



Loneliness and friendship quality in early adolescence: Analyzing bidirectional associations

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ABSTRACT

The aim of the present study was to examine whether loneliness and friendship quality are bidirectionally associated with one another over time. Based on the Evolutionary Theory of Loneliness (Cacioppo & Cacioppo, 2018) and the classical definition of loneliness (Peplau & Perlman, 1982), such a bidirectional association would be expected, but empirical research in this regard is limited. We used data from 615 adolescents ($M_{age} = 10.77$ years at Wave 1; 53.5% girls) in a three-wave longitudinal study with one-year intervals between successive measurement waves. Loneliness was measured using the peer-related loneliness subscale of the Loneliness and Aloneness Scale for Children and Adolescents. Friendship quality was measured using the help and closeness subscales of the Friendship Qualities Scale. To test our hypothesis we estimated a cross-lagged panel model. Higher friendship quality was associated with lower levels of concurrent loneliness, which is in line with findings of previous research. However, no significant across-time predictions were found between the two constructs. Hence, using a sample of early adolescents, we could not provide evidence supporting important aspects of the aforementioned loneliness theories.

Introduction

Loneliness is defined as the negative and painful experience of dissatisfaction with social relationships, which can occur regarding both the quantity and the quality of those social relationships (Peplau and Perlman, 1982). It is often assumed that loneliness is a problem for the elderly, but research shows that also in adolescence, loneliness levels peak (Qualter et al., 2015). This peak could occur because early adolescents are confronted with the crucial developmental task of developing and maintaining high-quality friendships (Steinberg and Morris, 2001) as parents lose and peers gain importance (Laursen and Hartl, 2013). High-quality friendships are characterized by, for example, feelings of closeness and providing and receiving help (Bagwell and Bukowski, 2018; Bukowski et al., 1994). When adolescents do not succeed in developing or maintaining these friendships, they may be at risk of feeling lonely (Goossens, 2018).

Previous research showed that having lower quality friendships is related to more loneliness (Vanhalst et al., 2014). However, studies thus far have been mostly cross-sectional. The question remains whether one feels lonely because of unsatisfying friendships or whether one does not have rewarding friendships because one is lonely. In other words, the direction of associations remains unclear (Schwartz-Mette et al., 2020), and both directions are plausible based on the loneliness literature. The present study aims to fill this gap in the literature by investigating the longitudinal bidirectional association between loneliness and friendship quality (i.e., closeness and help) in early adolescence.

Loneliness and friendship quality

Although loneliness is a negative and painful feeling, temporary feelings of loneliness have some adaptive features as well. Specifically, the Evolutionary Theory of Loneliness makes the analogy with being

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hungry or thirsty, which reminds people that food or fluid intake is needed. As such, feelings of loneliness would function as a similar warning signal that indicates that basic needs are not satisfied and that reconnection with other people would alleviate this feeling (Cacioppo and Cacioppo, 2018). This theoretical framework also states that not all people who feel lonely succeed in reconnecting with others, resulting in chronic loneliness. It has been proposed that cognitive biases in social information processing and negative social behaviors could hamper reconnection with others (Qualter et al., 2015). Specifically, loneliness is associated with several negative cognitions concerning social information (Spithoven et al., 2017), such as increased fear of being evaluated negatively by others (Geukens et al., 2022) and with negative social behaviors, such as more withdrawn behavior and less prosocial behavior (Geukens et al., 2021).

As stated above in the definition of loneliness, people can develop feelings of loneliness by lacking quality in their social relationships (Peplau and Perlman, 1982). This definition implies that insufficient quality in social relationships fosters feelings of loneliness. However, arguments can also be made for the opposite direction of effect, that is, loneliness could elicit lower experienced quality in social relationships. Specifically, as proposed by the Evolutionary Theory of Loneliness, social information processing biases could lead to a more pessimistic interpretation of the quality of social relationships. This assumption is supported by previous research, which suggests that lonely adolescents evaluate their friendships as being of lower quality than their non-lonely friends do (Lodder et al., 2017). Moreover, lonely individuals' negative social behaviors can cause the environment to react more negatively toward them (Kerr and Stanley, 2020), leading to a decreased quality of social relationships. In both cases (i.e., social information processing biases and negative social behaviors), experiencing loneliness would elicit lower experienced quality in social relationships rather than diminished quality in social relationships that provoked loneliness. It is most likely that a bidirectional association is at play, in which loneliness and experienced quality in social relationships continuously influence one another.

Loneliness can be experienced in all types of social relationships, for example, in the parent-child relationship, in a romantic relationship, and in friendships (Goossens, 2016). The present study focused specifically on the experienced friendship quality with the best friend in early adolescence. Previous research has consistently established a negative association between loneliness and experienced friendship quality (e.g., Lodder et al., 2017). Friendship quality is a stronger predictor of concurrent loneliness than peer victimization, low peer preference, or even friendship quantity (Vanhalst et al., 2014). There is also a limited number of prospective correlational studies on the association between friendship quality and loneliness. However, in these studies, either loneliness or friendship quality was measured multiple times but never concurrently. Some of these studies did not find evidence for an association between friendship quality and loneliness later in time. At the same time, other research suggests a negative association between the two (for a review, see Schwartz-Mette et al., 2020). However, these results do not shed light on the bidirectional links between loneliness and friendship quality (Schwartz-Mette et al., 2020). Only one study examined the bidirectional association between the two constructs (Spithoven et al., 2018). The results of this study revealed that loneliness and friendship quality did not predict one another over a one-year interval (Spithoven et al., 2018). However, adolescents without reciprocal best friends, who also experienced more loneliness and lower friendship quality, were excluded from the analyses. It is possible that excluding these adolescents from the sample affected the longitudinal association between loneliness and friendship quality (Spithoven et al., 2018).

The present study aims to overcome the limitations of previous studies by investigating the association between loneliness and friendship quality longitudinally in a less restricted sample in terms of friendship types. That is, all adolescents who indicated having friends, regardless of whether these friendships were reciprocal, were included

in the sample. This is important, because previous research has shown that lonely adolescents were less likely to have reciprocated friendships (Lodder et al., 2017). Hence, by being less restrictive in terms of friendship types, we aimed to have a more representative sample of adolescents and their varying levels of loneliness and perceived friendship quality. Additionally, the current study expands upon extant longitudinal research on loneliness and friendship quality by including three measurement waves instead of two. In doing so, we aim to empirically test the assumption of a bidirectional association between the two constructs.

The present study

The current study aimed to examine the bidirectional association between loneliness and friendship quality in early adolescence. We expected to find a negative association between loneliness and friendship quality at one point in time. In addition, we expected to find a bidirectional association between loneliness and friendship quality, with loneliness at time $t-1$ negatively predicting friendship quality at time t and vice versa. The hypothesized model is presented in Fig. 1.

Method

Participants and procedure

Adolescents in the present study participated in the MIND project (i.e., Methylation in Development). This project is a longitudinal and multidisciplinary study focusing on the development of internalizing and externalizing problem behaviors, parent and peer relationships, and biological markers of stress. Participants were recruited through flyers in public spaces, messages on social media, and information sessions at schools. Early adolescents ($N = 622$) were followed across three waves (2017 – 2020) with one-year intervals. During the first two waves, data collection took place at school or at the research lab. During the third wave, data were collected during home visits or at the research lab. Both the adolescents and their parents gave active written consent to take part in the study and could revoke this consent each year. This procedure was approved by the Institutional Review Board of KU Leuven.

In the current study, adolescents who indicated not having any friends were excluded from the analyses ($N = 7$). Our rationale for this exclusion criterion was that participants who did not have any friends could not fill out a measure of friendship quality in a reliable way. This resulted in a sample of 615 early adolescents ($M_{\text{age}} = 10.77$ years, $SD = 0.50$; 53.5% girls at Wave 1). All adolescents were in primary school when the project started ($N_{\text{Grade4}} = 47$; $N_{\text{Grade5}} = 526$; $N_{\text{Grade6}} = 4$). Most of the adolescents were born in Belgium (96.5%), others were born in the Netherlands (2.6%), France (0.2%), Morocco (0.2%), Poland (0.2%), Rwanda (0.2%), and Syria (0.2%). In the current sample, 83.7% of the adolescents had parents with a bachelor's degree or higher, 7.2% had parents who were unemployed, and 13.6% had parents who indicated they experienced stress with regard to their financial situation.

Attrition analyses

Adolescents who did not participate in all three waves of the study ($N = 287$) were slightly older than adolescents who did participate in all three waves ($N = 328$). Regarding loneliness, friendship quality, or gender, no significant differences were found between the adolescents who dropped out of the study and those who did not. The proportion of variance explained by each of these variables was very small. The results of these attrition analyses are presented in Table 1.

Missing value treatment

To test whether the data were missing at random, Little's Missing Completely at Random test (MCAR) was used. This test was not statistically significant, and the normed χ^2 was acceptable (i.e., ≤ 3 ; Ullman, 2013). Therefore, Full Information Maximum Likelihood (FIML) was

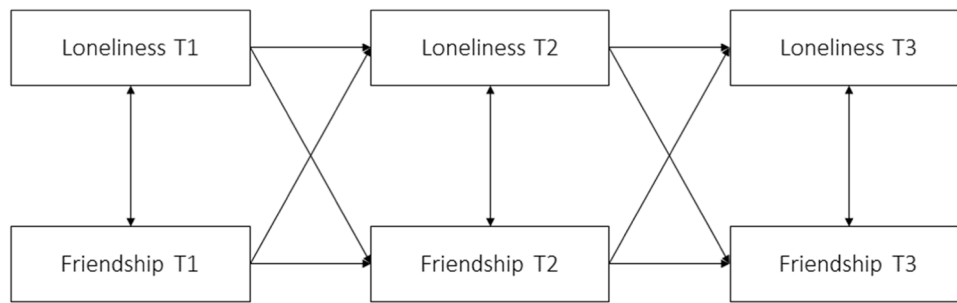


Fig. 1. Hypothesized model on the bidirectional association between loneliness and friendship quality in the current study. T1 = Time 1. T2 = Time 2. T3 = Time3.

Table 1
Attrition analyses.

Variable	Mean (SD) Participants all waves	Mean (SD) Dropouts	F	p	df	η^2_p	χ^2	df	Cramer V
Loneliness	1.60 (0.54)	1.58 (0.55)	0.084	.77	(1, 568)	<0.001			
Friendship Quality	4.11 (0.59)	4.01 (0.67)	3.881	.05	(1, 567)	.007			
Age	10.73 (0.46)	10.83 (0.49)	5.957	.02	(1, 568)	.010			
Gender							.033	1	.007

Note. Attrition analyses were conducted on Wave 1 variables. η^2_p = partial eta squared. χ^2 = Pearson chi squared.

considered an appropriate method to handle missing data.

Measures

Loneliness

The peer-related loneliness subscale of the Loneliness and Aloneness Scale for Children and Adolescents (LACA; Goossens, 2016) was administered in Dutch to assess loneliness. This subscale consists of 12 items, which were rated on a 4-point Likert scale (1 = never; to 4 = often). Example items are “I feel left out by my friends” and “I feel alone at school”. Scores on the individual items were averaged to yield an overall score for loneliness, with higher scores representing more loneliness. The LACA subscale has been shown to be a reliable and valid measure for peer-related loneliness in childhood and adolescence (Maes et al., 2015). Cronbach’s alphas in the current study ranged from 0.88 to 0.89 across the three waves.

Friendship quality

To assess friendship quality, the closeness and help subscales of the Friendship Qualities Scale were administered (FQS; Bukowski et al., 1994). The other subscales were not administered for reasons of feasibility. The FQS measures friendship quality in relation to the best friend specifically. Both subscales (i.e., help and closeness) consist of 5 items, which were rated on a 5-point Likert scale (1 = Strongly disagree; to 5 = Strongly agree). Example items of the closeness subscale are “I feel good when I am with my friend” and “Sometimes my friend does something for me which makes me feel special”. Example items of the help subscale are “My friend would protect me if someone would cause me trouble” and “My friend would help me if it would be necessary”. Given the high correlation between the subscales (i.e., $r = 0.69 - 0.75$ across the three waves), we decided to average the individual items to yield an overall score for friendship quality, with higher scores representing higher friendship quality. The FQS has been shown to have good validity in early adolescence (Bukowski et al., 1994). Cronbach’s alphas in the current study ranged from 0.86 to 0.88 across the three waves.

Statistical analyses

To examine the longitudinal bidirectional association between loneliness and friendship quality, we estimated an unconstrained Cross-Lagged Panel Model (CLPM) in which cross-time effects between

loneliness and friendship quality were estimated while controlling for the stability of the constructs and concurrent associations among the constructs. Although the use of a Random Intercept CLPM would allow us to distinguish between within-person and between-person effects, previous research has shown that relatively large sample sizes (i.e., $N > 1500$) are needed to have sufficient power (i.e., > 0.80) for these analyses in a three-wave longitudinal design (Masselink et al., 2018).

The unconstrained CLPM was fitted using Mplus version 8.2 (Muthén and Muthén, 1998 - 2017). The robust maximum likelihood estimator (MLR) was used to account for the non-normality of the data. A non-significant robust Satorra-Bentler chi-square statistic (Satorra and Bentler, 2001) is indicative of a good model fit (Hu and Bentler, 1999). Given that this chi-square statistic is very sensitive to sample size, other fit indices should be taken into account as well (Barrett, 2007). A Root Mean Square Error of Approximation (RMSEA) below 0.06, a Standardized Root Mean Square Residual (SRMR) below 0.08, and a Comparative Fit Index (CFI) exceeding 0.95 indicate good model fit (Hu and Bentler, 1999). A RMSEA and SRMR below 0.08 and 0.10, respectively, and a CFI exceeding 0.90 indicate adequate model fit (Kline, 2005). Next, a more parsimonious model was estimated and compared to the first unconstrained model. In this second, more parsimonious model, the stability coefficients were constrained to be equal (e.g., the path from loneliness Time 1 to loneliness Time 2 were constrained to be equal to the path from loneliness Time 2 to loneliness Time 3) and within time residual correlations between loneliness and friendship quality were constrained to be equal at Time 2 and Time 3. When comparing the model fit of the unconstrained CLPM with the constrained CLPM, the model with the lowest Bayesian Information Criterion (BIC), RMSEA, and SRMR, and the highest CFI would be preferred (Geiser, 2010). Additionally, a significant chi-square difference test would indicate that the models are significantly different from one another and that the less parsimonious model (i.e., the unconstrained model) is preferred, a non-significant chi-square difference test would indicate that the more parsimonious model (i.e., the constrained model) is preferred (Satorra and Bentler, 2001). The paths in the preferred model were investigated, and coefficients with p -values below 0.05 were considered statistically significant. The syntax and output of these analyses are available on the Open Science Framework.

(https://osf.io/c8s5w/?view_only=d2ee94b78d104859a6ebb678327f7c1a).

Results

Descriptive statistics

Means, standard deviations, and correlations between loneliness and friendship quality are presented in Table 2. Loneliness at two successive measurement waves was strongly and positively correlated. Friendship quality at two successive measurement waves was strongly and positively associated as well. These over-time correlations suggest moderate stability of the constructs. Loneliness correlated moderately and negatively with friendship quality at the same measurement occasion. Loneliness and friendship quality correlated negatively with one another over time as well (e.g., Loneliness at Time 1 and friendship quality at Time 2). However, these correlations reduce in effect size as the time interval between the two measurement occasions of both variables becomes larger. These correlational findings are in line with previous research (e.g., Spithoven et al., 2018).

Bidirectional effects

Table 3 represents the fit indices, which suggest that the constrained model is preferred over the unconstrained model. That is, the BIC and RMSEA are slightly lower, and the Satorra-Bentler chi-square difference test was not significant. This constrained model showed adequate model fit. The autoregressive paths (i.e., the stability coefficients) were significant for both loneliness and friendship quality. None of the crossed paths were significant, suggesting that there is no evidence for a bidirectional association between loneliness and friendship quality in this study. Hence, the findings were not in line with our hypothesis. At each given moment, however, a significant negative association between loneliness and friendship quality was found. The CLPM with standardized coefficients is shown in Fig. 2. The unstandardized coefficients, as well as the confidence intervals of the standardized path coefficients, are shown in Table 4. As a sensitivity check, we added random intercepts for loneliness and friendship quality to the constrained CLPM. The results of this Random Intercept CLPM were similar, that is, no evidence for a bidirectional association between the two constructs was found (see Appendix).

Discussion

The present study aimed to examine the longitudinal and bidirectional association between loneliness and friendship quality. In early adolescence, loneliness and friendship quality have been shown to be concurrently associated with one another (e.g., Lodder et al., 2017), but empirical research on the longitudinal association between the two constructs was limited. However, from theoretical perspectives on loneliness, a bidirectional association between the two constructs would be expected. The results from the present study did not support this hypothesis of a bidirectional association.

Loneliness and friendship quality

In line with previous research, we found that loneliness and

friendship quality were moderately and negatively associated with one another at the same time point, meaning that more loneliness was associated with lower experienced friendship quality in relation to the best friend (e.g., Lodder et al., 2017). We did not find evidence for a bidirectional association between loneliness and friendship quality over time. That is, loneliness did not significantly predict lower friendship quality one year later or vice versa. This finding is not in line with theoretical assumptions of the Evolutionary Theory of Loneliness (Cacioppo and Cacioppo, 2018) but is in line with one previous study which examined this bidirectional association with just two time points (Spithoven et al., 2018). Although more research should carefully look into this association, the fact that two recent empirical studies (i.e., the present study and Spithoven et al., 2018) failed to support this theoretical assumption of a bidirectional association between loneliness and friendship quality, could be an indication that the two constructs simply are not longitudinally associated.

Although some definitions and theories of loneliness so far suggested that poor quality of social relationships is an important contributor to developing feelings of loneliness (Cacioppo and Cacioppo, 2018; Peplau and Perlman, 1982), the current longitudinal study is not able to support this notion. This raises the question of whether the quality of social relationships effectively has an important role in the development of feelings of loneliness. One argument might be that the number of social relationships is more important (i.e., quantity) than the quality. In the present study, no information about the number of friends was available, and thus, this idea could not be empirically examined. However, previous cross-sectional research has shown that friendship quality correlated more strongly with concurrent loneliness than friendship quantity in early adolescence (Lodder et al., 2017) and that friendship quality is a stronger predictor of concurrent loneliness than friendship quantity (Vanhalst et al., 2014). Additionally, research on loneliness interventions across the lifespan showed that simply increasing the number of social contacts is insufficient to alleviate feelings of loneliness (Masi et al., 2011). This finding suggests that an excessively low number of social relationships is not the main problem for lonely people in most cases. However, longitudinal research examining the relative contribution of friendship quality and friendship quantity to loneliness in early adolescence is lacking thus far. Moreover, it is possible that the combination of friendship quality and quantity is important in the development of loneliness. An interesting avenue for future research would be to identify four subgroups of adolescents that reflect the following combinations: (a) high friendship quality and a high number of friends, (b) low friendship quality and a low number of friends, (c) high friendship quality and a low number of friends, and (d) low quality and a large number of friends. Comparing such subgroups regarding their loneliness levels could shed light on the relative importance of relationship quantity and quality.

Within the evolutionary framework of loneliness, it is assumed that especially those individuals who fail to reconnect to others and thus feel lonely for longer periods of time, are subject to cognitive biases and exhibit negative social behaviors (Cacioppo et al., 2014; Qualter et al., 2015). Hence, it is possible that the longitudinal association between loneliness and experienced friendship quality is different for adolescents who feel lonely throughout a longer period of time compared to

Table 2
Correlations among study variables.

Variable	M	SD	1	2	3	4	5
1. LACA T1	1.59	0.54	–				
2. LACA T2	1.50	0.47	.53***	–			
3. LACA T3	1.47	0.46	.30***	.56***	–		
4. FQ T1	4.17	0.63	–.33***	–.17**	–.09*	–	
5. FQ T2	4.20	0.62	–.21***	–.34***	–.18**	.47***	–
6. FQ T3	4.24	0.62	–.14***	–.24***	–.32***	.25***	.52***

Note. N = 615. LACA = Loneliness. FQ = Friendship Quality. T1 = Time 1. T2 = Time 2. T3 = Time 3.

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

Table 3
Model fit of the cross-lagged panel models of loneliness and friendship quality.

Model	BIC	RMSEA	SRMR	CFI	χ^2	df	$\Delta\chi^2$	df
Unconstrained	3952.14	0.094	0.050	0.940	25.551***	4		
Constrained	3945.72	0.074	0.054	0.935	30.496***	7	3.76	3

Note. BIC = Sample Size Adjusted BIC. χ^2 = Satorra-Bentler χ^2 . $N = 615$.
* $p < .05$. ** $p < .01$. *** $p < .001$.

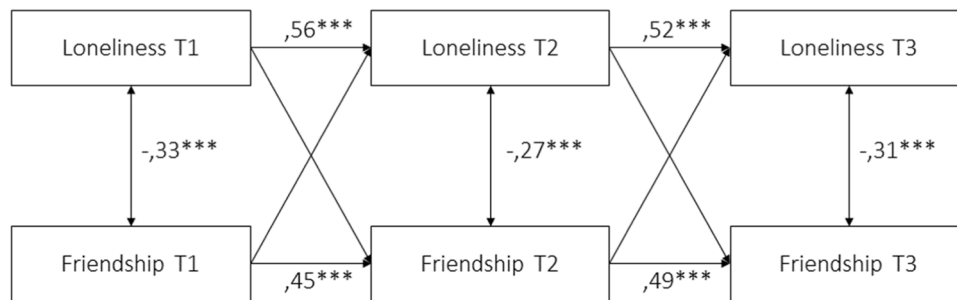


Fig. 2. Cross-lagged panel model with standardized coefficients. Only significant paths are represented.

Table 4
Path coefficients of cross-lagged panel model of loneliness and friendship quality.

Path	B	S.E.	β	p	C.I.
LACA T1 → LACA T2	0.50	0.04	.56	<0.001	.48 - 0.64
LACA T2 → LACA T3	0.50	0.04	.52	<0.001	.43 - 0.62
FQ T1 → FQ T2	0.45	0.04	.45	<0.001	.37 - 0.53
FQ T2 → FQ T3	0.45	0.04	.49	<0.001	.40 - 0.58
LACA T1 → FQ T2	-0.09	0.06	-.08	.114	-0.18 - 0.02
LACA T2 → FQ T3	-0.07	0.07	-.06	.315	-0.17 - 0.05
FQ T1 → LACA T2	0.02	0.04	.02	.646	-0.07 - 0.12
FQ T2 → LACA T3	0.00	0.04	-.01	.984	-0.10 - 0.09
LACA T1 - FQ T1	-0.11	0.02	-.33	<0.001	-0.42 - -0.24
LACA T2 - FQ T2	-0.06	0.01	-.27	<0.001	-0.35 - -0.20
LACA T3 - FQ T3	-0.06	0.01	-.31	<0.001	-0.40 - -0.23

Note. $N = 615$. LACA = Loneliness. FQ = Friendship Quality. T1 = Time 1. T2 = Time 2. T3 = Time 3.
S.E. = Standard Error. C.I. = 95% Confidence Intervals of the standardized estimates.
→ represents regression paths. - represents correlations.

adolescents who only feel lonely at one point in time. As the experienced quality in best friendships can be shaped by these negative cognitions and negative social behaviors, it is possible that a bidirectional association only holds for those who are chronically lonely. Only a handful of studies tested this assumption of increased cognitive biases and negative social behaviors in chronically lonely individuals compared to temporarily lonely individuals and showed that chronically lonely adolescents made more maladaptive attributions of social events (Vanhalst et al., 2015) and that they were less likely to accept invitations for social inclusion (Vanhalst et al., 2018).

Limitations and directions for future research

The current study had several strengths, such as the use of a large sample of early adolescents and its longitudinal design. In this study, we addressed a major assumption of the Evolutionary Theory of Loneliness (Cacioppo and Cacioppo, 2018) and the definition of loneliness as proposed by Peplau & Perlman (1982), which was not empirically tested before. The findings of this study substantially advance current understanding of loneliness in early adolescence and provide starting points for further research. Nonetheless, this study has some important limitations as well. Our findings should therefore be interpreted with

caution, and future research should re-examine this issue whilst overcoming the limitations of the present study listed below.

First, the loneliness measure used in this study, that is, the peer-related loneliness subscale of the LACA (Goossens, 2016), focuses mainly on social loneliness (Maes et al., 2017). This type of loneliness is experienced when one does not feel like belonging to a social network (S. Cacioppo et al., 2015; Weiss, 1973). Another type of loneliness is emotional loneliness, which is experienced when one lacks an intimate relationship or when an intimate relationship is of insufficient quality (S. Cacioppo et al., 2015; Weiss, 1973). These two types of loneliness are distinct from one another and are not necessarily experienced simultaneously (Qualter and Munn, 2002). So, when examining intimate relationships, such as the bond with a best friend, the use of a measure of emotional loneliness may result in different findings (Maes et al., 2017). In early adolescence, the peer dyadic loneliness subscale of the Peer Network and Dyadic Loneliness Scale (PNDLS; Hoza et al., 2000) and the peer personal intimacy subscale of the Relational Provisions Loneliness Questionnaire (RPLQ; Hayden, 1989) are good measures of emotional loneliness. Therefore, we recommend that future researchers address the research questions of the current study using a measure of emotional loneliness.

Second, not all aspects of friendship quality were measured in the current study. In this study, we only included the closeness and help subscales of the FQS (Bukowski et al., 1994). Other subscales of this questionnaire measure conflict, companionship, and security. It is possible that our results would have been different if another aspect of friendships had been assessed. A recent study has shown that the security subscale of the FQS showed the strongest associations of all FQS subscales with loneliness (Antonopoulou et al., 2019). More experienced security in best friendships is associated with less loneliness. Additionally, the two subscales we included (i.e., closeness and help) only reflected positive aspects of best friendships. However, low-quality friendships are characterized by the absence of positive aspects and the presence of negative aspects, such as conflict (Bagwell and Bukowski, 2018). In the recent study of Antonopoulou et al. (2019), the subscale conflict of the FQS showed the second strongest association with loneliness, with more conflict being associated with more loneliness. Hence, all aspects of friendship quality, particularly security, and conflict, should be included in future research to obtain a comprehensive understanding of its association with adolescent peer-related loneliness.

Third, we were not able to take the stability of friendships into account. In early adolescence, it frequently happens that old friendships end and new friendships are formed (Poulin and Chan, 2010).

Friendship stability is an important aspect of adolescent friendships that affects mental well-being, and adolescents' internalizing symptoms play a role in friendship stability (Marengo et al., 2018). Hence, a bidirectional association between adolescents' internalizing symptoms and friendship stability can be expected to hold. However, we are not aware of research examining the association between loneliness and friendship stability. Lonely adolescents may experience more disruptions in their friendships due to their withdrawn behavior and lack of prosocial behavior (Geukens et al., 2021). In addition, higher levels of experienced friendship quality are associated with greater friendship stability. Therefore, future research examining friendships and loneliness in adolescence should also consider friendship stability or should take friendship instability in early adolescence into account when designing the study. Moreover, friendship instability in early adolescence could be an explanation for the absence of a bidirectional association between loneliness and friendship quality in the current study. Specifically, it is possible that the one-year time intervals between the measurement occasions were too long. In early adolescence, friendships may change too quickly to still affect adolescents' loneliness one year later. Future research should therefore examine this association with shorter time intervals between the measurement waves.

Fourth, we focused on the Evolutionary Theory of Loneliness (Cacioppo and Cacioppo, 2018) and Peplau and Perlman's (1982) definition of loneliness, but did not consider other relevant theoretical perspectives on loneliness. For instance, previous research has linked loneliness to personality traits like neuroticism and extraversion (e.g., Buecker et al., 2020), and personality is also associated with friendship quality (e.g., Berry et al., 2000). However, in the present study we could not control for these confounders. Although both a regular CLPM and a RI-CLPM were estimated, and both models yielded similar non-significant results, it is possible that loneliness and friendship quality are relatively stable constructs associated with stable trait-like variables such as personality traits (Mund et al., 2020). Additionally, the lack of significant bidirectional effects in our study may be due to the large time interval between measurement waves. According to the Evolutionary Theory of Loneliness and the conceptual model of loneliness as proposed by Lim et al. (2020), individuals may recover from a decrease in friendship quality over the course of a year, resulting in relatively stable levels of loneliness (Cacioppo and Cacioppo, 2018). Future research should expand on these theoretical frameworks to address these issues. Finally, the sample in the present study lacked demographic variability. That is, the majority of the adolescents were born in Belgium and came from relatively high SES backgrounds. Moreover, the attrition rate in the sample of this project was rather high. That is, 46.6% of the adolescents did not participate in all three waves of the study. Therefore, the results cannot be generalized to adolescents with different demographic backgrounds and the results should be interpreted with caution. Future research should examine the research questions of the current study in other demographic groups and add demographic variables as covariates in analyses with larger sample sizes.

Conclusion

In the present study, loneliness and friendship quality were concurrently associated with one another in early adolescence, but no evidence was found for a longitudinal bidirectional association between the two constructs. This finding raises questions about the importance of perceived quality in social relationships in the development of feelings of loneliness in early adolescents. However, given the limitations of the current study, more research is needed to replicate our findings and investigate the relative importance of friendship quality in the development of loneliness.

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Declaration of Competing Interest

The authors declare that they have no conflict of interest.

Data availability

Data will be made available on request.

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FG designed the study, drafted the manuscript, performed the statistical analyses, and interpreted the data; SB performed the statistical analyses, interpreted the data, and provided input on the intellectual content of the manuscript; WVDN, PB, GB, and KVLV provided input on the intellectual content of the manuscript; LG participated in the interpretation of the data and provided input on the intellectual content of the manuscript. All authors read and approved the final manuscript.

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at [doi:10.1016/j.crbeha.2023.100132](https://doi.org/10.1016/j.crbeha.2023.100132).

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