’ sociable behavior predicted ego’s sociable behavior changes (i.e., behavioral mimicry), and (III) whether ego’s sociable behavior, in turn, predicted ego’s extraversion changes.

The relevant effects for the second interaction mechanism were labeled I, II, and III in both Table 5 and Figure 2. All three effects were significant and positive. Specifically, results showed that alters' extraversion positively predicted alters' sociable behavior changes (effect I; column labeled "Interaction Mechanism II: Sociable Behavior", the row "Ego extraversion" in Table 5). This means that alters who had higher scores on extraversion also showed sociable behavior. More specifically, when alter Terry was more extraverted than alter Maya, then alter Terry was more likely to change from less sociable to more sociable behavior over time, or to maintain her or his sociable behavior over time, compared to alter Maya. Note that, because alter and ego are interchangeable, this effect could also be interpreted to show that ego's extraversion predicted ego's sociable behavior changes.

Additionally, alters' sociable behavior predicted ego's sociable behavior changes (effect II; column labeled "Interaction Mechanism II: Sociable Behavior", in the row "Reciprocity" in Table 5). More specifically, if Klara nominated Terry as a friend, and if alter Terry showed sociable behavior, then ego Klara had a higher likelihood of changing from less sociable behavior to more sociable behavior (according to alter Terry's report on Klara) or to maintain sociable behavior over time. This indicated that friends became more similar in sociable behavior, showing mimicry of sociable behavior.

Finally, ego's sociable behavior predicted ego's extraversion changes (effect III; column labeled "Extraversion", in the row "Sociable behavior" in Table 5). This indicated that when comparing Klara, who showed more sociable behavior, to Maya, who showed less sociable behavior, Klara had a higher likelihood of increasing her extraversion over time than Maya. As we found support for all three hypothesized effects, our results show support for behavioral mimicry underlying friendship influence on extraversion.^{4,5}

Goodness of fit. Given the large number of models and parameters for which we estimated goodness of fit, we uploaded all visualization files of goodness of fit for each of the four specific parameters (outdegree, indegree, extraversion, and triad census) on the OSF page (<https://osf.io/f7ty9/> in the subfolder “GoF”). Visual inspection of the violin plots showed acceptable fit, as the observed estimates (red dots) were inside the confidence intervals of simulated networks (dotted lines).

Discussion

Do we choose friends who are as extraverted as we are and do we become more like our friends in our own extraversion? The answer to this question seems to be “yes”, according to the current findings. This study was the first to examine to what extent and through which interaction mechanisms friends influence extraversion. Importantly, we chose an integrative approach in which extraversion effects on friendship selection feed back into influence effects on extraversion development.

Explaining Friends’ Similarity in Extraversion: Transactional Selection and Influence Effects

Results confirmed prior studies showing that young adults tended to select friends who were similar to them in extraversion (e.g., Selfhout et al., 2010; Van Zalk & Denissen, 2015). Moreover, the current studies expanded these prior findings by indicating that, over and above these selection effects, friends subsequently influence extraversion development. Findings from two independent samples from different countries, in which both shorter (i.e., 16 weeks) and longer (i.e., four years) friendship changes and extraversion were assessed, provided support for these selection and influence effects. Importantly, despite the different average number of friendships in each sample (i.e., Sample 1 had lower friendship degrees than Sample 2), selection

and influence effects were found in both samples. We argue that this simultaneous consideration of selection and influence is important to understand how personality and social relationship development become intertwined, as findings suggest that, through a person's social choices, social contexts are constructed that lead to further reinforcement of their dispositional tendencies. These findings support transactional personality models and the corresponsive principles underlying personality development (Caspi et al., 1987; Emmons et al., 1986; Roberts, Caspi, & Moffitt, 2003), and are among the first to provide empirical evidence for these approaches in the context of personality dispositions (but see also Denissen, Ulferts, Lüdtke, Muck, & Gerstorf, 2014; Hutteman, Nestler, Wagner, Egloff, & Back, 2015). We turned toward possible explanatory mechanisms to delve deeper into the possible workings of the selection and influence effects regarding friendship similarity in extraversion.

Interaction Mechanisms Underlying Similarity in Extraversion Effects on Friendship Selection

Consistent with conventional wisdom, findings showed that birds of a feather tend to flock together. Similarity in extraversion affected friendship selection in two independent samples, irrespective of relatively strong effects of demographic homophily (Kiesner, Poulin, & Nicotra, 2003; McPherson et al., 2001). Put differently, as found in other prior studies (e.g., Selfhout et al., 2010; Van Zalk & Denissen, 2015), extraverts are more likely to become friends with extraverts, and introverts are more likely to become friends with introverts. More importantly, the current studies provided initial evidence for interaction mechanisms behind friendship selection. Studies on friendship network selection have only recently started to empirically examine underlying interaction mechanisms (e.g., Baerveldt, Van de Bunt, & Vermande, 2014). Here, we unraveled one specific bonding mechanism by showing that similarity in extraversion predicted positive interaction quality in real-life social interactions,

which, in turn, predicted a higher likelihood of friendship selection (Selfhout et al., 2010; Van Zalk & Denissen, 2015). This indicates that participants who were more similar in extraversion enjoyed their interactions more, which increased the odds that they befriended each other. Taken together, these results support classic theoretical frameworks suggesting that similarity effects are explained by increased positive affect during interactions (Berger & Calabrese, 1975). In sum, interaction quality may be seen as the social glue that brings persons similar in extraversion together in friendship networks.

Interaction Mechanisms Underlying Friendship Influences on Extraversion Development

Friendship networks can be seen as powerful socialization contexts, especially with regard to attitudes, cognitions, feelings, and (problematic) behavior (e.g., Veenstra et al., 2013). The current studies extend this knowledge to the area of personality development and provide one answer to the recent call to combine research on relatively enduring personality traits with studies on behavioral interaction mechanisms within specific social contexts that are thought to influence and be influenced by personality dispositions (e.g., Back, 2015; Baumert et al., 2017; Denissen, van Aken, Penke, & Wood, 2013). The PERSOC model (Back et al., 2011) and similar approaches (e.g., the Integrative State Process Model; Geukes et al., 2018; Wrzus & Roberts, 2017) have stressed the need to fill the current gap of knowledge concerning how personality affects social relationships and social relationships influence personality through specific state-like interaction mechanisms. We focused on young adulthood, a period marked by important social and personality changes (Hutteman et al., 2014), to examine how these changes are linked through concrete, everyday social interactions. Friendship selection can set important preconditions for friendship influence, as individuals may pick certain social niches that correspond to their trait-like tendencies, thus further reinforcing these tendencies through friendship influence (e.g., Kandel, 1978a; McPherson et al., 2001). This is consistent with the

corresponsive principle (Roberts et al., 2003, pp. 583), as young adults selected friends with similar extraversion and then seemed to influence each other on this same trait. In the occupational context, similar corresponsive principles have been shown (Denissen et al., 2014; Roberts et al., 2003). For example, Denissen et al. (2014) showed that initial levels of extraversion, openness, and agreeableness predicted personality role demands fitting these specific traits in selecting first jobs. For people who changed their jobs, extraversion, openness, and agreeableness predicted changes in role demands for these specific traits. These findings suggest that individuals picked new jobs based on their specific personality traits that subsequently changed these specific traits over time. Taken together, the current studies expanded other findings in the work context by showing that extraversion effects on friendship choices were corresponsive with friendship influence on extraversion.

Although some studies have focused on explanatory interaction mechanisms in the context of antisocial behavior (e.g., Dishion & Patterson, 2006; Dishion, Spracklen, Andrews, & Patterson, 1996) and depressive symptoms (e.g., Van Zalk et al., 2010), little is currently understood about how friends may influence other areas, and in particular personality. The present empirical study provides a first step towards a more detailed understanding of possible causal interaction mechanisms underlying longitudinal links between friendships and personality. Specifically, this study points to behavioral mimicry as an important explanation for friends' extraversion influence on young adults' extraversion, which fits prior findings showing that extraverted friends mimic sociable behavior (Nelson et al., 2011). We do want to stress, however, that although the SAOM approach allows us to disentangle influence and selection effects, the model results may nevertheless be influenced by other (environmental) confounders and hence a causal interpretation of our results should be made with caution. We encourage other researchers

to turn to interaction mechanisms embedded within specific social contexts to examine how social network influence on personality works.

Integration of Macro-Level Measures with Event-Based Mechanism Assessments

To the best of our knowledge, this is the first study to use event-based micro-level assessments of interaction mechanisms to explain longitudinal associations between macro-level measures of personality and friendships. In our analyses, we integrated macro-level person-environment changes (i.e., the co-development of extraversion and friendships) with interaction mechanisms within social interaction contexts (i.e., sociable behavior and interactions quality in social interaction dyads). Arguably, using these repeated event-based assessments right after friendship interaction situations took place provided a more reliable estimate and maximizes generalizability of individuals' perceived interaction quality compared to using survey methods with recall questions (Brose, Lindenberger, & Schmiedek, 2013; Grühn, Rebucal, Diehl, Lumley, & Labouvie-Vief, 2008). Furthermore, by combining event-based experience-sampling with survey methods using various combinations of *both* interaction partners' reports, we reduced shared method variance. In particular, through the use of network data combined with self- and other reports on friendships, extraversion, interaction quality, and sociable behavior, we avoided alternative explanations (e.g., self-projection; Ennett & Bauman, 1994) for the selection and influence shown by the results. Thus, our approach in Study 2 is unique in combining macro-level assessments of extraversion and friendships with micro-level assessments of interaction mechanisms in everyday social interactions and avoided shared observer bias by combining self-ratings, other-ratings, and social network ratings.

Limitations and Future Directions

Although this study is the first to examine interaction mechanisms that underlie bi-directional longitudinal effects between extraversion and friendships, several limitations should

be noted. A first limitation is that our conceptual model and analyses only focus on extraversion. Given the complexity of our models, we suggest that extraversion was a good starting point to explore possible interaction mechanisms that underlie selection and influence effects. Nevertheless, we join other scholars (e.g., Asendorpf & Wilpers, 1998; Back, 2015; Branje, Van Lieshout, Van Aken, & Haselager, 2004) in stressing trait-specific relationship effects are important to consider and our model cannot be generalized to other personality traits. In fact, additional analyses (see Footnote 1) show no evidence for friendship influence on other personality traits. Thus, these findings suggest that our conceptual model does not generalize to other big five traits.

A second limitation is that only two interaction mechanisms – social bonding and behavioral mimicry – were examined and additional interaction mechanisms that may have explained the co-development between extraversion and friendships were not studied. For example, intra-individual processes, such as cognitive interaction mechanisms (perceived similarity and estimated utility; Sunnafrank & Ramirez, 2004) or socio-emotional interaction mechanisms (Clore & Byrne, 1974; Denissen & Penke, 2008), and further dyadic processes (perceived meta-similarity and meta-liking; e.g., Van Zalk & Denissen, 2015) might additionally explain friendship selection and influence.

A third limitation is that recent technological developments have provided other less obtrusive methods to examine interaction behaviors and social situation selection, such as the Electronically Activated Recorder (EAR; Mehl, Pennebaker, Crow, Dabbs, & Price, 2001; Mehl, Robbins, & Deters, 2012) and smartphone sensing techniques (e.g., Chittaranjan, Blom, & Gatica-Perez, 2013; Harari et al., 2016). Thus, one limitation is that we examined only two possible interaction mechanisms with one type of event-based assessment. We encourage researchers to further examine the same and additional interaction mechanisms with multiple

(and less obtrusive) methods, as we believe to have demonstrated that this might be a fruitful way to understand the complex dynamics of personality and relationship co-development.

A fourth limitation regards Sample 1 and the snow-ball technique (Kerr et al., 2007; Kiesner et al., 2004), which we used to successfully increase friendship participation rates and increase the sample size. Differences in the procedure for the target sample and the procedure for the newly acquired friendship sample may result in unintended, unmeasured errors in network estimates (Frank & Snijders, 1994; Goodman, 1961). Although we kept the procedure identical and analyses showed no significant differences between the target sample and non-target friends on our key variables, our approach was furthermore limited as we restricted this procedure to a maximum of three friends and did not invite any more friends. First, this meant that the non-target friends nominated other persons, who may or may not have been part of our analytic sample. For example, if target Klara nominated Maya, a non-target person, and Maya nominated Terry, another non-target person who was also not nominated by any other person, then we could *not* examine who Jimmy nominated (e.g., whether Jimmy and Maya had a reciprocal friendship). Second, our snowball procedure meant that potentially five of the eight nominated friends were not part of Sample 1, and we could not examine friendship characteristics for these specific friendships, such as reciprocity in friendship selection, or how these friends influenced extraversion. Nevertheless, results obtained with the snowball technique used in Sample 1 were replicated with our findings in Sample 2, where we used an unlimited nomination approach with a network boundary (i.e., only other Psychology freshmen could be nominated as friends). The lack of differences between findings from two studies with different methods indicates that limitations that specifically arose because of the snow-ball technique did not systematically influence our findings. Future research should further examine the robustness of our findings by using a wider range of network techniques.

A fifth limitation of the SAOM approach used in the current studies is that we examined a causal model with nomothetic selection and influence effects and how their underlying interaction mechanisms work generally across all participants within our samples. Future research should examine more closely to what extent variation within selection and influence effects exist on the individual, dyadic, and group level, and empirically examine to what degree such cross-level variation can be explained by corresponding interaction mechanisms. One example would be to examine to what extent group norms toward sociable behavior interact with friendship influence on extraversion. Several scholars (Denissen et al., 2014; McGuire, Rutland, & Nesdale, 2015; Veenstra & Dijkstra, 2011; Veenstra et al., 2007) suggested that repeated and consistent behavior within friendship groups, especially when displayed by influential group leaders, could lead to behavioral norms, which subsequently influence individual group members' behavior. Studies on aggression show, for example, that classroom norms moderate how friends' aggression influences individuals' aggression (Veenstra et al., 2007). In a similar vein, friendship group norms concerning sociable behavior may therefore moderate friends' sociable behavior influence on extraversion.

Conclusion

Why do people have relationships with others who are like them? Regarding extraversion, this study indicates that the answer is twofold: First, people select others as friends who are like them and second, people become more like the people they chose as friends over time. These effects are not mutually exclusive but complement each other via interaction mechanisms of social bonding and behavioral mimicry. Extraversion development is intricately connected to friendship development, as extraversion forms and is formed by repeated friendship interactions within specific social contexts. The dynamic nature of personality traits and social relationships calls for similarly versatile statistical methodology that simultaneously considers personality

influences on social choices and how these social choices, in turn, affect personality development. Dynamic social network analyses combined with mixed methodology to assess interaction mechanisms represent one fruitful approach to study longitudinal changes that link personality and relationships, and to unravel the specific underlying interaction mechanisms that explain how these changes unfold over time.

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Footnotes

¹ The data for Sample 1 cannot be made publicly available because participants were not asked to explicitly give ethical consent to making their anonymous data publicly available. We did publish all the scripts and outcome files (i.e., excluding the data and the materials), discussed in more detail under Analytic Strategy.

² We examined whether friendship selection and influence effects were found for other Big Five dimensions than extraversion, namely agreeableness, openness, conscientiousness, and neuroticism (on the OSF page <https://osf.io/f7ty9/>: See subfolder “Footnote 1”). Findings showed that only for extraversion, friends’ (alters’) personality traits predicted ego’s personality traits changes. Thus, we found no evidence for friendship influence on agreeableness, openness, conscientiousness, and neuroticism.

³ We examined whether our choice for the cut-off value when dichotomizing the continuous interaction quality variable into positive interaction quality (i.e., values 1 and 2 on a scale from 1 = “positive“ to 7 = “negative“ were coded as 1) versus less positive interaction quality (i.e., values lower than 2 where coded as 0) affected our results by considering an alternative dichotomization of this scale, with varying cut-offs for the dichotomization (i.e., contrasting values 1 to 3 versus values 4 to 7; on the OSF page <https://osf.io/f7ty9/>: See subfolder “Footnote 2”). We did the same for our dichotomization of the continuous sociable behavior variable. Findings showed that this alternative dichotomization yielded similar results: Changes in all effect estimates ($\Delta\hat{\beta} < .001$) and all p -values ($\Delta p < .0001$) were small, all insignificant effects remained insignificant, and all significant effects remained significant.

The same R-script also shows that, when comparing the model estimates with self-reports on sociable behavior to the original model estimates using other-reports on sociable behavior, changes in all effect estimates ($\Delta\hat{\beta} < .01$) and all p -values ($\Delta p < .01$) were small, all insignificant effects remained insignificant, and all significant effects remained significant.

Finally, we examined whether our dichotomization of the continuous interaction quality variable into a dichotomous variable with positive interaction quality (i.e., scores 1 and 2 on a scale from 1 = “positive“ to 7 = “negative“) versus less positive interaction quality (i.e., other scores on the same scale) affected our results on friendship selection. We estimated an additional model by considering interaction quality as a continuous score (i.e., a varying dyadic covariate; see Snijders et al., 2010). Note that varying dyad covariates cannot be used as outcome/dependent variables, and we could not test the hypothesized interaction mechanisms (i.e., we could not test whether similarity in extraversion predicted dyadic covariate interaction quality changes). Findings showed that, when using interaction quality as a dyadic covariate, similarity in interaction quality predicted friendship selection. Changes in all effect estimates ($\Delta\hat{\beta} < .001$) and all p -values ($\Delta p < .0001$) were small, all insignificant effects remained insignificant, and all significant effects remained significant.

⁴ We examined to what extent other types of network effects (i.e., outAct, inPop, outPop) were significant and whether their inclusion changed our main findings for selection and influence with regard to similarity in extraversion (on the OSF page <https://osf.io/f7ty9/>: See subfolder “Footnote 3”). Results show that, when comparing these alternative model estimates to the original model estimates, all insignificant effects remained insignificant, and all significant effects remained significant.

⁵ Additional dependency between friendship, interaction quality, and sociable behavior may exist, which would represent possible additional confounding effects on changes in these three variables. We therefore estimated an additional model in which friendship and interaction quality predicted sociable behavior dynamics and sociable behavior and friendship predicted interaction quality dynamics (on the OSF page <https://osf.io/f7ty9/>: See subfolder “Footnote 4”). Findings showed, when comparing model results with these additional network dependencies included to the original model estimates, all insignificant effects remained insignificant, and all significant effects remained significant.

Tables

Table 1

Sample 2: Overview of Timing of Measurements

Wave	1	2	3	4
Dates	13/10/12 – 20/10/2012	23/10/12 – 03/11/2012	01/12/12 – 08/12/12	19/01/13 – 26/01/13
Event-Based Assessment				
Interaction Quality and Sociable Behavior	Repeatedly after social interactions	Repeatedly after social interactions	Repeatedly after social interactions	Repeatedly after social interactions
Time-Based Assessment				
Extraversion	13/10/12	27/10/12	01/12/12	26/01/13
Friendship	20/10/12	03/11/12	08/12/12	19/01/13

Note. Dates are formatted DD/MM/YY. For details about all available measurements, see <https://osf.io/d53zs/>.

Table 2

Sample 1: Means, Standard Deviations, and Correlations of Extraversion and Friendship Degree

	<i>M</i>	<i>SD</i>	2	3	4	5	6
1 T1 Friendship Degree	2.612	1.213	.252	.579	.162	.341	.131
2 T1 Extraversion	5.585	0.624		.214	.433	.114	.212
3 T2 Friendship Degree	2.132	1.111			.304	.612	-.023
4 T2 Extraversion	5.582	0.672				.224	.444
5 T3 Friendship Degree	2.443	1.539					.209
6 T3 Extraversion	5.575	0.721					

Note. $N = 1,698$ participants. T1 = Time 1, T2 = Time 2, T3 = Time 3. Friendship degree refers to the average number of incoming and outgoing friendship nominations a participant had at that time of measurement. **Bold** correlations were significant ($p < .05$).

Table 3

Sample 2: Means, Standard Deviations, and Correlations of Extraversion and Friendship Degree

	<i>M</i>	<i>SD</i>	2	3	4	5	6	7	8
1 W1 Friendship Degree	14.794	9.483	.300	.816	.418	.766	.369	.643	.249
2 W1 Extraversion	4.138	2.121		.351	.614	.273	.517	.389	.444
3 W2 Friendship Degree	12.504	7.866			.445	.784	.460	.737	.259
4 W2 Extraversion	4.036	1.898				.384	.739	.422	.638
5 W3 Friendship Degree	10.336	7.551					.342	.745	.146
6 W3 Extraversion	3.926	1.709						.424	.790
7 W4 Friendship Degree	9.008	6.686							.277
8 W4 Extraversion	4.179	1.857							

Note. $N = 131$ participants. W1 = Wave 1, W2 = Wave 2, W3 = Wave 3, W4 = Wave 4. Friendship degree refers to the average number of incoming and outgoing friendship nominations a participant had at that time of measurement. See the R-script “Model Main Analyses in R Tables 4, 5, and 6” on the OSF page <https://osf.io/f7ty9/> for specific descriptives on outdegree (i.e., outgoing friendships) and indegree (incoming friendships). **Bold** correlations were significant ($p < .05$).

Table 4

Selection and Influence for Extraversion in Sample 1 and Sample 2

	Sample 1 (n = 1,698)			Sample 2 (n =131)		
	$\hat{\beta}$		s.e.	$\hat{\beta}$		s.e.
<u>Selection</u>						
Outdegree	-2.981	***	0.099	-3.379	***	0.110
Reciprocity	2.921	***	0.211	2.467	***	0.145
Transitive triplets	0.201	***	0.039	0.111	**	0.041
Transitive reciprocated triplets	-0.291	***	0.012	-0.253	***	0.045
GWESP	2.913	***	0.614	1.393	***	0.157
Alter extraversion	-0.010		0.012	0.126	***	0.026
Ego extraversion	-0.012		0.012	0.006		0.024
Similarity Extraversion	0.779	***	0.081	0.949	**	0.325

Table 4 (*continued*)

	Sample 1 (<i>n</i> = 1,698)		Sample 2 (<i>n</i> =131)	
	$\hat{\beta}$	s.e.	$\hat{\beta}$	s.e.
<u>Influence</u>				
Linear Shape	-0.001	0.066	0.134	0.108
Quadratic Shape	-0.009	0.014	-0.114	0.125
Indegree extraversion	-0.010	0.010	-0.030	0.019
Outdegree extraversion	0.015	0.011	0.011	0.015
Average Alter Extraversion	0.184	*	0.287	*

Note. * $p < .05$; ** $p < .01$; *** $p < .001$. Two identical RSiena models were estimated: One for Sample 1 and one for Sample 2. For details about all effects, we refer to the R-script on <https://osf.io/f7ty9/>.

Table 5

Interaction Mechanisms Underlying Selection and Influence Effects in Sample 2

	Dependent Variables											
	Friendship Network			Extraversion		Interaction		Interaction Mechanism II:				
						Mechanism I:		Sociable Behavior				
						Interaction Quality						
	$\hat{\beta}$		s.e.	$\hat{\beta}$	s.e.	$\hat{\beta}$	s.e.	$\hat{\beta}$		s.e.		
<u>Selection</u>												
Outdegree	-3.562	***	0.119			-2.509	***	0.036		-2.752	***	0.050
Reciprocity	2.220	***	0.147			1.800	***	0.062	(II)	1.760	***	0.078
Transitive triplets	0.093	*	0.043			-0.042		0.047		-0.091		0.064
Transitive reciprocated triplets	-0.236	***	0.044			-0.227	***	0.038		-0.174	***	0.045
GWESP	1.340	***	0.173			1.291	***	0.131		1.692	***	0.181

Table 5 (continued)

Dependent Variables															
Friendship Network					Extraversion		Interaction Mechanism I:			Interaction Mechanism II:					
							Interaction Quality			Sociable Behavior					
$\hat{\beta}$					s.e.		$\hat{\beta}$		s.e.		$\hat{\beta}$		s.e.		
Alter extraversion					0.151	***	0.028				0.012	0.012		0.003	0.018
Ego extraversion					0.021		0.028				0.027	*	0.012	(I) 0.028	* 0.011
Similarity extraversion					1.052	**	0.371		(A)		0.388	*	0.170	0.178	0.233
Cross-network effects															
Interaction quality outdegree					(B)	0.580	*	0.226							
Sociable behavior outdegree					1.486	***	0.219								

Table 5 (*continued*)

<i>Dependent Variables</i>								
Friendship Network		Extraversion		Interaction Mechanism I: Interaction Quality		Interaction Mechanism II: Sociable Behavior		
	$\hat{\beta}$	s.e.		$\hat{\beta}$	s.e.		$\hat{\beta}$	s.e.
<u>Influence</u>								
Linear shaped				0.107	0.124			
Quadratic shaped				-0.052	0.035			
Indegree extraversion				-0.035	0.032			
Outdegree extraversion				0.010	0.017			
Average alter extraversion				0.213	0.130			
Sociable behavior			(III)	0.787	*	0.321		
Indegree sociable behavior				0.024	0.041			
Outdegree sociable behavior				-0.012	0.024			

Note. * $p < .05$, ** $p < .01$, *** $p < .001$.

For details about all effects, we refer to our R-script on <https://osf.io/f7ty9/>. Results from one RSiena model with four dependent variables (three networks and extraversion). All effects from the prior model (Table 4) were included in this model, yet not shown in the Table 5 for sake of clarity (for details about all included effects, see R-script labeled “Model Main Analyses in R Tables 3, 4, and 5”). Effects for extraversion, interaction quality, and sociable behavior were recoded to enhance interpretation, so that higher scores reflect higher levels of extraversion, interaction quality, and sociable behavior, respectively.

Note that although transitive triplets was not significant in the sociable behavior and interaction quality dependent networks, we included this effect in all networks, because it was a main effect that should be controlled for when estimating the interaction between reciprocity and transitive triplets (i.e., in our Table labeled “Transitive reciprocated triplets”; the effects reciprocity and transitive triplets are the main effects of this interaction; see Block, 2015).

The first dependent variable was a *Friendship Network*. *Outdegree* refers to the overall number of outgoing nominations and can be interpreted as an intercept when predicting friendship network changes. *Reciprocity* refers to the tendency of ego reciprocating a friendship nomination to alter over time. *Similar Extraversion* refers to the reversed difference score between ego and alter in extraversion scores, which was used to predict whether ego and alter formed a friendship tie over time.

The second dependent variable concerned *Extraversion*. *Linear Shape* and *Quadratic Shape* are the intercepts when predicting extraversion changes. *Average Alter* refers to the average friends’ score on extraversion, sociable behavior, and interaction quality at a prior time of measurement predicting extraversion changes. *Average Ego* refers to effects of the average friends’ extraversion score on extraversion changes. *Sociable Behavior* refers to ego’s and alters’ sociable behavior effects on subsequent extraversion changes.

The third dependent variable concerned *Interaction Quality*. *Outdegree* refers to the overall number of outgoing nominations and is the intercept when predicting interaction quality network changes. *Average Alter* refers to effects of the average friends’ extraversion, sociable behavior, and interaction quality at a prior time of measurement predicting the creation or maintenance of an interaction quality tie between ego and alter.

The fourth dependent variable concerned *Sociable Behavior* as reported by alter. *Outdegree* refers to the overall number of outgoing nominations and is the intercept when predicting sociable behavior network changes. *Average Alter* refers to the average friends’ score on extraversion, sociable behavior, and interaction quality at a prior time of measurement predicting the creation or maintenance of a sociable behavior tie (i.e., ego shows high sociable behavior).

Findings showed that similarity in extraversion predicted interaction quality changes (arrow A). Further, interaction quality predicted the likelihood of a friendship selection (arrow B). Thus, we found that support for the idea that interaction quality underlies similarity in extraversion effects on selection.

For the second network mechanism, mimicry in social behavior, the three relevant effects were labeled I-III. Results showed that alters’ extraversion predicted alters’ sociable behavior (arrow I). Additionally, alters’ sociable behavior predicted ego’s sociable behavior changes (arrow

II). Finally, ego's sociable behavior predicted ego's extraversion changes (arrow III). Thus, we found support for the idea that behavioral mimicry underlies friendship influence on extraversion.

Figures

Figure 1. Conceptual model: Two underlying interaction mechanisms explaining selection and influence effects.

The two interaction mechanisms illustrated with sequential hypothetical stages. These stages are shown sequentially, in the fashion that we examined in our empirical model. However, please note that with a Stochastic Actor-Oriented Model, selection and influence effects are estimated simultaneously in one model (Snijders et al., 2010), reflecting that people can select new friends at the same time as being influenced in existing friendships. This is a major advantage of this type of modelling, as it allows for comparing the relative degree of selection with the relative degree of influence.

Ovals depict five fictitious persons (Klara A, Maya B, Terry C, Jimmy D, and Peter E). Darker shades of the ovals depict higher levels of extraversion (e.g., Klara A is far more extraverted than Peter E). The connecting lines show interactions and relationships between the persons. Dashed connecting lines show that which persons interacted, with the dashed lines with more weight indicating more positive interaction quality than broken lines with less weight (e.g., Klara A and Maya B have more positive interaction quality than Klara A and Peter E). Solid connecting lines show friendship choices (e.g., Klara A, Maya B, and Jimmy C are friends). Finally, curved arrows show behavioral mimicry of sociable behavior (e.g., Klara A and Maya B mimic each other's sociable behavior).

The top part of the Figure shows interaction mechanisms underlying friendship selection effects (stages 1a to 1c), by which people form relationships with others who are similar to them in extraversion. Before getting acquainted, none of the persons interacted with each other, or selected each other as friend. This is shown in Stage 1a, with no connecting lines between ovals. In the next Stage 1b, all persons interacted with each other at some point in time. Positive interaction quality is indicated by the dashed connecting lines, showing that persons with similar levels of extraversion (e.g., Klara A and Maya B) perceived, on average across interactions, more positive interaction quality than persons with less similar extraversion (e.g., Klara A and Peter E). This is shown with dashed connecting lines are thicker for persons with similar extraversion levels. In the final stage of selection, Stage 1c, friendships are formed. Specifically, positive interaction quality enhances friendship selection, so that persons who are similar in extraversion are more likely to form friendships than persons with dissimilar levels of extraversion (e.g., Klara A and Maya B became friends, Klara A and Peter E did not become friends). This last stage of selection interaction mechanisms is shown with ovals with similar shading have connecting lines.

The bottom part of the Figure shows behavioral mimicry as a mechanism underlying how friends influence extraversion (stages 2a to 2c). The start for friendship influence (Stage 2a) is the friendship network resulting from the friendship selection effects, with friends having similar levels of extraversion. In the next stage, friends mimic each other's sociable behavior, with extraverted friends showing increases in sociable behavior, and introverted friends showing decreases in sociable behavior (Stage 2b; indicated by curved arrows between friends). In the transition to the final stage, ego's sociable behavior predicted changes ego's extraversion, so that when ego shows sociable behavior, ego shows an increase in extraversion; when ego shows more reclusive behavior, ego shows less increases in extraversion (Stage 2c).

Figure 2. Summary of findings for interaction mechanisms underlying selection and influence effects.

Note. * $p < .05$, ** $p < .01$, *** $p < .001$.

Only effects relevant to the interaction mechanisms underlying selection and influence are shown (see Table 5 for all effects included in the model). The solid arrows show significant ($p < .05$) effects, the dotted lines show non-significant effects. For the first network mechanism, bonding is indicated by interaction quality and the two relevant effects were labeled A and B. Findings showed that similarity in extraversion predicted interaction quality changes (arrow A). Further, interaction quality changes predicted the likelihood of friendship selection (arrow B). Thus, we found that support for the idea that interaction quality underlies similarity in extraversion effects on selection.

For the second network mechanism, mimicry in social behavior, the three relevant effects were labeled I-III. Results showed that alters' extraversion predicted alters' sociable behavior (arrow I). Additionally, alters' sociable behavior predicted ego's sociable behavior changes (arrow II). Finally, ego's sociable behavior predicted ego's extraversion changes (arrow III). Thus, we found support for the idea that behavioral mimicry underlies friendship influence on extraversion.

Appendix 1

In the following text and in Table A1 below, we describe the snow-balling sampling procedure in detail.

Target sample (a). At the start of the study in 2013, 24-year-olds ($n = 2,543$; Cohort 1), and 26-year-olds ($n = 1,987$; Cohort 2) were targeted in the Swedish city. Using the municipality register, we randomly selected 1,000 persons from Cohort 1 and 1,000 persons from Cohort 2. These 2,000 potential target participants were sent invitation letters and questionnaires by post, with prepaid envelopes to return the questionnaires. Participation rates were 60% for Cohort 1 ($n = 598$) and 60% for Cohort 2 ($n = 601$), creating a target sample of 1,199 participants.

Target sample friends (b). Friends were identified with a validated friendship nomination questionnaire (e.g., Kiesner et al., 2004; Van Zalk et al., 2010; see Measures section for details). A relatively high percentage of nominated friends already participated as targets themselves (on average across the three waves, 55% and 52% in Cohorts 1 and 2, respectively). These persons were, therefore, both target participants and target sample friends in our analyses. Thus, a relatively large portion of nominated friends already participated as target participants and provided reciprocal information on friendships.

Because participants were not restricted to exclusively nominate friends of their own cohort, some participants from Cohort 1 nominated participants from Cohort 2 as friends (7% on average across the waves), and some participants from Cohort 2 nominated participants from Cohort 1 as friends (5% on average across the waves). We, therefore, combined Cohort 1 and Cohort 2 into one sample.

Non-target sample friends (c). To further enhance friendship participation rates and to increase the sample size, we invited up to three nominated friends per target participant. Only those friends were invited who did not already participate in the target sample at that respective wave. This means that, of the maximum of eight nominated friends per wave, we contacted the first three friends who were not yet participating. Importantly, we invited friends who were not participating yet *at that specific wave*. If target Klara nominated Maya at Wave 1, and Maya was not a target participant at Wave 1 (and thus did not participate yet at Wave 1), Maya was invited to participate at Wave 1. At subsequent waves, the exact same procedure as at Wave 1 was applied (i.e., all information from prior waves was ignored). Thus, if Maya, who was nominated at Wave 1 by Klara, was nominated again as a friend (by any target participant) at Wave 2, Maya was contacted again. If Maya was not nominated at Wave 2, she was not invited to participate, regardless of whether Maya participated before. Thus, both old and new friends were invited to participate, as long as they were (1) nominated by a target participant at that specific wave and (2) not already participating as target participants themselves at that specific wave.

These non-target sample friends were invited by sending them an invitation letter and questionnaire via post, with prepaid envelopes to return the questionnaires. The non-target sample friends were asked to fill out the exact same questionnaires as the target sample participants, which allowed us to examine whether friendships were reciprocated (e.g., target sample Klara nominated non-target sample Maya; Did Maya nominate Klara as a friend in return?). We specifically address the importance of reciprocity and how it may affect friendship selection in our analyses (If Klara nominated Maya at Wave 1, does this predict Maya *subsequently* selecting Klara?), as explained in the analysis strategy. Participants were not made aware of being nominated as friend but rather were sent the exact same invitation letter as the target participants did (e.g., Maya did not know Klara selected her as friend, and received the same invitation letter as Klara did).

This final step (c) resulted in adding 499 non-target sample friends, which increased the final participation rate of friends. Specifically, across the three waves, an average of 71% (compared to 55%) of all nominated friends participated as participants themselves in Cohort 1, and 81% (compared to 52%) of all nominated friends in Cohort 2 participated as participants themselves, respectively. Thus, 435 friends additionally participated at Wave 1 (201 from Cohort 1, 234 from Cohort 2), 22 at Wave 2 (15 from Cohort 1, 7 from Cohort 2), and 42 at Wave 3 (16 from Cohort 1, 26 from Cohort 2), totaling 499 non-target sample friends (232 from Cohort 1, 267 from Cohort 2) who were added to the 1,199 target sample participants and their friends. These 499 non-target sample friends did not differ significantly ($p > .10$) from the 1,199 target sample participants in gender, age, ethnicity, number of nominated friends, or extraversion.

Final sample. The final sample consisted of the combination of the 1,199 target sample (598 for Cohort 1, 601 for Cohort 2) and the 499 non-target sample friends (232 for Cohort 1, 267 for Cohort 2), resulting in a total of 1,698 participants (see Table 1; $M_{\text{age}} = 22.72$ years, $SD = 2.99$, 49% female). In sum, all participants fulfilled two criteria: (1) They had at least one wave of data with extraversion scores; and (2) they had at least one wave of data where they were either (a) nominating a friend, and/or (b) being nominated as a friend.

Table A1

Friendship Sample Distribution for Sample 1

	Initial Target sample	Final Target Sample	I. Target- Sample Friends	Non-Target Sample Friends Contacted per Post	New Friends Among Non- Target Sample Friends	II. Participating Non- Target Sample Friends (Response % of Contacted Friends)	New Non- Target Sample Friends
Cohort 1	1,000	598 (60%)					
Wave 1			291	257	257	201 (78%)	201
Wave 2			290	237	21	211 (89%)	15
Wave 3			284	240	16	229 (95%)	16
<i>New Friends Across waves</i>					294		232 (79%)

Table A1 (continued)

	Initial Target Sample	Final Target Sample	I. Target- Sample Friends	Non-Target Sample Friends Contacted per Post	New Friends Among Non- Target Sample Friends	II. Participating Non- Target Sample Friends (Response % of Contacted Friends)	New Non- Target Sample Friends
Cohort 2	1,000	601 (60%)					
Wave 1			287	283	283	234 (83%)	234
Wave 2			297	311	25	226 (73%)	7
Wave 3			291	299	18	221 (74%)	26
<i>New Friends Across waves</i>					326		267 (82%)

<i>Final</i>		499
<i>Sample</i>	1199	(232 +
	(598 + 601)	267)

Note. The table explains the friendship sampling procedure for Sample 1 in a step-by-step fashion (i.e., from left to right). We randomly selected 1,000 persons from Cohort 1 and 1,000 persons from Cohort 2 (*Initial Target Sample*). Target participants were those who returned their consent form and questionnaire via post (*Final Target Sample*). Target participants were asked to nominate friends and a large portion of these nominated friends already participated as target participants themselves (*I. Target-Sample Friends*). Participants were restricted to nominate a maximum of eight friends. When these nominated friends were not participating already in the target sample, a maximum of three were contacted with an invitation to participate at that wave (*Non-Target Sample Friends Contacted per Post*). Of these contacted friends, a certain number of friends were new, meaning they had not participated yet at a prior wave (*New Friends Among Non-Target Sample Friends*). In the next column, the number of friends who responded per wave are shown (*Participating Non-Target Sample Friends*). At each wave, both old and new friends could be added, but few new friends were added after wave 1 (under *New Non-Target Sample Friends*).

Table 1 also shows how the response rates for the target sample (60% for Cohorts 1 and 2, respectively, under *Final Target Sample*) and the participation rates of friends (who did not participate as target adolescents) were calculated (i.e., 79% and 82% for Cohorts 1 and 2, respectively, under *New Non-Target Sample Friends*). Participation rates for the target sample were calculated by taking the percentage of participating target participants of the 1,000 randomly contacted persons. Finally, the *New Friends Across Waves* refers

to the number of persons who were *uniquely* present among the friends across the three waves across the two cohorts; That is, individuals who were present at multiple waves (i.e., old friends) were counted only once per wave. For Cohort 1, there were 294 new individuals nominated as friends across the three waves. Of these 294, 232 (79%) friends filled out the questionnaire at least at one wave. For Cohort 2, there were 326 new individuals nominated as friends across the three waves. Of these 326, 267 (82%) friends filled out the questionnaire on at least one wave.

Appendix 1

In the following text and in Table A1 below, we describe the snow-balling sampling procedure in detail.

Target sample (a). At the start of the study in 2013, 24-year-olds ($n = 2,543$; Cohort 1), and 26-year-olds ($n = 1,987$; Cohort 2) were targeted in the Swedish city. Using the municipality register, we randomly selected 1,000 persons from Cohort 1 and 1,000 persons from Cohort 2. These 2,000 potential target participants were sent invitation letters and questionnaires by post, with prepaid envelopes to return the questionnaires. Participation rates were 60% for Cohort 1 ($n = 598$) and 60% for Cohort 2 ($n = 601$), creating a target sample of 1,199 participants.

Target sample friends (b). Friends were identified with a validated friendship nomination questionnaire (e.g., Kiesner et al., 2004; Van Zalk et al., 2010; see Measures section for details). A relatively high percentage of nominated friends already participated as targets themselves (on average across the three waves, 55% and 52% in Cohorts 1 and 2, respectively). These persons were, therefore, both target participants and target sample friends in our analyses. Thus, a relatively large portion of nominated friends already participated as target participants and provided reciprocal information on friendships.

Because participants were not restricted to exclusively nominate friends of their own cohort, some participants from Cohort 1 nominated participants from Cohort 2 as friends (7% on average across the waves), and some participants from Cohort 2 nominated participants from Cohort 1 as friends (5% on average across the waves). We, therefore, combined Cohort 1 and Cohort 2 into one sample.

Non-target sample friends (c). To further enhance friendship participation rates and to increase the sample size, we invited up to three nominated friends per target participant. Only those friends were invited who did not already participate in the target sample at that respective wave. This means that, of the maximum of eight nominated friends per wave, we contacted the first three friends who were not yet participating. Importantly, we invited friends who were not participating yet *at that specific wave*. If target Klara nominated Maya at Wave 1, and Maya was not a target participant at Wave 1 (and thus did not participate yet at Wave 1), Maya was invited to participate at Wave 1. At subsequent waves, the exact same procedure as at Wave 1 was applied (i.e., all information from prior waves was ignored). Thus, if Maya, who was nominated at Wave 1 by Klara, was nominated again as a friend (by any target participant) at Wave 2, Maya was contacted again. If Maya was not nominated at Wave 2, she was not invited to participate, regardless of whether Maya participated before. Thus, both old and new friends were invited to participate, as long as they were (1) nominated by a target participant at that specific wave and (2) not already participating as target participants themselves at that specific wave.

These non-target sample friends were invited by sending them an invitation letter and questionnaire via post, with prepaid envelopes to return the questionnaires. The non-target sample friends were asked to fill out the exact same questionnaires as the target sample participants, which allowed us to examine whether friendships were reciprocated (e.g., target sample Klara nominated non-target sample Maya; Did Maya nominate Klara as a friend in return?). We specifically address the importance of reciprocity and how it may affect friendship selection in our analyses (If Klara nominated Maya at Wave 1, does this predict Maya *subsequently* selecting Klara?), as explained in the analysis strategy. Participants were not made aware of being nominated as friend but rather were sent the exact same invitation letter as the target participants did (e.g., Maya did not know Klara selected her as friend, and received the same invitation letter as Klara did).

This final step (c) resulted in adding 499 non-target sample friends, which increased the final participation rate of friends. Specifically, across the three waves, an average of 71% (compared to 55%) of all nominated friends participated as participants themselves in Cohort 1, and 81% (compared to 52%) of all nominated friends in Cohort 2 participated as participants themselves, respectively. Thus, 435 friends additionally participated at Wave 1 (201 from Cohort 1, 234 from Cohort 2), 22 at Wave 2 (15 from Cohort 1, 7 from Cohort 2), and 42 at Wave 3 (16 from Cohort 1, 26 from Cohort 2), totaling 499 non-target sample friends (232 from Cohort 1, 267 from Cohort 2) who were added to the 1,199 target sample participants and their friends. These 499 non-target sample friends did not differ significantly ($p > .10$) from the 1,199 target sample participants in gender, age, ethnicity, number of nominated friends, or extraversion.

Final sample. The final sample consisted of the combination of the 1,199 target sample (598 for Cohort 1, 601 for Cohort 2) and the 499 non-target sample friends (232 for Cohort 1, 267 for Cohort 2), resulting in a total of 1,698 participants (see Table 1; $M_{\text{age}} = 22.72$ years, $SD = 2.99$, 49% female). In sum, all participants fulfilled two criteria: (1) They had at least one wave of data with extraversion scores; and (2) they had at least one wave of data where they were either (a) nominating a friend, and/or (b) being nominated as a friend.

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<i>New Friends Across waves</i>					326		267 (82%)
<i>Final Sample</i>		1199 (598 + 601)					499 (232 + 267)

Note. The table explains the friendship sampling procedure for Sample 1 in a step-by-step fashion (i.e., from left to right). We randomly selected 1,000 persons from Cohort 1 and 1,000 persons from Cohort 2 (*Initial Target Sample*). Target participants were those who returned their consent form and questionnaire via post (*Final Target Sample*). Target participants were asked to nominate friends and a large portion of these nominated friends already participated as target participants themselves (*I. Target-Sample Friends*). Participants were restricted to nominate a maximum of eight friends. When these nominated friends were not participating already in the target sample, a maximum of three were contacted with an invitation to participate at that wave (*Non-Target Sample Friends Contacted per Post*). Of these contacted friends, a certain number of friends were new, meaning they had not participated yet at a prior wave (*New Friends Among Non-Target Sample Friends*). In the next column, the number of friends who responded per wave are shown (*Participating Non-Target Sample Friends*). At each wave, both old and new friends could be added, but few new friends were added after wave 1 (under *New Non-Target Sample Friends*).

Table 1 also shows how the response rates for the target sample (60% for Cohorts 1 and 2, respectively, under *Final Target Sample*) and the participation rates of friends (who did not participate as target adolescents) were calculated (i.e., 79% and 82% for Cohorts 1 and 2, respectively, under *New Non-Target Sample Friends*). Participation rates for the target sample were calculated by taking the percentage of participating target participants of the 1,000 randomly contacted persons. Finally, the *New Friends Across Waves* refers to the number of persons who were *uniquely* present among the friends across the three waves across the two cohorts; That is, individuals who were present at multiple waves (i.e., old friends) were counted only once per wave. For Cohort 1, there were 294 new individuals nominated as friends across the three waves. Of these 294, 232

(79%) friends filled out the questionnaire at least at one wave. For Cohort 2, there were 326 new individuals nominated as friends across the three waves. Of these 326, 267 (82%) friends filled out the questionnaire on at least one wave.