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What leads to loneliness?An integrative model of Social, Motivational and Emotional approaches in adolescence

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Abstract:	Loneliness has been linked to many physical and mental health problems especially during adolescence. From an evolutionary, social needs, and cognitive approaches, this study examined whether emotional repair, relatedness need, and peer-rated indicators of relations behave in predicting loneliness, considering all approaches together. The sample consisted of 373 adolescents measured longitudinally at 3 time points. Results of a cross-lagged panel design found that considering all the influences together, relatedness need showed the highest strength to predict loneliness. Furthermore, adolescents who were accepted by their peers and whose relatedness need was satisfied activated emotional regulation which additionally produced a decrease of prospective feelings of loneliness. In addition, loneliness has been shown to be a consequence of these variables

What leads to loneliness? An integrative model of social, motivational, and emotional approaches in adolescents.

Loneliness can be described as an unpleasant state due to cognitive awareness of the discrepancies between current relationships and the relationships one would like to have (Peplau & Perlman, 1982), as an unpleasant state because one lacks some definite, needed relationship or set of relationships (Weiss, 1973), or as an intrinsic and organic reality of human life (Moustakas, 1961). Loneliness has been studied from many different approaches (Peuplau & Perlman, 1982). All approaches agree that loneliness may be experienced at a situational point for most people, but it can also be a chronic emotional response. In the latter case, research has shown that loneliness places individuals at risk for poor psychological outcomes. In particular, failure to resolve loneliness has been associated with psychological difficulties (e.g., low self-esteem, low social competence), mental health problems (e.g., depression, anxiety disorders, substance use, suicidal ideation), and physical issues (e.g., eating disorders, sleep disturbances, and poorer cardiovascular functioning) (Cacioppo et al., 2002; Heinrich & Gullone, 2006; Qualter et al., 2015; Vanhalst, Luyckx, & Goossens, 2014), especially during adolescence. Not surprisingly, it is the developmental period when loneliness is more prevalent compared to more advanced developmental periods (for review, see Qualter et al., 2015). Adolescence is marked by social, cognitive and physical maturation developmental evolution in a social world that rapidly changes social expectations, roles, relationships, and personal identities, which may increase the risk for experiencing the painful emotional response of loneliness (Rubin, Bukowski, & Laursen, 2009).

Although research converges in the wide variety of consequences derived from loneliness, there are diverse theoretical approaches that predict loneliness, as the variety of definitions of loneliness show (Tzouvara, Papadopoulos, & Randhawa, 2015). Currently, the main approaches that dominate its scientific study are: the cognitive approach, the social needs approach, and the evolutionary approach, each one proposing its own predictors of loneliness with scarce attention to

interactions (Cacioppo & Hawkley, 2009). Consequently, there is a lack of connections among approaches, which means that the major questions remain unanswered: May loneliness approaches be empirically related? May one approach explain loneliness better than the others? The aim of the present study was to determine how the proposed predictors within each loneliness approach function in an integrative model to explain loneliness. For this purpose, we used a three-wave study to examine longitudinal relations between the predictors proposed within the different approaches and loneliness.

Loneliness approaches

Loneliness is described as a social deficiency: a cognitive awareness of the discrepancies between current relationships and the relationships one would like to have (Asher & Paquette, 2003). From the cognitive approach, loneliness exists when one's social relationship network is smaller or less satisfying than desired (Peplau & Perlman, 1982). It emphasises the social mechanism, the importance of the quantity of social relationships and the situational or environmental attributions (Anderson, 1998; Dykstra, van Tilburg, & de Jong Gierveld, 2005). Drawing on the cognitive approach, peer relationships have been shown to be the main source of loneliness among adolescents (Asher & Paquette, 2003; Heinrich & Gullone, 2006; Qualter et al., 2015). Thus far, research has assessed the individual's situation within a group to determine acceptance and rejection by peers as indicative of peer relationships (Cillessen & van den Berg, 2012). Consistent findings have associated peer acceptance negatively with loneliness (Buhs & Ladd, 2001; Mouratidis & Sideritis, 2009; Woodhouse, Dykas, & Cassidy, 2011) and peer rejection positively with loneliness (Crick & Ladd, 1993; Betts & Stiller, 2014; Pedersen, Vitaro, Barker, & Borge, 2007), in cross-sectional and longitudinal studies. Regarding these results from the cognitive approach, positive peer relationships seem to protect one against loneliness. On the contrary, feelings of loneliness increase among individuals who experience peer difficulties as rejection by the peer group.

Albeit, Asher and Paquette (2003) pointed out: “It is possible to have many friends and still feel lonely. Likewise, it is possible to be poorly accepted by the peer group or to lack friends and yet to not feel lonely”. From the social needs approach, loneliness occurs due to an unfulfilled social need for relationships or a set of relationships and not because one is being alone (Baumeister & Leary, 1995; Heinrich & Gullone, 2006; Weiss, 1973). Weiss (1973) supports that when one cannot fulfil one’s social and/or intimacy needs of relationships, then loneliness arises. This definition underlines the importance of one’s social needs in the causation of loneliness, such that a small network may satisfy one’s social needs, underlying a motivational mechanism. Within the framework of the self-determination theory (STD), relatedness refers to feeling close to, connected to, and mutually supportive of significant others (Deci & Ryan, 1985). The basic psychological need is innate, universal, and essential for optimal psychological functioning (Neubauer & Voss, 2016). Specifically, there is evidence that the fulfillment of the need for relatedness has exhibited the highest negative relation with all of the subscales of the UCLA Loneliness Scale (Russell, 1996), which is the most commonly used loneliness measure (Heinrich & Gullone, 2006). For example Wei, Shaffer, Young, and Zakalik (2005) in a cross-sectional study, found that adolescents who felt connected to others decreased their feelings of loneliness. Or more recently, Neubauer and Voss (2016) found that relatedness was a predictor of loneliness and also that those youths whose relatedness need was fulfilled reported low feelings of loneliness across three studies in youths samples. Likewise, in a cross-sectional study, Lin (2016) showed that the relatedness need was essential to predict loneliness and psychological well-being in social media research. Thus, from this motivational perspective, relatedness need has been shown to be the main contributor in loneliness, such that unfulfilled relatedness leads to loneliness.

A third approach, derived from an evolutionary perspective, holds that loneliness is an aversive signal that helps to promote and maintain social connections or to repair or replace ruptures in social connections (Cacioppo & Patrick, 2008). From this approach, loneliness is seen as

a "regulatory loop": loneliness functions by motivating cognitive efforts to establish and maintain social connections, efforts that typically produce less loneliness. Otherwise, loneliness experiences active some cognitions that are bised in a way that social interactions are seen as more negative and less positive, resulting in behaviors, thoughts or emotions that do not facilitate reconnection with others and produce more loneliness (Cacioppo & Hawkely, 2009; Qualter et al., 2015). The emotions associated with loneliness serve to take action and thereby be alleviated (Heinrich & Gullone, 2006). Drawing on an emotional mechanism, *Emotional Repair* is the ability to regulate one's emotional states (Salovey et al., 1995). Additionally, the ability to regulate emotional states has been linked to psychological adjustment (Extremera, Durán, & Rey, 2007; Thompson et al., 2007) and was proposed to specifically influence feelings of loneliness (Zysberg, 2012). Furthermore, emotional repair has shown to be related to feelings of loneliness in adolescents in cross-sectional data (Martín-Albo et al. 2005). From this emotional approach, the results support the notion that emotional repair may be a key variable that leads to loneliness.

The three, cognitive, social needs, and evolutionary approaches, have offered three different ways of understanding loneliness with different predictors involved, guided either by social, motivational, or emotional mechanisms. For instance, Woodhouse , Dykas, and Casidy (2011) examined peer-rated social behaviors (i.e., social acceptance, reciprocal liking, and romantic relationship history)and loneliness. The authors found that the 3 social behaviors were predictors of loneliness, with social acceptance explaining the bulk of variance in adolescents' loneliness (almost 8%). Nevertheless, research integrating predictors from more than one approach is scarce and limited. For instance, Vanhalst, Luyckx, and Goossens (2014) found that social frienships quantities and qualities are associated with loneliness among adolescents. Both variables explain 11% of the variance of loneliness. An integrative empirical framework with the different approaches in the study of loneliness has not been achieved. To our knowledge, Martín -Albo et al. (2015) recently constituted the exception in the field although their results were based on cross-sectional data. They

tested motivational and emotional mechanisms to explain loneliness, as well as social mechanisms to explain their findings. Interestingly, they found that, when the need for relatedness was unfulfilled, emotional repair played a key role in the dis- appearance of loneliness. Accordingly to their results, two different mechanisms were proposed through which adolescents may handle loneliness, based on the satisfaction of the relatedness need and the ability to regulate emotions (repair). The first mechanism proposed postulates that adolescents with the unfulfilled relatedness need regulated emotions by directly improving social relationships, thereby also improving their perception of social connections. Certainly, the mechanism proposed that a key issue to alleviate loneliness throughout motivational approaches involved social mechanisms as the improvement of social skills, number of friends, etc. The second mechanism proposed postulates that adolescents may regulate loneliness either by increasing their perception of social connection or by reducing the importance of social relationships through thoughts (e.g., "I am not alone, my friends are busy today" or "It is not bad to be alone, I can do whatever I want"). In other words, loneliness may be alleviated throughout activating emotional repair. Nevertheless, the results of the study are based on cross-sectional data which do not permit establishing causal relations. Besides these limitations, the results showed the existence of interconnections among loneliness approaches and new perspectives in the study of loneliness. It highlights the need for an integrative model to reveal how social, motivational, and emotional mechanisms may behave conjointly.

The current study

The overall goal of the current study was to integrate the cognitive, social needs, and evolutionary approaches reviewed in predicting loneliness during adolescence. Consequently, this study is of an exploratory nature, considering that, to our knowledge, no study has yet analysed longitudinally social relationship indicators, the motivational need to connect, and emotional perspectives in the study of loneliness. In this sense, we tested models with longitudinal analyses

composed of three waves to determine whether peer relationships (acceptance and rejection), a need of relatedness, and emotional regulation influence loneliness among adolescents.

Firstly, we tested each model separately, each of the theorectical components were run independently with loneliness. Drawing on the cognitive approach, peer relationships may be the main source of loneliness and considering that acceptance and rejection have been linked to loneliness positive and negative respectively (e.g., Betts & Stiller, 2014; Woodhouse, et al. 2011). Therefore we hypothesized: (a) a positive association between peer rejection and loneliness; (b) a negative association between peer acceptance and loneliness. From the social needs approach loneliness is characterized for the unfulfillment of the need of relationship (Heinrich & Gullone, 2006). Accordingly, we hypothesized: (c) a negative association between relatedness and loneliness. The evolutionary approach considers emotions from loneliness as key to facilitate reconnection to others, to establish, and to maintain social connections (Cacioppo & Hawkely, 2009). Consequently, we hypothesized: (d) a negative association between repair and loneliness. A total of 4 longitudinal models were run based on previous works.

Furthermore, we tested a model integrating acceptance, rejection, relatedness need and repair to predict loneliness in adolescents longitudinally. In addition to previous research, recently, Martin-Albo et al. (2015) in a cross-sectional integration found relations between theoretical components. Based on the authors' results we expected to additionally find: (e) a positive association between repair and relatedness.

Moreover, so far, loneliness research has focused on peer relationships, relatedness need, and emotional repair as antecedents of loneliness independently. We considered it essential to determine longitudinally the directionality of the relations between the proposed predictors and loneliness, as many of the results are based on cross-sectional studies. Accordingly, we tested whether within our model, loneliness was a consequence or a precedent. We hypothesized that: (f) the model in which loneliness acts as a dependent variable fits the data better than the model in

which loneliness acts as a predictor of peer relationships, relatedness, and repair, and than the stability model developed.

Method

Participants

Participants were students from 1st grade through 4th grade (equivalent to 7st-10th grade in the USA) recruited in the northeast of Spain. The sample was selected using multi-phase sampling as follows. First, stratified sampling was performed to select the secondary schools. A total of five public centers participated in the study: four were in urban areas (town populations were over 2,000 people) and one was in a rural area. Second, in the first phase, we performed cluster sampling in each of the selected centers, taking as the unit of analysis the classroom. Data from this study were collected at three time points with a 6-month interval: Time 0 (T0) during the Fall semester (N = 545), Time 1 (T1) during the Spring semester (N = 539), and Time 2 (T2) during the Fall semester of the following year (N = 701). The inclusion criteria were: (a) the classroom (as unit) had participated across the three time points, (b) the classroom had a completion rate for the peer nomination instrument higher than 50% (Marks, Babcock, Cillessen, & Crick, 2013), and in addition (c) participants had completed all measures across the three time points. A total of 372 youths from 31 classrooms met the criteria for participation (M_{age} = 13.30, SD = 1.15; 55.9% females). No adolescents or guardians refused to participate in this study. T-tests were conducted to compare the original sample and final samples, and there were no significant differences between the participants who remained in the sample and those who withdrew from the study ($p > .05$).

Measures

Repair. The Repair subscale of the Trait Meta Mood Scale (Fernández-Berrocal, Extremera, & Ramos, 2004) has 7 items related to the belief that one can repair a bad mood. An example item is "Although I am sometimes sad, I mostly have an optimistic outlook". The version used was modified in line with Martin-Albo et al. (2010), with the removal of the item "I have lots of energy

when I am happy" (Item 23). Participants' response options ranged from *strongly disagree* = 1 to *strongly agree* = 7.

Relatedness. The Relatedness subscale of the Psychological Needs Scale (Gillet et al. 2008; Spanish-language version by León et al., 2011) assesses students' need for relatedness with items such as "I feel good with people with whom I interact". It has 7 items rated on a Likert scale from ranging *strongly disagree* = 1 to *strongly agree* = 7.

Peer relationships. Students were given a list with the names of their classmates to respond to the questions "Who do you like the most?" to assess peer acceptance and "Who do you like the least?" to assess peer rejection. Nominations for both questions were unlimited. The adolescents could choose as many or as few classmates as they wished. The reference group was the classroom, including same- and other-gender peers, but not themselves. Sociometric indexes were calculated using the CIVSoc software (Barrasa & Gil, 2004). The procedure used is identical to that utilized by Zakriski and Coie (1996).

Peer acceptance. The software procedure used to calculate an adolescent's peer acceptance score was the number of acceptance nominations received divided by the number of students in the class minus one. The value ranges from 0 (minimum) to 1 (maximum).

Peer rejection. The software procedure used to calculate an adolescent's peer rejection score was the number of nominations of rejection received divided by the number of students in the class minus one. The value ranges from 0 (minimum) to 1 (maximum).

Loneliness. The Isolation subscale of the UCLA Loneliness Scale Version 3 (Russell, 1996) emerged in most of the factor structure studies of the scale (e.g., Austin, 1983; Dussault, Fernet, Austin, & Leroux, 2009; Hartshore 1993; Hawkley, Browne, & Cacioppo, 2005). As described Dussault et al. (2009), it comprises the first factor of the scale, reflecting feelings of rejection and loneliness with items such as "I feel left out" or "I feel isolated from others". It has 11 items, and similarly to Hartshore's (1993) scale, the original anchors were changed from *strongly disagree* = 1

to *strongly agree* = 7 to avoid confusion with some items. The Spanish version used was validated by Expósito and Moya (1999).

Procedure

Firstly, we requested permission from the principal of each school to carry out the study. After the principals had agreed to participate, consent from parents and/or guardians was requested, as well as the students' assent to participate in the study. Data collections were carried out during the fall and spring semester of one academic course, and again during the following fall semester (with a 6-month interval between time points) in the students' classrooms at school, during regular classes. The questionnaire used was the same at all three time points. To ensure that there was no bias due to reading difficulties, at least one researcher remained in the room to monitor students' progress and answer any questions. Before completing the questionnaire by computer, we informed the students that all of their answers were confidential and their participation was voluntary.

Statistical Analysis

Three-time points cross-lagged panel designs and structural equation modelling were used to analyze the data with Mplus, Version 7.11. In order to reduce sampling error by reducing the specific variances of each item, parcels were composed. Parcels were configured following the recommendations of Little, Rhemtulla, Gibson, and Schoemann (2013), items were randomly assigned to parcels and then averaged. In addition, to precisely define the constructs (Little, 2013), a just-identified measurement space was created, and each latent construct was based on 3 parcels. The parcelling procedure was conducted similarly in all models tested.

Next, confirmatory factor analyses (CFAs) were conducted to establish longitudinal factorial invariance as a prerequisite to assess the cross-lagged structural models. For this purpose, an unconstrained model was established and hierarchically advanced to more restricted (and nested) models (Little, 2013). The invariance routine started by testing the unconstrained model, in which the pattern of indicator-to-construct is equal across time points (configural invariance). This

baseline model was subsequently compared with the next level of measurement invariance, including factor loading equality (weak factorial invariance), equality of the intercepts of the corresponding indicators (strong factorial invariance), and equality of the residual variances of the corresponding indicators (strict factorial invariance). In all tested models, the residuals of the corresponding indicators were allowed to correlate across time points, and the first factor loading per latent variable was set to unity in order to set the scale of the latent variables, as recommended by Little, Preacher, Selig, and Card (2007). A CFI increment larger than 0.01 between nested models indicates a significant change in model fit for testing invariance. Thus, "a value of ΔCFI smaller than or equal to 0.01 indicates that the null hypothesis of invariance should not be rejected" (Cheung & Rensvold, 2002, p. 251).

Consequently, 5 fully cross-lagged panel models were tested. Firstly, each of the independent variables (repair, relatedness, peer acceptance, and peer rejection) were separately run to predict loneliness. 4 models were run. Moreover, we longitudinally assessed whether repair, relatedness, peer acceptance, and peer rejection influence loneliness among adolescents (see Figure 1). In addition, indirect effects of T0 repair, relatedness, peer acceptance, and peer rejection on T2 loneliness were tested with the Mplus MODEL INDIRECT procedure, in the integrated model. Although a three-time points panel design cannot conclusively demonstrate causality (Burkholder & Harlow, 2003), this approach permits us to explore and test key questions about the pattern of autoregressive and cross-lagged relations among the variables over time.

Finally, to test directional patterns of effects of loneliness, we developed models and compared them with the proposed integrated model of cross-lagged panel. For this purpose, firstly, we developed a structural null model with autoregressive paths and paths that did not include loneliness. Then, based on the structural model, the paths from loneliness to all covariates were added. Comparisons between nested models were performed.

Considering the possible multivariate nonnormality of the measures, the robust maximum likelihood (MLR) estimator was selected for model estimations (Wang & Wang, 2012). This procedure allows us to verify that the estimators were not affected by the lack of normality and, therefore, they were robust (Byrne, 2012). The internal consistency among parcels of each of the instruments employed at each temporal moment was assessed via omega (McDonald, 1999). Omega has been shown to have less risk of reliability overestimation or underestimation (Dunn, Baguley, & Brunsden, 2013), and a more sensitive index of internal consistency, in relation to alpha and also when compared with others (Revelle & Zinbarg, 2009; Zinbarg, Yovel, Revelle, & McDonald, 2006). The initial step entailed the examination of the intraclass correlation coeficients (ICCs) of the parcels showing most of them ICCs < .05. Thus, all tested models included the COMPLEX option of the Mplus software to adjust for standard errors and chi-square fit statistics for the within-class covariances and for the dependency of the data (Brown, 2006)

Goodness-of-fit was tested with the common fit indexes. Thus, an adequate model fit is considered when the Comparative Fit Index (CFI) and the Tucker-Lewis Index (TLI) have values >0.90, the Root Mean Square Error of Approximation (RMSEA) is <0.06, and Standardized Root Mean Square Residual (SRMR) is <0.08 (Iacobucci, 2010).

Results

After parcelling procedure was conducted, repair, relatedness, and loneliness were treat as 3 latent variables (each one composed of 3 parcels) and acceptance and rejection were 2 observed variables. Longitudinally, in sum, 9 latent variables (27 parcels) and 6 observed variables were examined. Firstly, we run the 4 models to predict loneliness independently (repair, relatedness, acceptance, and rejection), and then we run an integrated model with all variables, the proposed model.

In order to enable replication of the present study, the covariance matrix with the MLR estimation method among indicators and observed variables in the integrated model, as well as

factor loadings and omega reliabilities, are presented in Table 1. Omega, a reliability indicator, ranged between .79 and .89, which is considered acceptable.

Previous analysis: invariance testing

Tests of longitudinal factorial invariance are presented in Table 2 and 3. A decrease in CFI <0.01 implies invariance. Thus, according to this criterion, weak, strong, and strict factorial invariance were supported in comparisons across time points. The most parsimonious model with equal residual variances was selected. This implies that the measures have equivalent relationships between the indicators and latent factors across time points (equality of factor loadings), any changes in the mean levels of the indicators are fittingly fallen as changes in the means of the latent variables (equality of intercepts) across measurements, and the sum of the indicator-specific and random sources of measurement error variances for each indicator does not change across time points (equality residual variances of indicators). Consequently, time points can be compared on their scores on the latent variables.

Patterns over time

Descriptive data and correlations are displayed in Table 4. Repair, relatedness, and peer acceptance were negatively related to loneliness across time points. Conversely, peer rejection was positively related to loneliness at each time point. The relation between emotional repair and loneliness across time points displayed a stable pattern with similar correlation values, as did the relation between peer acceptance and loneliness. The pattern of the relation between relatedness and loneliness showed a small increase in the strength of the relation at T2, whereas T0 and T1 had similar correlation values. Moreover, the pattern of the relation between peer rejection and loneliness showed similar correlation values between T0 and T1, and a large increase in the strength of the relation at T2.

Once factorial measurement invariance of the proposed model was supported, we conducted a test of equality of latent means across time points by fitting an additional model in which all latent

state means were set equal across time. The fit of the model was significantly worse than the strong factorial invariance model without restrictions on the latent means (ΔCFI = 0.140). This indicates that the means changed over time points at least between two time points. Moreover paired sample t-tests (see Table 5) revealed that there are no significant differences between the means of repair or loneliness across time points and. Relatedness showed the significantly highest level at T0 when compared with T1 or T2. Regarding the sociometric variables, the peer acceptance mean showed a significantly increased pattern over time points (T0-T1 and T1-T2), and the peer rejection mean showed an increase between T0-T1 and between T0-T2, but between T1 and T2, the measure did not show any differences.

The individual cross-lagged panel models

The measurement components of the proposed cross-lagged panel models (structural models) were constrained in accordance with strict factorial invariance correspondingly, and all the structural models presented adequated fit to the data (see Table 2). Figure 2 presents all the standardized parameters examining the relations between repair, relatedness, acceptance, rejection, and loneliness individually.

The proposed cross-lagged panel model

The measurement components of the proposed cross-lagged panel model (structural model) were constrained in accordance with strict factorial invariance. The structural model presented an acceptable fit to the data ($\chi^2 = 605.435$, $df = 438$; CFI = .969, TLI = .963, RMSEA = .032, 90% CI [.026, .038], SRMR = .064). Table 6 presents all the paths, covariances and residual correlations tested. All autoregressive regression weights were positive and strong (all ps < .01), denoting that individuals' relative scores on the variables had changed very little over time (the temporal stability of the variables).

Mediation analysis

We explored indirect effects of the variables measured at the initial time point (T0) to loneliness at T2. Analyses revealed a specific significant indirect effect from T0 relatedness to T2 loneliness through T1 loneliness (β = -0.162, 95% CI [-.307, -.016], p = .030). The tested indirect effects of repair (β = .072, 90% CI [.002, .142], p = .099), rejection (β = .079, 90% CI [.006, .152], p = .077), and acceptance (β = -0.018, 90% CI [-.076, .041], p = .616) were nonsignificant. Hence, we replicated the structural model, adding the direct paths.The results displayed no significant direct path from variables at T0 to loneliness at T2 (all ps > .05). In accordance, loneliness at T1 mediated the prospective effect of T0 relatedness on T2 loneliness.

Comparing models: loneliness as dependent variable vs. as independent variable

In order to test directional patterns of the effects of loneliness, comparisons between models were needed. Firstly, a structural null model was developed with auto-regressive paths and paths that did not include loneliness (χ^2 = 705.599, df = 454; CFI = .958, TLI = .947, RMSEA = .039, 95% CI [.033, .044], SRMR = .087). Based on the null model, the relations from loneliness at T0 to any covariates at T1 and from T1 to T2 were added to the model (χ^2 = 794.420, df = 456; CFI = .933, TLI = .928, RMSEA = .045, 90% CI [.039,.050], SRMR = .092). Then, the resulting model was compared with the structural null model. Results indicated that the resulting model was significantly worse than the structural null model (ΔCFI = 0.025). In addition, the proposed cross-lagged panel model, in which loneliness was the dependent variable was compared with the structural null model (ΔCFI = 0.01) and with the resulting model (ΔCFI = 0.036). Hence, these results show that the model with loneliness functioning as dependent variable fit the data better than loneliness as an independent variable.

Correspondingly, we constrained the paths from loneliness to covariates. The final model presented an adequated fit to the data (χ^2 = 622.715, df = 446; CFI = .968, TLI = .962, RMSEA = .033, 90% CI [.026, .039], SRMR = .070; AIC = 23099.154), and additionally, the comparison between nested models indicated no significant change in model fit (ΔCFI = 0.001). Figure 3 shows

the significant paths in the final model. Moreover, the explained variance (R^2) located in figure 3 indicate the amount of variability in the latent or endogenous variables at T1 and T2 respectively that can be explained by the sum of autoregressive and cross-lagged effects. It turns out that, overall, 34% of repair, 44% of relatedness, 27% of acceptance, 38% of rejection, and 55% of loneliness can be explained at T1. At T2, the amount of explained variability is 20% for repair, 38% for relatedness, 18% for acceptance, 18% for rejection, and 36% for loneliness. Adachi and Willoughby (2015) concluded that all very small effects (e.g., $\beta > .05$) are meaningful in longitudinal autoregressive models.

Additionally, the Akaike Information Criterion (AIC) is a way of selecting a model from a set of models. It is based on information theory and seeks the model that minimizes the Kullback-Leibler distance between the model and the truth. Comparing our 4 individual models and the final model, the smallest AIC number corresponds to an individual model between rejection and loneliness.

Discussion

The aim of the present study was to integrate longitudinally the motivational, emotional, and social approaches that lead to loneliness among adolescents. The results showed that all approaches participated in the prediction of loneliness, and also that the different approaches interacted with each other. To the best of our knowledge, this is the first longitudinal study that proposes an integration of different approaches to loneliness among adolescents.

From the cognitive approach, our first hypothesis (Hypothesis a) was confirmed: our model did find significant associations between peer rejection and loneliness with data analysed individually. Nevertheless, the propsed cross-lagged panel model showed that peer rejection at T0 was almost predictor of loneliness at T1. Previous longitudinal studies showed a relation between peer rejection and loneliness, and the notion that a poor social situation within one's peer group, as defined by rejection, influences prospective feelings of loneliness (Betts & Stiller, 2014; Heinrich &

Gullone, 2006), as we did individually. Additionally, data showed that rejection and loneliness model obtained the best fit of indices. It denotes that the model that better represents the truth should be rejection and loneliness. Nevertheless, our study was the first one to integrate different approaches that could have undermined the strength of the relation between peer rejection and loneliness among adolescents. Similarly, peer acceptance was a significant predictor of loneliness, supporting our second hypothesis (Hypothesis b), when both variables are considered individually. While peer acceptance showed no influence on loneliness when all approaches were taken into account at the same model. The vast research predicting loneliness from social relationships has been cross-sectional and has focused on analyzing constructs from one perspective: social, developmental, motivational, or other theorecial frameworks (Gorman, Schwartz, Nakamoto, & Mayeux, 2011; Mouratidis & Sideridis, 2009; Vanhalst, Luyckx, & Goossens, 2014; Woodhouse, Dykas, & Cassidy, 2011). Therefore, this may explain the discrepant results and the loss of strength of peer relations, the social mechanism, versus motivational and emotional mechanisms presented in our model.

From the social needs perspective, to the extent that an individual has fulfilled his or her relatedness need this will reduce feelings of loneliness, confirming our third hypothesis (Hypothesis c). Additionally, the proposed cross-lagged model showed that relatedness was negatively related with loneliness at one time point and rejection. Despite the scarce studies published about the relation between reltadness and loneliness, our results are consistent with previous research (e.g., Lin, 2016; Wei et al., 2015), confirming the influence of relatedness on loneliness during adolescence. By definition, relatedness need and loneliness share some similarities, suggesting that the two constructs refer to the same phenomenon. In fact, our study showed high correlations between the two constructs across time points. Nevertheless, previous studies have shown that the two variables are not always associated (Martín-Albo et al., 2015) and are related differently to other third variables (e.g., Neubauer & Voss, 2016; Wei, Shaffer, Young, & Zakalik, 2005). Once

the idea of an overloap between loneliness and relatedness is ruled out (Martín-Albo et al., 2015), our results support the motivational or social needs approach, showing that when the relatedness need is fulfilled, loneliness decreases (e.g., Weiss, 1973) and even peer rejection.

From an evolutionary perspective, repair was slightly and negatively related to loneliness when we consider both variables individually, supporting our fourth hypothesis (Hypothesis d). Moreover, the final model showed that the relations were not significant. However, looking the direction we may observe two different relations: first, initial levels of repair will increase loneliness. And second, levels of repair at the end of the course will decrease loneliness in the next course. Previous research on emotional intelligence found support for the model proposed by Cacioppo and Hawkley (2009), which states that poor emotional skills increase loneliness over time (Zysberg, 2012; Wols, Scholte, & Qualter, 2015), denoting a negative relation between repair and loneliness, as we had hypothesized (Hypothesis d). Neverthelss, it is noteworthy that, beyond the small size of the results, initial levels of repair at the beginning of the course will increase loneliness. This result was unexpected. Future research may determine exactly how certain emotional skills could affect loneliness differently. Given that the understanding of emotions involves complicated relationships between emotions, incluiding how they may change over time, future research should assess the consequences of development in samples of adolescents and youths.

From an integrative perspective, our results showed an associations between relatedness and repair (Hypothesis e). Considering these findings conjointly, a mechanism seems to lead to loneliness: At the beginning of a course (T0), high relatedness influenced a decrease in feelings of loneliness (T1) and increased repair (T1), which, in turn, could almost influence a further decrease in loneliness (T2). In other words, satisfied relatedness need prospectively produced fewer feelings of loneliness by regulating emotions, which, in turn, may decrease future loneliness, thereby the research conducted by Martin-Albo et al. (2015) may be supported. Furthermore, our results also

add to the mechanism through which initial peer acceptance influenced prospective repair at the end of the academic course, probably by maintaining a positive situation within the peer group, and thus, influencing a decrease in loneliness measured in the next course. This mechanism revealed that satisfied relatedness need, together with a positive social status, led to fewer future feelings of loneliness. An adolescent whose need of relatedness is satisfied and who is accepted within the peer group will be increased his/her repair, which will decrease loneliness feelings. It is important to realise that our data only considers one academic transition, and accordingly, future research should increase time data points.

One of the strengths of our study is the combitation of peer- and self-report methods of data collection. Surprinsingly, when social, motivational, and emotional approaches are considered conjointly in predicting loneliness, self-reported measures, especially relatedness satisfaction, have shown higher influence on loneliness (Neubauer & Voss, 2016). Besides the fact that between T1 and T2, there is an academic transition, with the beginning of a new course, the different number or strength of the relationships in the model should be explained by the integration of all the variables taken together. Accordingly, Conway and Lance pointed out: “the widespread belief that common method bias serves to inflate common method correlations as compared to their true-score counterparts is substantially a myth” (Conway & Lance, 2010. p. 327). To the best of our knowledge, this is the first study that integrates social, motivational, and emotional approaches in the study of loneliness.

The cross-lagged panel design of three time points allowed us to examine the direction of the patterns of loneliness in the model. By comparing models (Hypothesis f), loneliness has been shown to better fit the data as a consequence rather than as an antecedent of peer relations, repair, and relatedness, supporting our hypothesis. This result is in line with previous research that has established feelings of loneliness as a consequence of peer experience, and individuals’ emotions and motivations, respectively (Cheng & Furnham, 2002; Gest, Domitrovich, & Welsh, 2005;

Mahon, Yarcheski, Yarcheski, Cannella, & Hanks, 2005; Mouratidis & Sideridis, 2009; Thompson et al., 2007; Zysberg, 2012).

Limitations and future directions

The findings described above should be considered with regard to the following limitations: First, we collected data at the beginning and the end of an academic course and once again, at the beginning of the next course. This only represents a single academic transition in time data collection. Thus, our results cannot be compared to other course transitions or even be generalized. Further longitudinal research should be developed incluiding more course transitions to be able to generalize results. Second, the sample size was not very large and was made up of Spanish adolescents, restricting the generalizability of the findings to other cultures. Replications in other countries are warranted to test the generalizability of results. Finally, a third limitation worth considering is that, based on the longitudinal nature of our study and the various measures used, parcels were developed. Despite the fact that we considered all the recommendations in the parcelling methodology used (Little, Rhemtulla, Gibson, & Schoemann, 2013), we did not model as closely to the collected data as possible, and thus some kind of contamination may have occurred (Little, Cunningham, Shahar, & Widaman, 2002).

Conclusions

The results highlighted the effect of the motivational approach on loneliness, concretely the relatedness need. Moreover, the model showed that loneliness occurs in adolescents in different ways depending on their emotion regulation abilities, relatedness need satisfaction, and social situation within the peer group. Concretely, our data found that adolescents with an initial positive social status or satisfied relatedness need activated emotion regulation, which produced a decrease in future feelings of loneliness. Relatedness itself produced a reduction in loneliness.

On basis of the present results, specific interventions focused on the motivational perspective, and concretely on satisfaction of needs, could reduce feelings of loneliness among

adolescents. Qualter (2003) suggested that increasing opportunities to interact with others, teaching social skills to those who cannot reconnect or who have social difficulties would enable them to be more successful in their peer interactions and thus satisfy the relatedness need.

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Table 1.

Matrix of covariances and variances (on the diagonal) between parcels and observed variables of the study, items, intraclass correlation coefficients (ICCs), factor loadings and, McDonalls' omega index of internal consistency among parcels of each instrument.

Matrix of		Parameters	Items	ICCs	λ	*SE*	ω	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
		1 Rep-0a	1,2,3	.11	.85	.02		1.5																															
	T0	2 Rep-0b	4,5	.66	.84	.02	.79	1.8	1.7																														
		3 Rep-0c	6,7,8	.66	.65	.02		.77	.77	1.4																													
		4 Rep-1a	1,2,3	.66	.86	.02		.75	.69	.44	1.6																												
Repair	T1	5 Rep-1b	4,5	.07	.85	.02	.82	.59	.68	.36	1.2	1.6																											
		6 Rep-1c	6,7,8	.06	.67	.02		.51	.54	.65	.96	.99	1.6																										
		7 Rep-2a	1,2,3	.03	.85	.02		.56	.60	.24	.74	.63	.41	1.6																									
	T2	8 Rep-2b	4,5	.01	.84	.02	.84	.44	.50	.24	.58	.52	.38	1.20	1.5																								
		9 Rep-2c	6,7,8	<.01	.66	.02		.32	.40	.45	.42	.48	.50	.78	.96	1.4																							
		10 Rel-0a	1,2	.02	.77	.02		.24	.18	.27	.31	.21	.27	.28	.23	.16	.83																						
	T0	11 Rel-0b	3,4	<.01	.74	.03	.88	.32	.34	.33	.41	.36	.37	.30	.23	.17	.60	1.2																				
		12 Rel-0c	5	.02	.78	.02		.36	.42	.39	.46	.35	.39	.31	.22	.27	.66	.68	1.4																				
		13 Rel-1a	1,2	<.01	.80	.03		.25	.20	.29	.56	.42	.53	.37	.26	.28	.38	.43	.38	1.0																			
Relatedness	T1	14 Rel-1b	3,4	<.01	.78	.03	.89	.33	.28	.39	.60	.44	.57	.37	.28	.27	.47	.69	.55	.79	1.4																		
		15 Rel-1c	5	<.01	.81	.02		.36	.30	.32	.67	.50	.61	.42	.26	.30	.45	.54	.74	.79	.93	1.5																	
		16 Rel-2a	1,2	<.01	.79	.02		.27	.27	.29	.42	.30	.36	.48	.41	.32	.42	.45	.42	.44	.49	.48	.99																
	T2	17 Rel-2b	3,4	<.01	.76	.03	.89	.41	.36	.30	.41	.28	.33	.50	.34	.20	.42	.61	.41	.38	.61	.49	.71	1.2															
		18 Rel-2c	5	.01	.80	.02		.35	.33	.32	.48	.35	.35	.58	.43	.42	.40	.46	.44	.44	.54	.58	.79	.85	1.4														
	T0	19 Accept						.01	.01	.01	.02	.03	.02	.01	.00	.01	.01	.02	.02	.02	.02	.02	.01	.01	.02	.01													
Acceptance	T1	20 Accept						.01	.01	.02	.03	.02	.01	.00	.01	.01	.02	.03	.03	.02	.03	.04	.03	.02	.03	.01	.02												
	T2	21 Accept						.02	.01	.02	.02	.01	.01	.01	.01	.01	.02	.03	.02	.03	.03	.03	.03	.03	.03	.01	.01	.03											
	T0	22 Rejection						-.01	-.01	.00	-.01	-.01	.00	.00	.00	.00	-.01	-.02	-.01	-.01	-.01	-.02	-.02	-.02	-.02	.00	.00	-.01	.01										
Rejection	T1	23 Rejection						-.01	.00	-.01	-.01	-.01	-.01	-.01	.00	.00	-.01	-.02	-.01	-.01	-.01	-.02	-.02	-.01	-.02	.00	-.01	-.01	.01	.01								
	T2	24 Rejection						.00	-.01	-.01	-.01	-.01	-.01	-.01	-.01	-.01	-.02	-.02	-.02	-.02	-.03	-.03	-.02	-.02	-.03	.00	-.01	-.01	.01	.01	.01							
		25 Iso-0a	1,2,3	<.01	.79	.02		-.34	-.33	-.23	-.36	-.30	-.32	-.34	-.21	-.20	-.29	-.39	-.58	-.17	-.39	-.47	-.32	-.36	-.38	-.03	-.03	-.03	.02	.02	.03	1.2							
	T0	26 Iso-0b	4,5,6,7	<.01	.83	.02	.87	-.24	-.27	-.20	-.26	-.23	-.25	-.22	-.16	-.14	-.29	-.39	-.47	-.21	-.41	-.43	-.30	-.34	-.33	-.02	-.02	-.02	.01	.01	.02	.64	.76						
		27 Iso-0c	8,9,10,11	<.01	.77	.02		-.16	-.19	-.17	-.27	-.17	-.22	-.33	-.17	-.16	-.39	-.43	-.54	-.29	-.47	-.45	-.25	-.33	-.33	-.03	-.03	-.03	.01	.02	.02	.77	.65	1.2					
		28 Iso-1a	1,2,3	.01	.82	.02		-.19	-.23	-.19	-.38	-.24	-.33	-.36	-.29	-.19	-.33	-.34	-.51	-.40	-.56	-.66	-.41	-.37	-.46	-.02	-.04	-.03	.01	.02	.03	.72	.54	.60	1.4				
Loneliness	T1	29 Iso-1b	4,5,6,7	.03	.86	.02	.87	-.10	-.17	-.19	-.25	-.22	-.29	-.23	-.20	-.21	-.33	-.43	-.45	-.40	-.54	-.54	-.39	-.32	-.40	-.03	-.03	-.03	.02	.02	.03	.54	.52	.54	.83	1.0			
		30 Iso-1c	8,9,10,11	.02	.81	.02		-.11	-.17	-.20	-.39	-.28	-.39	-.30	-.19	-.17	-.42	-.52	-.56	-.46	-.63	-.67	-.42	-.41	-.47	-.03	-.05	-.04	.02	.02	.03	.65	.58	.87	.94	.85	1.4		
		31 Iso-2a	1,2,3	.01	.79	.03		-.16	-.17	-.19	-.27	-.26	-.28	-.38	-.27	-.26	-.24	-.32	-.30	-.17	-.30	-.38	-.45	-.47	-.61	-.02	-.02	-.03	.02	.02	.04	.59	.41	.44	.62	.49	.55	1.1	
	T2	32 Iso-2b	4,5,6,7	.01	.84	.02	.88	-.19	-.19	-.19	-.21	-.21	-.18	-.29	-.24	-.23	-.25	-.31	-.31	-.24	-.32	-.36	-.42	-.40	-.56	-.02	-.03	-.04	.02	.02	.03	.42	.38	.38	.45	.47	.50	.69	.87	
		33 Iso-2c	8,9,10,11	<.01	.77	.03		-.21	-.22	-.15	-.30	-.22	-.26	-.41	-.24	-.24	-.30	-.36	-.42	-.29	-.44	-.46	-.45	-.47	-.59	-.02	-.04	-.04	.02	.02	.03	.55	.47	.73	.60	.53	.83	.75	.67	1.2

Note. Repair, relatedness, and loneliness are latent variables. Acceptance and rejection are observed variables.

Table 2.

Longitudinal factorial invariance analysis of the measurement model and structural model of all the independent variables to predict loneliness individually.

Measurement invariance test	χ^2	df	RMSEA	SRMR	TLI	CFI	ΔCFI	Δmodel
Repair								
Configural invariance	123.840	102	.024	.035	.990	.993		
Weak factorial invariance	125.235	110	.019	.037	.993	.995	–0.002	2 vs. 1
Strong factorial invariance	145.558	118	.025	.038	.989	.991	0.004	3 vs. 2
Strict factorial invariance	186.374	130	.034	.049	.979	.982	0.009	4 vs. 3
Structural model	203.050	134	.037	.050	.975	.978		
Relatedness								
Configural invariance	123.019	102	.023	.032	.989	.993		
Weak factorial invariance	125.051	110	.019	.036	.993	.995	–0.002	2 vs. 1
Strong factorial invariance	135.831	118	.020	.037	.992	.994	0.001	3 vs. 2
Strict factorial invariance	151.452	130	.021	.043	.992	.993	0.001	4 vs. 3
Structural model	183.901	133	.031	.055	.980	.983		
Acceptance								
Configural invariance	86.488	42	.052	.11	.959	.974		
Weak factorial invariance	83.451	46	.046	.11	.969	.978	–0.004	2 vs. 1
Strong factorial invariance	90.783	50	.046	.11	.969	.976	0.002	3 vs. 2
Strict factorial invariance	93.855	56	.042	.11	.974	.978	–0.002	4 vs. 3
Structural model	71.031	51	.032	.04	.985	.988		
Rejection								
Configural invariance	80.395	42	.048	.11	.966	.979		
Weak factorial invariance	78.316	46	.042	.11	.974	.982	–0.003	2 vs. 1
Strong factorial invariance	85.546	50	.043	.11	.974	.980	0.002	3 vs. 2
Strict factorial invariance	89.283	56	.039	.11	.978	.981	–0.001	4 vs. 3
Structural model	52.296	51	.011	.03	.998	.999		

Note. $\chi 2$: Chi-square test; df: degrees of freedom; RMSEA: Root Mean Square Error of Approximation; SRMR: Standardized Root Mean Square Residual; TLI: Tucker-Lewis Index; CFI: Comparative Fit Index; ΔCFI: variations in CFI.

Table 3.

Longitudinal factorial invariance analysis of the measurement model and test of equality of latent means across time points.

Measurement invariance test	χ^2	df	RMSEA	SRMR	TLI	CFI	ΔCFI	Δmodel
Configural invariance	329.899	261	.027	.039	.981	.986		
Weak factorial invariance	333.290	273	.024	.040	.984	.987	–0.001	2 vs. 1
Strong factorial invariance	356.921	285	.026	.041	.981	.985	–0.002	3 vs. 2
Strict factorial invariance	400.577	303	.029	.048	.976	.980	0.005	4 vs. 3
Equalíty of latent means across time points test	1033.478	293	.082	.828	.814	.845	0.140	5 vs. 3

Note. $\chi 2$: Chi-square test; df: degrees of freedom; RMSEA: Root Mean Square Error of Approximation; SRMR: Standardized Root Mean Square Residual; TLI: Tucker-Lewis Index; CFI: Comparative Fit Index; ΔCFI: variations in CFI.

Table 4.

Means, standard deviations, and correlations among latent and observed variables are presented.

	Variables	*M*	*SD*	T0					T1						T2				
				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
	1 Repair	4.60	1.05	–															
	2 Relatedness	5.73	0.74	.37*	–														
T0	3 Acceptance	0.20	0.12	.08	.21*	–													
	4 Rejection	0.07	0.09	-.08	-.16*	-.33*	–												
	5 Loneliness	1.87	0.85	-.30*	-.62*	-.25*	.18*	–											
	6 Repair	4.68	1.11	.54*	.41*	.16*	-.06	-.30*	–										
	7 Relatedness	5.61	0.82	.36*	.62*	.18*	-.18*	-.51*	.54*	–									
T1	8 Acceptance	0.24	0.13	.10*	.23*	.47*	-.37*	-.26*	.14*	.24*	–								
	9 Rejection	0.10	0.11	-.02	-.15*	-.32*	.60*	.14*	-.07	-.15*	-.36*	–							
	10 Loneliness	1.95	0.97	-.19*	-.57*	-.22*	.23*	.74*	-.29*	-.61*	-.30*	.19*	–						
	11 Repair	4.62	1.08	.40*	.28*	.09*	-.03	-.23*	.49*	.33*	.03	-.04	-.25*	–					
	12 Relatedness	5.57	0.78	.30*	.61*	.15*	-.17*	-.43*	.40*	.58*	.22*	-.14*	-.51*	.46*	–				
T2	13 Acceptance	0.32	0.16	.06	.18*	.39*	-.33*	-.19*	.07	.19*	.54*	-.35*	-.23*	.06	.22*	–			
	14 Rejection	0.10	0.12	-.05	-.20*	-.21*	.33*	.23*	-.09	-.22*	-.29*	.48*	.28*	-.08	-.23*	-.46*	–		
	15 Loneliness	1.89	0.87	-.16*	-.45*	-.20*	.20*	.62*	-.26*	-.43*	-.26*	.19*	.67*	-.32*	-.66*	-.25*	.31*	–	

Note. * $p < 0.05$. $N = 372$

Table 5.
Paired sample t-tests

Paired-sample *t*-test	Mean differences	*t*	df	*p*
Repair T0 – Repair T1	-.06	-1.05	371	.29
Repair T0 – Repair T2	-.01	-.12	371	.90
Repair T1 – Repair T2	.05	.86	371	.39
Relatedness T0 – Relatedness T1	.12	2.64	371	<.01
Relatedness T0 – Relatedness T2	.16	3.46	371	<.01
Relatedness T1 – Relatedness T1	.04	.75	371	.45
Acceptance T0 – Acceptance T1	-.04	-5.32	371	<.01
Acceptance T0 – Acceptance T2	-.12	-15.14	371	<.01
Acceptance T1 – Acceptance T2	-.09	-11.71	371	<.01
Rejection T0 – Rejection T1	-.03	-5.33	371	<.01
Rejection T0 – Rejection T2	-.03	-5.68	371	<.01
Rejection T1 – Rejection T2	-.01	-1.19	371	.23
Loneliness T0 – Loneliness T1	-.06	-1.61	371	.11
Loneliness T0 – Loneliness T2	-.01	-.10	371	.92
Loneliness T1 – Loneliness T2	.06	1.37	371	.17

Table 6.

Standardized parameters examining the relations between repair, relatedness, acceptance, rejection, and loneliness longitudinally. Paths of the structural model above the diagonall and standard errors in parentheses. Covariances and correlations among residuals of indicators below the diagonal.

	Variables	T0					T1					T2				
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
T0	1 Repair	–					.46**(.06)	.07(.05)	.01 (.05)	.06 (.04)	.08† (.04)					
	2 Relatedness	.37**	–				.21**(.08)	.55**(.07)	.05 (.07)	-.06 (.08)	-.18**(.06)					
	3 Acceptance	.08*	.21**	–			.09*(.04)	.03 (.03)	.36**(.12)	-.15**(.03)	-.02 (.04)					
	4 Rejection	-.08	-.16*	-.33**	–		.03 (.04)	-.06 (.04)	-.24**(.05)	.55**(.07)	.09† (.04)					
	5 Loneliness	-.30**	-.62*	-.25**	.18**	–	-.01 (.07)	-.10 (.07)	-.09† (.05)	-.01 (.06)	.64**(.07)					
T1	6 Repair						–					.76**(.15)	.13 (.09)	-.07 (.06)	.03 (.05)	-.09† (.05)
	7 Relatedness						.41**	–				-.16 (.11)	.36**(.13)	.04 (.07)	-.05* (.07)	.18 (.13)
	8 Acceptance						.03	.09†	–			-.10 (.05)	.04 (.04)	.89**(.14)	.01 (.06)	-.01 (.04)
	9 Rejection						-.03	-.03	-.13*	–		-.02 (.05)	-.01 (.05)	-.03 (.07)	.71**(.10)	.04 (.05)
	10 Loneliness						-.14†	-.42**	-.14**	.05	–	-.14† (.07)	-.24† (.14)	.05 (.04)	.12† (.06)	.88**(.12)
T2	11 Repair						-.30*					–				
	12 Relatedness							-.64**				.31**	–			
	13 Acceptance								-.46**			.04	.08	–		
	14 Rejection									-.35**		-.04	-.07	-.24**	–	
	15 Loneliness										-.29*	-.20**	-.52*	-.07	.11*	–

**$p < .01$, *$p < .05$, $^{\dagger}p < .10$

Figure 1.Structural model proposed to be tested.

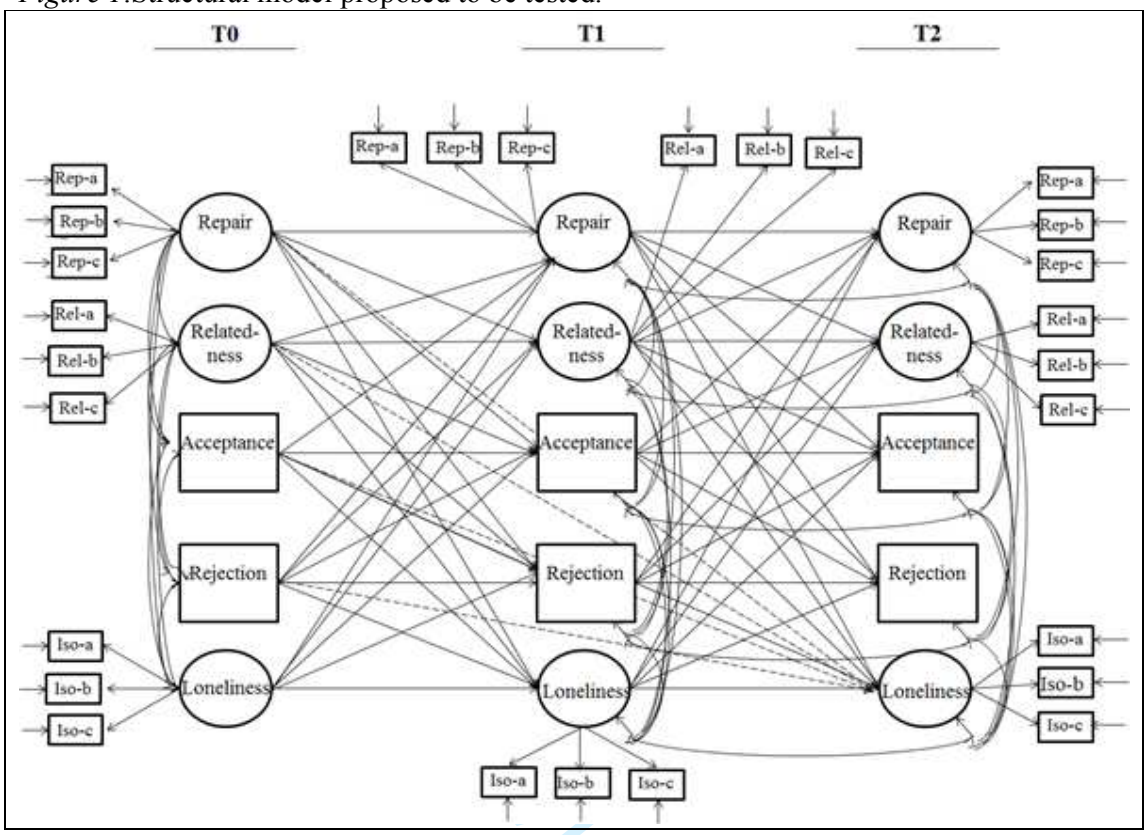


Figure 2. Standardized parameters examining the relations between repair, relatedness, acceptance, rejection, and loneliness individually. *$p < .05$

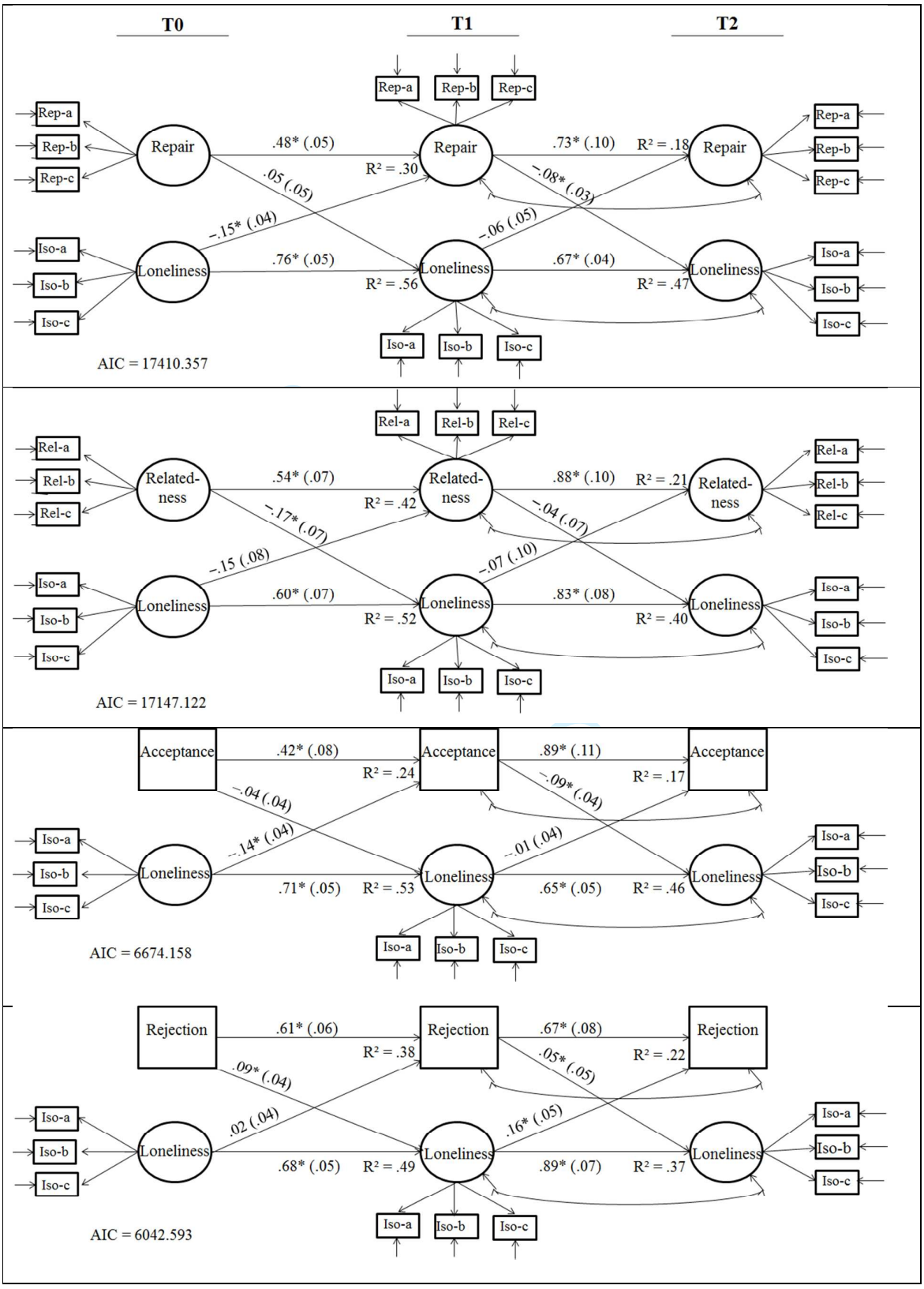
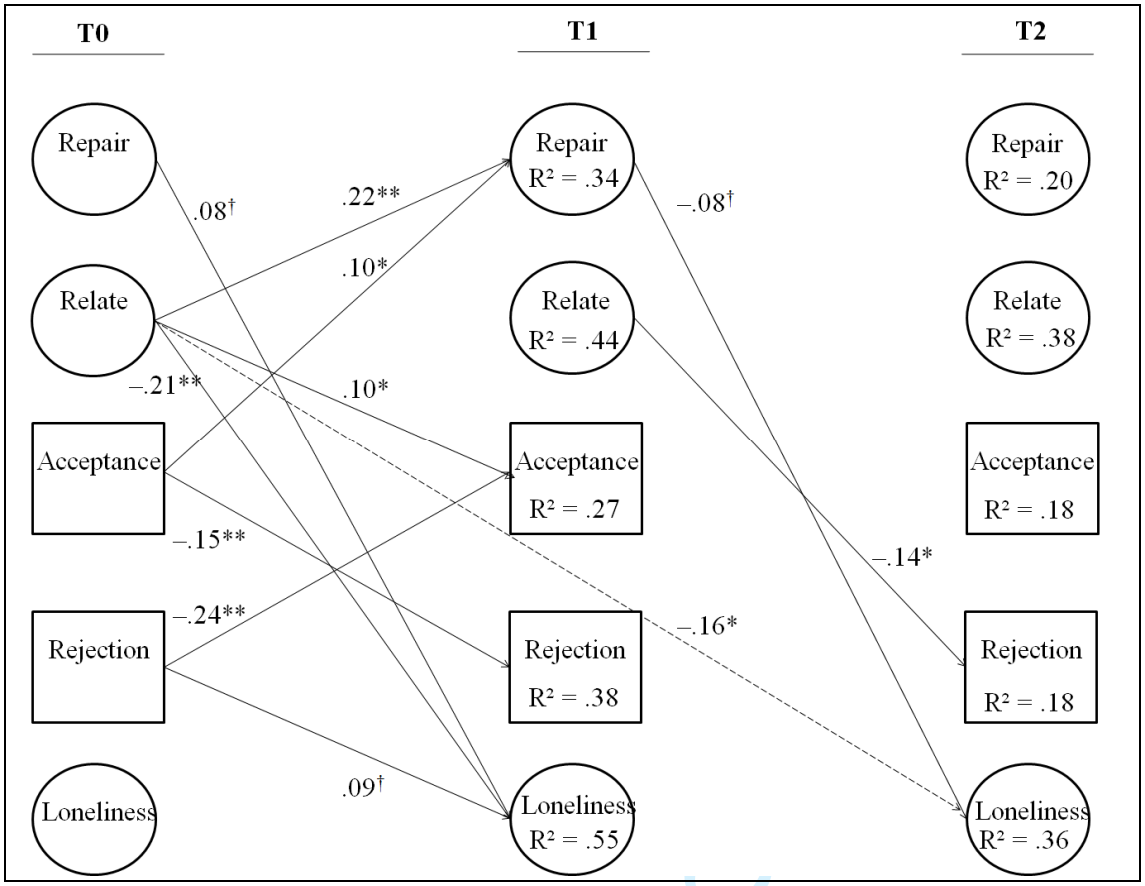


Figure 3. Final model. Standardized parameters examining the relations between repair, relatedness, acceptance, rejection, and loneliness. Covariances, auto-regressive, and non-significant paths in the structural model are omitted for presentation clarity. $^{**}p < .01$, $^{*}p < .05$, $^{\dagger}p < .10$.



Appendix

CFA model of loneliness, relatedness, and repair variables

Latent construct	Time	Parcel	β	*B*	*SE*
Loneliness	T0	Iso-0a	.79	1.00	.02
		Iso-0b	.83	.90	.04
		Iso-0c	.77	.99	.04
	T1	Iso-1a	.82	1.00	.02
		Iso-1b	.86	.90	.02
		Iso-1c	..81	.99	.02
	T2	Iso-2a	.79	1.00	.03
		Iso-2b	.84	.89	.02
		Iso-2c	.77	.99	.03
Relatedness	T0	Rel-0a	.77	1.00	.02
		Rel-0b	.74	1.09	.03
		Rel-0c	.78	1.20	.02
	T1	Rel-1a	.80	1.00	.03
		Rel-1b	.77	1.09	.03
		Rel-1c	.81	1.20	.03
	T2	Rel-2a	.79	1.00	.02
		Rel-2b	.76	1.09	.03
		Rel-2c	.81	1.20	.02
Repair	T0	Rep-0a	.85	1.00	.02
		Rep-0b	.84	1.00	.02
		Rep-0c	.66	.76	.02
	T1	Rep-1a	.85	1.00	.02

		Rep-1b	.85	1.00	.02
		Rep-1c	.67	.76	.02
	T2	Rep-2a	.85	1.00	.02
		Rep-2b	.84	1.00	.02
		Rep-2c	.66	.76	.02