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EMPIRICAL RESEARCH

Developmental Change in Loneliness and Attitudes Toward Aloneness in Adolescence

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Abstract Adolescents are particularly vulnerable to experiencing feelings of loneliness. Changes in different social contexts and the inability to cope with these changes can result in different types of loneliness. According to the multidimensional view on loneliness, loneliness can be experienced in relationships with peers and parents and can be placed in a broader perspective by taking into account attitudes toward aloneness (i.e., positive and negative). However, we do not yet know how loneliness and attitudes toward aloneness develop across adolescence. These developmental trends were examined in two samples of Flemish adolescents consisting of 834 adolescents (61.9% girls, $M_{age} = 14.84$; Sample 1), and 968 adolescents (58.6% girls, $M_{age} = 14.82$; Sample 2), respectively. Adolescents filled out the Loneliness and Aloneness Scale for Children and Adolescents (LACA) during regular school hours on three (Sample 1) and four (Sample 2) measurement occasions with a 1-year interval. Latent growth curve modeling (LGCM) was applied. In line with theoretical notions, adolescents' parent-related loneliness and positive attitude toward aloneness were expected to increase, and adolescents' peer-related loneliness and negative attitude toward aloneness were expected to decrease. Clear evidence was found for the hypotheses regarding attitudes toward aloneness. The results regarding peer-related loneliness were inconsistent across samples and parent-related loneliness decreased, which was in contrast with theoretical expectations. In general, the two types of loneliness and attitudes toward aloneness changed in different directions during adolescence, suggesting the added value of a multidimensional view on loneliness.

Keywords Loneliness · Attitudes toward aloneness · Developmental changes · Longitudinal measurement invariance

Introduction

Adolescence is a crucial developmental period that is characterized by numerous social changes, including greater sensitivity to loneliness (MacEvoy et al. 2011) and greater appreciation of time spent alone (Marcoen and Goossens 1993). Until now, age differences in loneliness and attitudes toward aloneness have been investigated primarily in cross-sectional studies (Corsano et al. 2006; Maes et al. 2015; Marcoen and Goossens 1993). Such studies have uncovered differences between age groups, but longitudinal studies that examine whether these differences reflect true developmental changes are scarce. The main aim of the present study was to fill that gap in current knowledge regarding adolescents' loneliness and their attitudes toward aloneness. However, before longitudinal trends can be examined, it is essential to test whether the scales designed to assess loneliness and attitudes toward aloneness measure the same construct over time. This particular aspect of validity, which is referred to as longitudinal measurement invariance (Van de Schoot et al. 2012), has not yet been examined for a

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commonly used instrument assessing adolescent loneliness and attitudes toward aloneness, that is, the Loneliness and Aloneness Scale for Children and Adolescents (LACA; Marcoen et al. 1987).

A Multidimensional View on Loneliness and Attitudes Toward Aloneness

Loneliness is the negative feeling that occurs when a person does not perceive his social relationships as satisfying in terms of quantity or quality (Perlman and Peplau 1981). Adolescents are particularly vulnerable to experiencing feelings of loneliness (Qualter et al. 2015), because they are typically confronted with numerous social changes. If their social skills are insufficient to cope with these changes or if their expectations regarding relationships are not being met, feelings of loneliness are likely to be experienced (Laursen and Hartl 2013). According to the multidimensional view on loneliness, loneliness can be experienced to a different degree in different relationships (Russell 1982). The most important relationships in adolescence are those with parents and with peers. Acquiring autonomy from parents while continuing to be connected to them (Heinrich and Gullone 2006; Steinberg and Morris 2001) and developing higher expectations regarding peer relationships (Heinrich and Gullone 2006) are key developmental tasks in these relationships, respectively. Failure to achieve these tasks can lead to specific forms of loneliness.

Some proponents of the multidimensional view on loneliness have developed hybrid models, that is, models that incorporate additional phenomena that are distinct from yet related to loneliness (Houghton et al. 2014; Majorano et al. 2015). These phenomena can be assessed to place feelings of loneliness in a broader perspective (Marcoen and Goossens 1993). Attitudes toward aloneness are a key example thereof. Aloneness is the objective state of being without company (Long and Averill 2003) and must, therefore, be distinguished from the subjective feeling of loneliness. Adolescents differ in their attitudes toward aloneness. More specifically, they can have a more or less positive and negative attitude toward aloneness (Goossens 2016). These attitudes toward aloneness may provide a better understanding of the relationship between aloneness and feelings of loneliness. For example, adolescents who spend a lot of time alone and have a negative attitude toward aloneness may be more likely to experience feelings of loneliness (Marcoen and Goossens 1993).

From Age Differences to Developmental Changes

In line with the multidimensional view on loneliness, parent- and peer-related loneliness and positive and negative attitude toward aloneness might show different developmental trends. The co-occurrence of a general increase in adolescents' desire for autonomy and adolescents' continued need for parental guidance and support, might result in an increase in parent-related loneliness (Marcoen et al. 1987). Adolescents' increased social competencies (Steinberg and Morris 2001) and perceived support from friends (Furman and Buhrmester 1992), in turn, might result in a decrease in peer-related loneliness. Finally, positive and negative attitude toward aloneness are expected to increase and decrease, respectively, throughout adolescence. These expectations stem from findings that adolescents spend an increasing amount of time alone and use this time spent alone in a constructive way (Larson 1997; Larson and Richards 1991). More specifically, time spent alone is increasingly used for the purpose of self-reflection, self-regulation, and creativity (Long and Averill 2003).

However, earlier studies investigating age trends in loneliness and attitudes toward aloneness failed to consistently confirm these theoretical expectations. One cross-sectional study using different age cohorts (i.e., participants from Grade 5, 7, 9, and 11) and different samples, has found some evidence for the above mentioned theoretical expectations, but results could not be replicated across all samples (Marcoen and Goossens 1993). In the same study, when focusing exclusively on middle to late adolescence, which is the age period of interest in the current study, adolescents from Grade 11 scored significantly higher than adolescents from Grade 9 on positive attitude toward aloneness only. No significant mean score differences were found for parent- and peer-related loneliness and negative attitude toward aloneness. Other studies using comparable age cohorts did not find support for the expected increase in positive attitude toward aloneness (Marcoen et al. 1987) or decrease and increase in peer- and parent-related loneliness, respectively (Corsano et al. 2006). In addition, age trends contrary to the theoretical expectations have been found as well. For example, senior high school students and college students scored higher on peer-related loneliness and negative attitude toward aloneness than junior high school students (Maes et al. 2015). However, these results stem from cross-sectional studies, whereas longitudinal studies are more suited to examine developmental trends.

So far, the limited number of longitudinal studies available have concentrated on peer-related loneliness only. These studies have confirmed the theoretically expected decreasing trend throughout adolescence (Vanhalst et al. 2013; Van Roekel et al. 2010). Another study has found a peak in peer-related loneliness around the age of 13 years followed by a decrease over the course of adolescence (Qualter et al. 2013). Until now, longitudinal studies investigating the developmental trends for parent-related loneliness and attitudes toward aloneness are lacking. The present study aimed to examine the developmental trends of

parent- and peer-related loneliness and positive and negative attitudes toward aloneness, using a longitudinal design in order to investigate whether feelings of loneliness and attitudes toward aloneness generally increase or decrease over time.

Gender Differences in Developmental Trends

Developmental trends for loneliness and attitudes toward aloneness might take on different forms depending on adolescents' gender. However, until now, the existence of gender differences in loneliness remains unclear and limited theoretical work has addressed this question (Weeks and Asher 2012). Empirical evidence from cross-sectional studies regarding gender differences in loneliness is mixed (Corsano et al. 2006; Maes et al. 2015; Scharf et al. 2011). Research on gender differences in attitudes toward aloneness is less common, but results seem to be inconsistent as well (Corsano et al. 2006; Maes et al. 2015). In addition, longitudinal studies that investigate gender differences in loneliness and attitudes toward aloneness are limited. A longitudinal study investigating gender differences in peer-related loneliness in adolescents from ages 13 till 18 found that peer-related loneliness remained stable over time in adolescent girls, but decreased in adolescent boys (Van Roekel et al. 2010). Studies investigating gender differences in developmental trends for parent-related loneliness and attitudes toward aloneness are lacking. The current study filled this gap in the literature.

Measurement Invariance: A Critical Prerequisite for Analyses Across Time and Gender

Measurement invariance is a prerequisite to conduct meaningful comparisons across groups or time (Vandenberg and Lance 2000). A scale is considered to show measurement invariance if it measures the same construct in the same metric within the same sample across groups or time (Van de Schoot et al. 2012). The latter is referred to as longitudinal measurement invariance. Establishing longitudinal measurement invariance for a scale is necessary if one aims to answer developmental questions using that specific instrument. If longitudinal measurement invariance has not been established, researchers can not be certain whether changes over time in a particular construct reflect true changes, or are the result of differences in interpretation of the construct across time. Although longitudinal measurement invariance is a necessary condition for conducting meaningful comparisons over time, researchers frequently assume that this condition is fulfilled, without empirically testing it (Brown 2006; Vandenberg and Lance 2000).

Because it is unknown whether the loneliness and aloneness scale for children and adolescents shows longitudinal measurement invariance and because our main research aim is to examine developmental trends in loneliness and attitudes toward aloneness, longitudinal measurement invariance will be investigated. In addition, measurement invariance across gender will be investigated as well.

The Current Study

The main aim of this study was to examine separate developmental trends for peer- and parent-related loneliness, and positive and negative attitudes toward aloneness. However, before this aim could be validly addressed, longitudinal measurement invariance of the Loneliness and Aloneness Scale for Children and Adolescents needed to be established. These longitudinal analyses were conducted on two samples in the age ranges of 15–17 and 15–18 years of age, respectively. In line with theoretical notions, we expected adolescents' parent-related loneliness and positive attitude toward aloneness to increase and adolescents' peer-related loneliness and negative attitude toward aloneness to decrease. An additional and final aim was to investigate gender differences in developmental trends for loneliness and attitudes toward aloneness. These analyses were purely explorative given the lack of consistency in the literature and the lack of a clear theory.

Method

Participants

Sample 1

Participants in Sample 1 were 834 adolescents (61.9% girls), with a mean age of 14.84 years (SD = 0.86), from three secondary schools in Flanders, the Dutch-speaking part of Belgium. The participants took part in a three-wave longitudinal study with annual measurement waves. In two of the participating schools, the academic track was offered and in the third one adolescents followed the artistic track. At Time 1, a total of 481 adolescents from Grade 9 and 10 participated. A total of 638 and 626 adolescents participated at Time 2 and 3, respectively. A total number of 247 (29.6%) adolescents participated in all three measurement waves, 263 (31.5%) participated in two out of three measurement waves, and 324 (38.8%) participated in only one wave. Based on the available information, which was collected at T2 and T3 only, the majority of the participants' parents lived together (percentages ranged between 71.5 and 74.9%) and the majority of participants lived with both their parents (69.5% at T2 and 68.3% at T3).

To investigate the effects of sample attrition, adolescents who participated at all three measurement waves were compared to drop-outs and drop-ins. Adolescents who participated at all three measurement waves did not significantly differ from those who dropped-out or dropped-in in terms of positive attitude toward aloneness ($F(1, 474) = .255$, $p = .614$, $\eta^2 = .001$), negative attitude toward aloneness ($F(1, 474) = .271$, $p = .603$, $\eta^2 = .001$), and peer-related loneliness ($F(1, 474) = .283$, $p = .595$, $\eta^2 = .001$) measured at T1. However, the group of adolescents who participated at all three measurement waves reported significantly less parent-related loneliness ($F(1, 474) = 14.422$ $p < .001$, $\eta^2 = .030$), had less parents who were divorced ($\chi^2 (3) = 16.381$, $p = .001$, Cramer $V = 0.187$), and lived more often with both parents ($\chi^2 (6) = 25.254$, $p < .001$, Cramer $V = 0.203$) at T1 compared to adolescents who dropped-out or dropped-in. In addition, significantly more girls participated in all three measurement waves ($\chi^2 (1) = 4.469$, $p = .035$, Cramer $V = 0.074$). Given the small effect sizes, we concluded that the effect of sample attrition was limited.

In addition, participants with and without missing data were compared using little's missing completely at random test (MCAR; Little 1988). Little's MCAR test was significant, but the normed chi square was acceptable ($\chi^2/df = 1.03$; Ulman 2013). This result indicated that the data were missing completely at random and that the full information maximum likelihood (FIML) estimator could be used to handle the missing data.

Sample 2

The participants in Sample 2 were 968 adolescents (58.6% girls), with a mean age of 14.82 years ($SD = 0.80$), from a secondary school in Flanders, the Dutch-speaking part of Belgium. The participants took part in a four-wave longitudinal study, again with annual measurement waves. Adolescents followed the academic, technical, or vocational track. At Time 1, a total of 553 adolescents from Grade 9 and 10 participated. A total of 570, 561, and 353 adolescents participated at Time 2, 3, and 4, respectively. A total number of 158 adolescents (16.3%) participated in all four measurement waves, 214 adolescents (22.1%) participated in three out of four measurement waves, 170 adolescents (17.6%) participated in two out of four measurement waves, and 426 adolescents (44%) participated in only one wave. The majority of the participants' parents lived together (percentages ranged between 81 and 82.1%) and the majority of participants lived at home with both parents (percentages varied between 81.9 and 84.2%).

To investigate the effects of sample attrition, adolescents who participated at all four measurement waves were compared to drop-outs and drop-ins. Adolescents who participated at all four measurement waves did not significantly differ from those who dropped-out or dropped-in in terms of positive attitude toward aloneness ($F(1, 551) = .002$, $p = .963$, $\eta^2 < .001$), negative attitude toward aloneness ($F(1, 551) = .941$, $p = .333$, $\eta^2 = .002$), peer-related loneliness ($F(1, 551) = .441$, $p = .507$, $\eta^2 = .001$), parent-related loneliness ($F(1, 551) = 1.261$, $p = .262$, $\eta^2 = .002$), or their living situation ($\chi^2 (5) = 10.475$, $p = .063$, Cramer $V = 0.138$) measured at T1. However, the group of adolescents who participated at all four measurement waves more often had parents who were divorced ($\chi^2 (4) = 13.799$, $p = .008$, Cramer $V = 0.158$). In addition, significantly more girls participated in all four measurement waves ($\chi^2 (1) = 18.675$, $p < .001$, Cramer $V = 0.140$). Given the small effect sizes, we concluded that the effect of sample attrition was limited.

In addition, participants with and without missing data were compared using little's missing completely at random test (MCAR, Little 1988). Little's MCAR test was significant, but the normed chi square was acceptable ($\chi^2/df = 1.05$; Ulman 2013). This result indicated that the data were missing completely at random and that the full information maximum likelihood (FIML) estimator could be used to handle the missing data.

Procedure

Data for the first study were part of a larger longitudinal study on loneliness in adolescence, which was initiated in February 2009 (for details, see Vanhalst et al. 2012). Data for the second study were part of a larger 4-wave study on the development of psychosocial well-being, personality, and identity throughout mid- and late adolescence, which was initiated in February 2010 (for details, see Teppers et al. 2013). A similar procedure was followed in both studies. Permission for the studies was obtained from the Institutional Review Board at the researchers' university. Prior to both data collections, active and passive informed consent was obtained from the adolescents and their parents, respectively. Participants filled out a paper-and-pencil questionnaire in their classroom during regular school hours. A research assistant was present during the test sessions to answer questions and to emphasize the voluntary and anonymous character of participating. In addition, the adolescents were informed that they could discontinue their participation at any time. Students who graduated or moved to another school received the questionnaires at home by mail or e-mail.

Measure

Loneliness and attitudes toward aloneness

In both samples, participants completed the loneliness and aloneness scale for children and adolescents (LACA;

Marcoen et al. 1987), which was used to measure loneliness and attitudes toward aloneness in adolescents. This measure was originally developed for use with Dutch-speaking adolescents from ages 10 to 19. The loneliness and aloneness scale for children and adolescents is based on the multidimensional view on loneliness and consists of 48 items, which are equally divided across four subscales. The subscales measure (a) loneliness in relation to parents (e.g., "I feel left out by my parents" and "My parents are willing to listen to me or to help me"), Cronbach's alphas across waves in Sample 1 varied between .91 and .92, and between .90 and .93 in Sample 2), (b) loneliness in relation to peers (e.g., "I feel left out by my friends" and "I think: There is not a single friend to whom I can tell everything"), Cronbach's alphas across waves varied between .88 and .90 in Sample 1, and varied between .86 and .91 in Sample 2, (c) negative attitude toward aloneness (e.g., "When I am alone, I feel bad" and "When I am lonely, I am bored"), Cronbach's alphas across waves varied between .82 and .83 in Sample 1, and between .78 and .85 in Sample 2), and (d) positive attitude toward aloneness (e.g., "I want to be alone" and "I separate myself from others because they bother me with their noise"), Cronbach's alphas across waves varied between .86 and .88 in Sample 1, and between .83 and .88 in Sample 2). All items were answered on a 4-point Likert scale ranging from (1) never to (4) often. The psychometric properties of the Loneliness and Aloneness Scale for Children and Adolescents are well-established (Goossens 2016). The measure has shown the expected four-factor structure that proved to be invariant across the entire intended age range from 10 to 19 years of age in cross-sectional analyses (Maes et al. 2015).

Plan of Analysis

Measurement invariance analyses

In both samples, longitudinal measurement invariance analyses were conducted in Mplus Version 7.31 (Muthén and Muthén 1998-2012) using the robust maximum likelihood estimator (MLR) to account for non-normality and the full information maximum likelihood estimator (FIML) to handle missing data. First, we investigated whether the well-established four-factor structure of the loneliness and aloneness scale for children and adolescents held across the different measurement waves (i.e., configural invariance) (Van de Schoot et al. 2012). Configural invariance was further investigated by running a multiple group confirmatory factor analysis without any equality constraints. Second, we investigated whether participants attributed the same meaning to the latent constructs across time (i.e., metric invariance). More specifically, another multiple group confirmatory factor analysis was conducted, but this

time the factor loadings were constrained to be equal across the three or four measurement waves. Subsequently, this more restricted model was tested against the less-constricted (i.e., configural) model. Third, we examined whether the participants attributed the same meaning to the different constructs and whether the starting levels of the different items were equal across time (i.e., scalar invariance). In other words, we ran a multiple group confirmatory factor analysis with both the factor loadings and intercepts constrained to be equal across time and we tested this model against the less-constrained metric model. In both samples, measurement invariance across gender at T1 was examined as well. The procedure for these analyses was similar to the procedure for the longitudinal measurement invariance analyses.

The model fit of the various models was evaluated by means of several fit indices. Because chi-square statistics, among which the robust Satorra-Benter scaled chi-square statistic (S-Bχ^2; Satorra and Bentler 2001), have been found to be highly sensitive to sample size (Barrett 2007), we relied on other commonly used fit indices as well. More specifically, we relied on the root mean square error of approximation (RMSEA), the standardized root mean square residual (SRMR), and the comparative fit index (CFI) for evaluating model fit (Boomsma 2000). Following the guidelines of Hu and Bentler (1999), a model is assumed to fit the data well when the RMSEA and SRMR are lower than .06 and .08, respectively, and the CFI exceeds .95. Adequate fit is achieved when the RMSEA and SRMR are lower than .08 and .10, respectively, and the CFI exceeds .90 (Kline 2005). Metric invariance was evaluated by comparing the previously mentioned fit indices of the metric model with the corresponding fit indices of the less constrained, configural model. According to the guidelines of Chen (2007), a difference in CFI equal to or more than -.010, accompanied by a change in SRMR or RMSEA equal to or above .030 and .015, respectively, indicates metric noninvariance. A similar procedure was followed when evaluating scalar invariance. More specifically, the CFI, SRMR, and RMSEA of the scalar model were compared to the corresponding fit indices of the less constrained, metric model. A difference in CFI equal to or above -.010, accompanied by a difference in SRMR or RMSEA equal to or above .010, and .015, respectively, indicates scalar noninvariance.

We aggregated the individual items into combined scores (i.e., parcels) and we used these parcels instead of the individual items in all our measurement invariance analyses. The well-established item-to-construct balance (ICB) parceling method was used to create the parcels (Little et al. 2002). More specifically, we created three parcels, each consisting of four items, for each subscale of the loneliness and aloneness scale for children and adolescents because the

use of three indicators per latent variable is considered optimal (Little et al. 2002; Matsunaga 2008). By using parcels instead of multiple individual items, models become more parsimonious. In addition, the use of a combined score to determine a latent construct is considered more realistic than the use of individual items and results in more representative outcomes (Little et al. 2002; Rushton et al. 1983). We allowed the different parcels to correlate across the three waves to take into account the longitudinal nature of the data.

Developmental changes

Second, the average developmental trajectories of loneliness and attitudes toward aloneness were investigated by means of latent growth curve modeling (LGCM; Kline 2005) in Mplus Version 7.31 (Muthén and Muthén 1998-2012). By means of latent growth curve modeling, differences between measurement waves regarding loneliness or attitude toward aloneness can be modelled to estimate the developmental patterns of these outcomes (Duncan and Duncan 2009). More specifically, at each annual measurement wave, the mean levels of loneliness or attitude toward aloneness were represented as indicators of two latent growth factors, that is, the initial mean level of loneliness or attitude toward aloneness (i.e., intercept) and the mean linear change in loneliness or attitude toward aloneness across time (i.e., slope) (Duncan and Duncan 2009). Because three measurement waves are sufficient to test for linear trajectories (Duncan and Duncan 2009), linear trajectories could be tested in both samples. We again followed the guidelines of Hu and Bentler (1999) and Kline (2005) to evaluate model fit for the various models.

Differences between boys and girls in developmental trends for loneliness and attitudes toward aloneness were investigated using multiple group latent growth curve modeling. More specifically, for each subscale separately, a multiple group linear growth model with and without equality constraints for both intercept and slope means across gender was estimated. Both models were compared using the Satorra-Bentler chi-square difference test (S-Bχ^2; Satorra and Bentler 2001). If the results indicated that there were gender differences, the Wald chi-square test of parameter equalities was used to investigate whether the intercept and slope means of boys and girls were significantly different.

Results

Descriptive Statistics

Ranges of subscale correlations for the two samples are presented in Table 1. Ranges of 1-year stability correlations across three and four measurement waves in sample 1 and sample 2, respectively, are presented on the diagonal. High positive correlations for each subscale indicated high stability across the different measurement occasions. In addition, ranges of cross-sectional correlations at each measurement wave are presented in the off-diagonal entries. In general, cross-sectional correlations were small (i.e., $r < .30$), with the exception of a moderate correlation between peer-related loneliness and positive attitude toward aloneness across the different measurement occasions. The fact that the correlation between negative and positive attitudes to aloneness was close to zero indicated that these attitudes do not represent opposite ends of a continuum but

Table 1 Summary of latent correlations across successive years and means and standard deviations at T1

Subscale	Wave 1		Across Waves			
	Mean	SD	1.	2.	3.	4.
Sample 1 (N = 834)						
1. Peer-related loneliness	1.61	0.54	**.53–.64**			
2. Parent-related loneliness	1.77	0.58	.21–.30	**.67–.75**		
3. Positive attitude toward aloneness	2.41	0.53	.37–.43	.12–.14	**.54–.64**	
4. Negative attitude toward aloneness	2.46	0.49	.18–.24	.06–.16	−.03–.12	**.58–.63**
Sample 2 (N = 968)						
1. Peer-related loneliness	1.54	0.46	**.43–.67**			
2. Parent-related loneliness	1.70	0.54	.19–.31	**.59–.78**		
3. Positive attitude toward aloneness	2.40	0.49	.38–.40	.04–.18	**.48–.70**	
4. Negative attitude toward aloneness	2.45	0.44	.19–.35	.11–.21	.05–.14	**.44–.70**

Note Ranges of 1-year stability correlations over successive measurement waves (i.e., three and four measurement waves in sample 1 and sample 2, respectively) on the diagonal (in bold) and ranges of cross-sectional correlations at each measurement wave off the diagonal. All correlations reported in this table were taken from the longitudinal configural invariance models in sample 1 and sample 2, respectively

Table 2 Configural invariance across gender and measurement waves

Measurement wave	S-Bχ²	df	CFI	RMSEA	SRMR
Sample 1					
Gender					
Boys	86.911***	48	.954	.071	.060
Girls	120.949***	48	.960	.070	.047
Measurement wave					
Wave 1	136.952***	48	.97	.06	.05
Wave 2	194.974***	48	.96	.07	.05
Wave 3	164.555***	48	.97	.06	.05
Sample 2					
Gender					
Boys	66.205*	48	.982	.043	.046
Girls	62.671	48	.992	.030	.032
Measurement wave					
Wave 1	87.890***	48	.99	.04	.04
Wave 2	114.579***	48	.98	.05	.04
Wave 3	155.054***	48	.97	.06	.05
Wave 4	69.398***	48	.99	.04	.03

S-Bχ² Satorra-Bentler scaled chi-square test statistic, *CFI* comparative fit index, *RMSEA* root mean square error of approximation, *SRMR* standardized root mean squared residual

***p < .001

reflect distinct aspects of adolescents' experience. In addition, Table 1 presents observed mean values for peer- and parent-related loneliness and positive and negative attitude toward aloneness for the two samples at T1. See Online Resources 3 and 4 for more detailed information about the observed means across time.

Measurement Invariance Analyses

Results on configural invariance for the different waves in both studies are presented in Table 2. Fit indices showed that the four-factor structure of the LACA fitted the data well in the various waves in both studies. In addition, results on multiple group measurement invariance analyses for both studies are presented in Table 3. Results showed that configural, metric, and scalar invariance was established for the LACA in samples 1 and 2, across three and four measurement waves, respectively. As a result, latent means for the different subscales across three and four annual waves in middle to late adolescence could be compared.

Measurement invariance across gender was investigated at Wave 1 in both samples. Results on configural invariance for boys and girls are presented in Table 2. Fit indices showed that the four-factor structure of the LACA fitted the data well for both boys and girls. In addition, results indicated that the loneliness and aloneness scale for children and adolescents showed measurement invariance across

gender (Table 3). When combined with the results on longitudinal measurement invariance, these findings indicated that gender differences could be validly examined over time.

Developmental Changes

Results on model fit and means and variances for each latent growth curve model examined in sample 1 and 2 are presented in Table 4. In Sample 1, fit indices indicated that for each subscale the linear latent growth curve model fitted the data well. Non-significant slope factors for both peer-related loneliness and parent-related loneliness indicated that the mean scores for these subscales did not change across the three measurement waves. Significant slope factors showing opposite signs indicated that adolescents' positive attitude toward aloneness increased, whereas their negative attitude toward aloneness decreased. A visual representation of these average developmental trends can be found in Fig. 1. See Online Resource 1 for longitudinal trajectory plots of participants' individual observed mean scores across time in Sample 1.

In sample 2, fit indices indicated that for both peer-related loneliness and positive attitude toward aloneness the linear growth curve model suited the data well, whereas for both parent-related loneliness and negative attitude toward aloneness linear growth curve models suited the data adequately. Peer-related loneliness and positive attitude toward aloneness significantly increased from 15 to 18 years of age, whereas parent-related loneliness and negative attitude toward aloneness significantly decreased during the same age period. A visual representation of these average developmental trends can be found in Fig. 2. See Online Resource 2 for longitudinal trajectory plots of participants' individual scores across time in Sample 2.

For each subscale in both samples, except for parent-related loneliness and negative attitude toward aloneness in Sample 1, significant variances were found around the intercept and slope factors. These findings indicated that there are substantial inter-individual differences in developmental trajectories for these subscales. Finally, it is important to note that changes in mean scores over time were small in all the analyses reported.

The results on gender differences in average developmental trends for loneliness and attitudes toward aloneness indicated that there were no gender differences in the intercept and developmental trend for peer-related loneliness. Regarding parent-related loneliness, girls showed somewhat higher scores on T1, but their scores decreased over time whereas the scores for boys did not. Similarly, girls reported a more negative attitude toward aloneness at T1 and, in contrast to boys, their scores showed a decline over time. Regarding positive attitude toward aloneness,

Table 3 Measurement invariance of the loneliness and aloneness scale for children and adolescents (LACA) across gender at wave 1 and time

Model	S-Bχ²	df	CFI	ΔCFI	RMSEA	ΔRMSEA	SRMR	ΔSRMR
Sample 1								
Gender								
Configural invariance	208.364***	96	.961		.070		.052	
Metric invariance	223.006***	108	.960	.001	.067	.003	.087	.035
Scalar invariance	266.133***	120	.950	.010	.072	.005	.093	.006
Across waves								
Configural invariance	966.367***	504	.965		.033		.050	
Metric invariance	1008.670***	540	.964	.001	.032	.001	.054	.004
Scalar invariance	1082.698***	564	.961	.003	.033	.001	.056	.002
Sample 2								
Gender								
Configural	128.916***	96	.988		.035		.038	
Metric invariance	146.560***	108	.986	.002	.036	.001	.074	.036
Scalar invariance	184.682***	120	.977	.009	.044	.008	.044	.000
Across waves								
Configural invariance	1462.296***	948	.969		.024		.044	
Metric invariance	1531.465***	984	.967	.002	.024	.000	.056	.012
Scalar invariance	1778.504***	1020	.954	.013	.028	.004	.058	.002

S-Bχ² Satorra-Bentler scaled chi-square test statistic, *CFI* comparative fit index, *RMSEA* root mean square error of approximation, *SRMR* standardized root mean squared residual

*** $p < .001$

girls showed somewhat higher scores on T1, but boys' scores tended to increase more strongly. However, it is important to note that even though the direction of effects was consistent across samples, the effects did not consistently reach significance and all effects were rather small. See Tables 5 and 6 for more detailed information.

Alternate Models

The main aim of the present study was to examine developmental trends in loneliness and attitudes toward aloneness. However, based on the multidimensional models that underlie these concepts, these developmental trends may not be independent of each other. Therefore, as an additional and rather exploratory analysis, we tested parallel linear latent growth models. More specifically, in each sample, a parallel latent growth model comprising four linear latent growth models was used to test the interrelations among the intercepts and slopes of peer- and parent-related loneliness and positive and negative attitudes toward aloneness. Non-significant slope variances were constrained to zero and covariances among the subscales at each time point were added to the model. The fit indices indicated that both models showed accurate fit to the data (See Online Resource 5). In both samples, all starting levels were positively and significantly related to each other, except the starting levels for negative and positive attitude

toward aloneness, which were unrelated (See Online Resource 6). These relations reflected the intercorrelations at Wave 1. Regarding the relationships between the slopes, in Sample 2, the slopes for peer-related loneliness and both positive and negative attitude toward aloneness were positively and significantly related to each other. These results indicated that changes in peer-related loneliness are related to changes in attitudes toward aloneness over time.

Discussion

The present study, which used data from two longitudinal samples, expands substantially on current knowledge regarding adolescents' loneliness and their attitudes toward aloneness in two different ways. First, longitudinal measurement invariance was examined for the Loneliness and Aloneness Scale for Children and Adolescents, a well-established measure of loneliness and attitudes toward aloneness. Second, longitudinal trends were examined for peer- and parent-related loneliness, and positive and negative attitudes toward aloneness.

Longitudinal Measurement Invariance

By means of multiple group confirmatory factor analyses, configural, metric, and scalar measurement invariance

**Table 4** Fit indices for different latent growth models and means and variances of intercepts and slopes

Subscale	S-Bχ²	df	CFI	RMSEA	SRMR	Intercept Mean	95% CI	Variance	Slope Mean	95% CI	Variance
Sample 1											
Peer-related loneliness	0.985	1	1	.000	.008	1.618***	1.577–1.660	0.203***	−0.008	−0.031–0.014	0.024*
Parent-related loneliness	1.224	1	1	.016	.007	1.777***	1.733–1.821	0.260***	−0.019	−0.040–0.002	0.015
Positive attitude to aloneness	2.312	1	.997	.040	.015	2.439***	2.396–2.482	0.218***	0.055***	0.033–0.078	0.034**
Negative attitude to aloneness	1.121	1	1	.012	.010	2.473***	2.436–2.510	0.146***	−0.023*	−0.043–0.003	0.006
Sample 2											
Peer-Related Loneliness	2.664	5	1	.000	.029	1.535***	1.503–1.567	0.138***	0.037***	0.020–0.053	0.012**
Parent-related Loneliness	21.115***	5	.969	.058	.091	1.712***	1.673–1.751	0.248***	−0.017*	−0.033- 0.000	0.011*
Positive attitude to aloneness	8.419	5	.994	.027	.037	2.410***	2.376–2.444	0.166***	0.043***	0.027–0.059	0.013***
Negative attitude to aloneness	18.861**	5	.973	.054	.089	2.452***	2.422–2.482	0.103***	−0.019*	−0.034–0.004	0.007*

S-Bχ² Satorra-Bentler scaled chi-square test statistic, CFI comparative fit index, RMSEA root mean square error of approximation, SRMR standardized root mean squared residual

*p <.05; **p <.01; ***p <.001
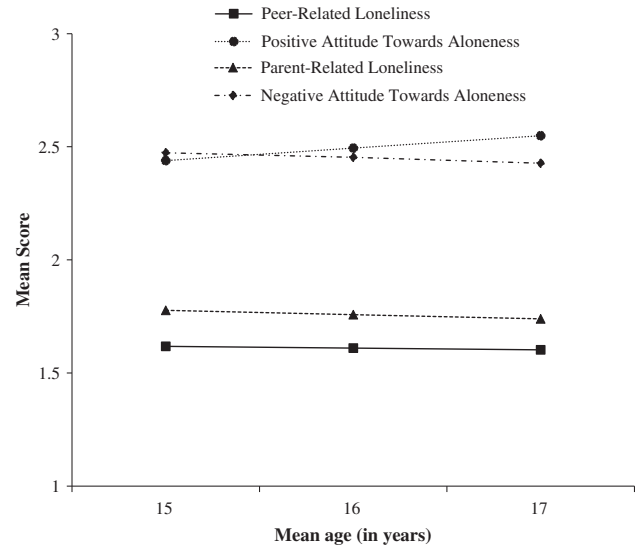
Fig. 1 Developmental trends for loneliness in relation to peers and parents and positive and negative attitudes toward aloneness in Sample 1. The y axis shows mean subscale scores which range from 1 to 4
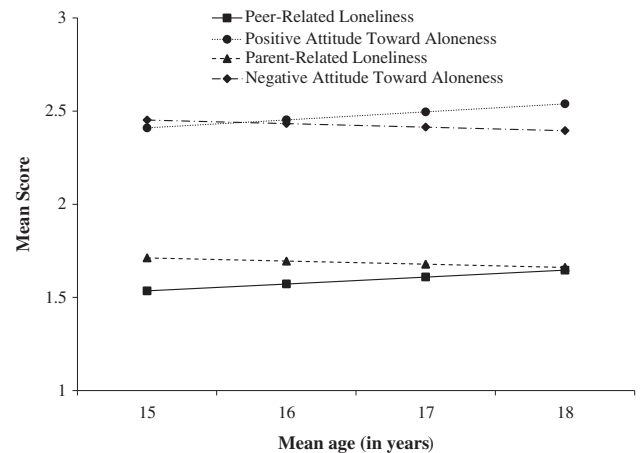
Fig. 2 Developmental trends for loneliness in relation to peers and parents and positive and negative attitudes toward aloneness in Sample 2. The y axis shows mean subscale scores which range from 1 to 4

across time was examined. Because measurement invariance was established at the scalar level, we can assume that adolescents interpret the items of the Loneliness and Aloneness Scale for Children and Adolescents and the underlying factors in a similar way across the age range examined (Chen 2007). As a consequence, a strong assumption for measuring changes in loneliness and attitudes toward aloneness over time has been met. That is, differences in the latent subscale means are not due to differences in interpretation of the items over time (Van de Schoot et al. 2012). Thus, we can validly compare developmental trends of mean score differences on the four subscales of the Loneliness and Aloneness Scale for Children and Adolescents across time.

Table 5 Fit indices for freely estimated and constrained multiple group latent growth curve models

Fit Index	Peer-related loneliness		Parent-related loneliness		Positive attitude toward aloneness		Negative attitude toward aloneness	
	Freely	Constraint	Freely	Constraint	Freely	Constraint	Freely	Constraint
Sample 1								
S-Bχ^2	0.892	1.994	1.093	5.009	3.377	8.825	9.646	49.683
df	2	4	2	4	2	4	6	8
CFI	.996	.996	1	.998	.996	.987	.991	.895
RMSEA	.041	.000	.000	.025	.041	.054	.038	.113
SRMR	.018	.017	.007	.024	.018	.036	.074	.120
$\Delta\chi^2_{SB}$		1.105		3.942		5.570		41.032***
Sample 2								
S-Bχ^2	15.485	23.008*	31.635***	40.131***	9.424	16.738	30.184**	51.813***
df	10	12	10	12	10	12	10	12
CFI	.987	.974	.959	.947	1	.992	.962	.925
RMSEA	.034	.044	.067	.070	.000	.029	.065	.083
SRMR	.099	.110	.099	.102	.049	.057	.119	.134
$\Delta\chi^2_{SB}$		7.661*		8.540*		7.434*		22.256***

S-Bχ^2 Satorra-Bentler scaled chi-square test statistic, CFI comparative fit index, RMSEA root mean square error of approximation, SRMR standardized root mean squared residual, $\Delta\chi^2_{SB}$ Satorra-Bentler scaled chi-square difference test statistic, Freely freely estimated model, Constraint constrained model, intercept and slope mean are constrained to be equal for boys and girls

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

Longitudinal Trends

The results on the longitudinal trends for the two types of loneliness were partly inconsistent across the two samples. In sample 1, no average change was observed in peer-related loneliness, whereas a significant increase was found in sample 2. The results of both sample 1 and 2 are in contrast with earlier longitudinal studies that found a decrease in peer-related loneliness (Vanhalst et al. 2013; Van Roekel et al. 2010; Qualter et al. 2013) and with our hypothesis, which stemmed from the theoretical notion of a decrease in peer-related loneliness throughout adolescence as a result of adolescents' increasing social competencies (Steinberg and Morris 2001). Related to an increase in their social competencies, adolescents are expected to develop more intimate relationships. However, at the same time, they are expected to gain more independence (Larson et al. 1996). This experienced discrepancy might explain the increase in peer-related loneliness throughout adolescence. However, the effects found in this study were small and inconsistent across the two samples. Therefore, caution is warranted when interpreting the results and replication research is needed.

Regarding parent-related loneliness, a decreasing trend was observed in both samples. The decreasing trend only reached significance in sample 2, but the difference in slope factors between sample 1 and 2 was small (i.e., .002). The findings are in contrast with the expected increase in parent-related loneliness as a result of a discrepancy between adolescents' increased need for autonomy, on the one hand, and their continued need for support, on the other hand. The present results suggest that this assumption might not hold. Adolescents seem to continue to perceive their parents as supportive even though they spend less time together. These findings are in line with an earlier study indicating that, although relationships with parents are expected to become more turbulent during adolescence due to adolescents' strive for independence, the majority of adolescents establish a harmonious relationship with their parents by the end of adolescence (Hadiwijaya et al. 2016).

Results regarding attitudes toward aloneness were consistent across the two samples. A slight, but significant, increase and decrease for positive and negative attitude toward aloneness, respectively, was found from ages 15 to 17 years. This finding was not only replicated across samples, but is also in line with most of the earlier cross-sectional studies which indicated an increase and a decrease in positive and negative attitude toward aloneness, respectively, throughout adolescence (Corsano et al. 2006; Marcoen and Goossens 1993; Maes et al. 2015). In addition, the results of both samples for attitudes toward aloneness are in line with our hypotheses and support the idea that an increase in the constructive use of time spent alone during

Table 6 Multiple group latent growth curve models: parameter estimates and equality constraints test

Subscale/Gender	Intercept				Slope			
	Mean	95% CI	Variance	Wald test (df)	Mean	95% CI	Variance	Wald test (df)
Sample 1								
Peer-related loneliness								
Boys	1.590***	1.523–1.658	0.199***		0.004	−0.032–0.040	0.037	
Girls	1.635***	1.582–1.688	0.207***		−0.016	−0.045–0.013	0.019	
Parent-related loneliness								
Boys	1.772***	1.706–1.839	0.211***		0.009	−0.027–0.045	0.042*	
Girls	1.773***	1.716–1.830	0.285***		−0.030*	−0.056−−0.004	0.004	
Positive attitude to aloneness								
Boys	2.378***	2.305–2.450	0.237***		0.086***	0.047–0.126	0.043*	
Girls	2.475***	2.423–2.527	0.198***		0.039**	0.011–0.066	0.024*	
Negative attitude to aloneness				2982.664***(1)				6497.965***(1)
Boys	2.317***	2.258–2.376	0.130***		0.040*	0.009–0.071	0.000	
Girls	2.561***	2.516–2.606	0.129***		−0.056***	−0.081 − −0.030	0.000	
Sample 2								
Peer-related loneliness				2.602 (1)				1.444 (1)
Boys	1.503***	1.453–1.554	0.110***		0.023	−0.006–0.052	0.011	
Girls	1.558***	1.515–1.600	0.159***		0.045***	0.024–0.065	0.012*	
Parent-related loneliness				4.430*(1)				8.086**(1)
Boys	1.653***	1.596–1.711	0.189***		0.012	−0.017–0.041	0.017*	
Girls	1.736***	1.684–1.788	0.277***		−0.038***	−0.057−−0.019	0.007	
Positive attitude to aloneness				5.584*(1)				6.344*(1)
Boys	2.358***	2.304–2.441	0.137***		0.073***	0.045–0.100	0.009	
Girls	2.441***	2.397–2.485	0.175***		0.028**	0.009–0.049	0.014***	
Negative attitude to aloneness				11.780***(1)				0.178 (1)
Boys	2.386***	2.331–2.440	0.127***		−0.025	−0.055–0.004	0.014*	
Girls	2.500***	2.464–2.537	0.090***		−0.018*	−0.040–0.000	0.005	

Wald test Wald chi-square test of parameter equalities. Wald tests were performed to test whether intercept and slope means significantly differed between boys and girls. Those Wald tests were performed if the freely estimated multiple group model showed a significantly better fit above the multiple group models with equality constraints for intercept and slope means

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

adolescence (Long and Averill 2003) is associated with an increase in positive attitude toward aloneness and a decrease in negative attitude toward aloneness (Marcoen and Goossens 1993). In addition, by including 18-year-olds in sample 2, the results show that the increasing trend in positive attitude toward aloneness and the decreasing trend in negative attitude toward aloneness extends across the transition period from secondary school to college or the labor market. This result is in line with earlier cross-sectional findings regarding higher mean level scores for positive attitude toward aloneness in college students compared to senior high school students (Maes et al. 2015). Because late adolescents have already become more independent, they

do not longer fear to be alone and recognize the positive aspects of being alone (Corsano et al. 2006).

It is important to note that, for all subscales, only small mean changes were observed across time. Given the small mean changes, it remains uncertain whether true changes are captured and whether they are meaningful. In addition, the results of earlier studies are inconsistent. Therefore, the results of the current study, have to be interpreted with caution. Nevertheless, it is striking to see that different developmental trends were found for the two types of loneliness, and for positive and negative attitudes toward aloneness. These findings add to the growing body of literature indicating that loneliness is best captured with a

multidimensional view. In addition, the significant variances around the slope factors found in this study indicate the presence of inter-individual differences in developmental trajectories for parent- and peer-related loneliness, and positive and negative attitude toward aloneness. So, several groups of adolescents could be distinguished that each show a distinctive developmental trajectory. Earlier work has already identified such groups for peer-related loneliness. These groups showed stable low levels, a decreasing trend, an increasing trend, and stable high levels for this type of loneliness (Van Dulmen and Goossens 2013). It would be interesting for future work to conduct similar analyses for parent-related loneliness and positive and negative attitudes toward aloneness.

Regarding gender differences, no clear conclusions can be drawn given the small effect sizes and partly inconsistent findings across both samples that were found in this study. Therefore, more research is needed to gain more insight in possible gender differences in developmental trends for loneliness and attitudes toward aloneness. Based on the results of this study, some hypotheses were formulated that can be considered as starting points for future research. For example, these results might suggest that girls have more difficulties with finding a balance between taking distance from their parents, on the one hand, and staying sufficiently connected with them, on the other hand, resulting in more parent-related loneliness. In addition, girls initially score higher on positive attitude toward aloneness than boys, but boys tend to catch up. A possible explanation for this finding might be that girls typically resolve developmental tasks successfully at an earlier age than boys (Cohn 1991) and, as a result, begin to appreciate the benefits of spending time alone earlier on. However, additional research is needed to test these hypotheses.

Finally, results of this study seem to support the multidimensional model of adolescent loneliness. More specifically, the initial mean levels of aloneness and attitudes toward aloneness were related to each other, but these effects did not seem to be strong or long-lasting because the slopes of the different growth models were not or only weakly correlated. In addition, the change in different directions for loneliness and attitudes toward aloneness suggests the added value of a multidimensional view on adolescent loneliness.

Strengths and Limitations

An important strength of this study is the use of two large community samples with partially overlapping age ranges, which created the opportunity to replicate results and to test for the robustness of the findings obtained. However, despite this clear strength, the results of the present study should be considered in light of some limitations.

First, the analyses were conducted on adolescents from a particular region in Europe. Care should be taken, therefore, when generalizing the findings on both measurement invariance and developmental trends to adolescents who live in other parts of the world.

Second, longitudinal measurement invariance of the loneliness and aloneness scale for children and adolescents was investigated across a limited subsection of its intended age range (i.e., from ages 15 till 18). Moreover, because developmental changes were only investigated in adolescents from ages 15 till 18, only a small section of the period of adolescence has been investigated. A study comprising the entire adolescent period, including the transitions from elementary school to secondary school and from secondary school to higher education, could provide a more detailed and complete picture of the developmental changes in peer- and parent-related loneliness and positive and negative attitudes toward aloneness.

Third, this manuscript focused on loneliness in two important relationships in adolescence, that is, the relationship with parents and peers. However, relationships with romantic partners become an important part of adolescents' social live as well (Connolly and Johnson 1996; Furman and Collins 2009) and can give rise to feelings of loneliness if adolescents, for example, do not receive the desired attention of the person they love. Moreover, adolescents' romantic relationships are linked to the quality of adolescents' relationships with parents and peers (Connolly and Johnson 1996). Therefore, it might be that developmental trends for peer- and parent-related loneliness depend on partner-related loneliness. A study comprising measures of loneliness in relationship with parents, peers, and romantic partners could provide a more complete understanding of loneliness in adolescence and its development over time.

Conclusion

This study investigated developmental changes for positive and negative attitude toward aloneness and both peer- and parent-related loneliness in adolescence. As we established longitudinal measurement invariance of the loneliness and aloneness scale for children and adolescents, changes in mean scores for positive and negative attitude toward aloneness and peer- and parent-related loneliness could be validly compared over time for adolescents from ages 15 till 18. Additional research on the normative development for peer-related loneliness is clearly indicated, as the results were inconsistent across both samples. In contrast with theoretical expectations, a decrease in parent-related loneliness was found, suggesting that adolescents from ages 15 till 18 continue to perceive their parents as supportive.

In line with earlier work, an increase for positive attitude toward aloneness was found in both samples, with an accompanying decrease for negative attitude toward aloneness. Thus, adolescents' growing appreciation of time spent alone as a constructive domain of experience, as predicted in theoretical work (e.g., Goossens 2006; Larson 1997), has been clearly corroborated. In addition, this study found support for the added value of a multidimensional view of adolescent loneliness.

Author Contributions S.D. conceived of the study, performed the statistical analyses, interpreted the data, and drafted the manuscript; M. M. helped to perform the statistical analyses, participated in the interpretation of the data, and critically revised the manuscript; J.V. collected the data and critically revised the manuscript; P.B. critically revised the manuscript. L.G. conceived of the study, participated in the interpretation of the data, helped to draft the manuscript, and critically revised the manuscript. All authors read and approved the final manuscript.

Compliance with Ethical Standards

Conflict of Interest The authors declare that they have no competing interests.

Ethical Approval All procedures were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. This article does not contain any studies with animals performed by any of the authors.

Informed Consent Informed consent was obtained from all individual participants included in the study.

References

Barrett, P. (2007). Structural equation modeling: Adjudging model fit. *Personality and Individual Differences*, *42*, 815–824. doi:10.1016/j.paid.2006.09.018.

Boomsma, A. (2000). Reporting analyses of covariance structures. *Structural Equation Modeling: A Multidisciplinary Journal*, *7*, 461–483. doi:10.1207/ S15328007SEM0703_6.

Brown, T. A. (2006). *Confirmatory factor analysis for applied research*. New York, NY: Guilford Press.

Chen, F. F. (2007). Sensitivity of goodness of fit indexes to lack of measurement invariance. *Structural Equation Modeling: A Multidisciplinary Journal*, *14*, 464–504. doi:10.1080/10705510701301834.

Cohn, L. D. (1991). Sex differences in the course of personality development: A meta-analysis. *Psychological Bulletin*, *109*, 252–266. doi:10.1037/0033-2909.109.2.252.

Connolly, J. A., & Johnson, A. M. (1996). Adolescents' romantic relationships and the structure and quality of their close interpersonal ties. *Personal Relationships*, *3*, 185–195. doi:10.1111/j.1475-6811.1996.tb00111.x.

Corsano, P., Majorano, M., & Champretavy, L. (2006). Psychological well-being in adolescence: The contribution of interpersonal relations and experience of being alone. *Adolescence*, *41*, 341–353.

Duncan, T. E., & Duncan, S. C. (2009). The ABC's of LGM: An introductory guide to latent variable growth curve modeling. *Social and Personality Psychology Compass*, *3*, 979–991. doi:10.1111/j.1751-9004.2009.00224.x.

Furman, W., & Buhrmester, D. (1992). Age and sex differences in perceptions of networks of personal relationships. *Child Development*, *63*, 103–115. doi:10.2307/1130905.

Furman, W., & Collins, A. (2009). Adolescent romantic relationships and experiences. In K. H. Rubin, W. Bukowski, & B. Laursen (Eds.), *Handbook of peer interactions, relationships, and groups* (pp. 341–360). New York, NY: Guilford Press.

Goossens, L. (2006). Affect, emotion, and loneliness in adolescence. In S. Jackson, & L. Goossens (Eds.), *Handbook of adolescent development* (pp. 51–70). Hove, UK: Psychology Press.

Goossens, L. (Ed.) (2016). *Leuvense Eenzaamheidsschaal voor Kinderen en Adolescenten: Handleiding [Loneliness and aloneness scale for children and adolescents: Manual]*. Leuven, Belgium: Acco.

Hadiwijaya, H., Klimstra, T. A., Vermunt, J. K., Branje, S. J. T., & Meeus, W. H. J. (2016). On the development of harmony, turbulence, and independence in parent-adolescent relationships: A five-wave longitudinal study. *Journal of Youth and Adolescence*. Advance online publication. doi:10.1007/s10964-016-0627-7.

Heinrich, L. A., & Gullone, E. (2006). The clinical significance of loneliness: A literature review. *Clinical Psychology Review*, *26*, 695–718. doi:10.1016/j.cpr.2006.04.002.

Houghton, S., Hattie, J., Wood, L., Carroll, A., Martin, K., & Tan, C. (2014). Conceptualising loneliness in adolescents: Development and validation of a self-report instrument. *Child Psychiatry & Human Development*, *45*, 604–616. doi:10.1007/s10578-013-0429-z.

Hu, L., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling: A Multidisciplinary Journal*, *6*, 1–55. doi:10.1080/10705519909540118.

Kline, R. B. (2005). *Principles and practice of structural equation modeling*. New York, NY: Guilford Press.

Larson, R. W. (1997). The emergence of solitude as a constructive domain of experience in early adolescence. *Child Development*, *68*, 80–93. doi:10.2307/1131927.

Larson, R., & Richards, M. H. (1991). Daily companionship in late childhood and early adolescence: Changing developmental contexts. *Child Development*, *62*, 284–300. doi:10.2307/1131003.

Larson, R. W., Richards, M. H., Moneta, G., Holmbeck, G., & Duckett, E. (1996). Changes in adolescents' daily interactions with their families from ages 10 to 18: Disengagement and transformation. *Developmental Psychology*, *32*, 744–754. doi:10.1037/0012-1649.32.4.744.

Laursen, B., & Hartl, A. C. (2013). Understanding loneliness during adolescence: Developmental changes that increase the risk of perceived social isolation. *Journal of Adolescence*, *36*, 1261–1268. doi:10.1016/j.adolescence.2013.06.003.

Little, R. J. A. (1988). A test for missing completely ad random for multivariate data with missing values. *Journal of the American Statistical Association*, *83*, 1198–1202. doi:10.1080/01621459.1988.10478722.

Little, T. D., Cunningham, W. A., Shahar, G., & Widaman, K. F. (2002). To parcel or not to parcel: Exploring the question, weighing the merits. *Structural Equation Modeling*, *9*, 151–173. doi:10.1207/S15328007SEM0902_1.

Long, C. R., & Averill, J. R. (2003). Solitude: An exploration of benefits of being alone. *Journal for the Theory of Social Behaviour*, *33*, 21–44. 10.1111/1468-5914.00204.

MacEvoy, J. P., Weeks, M. S., & Asher, S. R. (2011). Loneliness. In B. B. Brown & M. J. Prinstein (Eds.), *Encyclopedia of adolescence* (Vol. 2, pp. 178-187). San Diego, CA: Academic Press. doi:10.1016/B978-0-12-373915-5.00116.9.

Maes, M., Klimstra, T., Van den Noortgate, W., & Goossens, L. (2015). Factor structure and measurement invariance of a multidimensional loneliness scale: Comparisons across gender and age. *Journal of Child and Family Studies*, 24, 1829–1837. doi:10.1007/s10826-014-9986-4.

Marcoen, A., Goossens, L., & Caes, P. (1987). Loneliness in pre through late adolescence: Exploring the contributions of a multidimensional approach. *Journal of Youth and Adolescence*, 16, 561–577. doi:10.1007/BF02138821.

Marcoen, A., & Goossens, L. (1993). Loneliness, attitude toward aloneness, and solitude: Age differences and developmental significance during adolescence. In S. Jackson, H. Rodriguez-Tome (Eds.), *Adolescence and its social worlds* (pp. 197–227). Hove, UK: Erlbaum.

Matsunaga, M. (2008). Item parceling in structural equation modeling: A primer. *Communication Methods and Measures*, 2, 260–293. doi:10.1080/19312450802458935.

Majorano, M., Musetti, A., Brondino, M., & Corsano, P. (2015). Loneliness, emotional autonomy and motivation for solitary behavior during adolescence. *Journal of Child and Family Studies*, 24, 3436–3447. doi:10.1007/s10826-015-0145-3.

Muthén, L. K., & Muthén, B. O. (1998-2012). *Mplus user's guide*. 7th ed. Los Angeles, CA: Muthén & Muthén.

Perlman, D., & Peplau, L. A. (1981). Toward a social psychology of loneliness. In S. Duck, R. Gilmour (Eds.), *Personal relationships in disorder* (pp. 31–56). London, UK: Academic Press. Vol. 3.

Qualter, P., Brown, S. L., Rotenberg, K. J., Vanhalst, J., Harris, R. A., Goossens, L., Bangee, M., & Munn, P. (2013). Trajectories of loneliness during childhood and adolescence: Predictors and health outcomes. *Journal of Adolescence, 36,* 1283–1293. doi:10.1016/j.adolescence.2013.01.005.

Qualter, P., Vanhalst, J., Harris, R. A., van Roekel, E., Lodder, G., Bangee, M., et al. (2015). Loneliness across the life span. *Perspectives on Psychological Science*, 10, 250–264. doi:10.1177/1745691615568999.

Rushton, J. P., Brainerd, C. J., & Pressley, M. (1983). Behavioral development and construct validity: The principle of aggregation. *Psychological Bulletin*, 94, 18–38. doi:10.1037/0033-2909.94.1.18.

Russell, D. (1982). The measurement of loneliness. In L. A. Peplau, D. Perlman (Eds.), *Loneliness: A sourcebook of current theory, research, and therapy* (pp. 81–104). New York, NY: Wiley.

Satorra, A., & Bentler, P. M. (2001). A scaled difference chi-square test statistic for moment structure analysis. *Psychometrika*, 66, 507–514. doi:10.1007/BF02296192.

Scharf, M., Wiseman, H., & Farah, F. (2011). Parent-adolescent relationships and social adjustment: The case of a collectivistic culture. *International Journal of Psychology*, 46, 177–190. doi:10.1080/00207594.2010.528424.

Steinberg, L., & Morris, A. S. (2001). Adolescent development. *Annual Review of Psychology*, 52, 83–110. doi:10.1146/annurev.psych.52.1.83.

Teppers, E., Klimstra, T. A., Van Damme, C., Luyckx, K., Vanhalst, J., & Goossens, L. (2013). Personality traits, loneliness, and attitudes toward aloneness in adolescence. *Journal of Social and Personal Relationships*, 30, 1045–1063. doi:10.1177/0265407513481445.

Ulman, J. B. (2013). Structural equation modeling. In B. G. Tabachnick, L. S. Fidell (Eds.), *Using multivariate statistics*. 6th ed. (pp. 681–785). Boston, MA: Pearson Education.

Vandenberg, R. J., & Lance, C. E. (2000). A review and synthesis of the measurement invariance literature: Suggestions, practices, and recommendations for organizational research. *Organizational Research Methods*, 3, 4–70. doi:10.1177/109442810031002.

Van de Schoot, R., Lugtig, P., & Hox, J. (2012). A checklist for testing measurement invariance. *European Journal of Developmental Psychology*, 9, 486–492. doi:10.1080/17405629.2012.686740.

Van Dulmen, M. H. M., & Goossens, L. (2013). Loneliness trajectories. *Journal of Adolescence*, 36, 1247–1249. doi:10.1016/j.adolescence.2013.08.001.

Vanhalst, J., Goossens, L., Luyckx, K., Scholte, R. H. J., & Engels, R. C. M. E. (2013). The development of loneliness from mid- to late adolescence: Trajectory classes, personality traits, and psychosocial functioning. *Journal of Adolescence*, 36, 1305–1312. doi:10.1016/j.adolescence.2012.04.002.

Vanhalst, J., Luyckx, K., Scholte, R. H. J., Engels, R. C. M. E., & Goossens, L. (2012). Low self-esteem as a risk factor for loneliness in adolescence: Perceived—but not actual—social acceptance as an underlying mechanism. *Journal of Abnormal Child Psychology*, 41, 1067–1081. doi:10.1007/s10802-013-9751-y.

Van Roekel, E., Scholte, R. H., Verhagen, M., Goossens, L., & Engels, R. C. (2010). Loneliness in adolescence: Gene x environment interactions involving the serotonin transporter gene. *Journal of Child Psychology and Psychiatry*, 51, 747–754. doi:10.1111/j.1469-7610.2010.02225.x.

Weeks, M. S., & Asher, S. R. (2012). Loneliness in childhood: Toward the next generation of assessment and research. In J. B. Benson (Ed.), *Advances in child development and behavior* (pp. 1–39). San Diego, CA: Academic Press. Vol. 42.

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