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2   Loneliness in Early Adolescence:

3   Friendship Quantity, Friendship Quality, and Dyadic Processes

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5   Running head: Adolescent Loneliness and Friendships

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Running Head: Adolescent Loneliness and Friendships

1   Abstract

2   Objective. Friendship quantity and quality are related to adolescent loneliness, but the exact

3   link between these constructs is not well understood. The present study aimed to examine

4   whether adolescents' perception of friendship quantity and quality, and the perceptions of

5   their peers, were related to loneliness. We examined the relation between loneliness and the

6   number of unilateral and reciprocal friendships, and compared the views of best friendship

7   quality.

8   Methods. Overall, 1,172 Dutch adolescents (49.1% male, M age = 12.81, SD = .43) nominated

9   their friends and rated their friendship quality. Friendship quantity was measured using

10   sociometrics to distinguish reciprocated and unilateral (one-sided) friendships.

11   Results. The analyses indicated that loneliness was related to fewer reciprocal and unilateral-

12   received friendships (i.e., the adolescent received a friendship nomination but did not

13   reciprocate that nomination) and a lower quality of best friendship. Actor-partner

14   interdependence analyses revealed that adolescents' loneliness was related to a less positive

15   evaluation of their friendship, as reported by adolescents themselves (i.e., a significant actor

16   effect) but not by their friends (i.e., non-significant partner effect).

17   Conclusion. These findings (a) indicate that loneliness is negatively related to the number of

18   friends adolescents have, as perceived by themselves and their peers and (b) suggest that once

19   a friendship is established, lonely adolescents may interpret the friendship quality less

20   positively compared to their friends. Implications of these findings for our current

21   understanding of adolescent loneliness are discussed, and suggestions for future research are

22   outlined.

23   Keywords: Adolescents; Loneliness; Friendship Quality; Reciprocal; Unilateral; Dyadic

1   Loneliness is usually defined as a negative emotional reaction to experiencing

2   unsatisfactory quantity or quality of social relations (Perlman & Peplau, 1981). The

3   consequences of loneliness can be severe and lead to both physical and mental health

4   problems such as (social) anxiety, depression, and cardiovascular problems (Heinrich &

5   Gullone, 2006). Although most studies on the effects of loneliness have been conducted

6   among adults, loneliness also affects health outcomes in adolescence (Qualter, Brown, et al.,

7   2013). Loneliness can have direct consequences on the daily lives of adolescents because it is

8   related to lower school adjustment (Aikins, Bierman, & Parker, 2005). In the present study,

9   we focused on early adolescence. Loneliness can be experienced throughout the lifespan, but

10   seems to peak during early adolescence (Heinrich & Gullone, 2006). This may be due to the

11   fact the most important developmental tasks in early adolescence include gaining acceptance

12   within a peer group and initiating and maintaining friendships, making social relationships

13   especially important in this period (Buhrmester, 1990; Parkhurst & Hopmeyer, 1999). In

14   addition, in this period, adolescents experience the transition to a new school, which is also

15   related to an increase in loneliness (Kingery, Erdley, & Marshall, 2011; Van Roekel, Scholte,

16   Verhagen, Goossens, & Engels, 2010).

17 **Loneliness and Friendships**

18   One of the core features of loneliness is the experience of a low quality or quantity of

19   social relations (Weeks & Asher, 2012). Empirical research has revealed that loneliness is

20   related to fewer reciprocated (mutual) friendships and a lower perceived friendship quality

21   (Jobe-Shields, Cohen, & Parra, 2011; Kingery et al., 2011; Nangle, Erdley, Newman, Mason,

22   & Carpenter, 2003; Parker & Asher, 1993; Pedersen, Vitaro, Barker, & Borge, 2007). As of

23   yet, it is unclear whether the low friendship quality and quantity in the social worlds of lonely

24   adolescents are actual or merely perceived by adolescents as less positive. In the present

25   study, we aimed to extend the knowledge in this area by comparing adolescents' views of

1   their social world, specifically regarding friendship quantity and quality, with the views of

2   their peers and relate these perceptions to loneliness.

3   **Reciprocal and Unilateral Friendships**

4   Loneliness may be related to different aspects of friendship quantity and quality.

5   Previous research has focused only on *reciprocal* friendships, that is, mutual friendships in

6   which both adolescents perceive each other as a friend (e.g., Nangle et al., 2003; Parker &

7   Asher, 1993). Some researchers have argued that friendships only exist if both parties

8   recognize the friendship (cf. Rubin, Bukowski, & Parker, 2006), whereas others argued that

9   *unilateral* friendships (i.e., one-sided friendships) are just as relevant for adolescent

10   adjustment (cf. Berndt & McCandless, 2009). Indeed, reciprocal friendships are stronger

11   compared to unilateral friendships in terms of stability, quality, and lack of conflict. However,

12   unilateral friends also differ from non-friends in terms of the time unilateral friends spend

13   together and the quality of the relationship (Ciairano, Rabaglietti, Roggero, Bonino, &

14   Beyers, 2007; Newcomb & Bagwell, 1995; Vaughn, Covin, Azria, Caya, & Krzysik, 2001).

15   Thus, it is conceivable that unilateral friendships may also be important for loneliness.

16   Within unilateral friendships, a distinction can be made between unilaterally *given*

17   nominations (i.e., the adolescent gives a friendship nomination to a peer, but this nomination

18   is not reciprocated) and unilaterally *received* nominations (i.e., the adolescent receives a

19   friendship nomination from a peer but does not reciprocate this nomination) (Berndt &

20   McCandless, 2009). This distinction is meaningful, as both types of friendships seem to be

21   differently related to adjustment (Scholte et al., 2009). Although loneliness has been related to

22   friendship quantity in previous research, some researchers have argued that only friendship

23   quality but not friendship quantity is related to loneliness (Qualter & Munn, 2005; Qualter,

24   Rotenberg, et al., 2013). To ensure that the results regarding friendship quantity do not merely

25   reflect friendship quality, we controlled for the effects of network friendship quality (i.e.,

1 adolescents' overall attachment to their broader friendship network) in our analyses of

2 friendship quantity.

3 **Bias Hypothesis**

4   In the literature, opposing views have been proposed to explain why loneliness is

5 related to lower friendship quantity and quality. Social needs models (Baumeister & Leary,

6 1995; Cacioppo et al., 2006; Gardner, Pickett, Jefferis, & Knowles, 2005; Weiss, 1973) state

7 that all human beings have a universal need to belong - a need to have social contacts with

8 others - and that loneliness is experienced when this need is not being met. The need to

9 belong may be restored by paying more attention to social cues in the environment and using

10 the information provided by these cues to connect with others (Gardner et al., 2005).

11 Loneliness is thought to be related to heightened attention to social cues (Cacioppo et al.,

12 2006; Gardner et al., 2005). In fact, loneliness may be related to hypervigilance to negative

13 social cues, which makes lonely individuals hyperaware of signs of rejection, and it could

14 make them believe that they have fewer possibilities for friendships and lower friendship

15 quality than they actually have (Cacioppo et al., 2006; Qualter, Rotenberg, et al., 2013;

16 Vanhalst, Luyckx, Scholte, Engels, & Goossens, 2013). According to this view, the most

17 important source of loneliness is a negative perception of one's social environment. We refer

18 to this view as the *bias hypothesis*.

19 **Deficit Hypotheses**

20   Alternatively, loneliness may be related to actual differences in the social

21 environment. These differences could be due to social skills deficits of lonely individuals.

22 Lonely adolescents may lack certain social skills to form successful friendships or possess

23 undesirable behavioral characteristics, making them an unpopular friendship choice and

24 influencing the quality and quantity of their friendships (Jobe-Shields et al., 2011;

25 Woodhouse, Dykas, & Cassidy, 2012). Thus, according to this social skills deficit view, the

1   actual social environment rather than adolescents' interpretation of the environment is an

2   antecedent of loneliness. Lonely adolescents may or may not be aware of their low social

3   standing. On the one hand, lonely individuals may be very aware of their lower social skills

4   and social standing and accurately perceive their social environment negatively. We call this

5   the *recognized deficit hypothesis*. On the other hand, lonely adolescents with underdeveloped

6   social skills may be unaware of their low social standing. We call this the *unrecognized deficit*

7   *hypothesis*. In sum, different hypotheses have been developed to explore why lonely

8   adolescents may experience low friendship quantity and quality in adolescence, considering

9   adolescents and their peers' view on the social world of lonely adolescents.

10   **Loneliness in Relation to Friendship Quantity**

11   Each of these hypotheses includes different expectations regarding friendship quantity

12   (for an overview, see Table 1). If the bias hypothesis were correct, lonely individuals would

13   have a negative view of their social environment, whereas their peers would have a neutral

14   view of the lonely adolescents' social standing. This would result in negative relations of

15   loneliness with reciprocal relations and unilateral given friendships because lonely

16   adolescents would perceive few opportunities for friendship in their environment. Under the

17   bias hypothesis, lonely adolescents receive an equal number of nominations from their peers

18   but reciprocate only a few of these. Therefore, this hypothesis proposes that loneliness is

19   positively related to unilateral received friendships. According to the recognized deficit

20   hypothesis, lonely adolescents have a negative view of their social environment (i.e., they

21   perceive few friendships), and their peers agree with this view. This would suggest a negative

22   relation between loneliness and all measures of friendship quantity. Finally, considering the

23   unrecognized deficit hypothesis, we assume that lonely adolescents are unaware of their

24   social standing and thus have a neutral view of their social environment. Their peers,

25   however, have a negative view of the adolescents' social standing. Consequently, lonely

1 adolescents will nominate an average number of peers as friends but receive only few

2 nominations in return. Thus, this will result in a positive relation between loneliness and

3 unilateral given friendships (i.e., lonely adolescents will have more unreciprocated

4 friendships) as well as a negative relation of loneliness with reciprocal and unilateral received

5 friendships.

6 [Insert Table 1 about here]

7 **Loneliness in Relation to Friendship Quality**

8   To obtain a more detailed view of the relation between loneliness and friendship

9 quality, we focused on the quality of the *best friendship*, which is the most commonly

10 researched type of friendship quality, and it might also be the most important for adolescent

11 adjustment (Berndt & McCandless, 2009). We used a dyadic approach to examine the relation

12 between loneliness and friendship quality. This is important, because adolescents'

13 interpretations of the quality of their friendship are related to the interpretations of the quality

14 made by their best friends; therefore, they cannot be treated as independent data (Burk &

15 Laursen, 2005; Cillessen, Jiang, West, & Laszkowski, 2005; Parker & Asher, 1993). In

16 addition, earlier research showed that children tend to select other children based on their

17 level of loneliness and that children in best friendships may become more alike in loneliness

18 over time (Mercer & DeRosier, 2010). Thus, both adolescents and their best friends'

19 loneliness and their assessment of friendship quality are interdependent, and this

20 interdependency should be taken into account (Cillessen et al., 2005). Some studies have

21 randomly selected one of two friends to adjust for dependency in the data (e.g., Bagwell et al.,

22 2005), whereas others have used the Actor-Partner Interdependence Model for

23 Indistinguishable Dyads (APIM: Olsen & Kenny, 2006). Using this model, the data from both

24 friends can be included. The APIM has been used in earlier research to control for

1   interdependencies between best friends' evaluations of the friendship (e.g., Burk & Laursen,

2   2005) but never in relation to loneliness.

3   Two types of effects can be established using APIM. First, adolescents' own

4   loneliness can be related to friendship quality, as judged by adolescents *themselves* (i.e., a

5   significant actor effect can emerge). Second, adolescents' own loneliness can be related to the

6   experience of friendship quality, as reported by *their partner* (i.e., a significant partner effect

7   can emerge). Table 1 also shows the expectations for friendship quality based on the three

8   hypotheses. If the bias hypothesis is correct, loneliness will be related negatively to

9   adolescents' own evaluation of the friendship (i.e., a significant actor effect will occur) but

10   will be unrelated to their friends' evaluation of the friendship (i.e., the partner effect will be

11   non-significant). According to the recognized deficit hypothesis, both actor and partner effect

12   will be significant, indicating that loneliness is related to a negative perception of both

13   adolescents and their friends' evaluation of friendship quality. In contrast, according to the

14   unrecognized deficit hypothesis, the partner effect will be significant, indicating that the

15   friends of lonely adolescents will evaluate their friendships negatively. The actor effect will

16   be non-significant to positive, indicating that lonely adolescents will have either a neutral or a

17   positive view of their friendships (Qualter & Munn, 2005; Qualter, Rotenberg, et al., 2013).

18   **The Present Study**

19   In sum, the present study aimed to examine whether lower friendship quantity and

20   quality of lonely individuals are due to their own perceptions of their social world or the

21   social environments' response to the lonely individual or both. Expectations according to

22   these three views are summarized in Table 1. Regression analyses were used to examine

23   whether loneliness was positively or negatively related to the number of reciprocal and

24   unilateral friendships. We were particularly interested in the unilateral relations because these

25   allowed us to examine whether fewer reciprocal relations resulted from the view held by

1   lonely adolescents themselves (bias hypothesis), their environment (unrecognized deficit

2   hypothesis), or both (recognized deficit hypothesis). To compare views on friendship quality

3   between adolescents themselves and their best friends, we used an APIM model.

4   Little is known about the role of gender in the relationship between loneliness and

5   friendship quantity and quality. A few studies explored gender differences in the relation

6   between loneliness and friendship quantity or quality, and found no moderation by gender

7   (Nangle et al., 2003; Parker & Asher, 1993). However, although most studies found no gender

8   differences in the occurrence loneliness, earlier research provided some evidence to support

9   gender differences in friendships, such as a higher friendship quality among girls (Heinrich &

10   Gullone, 2006; Hoza, Bukowski, & Beery, 2000; Maccoby, 2002). In addition, earlier

11   research showed that girls may have stronger communal needs (i.e., need for interpersonal

12   closeness) in friendships, and that not meeting these needs is related to loneliness for girls but

13   not for boys (Zarbatany, Conley, & Pepper, 2004). This implies that not meeting needs for

14   interpersonal closeness in terms of friendship quality might be more strongly related to

15   loneliness for girls than for boys. We therefore explored whether gender differences occurred

16   in the relation between gender and friendship-related constructs. Additionally, we controlled

17   for the possible confounding effects of both social anxiety and depressive symptoms, which

18   have been found to be related to both loneliness and aspects of friendship such as perceived

19   support from close friendships (Hutcherson & Epkins, 2009).

Method

21   **Procedure**

22   Seven secondary schools participated after being informed about the study aims and

23   design through written and personal communication. We included participants after obtaining

24   passive parental consent for participation and active consent from the adolescents themselves.

25   All data were collected during regular school hours. Data collection took approximately 30 to

1   50 minutes. Participants completed the questionnaires individually on a computer in the

2   presence of graduate students involved in the project. Adolescents received a small gift (e.g.,

3   a pen) for their participation.

4   **Participants**

5   Overall, 1,361 students from 52 different classes were approached to participate in the

6   study. Parents of all students in the participating schools received a letter with information

7   about the study. If they did not wish their child to participate in the study, they could indicate

8   this via post, email, or phone. Parents of 47 adolescents (3.45%) indicated that they did not

9   want their child to participate. In addition, active consent was obtained from all but 3

10 adolescents themselves.

11   At the time of the data collection, 81 adolescents were absent due to illness or for

12 other reasons. Additionally, 49 adolescents were removed from the analyses because they

13 nominated themselves as friends in the classroom or they nominated everybody in the

14 classroom, which raises questions about the reliability of their friendship nominations.

15 Finally, 9 adolescents were not included because they used incorrect identity codes, which

16 made it impossible to determine who they were. The final sample consisted of 1,172 students

17 (49.1% male). Not all students completed all measures due to planning issues at some of the

18 schools (see Table 2). All students were in the first grade of Dutch secondary school

19 (comparable to US grade 7) with a mean age of 12.81 years ($SD = .43$ year). Classes varied in

20 size from 17 to 32 students. Adolescents remained in the same class group throughout the

21 day.

22   Most participants had a Dutch ethnic background (94.9%), 2.1% were of Turkish or

23 Moroccan descent, and the remaining students had a different ethnic background. Parental

24 education was high, with 18.3% of mothers reporting low education level, 32.2% reporting

25 middle education level, and 5.7% reporting high education level. Concerning fathers, 15.9%

1 had low, 28.9% had middle, and 55.2% had high education. For students themselves, different

2 educational levels within the Dutch secondary education system were fairly well represented

3 (24.7% of the students attended low to middle level of education, 45.6% attended middle to

4 high level of education, and 29.7% attended pre-university level of education).

5 **Measures**

6   **Loneliness.** Loneliness was measured using the peer-related subscale of the Louvain

7 Loneliness Scale for Children and Adolescents (LACA; Marcoen, Goossens, & Caes, 1987).

8 Because the friendship-related items of this scale may overlap with other friendship

9 assessments, we constructed a pure loneliness scale consisting of 6 not friendship related

10 items (e.g., "I feel alone at school") [1] measured on a 4-point scale ranging from *never* (1) to

11 *always* (4). Earlier research showed the LACA is one of the most reliable measures of

12 loneliness in childhood (Goossens & Beyers, 2002). Cronbach's alpha was .85 for the pure

13 loneliness measure (compared to $\alpha = .89$ for the original scale). The correlation between the

14 original scale and pure scale was high ($r = .95$, $p < .001$).

15   **Number of friends.** To determine the number of friendships within the classroom, we

16 first asked adolescents to select their best friend's name from a list of all students in their

17 classroom. After that, adolescents could select other friends within the classroom by clicking

18 on their names. If adolescents did not have any friends in the classroom, they could click a

19 button "I can't name anyone". Adolescents who were not present during data collection but

20 were nominated in the class (11.5%) were dropped, because it could not be determined

21 whether these nominations were reciprocal or unilateral.

22   *Number of reciprocal friends.* The number of reciprocal friends was calculated by

23 counting all friendship nominations by participants and their classmates (i.e., mutual

24 nominations).

1   ***Number of unilateral-given friends.*** The unilateral-given friendships were all

2   friendships in which the participant nominated a classmate as one of their friends, but this

3   classmate did not nominate the participant.

4   ***Number of unilateral-received friends***. The unilateral-received friendships were all

5   friendships in which the participant received a nomination from a classmate, but the

6   participant did not nominate this classmate as a friend.

7   **Best friendship quality.** The quality of the relationship with the best friend was

8   measured using the satisfaction and commitment subscale of a short version of the Investment

9   Model Scale (Branje, Frijns, Finkenauer, Engels, & Meeus, 2007). Adolescents answered 8

10   questions about their relationship with their best friend measured on a 5-point scale ranging

11   from *do not agree at all* (1) to *totally agree* (5). For each question, the name of the student

12   nominated as the best friend in the classroom was filled in. For example, if Jane S. was

13   nominated one of the questions would be "My friendship with Jane S. is almost perfect". The

14   Investment Model Scale has been used successfully in earlier research on friendships, and it

15   has good reliability and predictive validity (Branje et al., 2007). Cronbach's alpha was also

16   high in our sample ($\alpha = .88$).

17   **Network friendship quality**. Friendship quality within the broader network was

18   measured using the peer subscale of the short version of the Inventory of Parent and Peer

19   Attachment scale (IPPA; Armsden & Greenberg, 1987; Raja, McGee, & Stanton, 1992). This

20   scale consists of 12 items measuring attachment to friends on a 4-point scale ranging from

21   *almost never* (1) to *almost always* (4) (e.g., "I feel my friends are good friends"). Of these

22   items, 5 are reverse coded. The IPPA has good reliability and validity (Armsden &

23   Greenberg, 1987). Cronbach's alpha was also acceptable in the present study ($\alpha = .79$).

24   **Control Variables.**

1   ***Depressive symptoms***. Depressive symptoms were assessed using the Iowa short form

2   of the Center for Epidemiological Studies Depression scale (CES-D; Kohout, Berkman,

3   Evans, & Cornoni-Huntley, 1993), which consists of 11 items measuring the prevalence of

4   depressive symptoms during the past week (e.g., "I was sad"). The responses were measured

5   on a 5-point scale ranging from 0 (*rarely or never, < 1 day*) to 3 (*usually or always, 5 – 7*

6   *days*). Two items were reverse coded. Actual scores ranged from 0 to 31, with higher scores

7   indicating a higher prevalence of depressive symptoms (Cronbach's α = .81).

8   ***Social anxiety.*** Social anxiety was measured using the Dutch version of the Social

9   Phobia subscale of the Screen for Child Anxiety Related Emotional Disorders (SCARED;

10   Bodden, Bogels, & Muris, 2009). This scale consists of 9 items scored on a 3-point scale

11   ranging from *almost never* (1) to *often* (3) (e.g., "I am shy"). Actual scores ranged from 9 to

12   27 with higher scores indicating higher prevalence of social anxiety symptoms (Cronbach's α

13   = .80).

Data Analyses Plan

15   To examine the relationship between loneliness and friendship quantity, we used

16   hierarchical multiple regression analyses, which were estimated in Mplus Version 6 (Muthén

17   & Muthén, 1998-2010). We estimated parameters using the maximum likelihood estimator

18   with robust standard errors (MLR), which uses the FIML procedure for missing values. All

19   predictor variables were standardized. This estimator was used because not all variables were

20   normally distributed. All predictor variables were centered before the analyses.

21   Unstandardized results and STDYX standardized results are reported. In the first step, we

22   added the main effects of all friendship-related variables (i.e., network friendship quality,

23   number of reciprocal friends, number of unilateral-given friends, and number of unilateral-

24   received friends) and gender. In the second step, we added interactions between gender and

25   all friendship variables. Finally, we tested the most parsimonious model that included all

1   friendship quantity items, network friendship quality, and all gender-related effects that

2   reached significance. The results of this model are described in detail.

3   If loneliness is indeed related to friendship quantity, loneliness could also be related to

4   having a best friend, which may affect our analyses regarding the relation between loneliness

5   and friendship quality within best friend dyads. We used logistic regression to examine

6   whether loneliness was related to the likelihood of having a best friend, compared to not

7   nominating a best friend or having a unilateral best friend (i.e., nominating a classmate who

8   does not nominate the participant as best friend). First, we tested a model including

9   loneliness, gender and the interaction between loneliness and gender. Second, we tested a

10   model including only significant effects. Third, we explored variability of loneliness scores in

11   adolescents who had a reciprocal best friendship.

12   Finally, we examined whether loneliness was related to the quality of the best

13   friendship using an APIM model for indistinguishable dyads (Olsen & Kenny, 2006; see

14   Figure 1). We included only the same-sex dyads and ran this model. After running the basic

15   APIM model, we used multiple-group comparison to examine gender differences in the actor

16   or partner effects using a log-likelihood difference test. We ran a model with all paths

17   restricted to be the same between boys and girls and compared this model to a model in which

18   the actor and partner effects were freely estimated for boys and girls. Next, we examined

19   whether the difference between dyad members' loneliness scores were related to the outcomes

20   using an actor-partner interaction (Kenny & Cook, 1999). STDYX standardized results are

21   reported.

22   For all analyses, we examined whether the results remained the same after adding

23   depression and social anxiety as covariates. Because all effects related to friendship quantity

24   and quality in all analyses reached the same significance level after controlling for depression

1   and social anxiety, we only report models without these control variables in the Results

2   section.

<div align="center">**Results**</div>

Descriptives and Correlations

5   Table 2 summarizes the means and standard deviations for loneliness, friendship

6   quantity and quality, and control variables for the total sample and separately for boys and

7   girls. This table shows that girls had higher loneliness scores compared to boys. In line with

8   earlier research, girls also experienced higher friendship quality compared to boys, gave and

9   received more nominations, and had a higher number of reciprocal friendships. To test

10   whether clustering of loneliness occurred within different classrooms that were included in

11   the analyses, we calculated the intraclass correlation between adolescents in classrooms for

12   loneliness. The ICC was .02, indicating that only around 2% of the variation in loneliness

13   could be explained by a class effect. Therefore, the analyses were run without controlling for

14   the clustering of adolescents within classes.

15   [Insert Table 2 about here]

16   Table 3 displays correlations between loneliness and all other constructs, showing a

17   similar pattern for boys and girls. Reciprocal friendships were related to a higher number of

18   unilateral-given friendships and a lower number of unilateral-received friendships. Loneliness

19   was unrelated to unilateral-given friendship nominations and negatively related to all other

20   measures of friendship quantity and quality. Finally, higher loneliness was moderately

21   associated (i.e., $.30 < r < .50$) with both depressive symptoms and social anxiety.

22   [Insert Table 3 about here]

23   The Fisher r-to-z transformation was used to compare the strength of correlations

24   between loneliness and all constructs for boys and girls separately. Significant differences

25   were found only in the negative relation between loneliness and best friendship quality ($Z = -$

1   2.41, *p* = .016) and in the positive relation between loneliness and depression (*Z* = 2.40, *p* =

2   .016). Both correlations were stronger for girls than for boys.

3   **Loneliness and Friendship Quantity**

4   First we examined whether interactions between gander and measures of

5   friendship quantity or quality were related to loneliness. None of these interactions reached

6   significance, therefore the results without gender interactions are reported in Table 4. In total,

7   the model explained 26% of the variance in loneliness (F[5,1088] = 75.92, *p* = <.001). The

8   results indicated that network friendship quality contributed negatively to feelings of

9   loneliness. Controlling for the effects of friendship quality, friendship quantity was also

10   related to loneliness. Both the number of reciprocal friendships and unilateral-received

11   friendships were negatively related to loneliness, but the number of unilateral-given

12   friendships was not related to loneliness. Thus, adolescents who tended to report higher

13   feelings of loneliness also tended to experience lower friendship quality, have fewer

14   reciprocal friends, and have fewer instances in which they were nominated by a classmate

15   whom they did not nominate back. Tolerance levels and VIF were within acceptable range for

16   all analyses (i.e., VIF < 5, Tolerance > .2).

17   [Insert Table 4 about here]

18   **Loneliness in Relation to the Likelihood of Having a Best Friend**

19   In total, 2.8% of the adolescents did not nominate a best friend in their class, 49.3%

20   had a reciprocal best friend (i.e., the first nominated friend), 40.0% had a unilateral best friend

21   (i.e., they nominated a classmate who did not reciprocate the nomination), and 7.6%

22   nominated a best friend who was not present during data collection, thereby making it

23   impossible to determine whether this nomination was reciprocal or unilateral. Logistic

24   regression showed that the interaction between gender and loneliness had no significant effect

25   on the likelihood of having a best friend compared to having a unilateral best friend or not

1   nominating a best friend (OR = 1.07, 95% CI [.99, 1.16]). A model which included only

2   gender and loneliness showed that being a girl was related to a higher likelihood of having a

3   reciprocal friend (OR = 1.32, 95% CI [1.04, 1.68]) and loneliness was related to a lower

4   likelihood of having a reciprocal best friend (OR = .91, 95% CI [.87, .94]).

5   This indicates that very lonely participants may not be represented in the sample of

6   adolescents with a reciprocal best friend. However, there was sufficient variability in

7   loneliness scores among participants who had a reciprocal best friendship (i.e., $M = 8.41$, SD

8   $= 2.91$, range $= 6$-23 for the sample of participants with a reciprocal best friend, and $M = 8.92$,

9   $SD = 3.36$, range $= 6$-23 for the total sample). Therefore, we felt confident to further examine

10 the relationship between loneliness and friendship quality within best friend dyads.

11 [Insert Figure 1 about here]

12 **Perceptions of Quality within Best Friend Dyads**

13   In all, 281 best friendship dyads were identified in the sample. Of these dyads, 126

14 were male, 150 were female, and 5 were mixed gender. We analyzed the data for same-gender

15 dyads only, because there were too few mixed-gender dyads to perform the analyses. The

16 model described in Figure 1 was used to examine the relation between loneliness and

17 friendship quality within best friend dyads. The model fit the data well (RMSEA = .00 [90%

18 confidence interval .00, .04], CFI = 1.00). The model explained 6.0 % of the variance in

19 friendship quality scores. The results indicated that best friends' loneliness scores were

20 interrelated. In addition, friends' were alike in their evaluation of their friendship. In line with

21 expectations, we found a significant actor effect ($\beta = -.24$, $p < .001$). This finding indicates

22 that within the dyads, individuals' loneliness scores were related to their evaluation of

23 friendship quality. Higher loneliness was related to a lower experienced friendship quality.

24 However, the partner effect was not significant ($\beta = -.03$, $p = .65$). This result indicates that

25 higher loneliness, as experienced by one friend, was unrelated to lower friendship quality, as

1   experienced by other friend. Multiple group analysis showed similar effects for both male and

2   female dyads. Similarity between dyad members' loneliness scores did not affect the results,

3   evidenced by a non-significant actor by partner interaction ($\beta = .14$, $p = .14$).

4   **Discussion**

5   The aims of the present study were to examine the associations among adolescent

6   loneliness, friendship quality, and friendship quantity. We examined whether lonely

7   adolescents (bias hypothesis), their peers (unrecognized deficit hypothesis), or both

8   (recognized deficit hypothesis) held negative views of the social world of lonely adolescents

9   in terms of friendship quantity and quality. We explored the relationship between loneliness

10   and unilateral friendships and the relationship between loneliness and friendship quality

11   within best friend dyads. Our findings indicated that loneliness was negatively related to two

12   aspects of friendship quantity (i.e., number of reciprocal and unilateral-received friendships,

13   as assessed through peer nominations) and to friendship quality as experienced by adolescents

14   themselves but not their best friends. Thus, the findings regarding friendship quantity seem to

15   be in line with the recognized deficit hypothesis, whereas the findings regarding friendship

16   quality are more in line with the bias hypothesis. However, our findings do not provide

17   unequivocal support for any one of the hypotheses and are open to various interpretations.

18   Our findings showed that loneliness was negatively related to the number of unilateral-

19   received friendships. We did not find evidence that loneliness was related to unilateral-given

20   friendships. The finding that lonely adolescents have fewer unilateral-received friendships

21   could indicate that lonely adolescents may not be perceived as interesting by their peers.

22   Indeed, loneliness was related to lower popularity (Gorman, Schwartz, Nakamoto, & Mayeux,

23   2011). Alternatively, lonely adolescents may not send out signals to indicate that they would

24   want to befriend others. Indeed, loneliness was related to a lower number of given friendship

25   nominations. Therefore, their classmates may simply not be aware that lonely individuals

1   want to form friendships. Indeed, loneliness was found to be related to high social withdrawal

2   and shyness in social interactions (Jobe-Shields et al., 2011), possibly due to fear of rejection

3   (Qualter, Rotenberg, et al., 2013), which limits the opportunities to befriend others.

4   Consequently, lonely adolescents' negative views of the social world may also decrease the

5   number of friendship relations.

6   Regarding friendship quantity, we found no evidence that lonely adolescents evaluate

7   their social world more negatively compared to reality, which would have become apparent in

8   a high number of unilateral-received friendships. We also found no evidence that lonely

9   adolescents are not aware of their low social standing, and perceive their social world more

10   positively compared to reality, which would have been evidenced by a high number of

11   unilateral-given friendships. Our findings seem to indicate that lonely individuals are not a

12   very popular friendship choice, and also do not see many opportunities for friendships

13   themselves. This is most in line with the recognized deficit hypothesis.

14   Regarding friendship quality, our findings suggest a different interpretation. Here, we

15   find indications that loneliness is related to a negative interpretation of the social

16   environment, which is in line with the bias hypothesis. We found that loneliness scores were

17   related to a lower experience of friendship quality, as reported by adolescents themselves (i.e.,

18   a significant actor effect), but were unrelated to the experience of friendship quality reported

19   by their best friend (i.e., absence of a significant partner effect). These findings indicate that

20   once a relationship is established, loneliness does not seem to be indicative of being a poor

21   friend. The relation between loneliness and lower friendship quality was evident only in

22   adolescents' own experiences but not their friends' experiences. Friends of more lonely

23   adolescents did not report lower friendship quality. This finding contradicts the notion that

24   lonely individuals may lack social skills or specifically the skills to maintain high-quality

25   friendships. Rather, it implies that loneliness is related to the *perception* of friendship quality

1   as opposed to the actual (objective) quality of the relation. This interpretation is in line with

2   earlier studies that showed loneliness is related to a negative interpretation of the social

3   surrounding (e.g. Qualter, Rotenberg, et al., 2013). Alternatively, lonely individuals may not

4   interpret the behavior of their friends more negatively, but rather have a higher standard

5   compared to their less lonely friends of what friendships should entail, resulting in a lower

6   evaluation of the same situation (Russell, Cutrona, McRae, & Gomez, 2012).

7   Importantly, based on the present study, we cannot establish whether the friendships of

8   lonely individuals are only interpreted more negatively or whether their friendships are

9   objectively of a lower quality. Possibly, the differences we found between adolescents' own

10   and their friends' interpretation reflect actual differences in behavior of the best friends. For

11   instance, lonely adolescents may be in unequal relationships in which they invest a lot without

12   reciprocation of this investment from their best friend. Earlier research among college

13   students showed that loneliness was related to inequality in investment in relationships and

14   concern with the relative investment in the friendship of both friends (i.e., having an under-

15   benefitting exchange orientation) (Buunk & Prins, 1998). Thus, lonely individuals may not

16   only be more focused on the investment of both friends, but they may also receive less than

17   they give from their friends. Moreover, if lonely adolescents indeed have social skills

18   difficulties, as the findings regarding friendship quantity suggest, it may be difficult to be

19   friends with a lonely adolescent. Future research should examine objective versus subjective

20   differences in friendship quality of lonely adolescents.

21   Because our findings are based on cross-sectional research, we cannot draw

22   conclusions about directions of effects. For instance, our finding that loneliness is related to a

23   negative evaluation of adolescents' own friendships could be a sign that loneliness leads to a

24   negative interpretation of one's social environment (Qualter, Rotenberg, et al., 2013) or a sign

25   that low friendship quality leads to feelings of loneliness. In fact, being in a low-quality

1   friendship may also cause adolescents to imitate their friends' shy and withdrawn behavior,

2   thereby limiting their chances of developing satisfactory relationships with others (Berndt,

3   2002). Likewise, being lonely may make adolescents an unpopular friendship choice, but

4   alternatively, having few friends may cause adolescents to be lonely. Besides the obvious

5   disadvantage of uncertainty about the direction of the effects, the use of a cross-sectional

6   design has another disadvantage. Because we only measured friendship at a single time point,

7   we could not take into account the duration and developmental stage of the friendships.

8   Loneliness could be related to the differences in formation and maintenance of friendships

9   (Parker & Seal, 1996). The use of longitudinal data would make it possible to consider these

10   developmental stages.

11   Another limitation of the present study lies in the generalizability of the findings. For

12   instance, we only used information about friendships within the class. Although earlier

13   research shows that most good friendships in adolescence can be found within the class, other

14   studies also showed that unpopular children have a higher likelihood of having friendships

15   outside the school (George & Hartmann, 1996). This could also be the case for lonely

16   adolescents. If lonely adolescents fail to find satisfactory friendships at school, they may

17   search for friendships elsewhere. In addition, we cannot draw conclusions about the relations

18   between loneliness and friendship quantity and quality in collectivistic countries based on the

19   present research. Earlier research indicated that loneliness may be more strongly related to

20   contact with friends in individualistic rather than collectivistic countries (Lykes &

21   Kemmelmeier, 2014). In addition, we did not differentiate between dyadic loneliness, which

22   relates to dyadic friendships and closeness with individual friends, and network loneliness,

23   which refers to fitting in at a group level (Hoza et al., 2000). Future research should examine

24   whether the findings in the present study are similar for these two types of loneliness because

1   earlier research suggested that distinct mechanisms may underlie each of these types of

2   loneliness (Hoza et al., 2000).

3   Despite these limitations, the present study has a number of strengths, including its

4   broad set of peer-related variables, its large sample size, and the use of a sophisticated

5   procedure, i.e., the APIM model, which allowed us to account for the dependency between

6   best friends' evaluation of the quality of their relationship. This type of dependency is rarely

7   addressed properly in extant research on peer relationships (Cillessen et al., 2005). Our study

8   was the first to explicitly examine whether loneliness is related to a social skills deficit or to a

9   biased perception of the adolescents' social world. This is an important issue, especially

10   because these views typically suggest very different approaches towards intervention and

11   prevention. If loneliness is caused by a difficulty to operate within the social world, evidenced

12   by a social skills deficit, social skills training may be most beneficial for lonely adolescents.

13   However, if the most important cause of loneliness lies in biased perception of the social

14   environment, cognitive based therapies may benefit lonely adolescents most. Currently, little

15   is known about effective strategies for the prevention or intervention of loneliness in

16   adolescence. A review of the intervention strategies showed that cognition-based

17   interventions were more effective compared to social skills based interventions or

18   interventions aimed at increasing social support or opportunities for social contact (Masi,

19   Chen, Hawkley, & Cacioppo, 2011). However, because none of the reviewed studies included

20   early adolescents and only two studies included children, we cannot draw conclusions about

21   the most effective interventions in the young adolescent population.

22   Overall, future research is needed to further examine whether differences in social

23   experiences of lonely adolescents stem from the adolescents themselves, from their

24   environment, or from both. Our findings seem to suggest that lonely individuals may indeed

25   experience objective difficulties in peer relations, which is in line with the recognized deficit

1   hypothesis, but may also interpret their social environment more negatively than is warranted,

2   which is in line with the bias hypothesis. Earlier research suggested that depressed children

3   may exhibit some social skill difficulties, but interpret their functioning in the social

4   environment negatively over and beyond the effects of their actual social environment

5   (Rudolph & Clark, 2001). The same could be true for loneliness: Lonely individuals may

6   indeed have social skill difficulties, but these difficulties may be exaggerated by an overly

7   negative view on their social environment. Future research could benefit from an approach in

8   which adolescents' views on their social skills are compared directly to the views of their

9   peers. In addition, future research could examine whether friends of more lonely individuals

10   are indeed less supportive compared to friends of less lonely individuals, for instance, by

11   using observations or by comparing lonely adolescents' evaluations of their friends to

12   evaluations others have of these same friends. Furthermore, future research could use

13   longitudinal approach and more sophisticated techniques, such as SIENA, to examine the

14   development of social networks in relation to loneliness and friendship quality (Snijders, van

15   de Bunt, & Steglich, 2010). For now, our findings seem to indicate that there may be truth in

16   both the social skills hypothesis and the bias hypothesis. Lonely individuals actually have

17   fewer friendship options, and they seem to interpret their friendships even more negatively

18   than they actually are.

19

1   Footnotes

2   [1] All analyses were also performed using the original loneliness scale. These analyses yielded

3   similar results, with one exception: No difference was found between boys and girls in

4   loneliness scores using the original loneliness scale.

5

6

1   Table 1

2   *Expected Relations between Loneliness and Friendship Quantity and Quality According to*

3   *Different Hypotheses*

	Theoretical hypothesis		
Aspect	Bias	Recognized deficit	Unrecognized Deficit
Nominations given	Negative	Negative	NS
Nominations received	NS	Negative	Negative
Reciprocated	Negative	Negative	Negative
Unilateral given	Negative	Negative	Positive
Unilateral received	Positive	Negative	Negative
FQ Self	Negative	Negative	NS
FQ Best Friend	NS	Negative	Negative

4   *Note*. NS = Not significant; FQ = Friendship quality.

5

6

7

1   Table 2

2   *Sample Size, Means and Standard Deviations for Loneliness, Control Variables, Friendship*

3   *Quality and Number of Nominations*

Measure	Total			Girls		Boys		
	N	*M*	*SD*	*M*	*SD*	*M*	*SD*	t
Loneliness	1,171	8.93	3.36	9.14	3.52	8.70	3.16	-2.25[*]
Friendship quality								
Best friend	1,138	33.08	4.49	34.46	4.19	31.63	4.35	-11.17[***]
Network	1,095	36.84	5.20	37.94	5.46	35.74	4.68	-7.16[***]
Friend nominations								
Given	1,172	5.72	3.52	6.02	3.57	5.41	3.45	-2.98[**]
Received	1,172	5.47	2.59	5.73	2.65	5.20	2.49	-3.56[***]
Reciprocal	1,172	3.48	2.11	3.75	2.21	3.21	1.96	-4.45[***]
Unilat. given	1,172	1.78	2.26	1.84	2.25	1.72	2.28	-0.88
Unilat. received	1,172	1.99	1.89	1.98	1.95	1.99	1.83	0.06
Depressive symptoms	1,139	5.69	4.65	6.50	4.94	4.86	4.18	-6.03[***]
Social anxiety	1,117	14.43	3.57	15.15	3.71	13.70	3.26	-6.94[***]

4   ** *p* < .01. *** *p* < .001.

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Table 3. *Correlations between Loneliness, Friendship Quantity, Friendship Quality, and Control Variables for Girls and Boys*

Measure	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
1. Loneliness		-.49***	-.37***	-.09*	-.24***	-.19***	.04	-.11*	.57***	.45***
2. FQ – Network	-.45***`		.49***	.03	.13*	.12*	-.05	.04	-.45***	-.41***
3. FQ – BF	-.24***	.40***		.08	.15***	.18***	-.03	.01	-.21***	-.19***
4. *N* Given	-.15***	-.14**	.06		.34***	.73***	.77***	-.36***	-.00	-.03
5. *N* Received	-.28***	.21***	.19***	.29***		.69***	-.09*	.58***	-.06	-.11*
6. *N* Reciprocal	-.24***	-.18***	.15**	.69***	.69***		.18***	-.19***	-.05	-.09*
7. *N* Unilat. Given	-.01	.05	-.02	.79***	-.11*	.18***		-.33***	.03	.02
8. *N* Unilat. received	-.13**	.10*	.11*	-.34***	.63***	-.14**	-.34***		-.03	-.05
9. Depression	.47***	-.43***	-.23***	-.10*	-.18***	-.13**	-.02	-.11*		.43***
10. Social anxiety	.44***	-.37***	-.13**	-.14**	-.13**	-.14**	-.08	-.03	.40***	

Note. Correlations for girls are above the diagonal. Correlations for boys are below the diagonal. FQ = Friendship quality; BF =Best friend.

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

1   Table 4

2   *Regression Analysis Predicting Loneliness from Friendship Quality and Friendship Quantity*

Predictor	B	SE B	β
Gender	1.21	.18	.18***
Network friendship quality	-.29	.02	-.45***
N reciprocal	-.26	.05	-.17***
N unilateral given	.01	.04	.00
N unilateral received	-.20	.05	-.12***

3   *Noot.* Adjusted R^2 = .26. *** $p < .001$.

4

1
2
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