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Trait and State Levels of Loneliness in Early and Late Adolescents: Examining the Differential Reactivity Hypothesis

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According to the differential reactivity hypothesis, lonely individuals respond differently to their environment compared to nonlonely individuals, which may sustain their loneliness levels. However, this interesting hypothesis has not yet been explored in daily life: Do lonely individuals feel lonely all the time, or do they feel more or less lonely in specific social contexts? The main aim of the present study was to test the differential reactivity hypothesis in daily life by examining in three samples whether trait levels of loneliness affected the levels of state loneliness in different social contexts. We used baseline questionnaires to measure trait loneliness and the Experience Sampling Method to collect data on state loneliness, in early adolescents ($N = 269$, $M_{age} = 14.49$, 59% female) and late adolescents ($N = 223$, $M_{age} = 19.60$, 91% female) from the Netherlands and late adolescents from the United States ($N = 126$, $M_{age} = 19.20$, 51% female). Results provided evidence for the differential reactivity hypothesis in the total sample, as high lonely adolescents experienced higher levels of state loneliness in situations in which they were alone than low lonely adolescents, but also benefited more from being with intimate company than low lonely adolescents. In sum, the present study provided evidence for the differential reactivity hypothesis and showed that the experience of loneliness in daily life was remarkably similar across age and culture. Our findings provide important insights into the daily experiences of trait lonely people, which may provide starting points for interventions.

INTRODUCTION

Adolescence is an important period in life that is characterized by profound changes in the social domain. These social changes come into play because of intraindividual developments, such as pubertal development and brain maturation, which make adolescents increasingly able to initiate more intimate social relationships (Steinberg & Morris, 2001). Hence it is not surprising that feelings of loneliness are particularly present during adolescence (e.g., Heinrich & Gullone, 2006; Vanhalst et al., 2012). Loneliness is defined as the negative emotions that arise in response to a perceived discrepancy between the actual and desired quality and quantity of social relationships (Perlman & Peplau, 1981). Loneliness is typically examined as a trait, by means of questionnaires (e.g., Louvain Loneliness scale for Children and Adolescents [LLCA]; Marcoen, Goossens, & Caes, 1987; University of California, Los Angeles [UCLA] Loneliness Scale; Russell, Peplau, & Cutrona, 1980). Although many studies have investigated trait levels of loneliness, there are several questions that remain unanswered.

First, little is known about how loneliness is experienced in daily life (i.e., state levels of loneliness). When and in which social contexts do adolescents typically experience loneliness in daily life? Up to now, only four studies have examined state levels of loneliness by using momentary assessments in real life, all in early adolescents (Larson, 1981, 1990; Larson, Csikszentmihalyi, & Graef, 1982; van Roekel, Verhagen, Engels, Goossens, & Scholte, 2014). Those studies showed that adolescents experienced the highest levels of state loneliness in situations when they were alone compared to being with others (Larson, 1990; van Roekel et al., 2014), particularly when they were alone on Friday or Saturday nights (Larson et al., 1982). These findings show that state loneliness is dependent on the social context as well as on temporal characteristics (i.e., time of day). However, all studies have focused on early adolescents, and thus it remains unclear when late adolescents experience state loneliness. Levels of state loneliness may differ between early and late adolescents, as they are in different phases of their lives and may spend different amounts of time in different social contexts. Hence, in the present study we examined differences in state loneliness between type of day (i.e., week vs. weekend days) and social context (i.e., alone vs. intimate company vs. nonintimate company) in early and late adolescent samples.

Despite the wealth of research focusing on trait loneliness, it remains unclear what it means when individuals rates themselves as being lonely on a trait questionnaire. When do these individuals experience loneliness in their daily lives? Do they feel lonely all the time, or are there certain contexts or situations in which they do not feel lonely? According to the differential reactivity hypothesis (Cacioppo, Hawkley, & Berntson, 2003), loneliness may be sustained because lonely individuals respond differently to their environment, compared to nonlonely individuals. Previous research has found

support for the differential reactivity hypothesis in late adolescent samples, in that lonely adolescents perceived their daily activities as more threatening (Hawkley, Burleson, Berntson, & Cacioppo, 2003), perceived their interaction quality as more negative (Duck, Pond, & Leatham, 1994), and reported more intense hassles (Cacioppo et al., 2000) than do nonlonely adolescents. Further, one study in early adolescents has also found support for the differential reactivity hypothesis (van Roekel et al., 2013), in that lonely adolescents responded more negatively to negative social environments and more positively to positive social environments. Although these studies provide evidence for this hypothesis, no studies have yet examined whether this also applies to state levels of loneliness. In the present study, we examined this question by investigating whether trait levels of loneliness affected the levels of state loneliness experienced in different social contexts.

Adolescence is characterized by important social transitions that may impact the experience of loneliness. In early adolescence, the transition is made from primary school to secondary school, whereas in late adolescence the transition to college takes place. Although both these transitions may increase the likelihood of increases in loneliness, the transition to college often also includes moving out of the parents' home, which could have differential effects on loneliness. In addition to these age differences, the social contexts adolescents are in may also differ between cultures. For example, Dutch adolescents do not always move out of their parents' home, as the distances to university are often smaller than in the United States. In addition, the adolescents who do move out of their parents' home are likely to go home during weekends, which is less likely for the U.S. adolescents. As was discussed earlier, the differential reactivity hypothesis has mainly been examined in late adolescent samples from the United States and only one study included early adolescents, hence we do not yet know whether these results are dependent on age and culture. Therefore, a further aim of the present study was to explore whether the differential reactivity hypothesis applies to early and late adolescent samples and to Dutch and American samples.

The Present Study

The main aims of the present study were (a) to examine state levels of loneliness in different daily contexts (i.e., type of day and type of company) and (b) to examine relations between trait and state levels of loneliness in early and late adolescents and in Dutch and American adolescents. This first aim of this study has already been examined in the early adolescent sample we used (van Roekel et al., 2014), but we still included these data in the present article so that we were able to compare these findings between samples. The second aim (i.e., relations between trait and state loneliness) has not yet been examined in the samples used in the present study. We used the Experience Sampling Method (ESM) to examine these relations (Myin-Germeys et al., 2009). By using this method, adolescents reported on

their feelings of loneliness during the course of their daily lives. Compared to more traditional methods, ESM has two important advantages: (a) Recall bias is minimized and (b) ecological validity is high, because adolescents report on their feelings and social contexts while they are actually in it. As mentioned earlier, state levels of loneliness refer to momentary feelings of loneliness in daily life, whereas trait loneliness refers to a baseline measure of how lonely adolescents feel in general.

We examined whether state levels of loneliness differed between type of day (week vs. weekend) and type of company (alone vs. intimate vs. nonintimate company). Based on previous studies in early adolescents (Larson, 1981, 1990), we hypothesized that state loneliness would be higher on weekend days, compared to weekdays. In addition, we hypothesized that state loneliness would be highest in situations alone, followed by situations with nonintimate company and situations with intimate company. Finally, to examine the differential reactivity hypothesis, we examined whether trait loneliness moderated the relations between the different contexts and state loneliness. It was hypothesized that lonely adolescents in general would have higher levels of state loneliness. In addition, we expected lonely adolescents to be more negatively affected by situations spent alone or with nonintimate company, in that their levels of state loneliness would be even higher in those situations.

All relations were examined in three samples: early adolescents from the Netherlands (early adolescents NL), late adolescents from the Netherlands (late adolescents NL), and late adolescents from the United States (late adolescents U.S.). We did not have specific hypotheses regarding the different samples.

METHOD

Sample Characteristics

We used data from three different samples in the present study. As these samples were collected for different research purposes, some of the measures and study procedures differed. All samples are described in detail next.

Early adolescents NL sample. Data were collected on four high schools (van Roekel et al., 2013). The early adolescent sample consisted of 303 adolescents ($M_{age} = 14.19$, $SD = 0.54$), who were all in their second year of high school. Of this sample, 59% were female and 97.4% were born in the Netherlands. The different educational levels were all well represented: 22.8% of the adolescents attended preparatory secondary school for technical and vocational training, 34.8% attended preparatory secondary school for college, and 42.3% attended preparatory secondary school for university.

Late adolescents NL sample. The late adolescent sample consisted of 228 psychology and educational

science undergraduate students (91% female) from the Radboud University Nijmegen, the Netherlands ($M_{age} = 19.60$, $SD = 1.49$). Of this sample, 77% were of Dutch origin, 21% were born in Germany, and 2% were born in another country. Most students left their parents' home for college (65% vs. 35% living with their parents) and typically lived in student homes. Almost all students were in their 1st year of college (96%).

Late adolescents U.S. sample. The U.S. late adolescent sample consisted of 135 undergraduate students (51% female; $M_{age} = 19.20$, $SD = 1.00$) who were screened and selected to represent the lower, middle, and upper quintile of the R-UCLA Loneliness Scale (Russell et al., 1980). Of the total sample, 83% were Caucasian: 7% African American; 7% Asian, Asian American, or Pacific Islander; 3% other or undeclared. Almost all students left their parents' home for college (92.5%). The majority of the students were in their 1st (52%) or 2nd (33%) year of college. See Hawkley et al. (2003) for a detailed description of exclusion criteria.

Procedure

Early adolescents NL sample. High schools were contacted to participate in the present study, and when they consented, all 2nd-year adolescents were sent a letter in which information about the study was provided. When the adolescents and their parents agreed to participate, they had to return a signed consent form. All adolescents who returned a consent form could participate in the study.

The study consisted of a baseline questionnaire and the Experience Sampling period. In the baseline questionnaire, which was administered online during school hours, demographic characteristics and trait levels of loneliness were measured. Three to 8 weeks after this assessment, the Experience Sampling period started. Adolescents were individually briefed about the procedure of the study 1 day prior to the start of the sampling period. They received a smartphone, on which a program was installed that emitted nine randomly timed signals per day, on 6 consecutive days (always starting on Fridays and ending on Wednesdays). Adolescents were instructed to attend to the smartphone at all times and immediately fill out the questionnaire when they received a signal. When adolescents did not respond to a signal, another signal was emitted after 2 min, with a maximum of three reminders. After that, the questionnaire was made unavailable. It took around 3 min to fill out a questionnaire. Participants received a reward of €20 (i.e., about US\$27) when they completed at least 55% of the momentary assessments. The present study was approved by the Medical Ethical Committee (CMO Arnhem-Nijmegen, 2009, No. 285). See van Roekel et al. (2013) for a more detailed description of the procedure.

Late adolescents NL sample. All participants were recruited via an Internet sign-up program of the Behavioural Science Institute of the Radboud University Nijmegen, the Netherlands. Participants were required to have a smartphone, as the ESM questionnaires were to be filled out on their own smartphone. The study consisted of three parts. First, participants filled out an online baseline questionnaire, in which questions about demographic characteristics and trait loneliness were included. Second, 1 week after administration of the baseline questionnaire, participants were invited to an introduction to the ESM study in groups of four participants, which took place in the Behavioural Science Institute lab before the start of the momentary assessments. Participants were instructed to create a new Gmail e-mail address for the present study and to install the Gmail app on their smartphone. This app was programmed to emit a signal whenever participants received a new e-mail on their study e-mail address. Participants were instructed to pause their activity when they received a new e-mail and immediately fill out the questionnaire.

Third, the ESM data collection started 1 or 2 days after the instruction. The sampling period consisted of 11 days, with five questionnaires per day, at random time points between 10 a.m. and 11 p.m. on weekdays and between 11 a.m. and 11 p.m. on weekend days (resulting in 55 measurements in total). We used the program Mailchimp to send e-mails to participants on previously determined semirandom time points (i.e., time points were randomly chosen with an average time between time points of 160 min). In these e-mails, a link was provided to an online questionnaire. It took 3 to 5 min to fill out the online questionnaire. Participants received 12 course credits (for educational requirements) when they completed all parts of the study. The Ethical Committee of the Faculty of Social Sciences, Radboud University Nijmegen, approved the study protocols (2012, No. ECG2012-2711-061).

Late adolescents U.S. sample. One day prior to the Experience Sampling period, adolescents filled out a baseline questionnaire with which demographic variables and trait levels of loneliness were measured. The Experience Sampling period consisted of 7 days with nine randomly timed beeps per day. Participants carried a programmable watch that emitted signals between 10:00 a.m. and 12:00 a.m. When participants received a signal, they were instructed to pause their activity, take out one of the paper-and-pencil diaries, and fill out the questionnaire. Participants were asked to provide the time they received the beep and the time they started and finished filling out the diary, so that it was possible to check how much time elapsed between the beep and the moment when participants filled out the questionnaire. The study was approved by the Institutional Review Board at Ohio State University. Informed consent was obtained from all individual participants included in the study.

Measures

Trait Loneliness

Early adolescents NL sample. Trait loneliness was measured with the peer-related subscale of the Louvain Loneliness scale for Children and Adolescents (Marcoen et al., 1987), which consists of 12 items. Each item is rated on a 4-point scale, ranging from 1 (*never*) to 4 (*always*). A sample item was "I think I have fewer friends than others have." Cronbach's alpha was .88.

Late adolescent samples. Trait loneliness was assessed with the 20-item R-UCLA Loneliness Scale (Russell et al., 1980). Participants had to rate on a 4-point scale how often each statement was descriptive for them, from 1 (*never*) to 4 (*always*). A sample item was "I feel in tune with the people around me."

Although we used a different loneliness measure in the early adolescent sample, previous research has shown that the two measures provide relatively comparable measurements of individual differences in loneliness ($r = .76$; Goossens et al., 2009). Hence, to make the measures comparable across the three samples, we standardized the trait loneliness scores within samples.

State loneliness. In all samples, state loneliness was measured with one item that was measured at all momentary assessments: "I feel lonely." Participants filled out the extent to which they experienced these emotions on a 7-point scale, ranging from 1 (*not at all*) to 7 (*very much*) in the Dutch samples, and was rated on a 5-point scale in the U.S. sample, ranging from 1 (*not at all*) to 5 (*very much*).

Contextual Predictors

Early adolescents NL sample. For type of day (i.e., weekday vs. weekend day), a dummy variable was created to represent assessments on weekdays (0) and assessments on weekend days (1). For the social contexts, adolescents reported at each assessment whether they were alone or with company. When they were with others, they described in an open-ended question who that company was. These responses were coded to represent intimate (i.e., family and friends) and nonintimate company (i.e., classmates, teammates, strangers). For all samples, when adolescents reported that they were with both intimate and nonintimate company, only intimate company was scored.

Late adolescents NL sample. Type of day was measured similarly to the early adolescent sample. For the social contexts, adolescents reported at each assessment whether they were alone or with company. When they were with others, they were asked to describe who their company was by choosing from the following categories: family, friends, significant other, classmates, teammates, strangers, others.

These responses were coded to represent intimate company (i.e., family, friends, and significant other) and nonintimate company (i.e., classmates, teammates, strangers, others).

Late adolescents U.S. sample. Type of day was measured similarly to the early adolescent sample. For the social contexts, adolescents reported at each assessment with whom they were interacting and with whom they could be interacting. Based on these variables, we determined whether adolescents were alone (i.e., when they were not interacting with someone and could not be interacting with someone, they were alone) and who their company was. These responses were coded to represent intimate company (i.e., family, friends, and significant other) and nonintimate company (i.e., roommates, classmates, teachers, teammates, strangers, coworkers, neighbors, acquaintances, others).

Momentary Data Preparation

Early adolescents NL sample. The total data set consisted of 11,242 momentary assessments. Participants on average completed 37 momentary assessments, out of a maximum of 54 ($SD = 11.12$). Of the total sample ($N = 303$), we excluded the adolescents who had missing values on trait loneliness due to technical problems (1.65%, $n = 5$). Further, 17 adolescents (i.e., 5.61%) had less than 18 completed momentary assessments (i.e., one third of the maximum number of assessments), which was the minimum to be included in the analyses. In addition, as some of the research questions involved only the assessments in which adolescents were with others, we excluded those adolescents (2.64%, $n = 8$) who had very few assessments in which they were with others (i.e., fewer than 11 assessments with others). This resulted in a final data set with 10,404 momentary assessments in 269 adolescents. We checked whether the adolescents who were included in the analyses differed from the adolescents who were excluded from the analyses on demographic characteristics and trait loneliness. No differences were found ($p > .05$).

Late adolescents NL sample. The average number of assessments filled out within the time frame of 20 min after the signal was 35.85 ($SD = 9.18$), out of a maximum of 55. From the total sample ($N = 228$), a few participants were removed from the analyses ($n = 3$) because they had completed fewer than one third of the total number of assessments (i.e., 18 out of 55). Further, we excluded those participants who had fewer than 11 assessments in company ($n = 2$), which resulted in a final sample of 223 participants with 8,117 momentary assessments. We checked whether the participants excluded from analyses ($n = 5$) differed from those included in the analyses ($n = 223$) on demographic characteristics (i.e., age, sex) and trait loneliness. No differences were found ($p > .05$).

Late adolescents U.S. sample. Adolescents filled out on average 50.57 assessments ($SD = 11.95$) out of 63 assessments. In the total sample ($N = 135$), some participants filled out fewer than one third of the total number of assessments (i.e., fewer than 22 assessments) and were removed from the analyses ($n = 9$). All adolescents had more than 10 assessments in company. We checked whether the excluded adolescents differed from the adolescents in the analyses on demographic variables and trait loneliness. No differences were found ($p > .05$). The final data set consisted of 6,066 momentary assessments in 126 adolescents.

Plan of Analysis

Because our momentary assessments (Level 1) were nested within individuals (Level 2), we conducted multilevel regression analysis in Mplus (Muthén & Muthén, 1998–2007). The main advantages of multilevel analysis are that it does not require participants to have data on each assessment and it controls for the dependency of the data. In multilevel analysis, predictors can be entered at each level, making it possible to examine how situational characteristics (i.e., Level 1) as well as individual characteristics (i.e., Level 2) are related to state levels of loneliness. In addition, it is possible to examine cross-level interactions so that we can examine whether trait levels of loneliness (Level 2) moderate the relations between situational characteristics and state levels of loneliness (both Level 1 variables).

In the present study, we first calculated descriptive statistics for the three samples. For state loneliness, scores were aggregated within persons to represent a mean score calculated over all assessments. The correlations were calculated separately in the three samples, and correlation coefficients were compared between samples by using Fisher's r -to- z transformations.

Next, we conducted multilevel analyses to examine our research questions. As was mentioned earlier, trait and state loneliness measures were standardized within samples so that we were able to compare effects between samples. In all models, we first examined the relations in the total sample and subsequently used multigroup analyses to examine whether the results differed between the three samples. We did this by examining whether the model fit ($\Delta\chi^2$) of the model in which the paths of interest were allowed to differ between samples was significantly better than the model fit of the model in which all paths were constrained to be equal across samples. When significant differences were found between the samples for the path of interest, separate models were run to further examine these differences of early adolescents NL versus late adolescents NL to examine age-related differences and of late adolescents NL versus late adolescents U.S. to examine cultural differences.

First, we tested an initial model without predictors. Second, we examined the relation between trait and state levels of loneliness by adding trait loneliness as a Level 2 predictor.

For all next models, we first examined the relations between the Level 1 predictors and state loneliness, and in a subsequent model, the cross-level interaction with trait loneliness was entered to examine whether trait loneliness moderated the relations between the Level 1 predictors and state loneliness. Third, we examined whether the type of day (week vs. weekend) was related to state loneliness, by adding the dummy variable representing type of day to the model (with week days as the reference category). Fourth, the effects of social contexts were examined. Differences in state loneliness between situations alone and with company were examined by adding a dummy variable representing situations with company (score 0, reference category) versus situations alone (score 1). To examine differences in state loneliness between intimate and nonintimate company, a dummy variable was included with intimate company as the reference category. Finally, differences between being alone versus intimate and nonintimate company were examined. Assessments in which adolescents were alone were used as the reference category, and dummy variables representing intimate and nonintimate company were included. In all models, we controlled for sex.

RESULTS

Descriptive Statistics

First, mean levels of trait and state loneliness were calculated (see Table 1). The mean levels of trait loneliness in the early and both late adolescents were similar to those found in other Dutch community samples (e.g., van Roekel, Engels, Verhagen, Goossens, & Scholte, 2010) but slightly lower than those found in adolescent samples from the United States (e.g., Fiori & Consedine, 2013; Mounts, Valentiner, Anderson, & Boswell, 2006). Mean levels of trait loneliness in both late adolescent samples did not significantly differ from each other, $t(355) = -0.361, p > .05$. Mean trait loneliness levels could not be compared between the early and late NL samples, as different measures were used. State levels of loneliness were relatively low,

compared to the range (1–7 in early and late NL samples, 1–5 in late U.S. sample). The correlation between trait and state loneliness was significant in all three samples, indicating that higher levels of trait loneliness were associated with higher levels of state loneliness (see Tables 2 and 3). These correlations were similar in all three samples (Fisher's z scores ranged from $-.46$ to $-.04, ps > .05$).

Regarding the time spent in different contexts, it was found that compared to the late adolescent U.S. sample, early and late adolescents NL spent more time alone (Table 1). No significance difference was found between early and late adolescents NL. Late adolescents NL spent more time with intimate company than late adolescents U.S. and early adolescents NL. Finally, the time spent with nonintimate company significantly differed between the three samples; late adolescents NL spent the least time with nonintimate company, followed by early adolescents NL, and late adolescents U.S. spent most time with nonintimate company. We also tested whether the time spent in different contexts differed between week and weekend days. All samples spent more time in intimate company (i.e., 27% vs. 51% for early adolescents NL; 46% vs. 64% for late adolescents NL; 31% vs. 48% for late adolescents U.S.) and less time in nonintimate company (i.e., 39% vs. 5% for early adolescents NL; 13% vs. 6% for late adolescents NL; 40% vs. 22% for late adolescents U.S.) during weekends, compared to weekdays (ts ranged between -14.70 and -6.67 , all $ps < .001$). Time spent alone was higher during weekend days for early adolescents NL (i.e., 34% vs. 44%; $t = -6.06, p < .001$), was lower for late adolescents NL (i.e., 41% vs. 30%; $t = 5.78, p < .001$), but did not differ for late adolescents U.S. (i.e., 29% vs. 30%; $t = -0.56, p = .58$).

Model Results

First, we tested a model without predictors to estimate intraclass correlations for state loneliness. In all samples combined, the intraclass correlations was .30, indicating that 30% of the variance in state loneliness can be explained by individual predictors. Next, trait loneliness was entered

TABLE 1
Descriptive Statistics for Each Sample, Including Unstandardized Mean Levels

	Early Adolescents NL			Late Adolescents NL			Late Adolescents U.S.			F	df
	M (SD)	N	Range	M (SD)	N	Range	M (SD)	N	Range		
Trait Loneliness	17.67 (5.34)	269	12–48	35.88 _a (9.40)	223	20–80	35.12 _a (9.76)	126	20–80		
State Loneliness	1.31 (0.39)	269	1–7	1.34 (0.48)	223	1–7	1.31 (0.34)	126	1–5	0.30	622
% Alone	37.23 _a (14.94)	269	0–100	37.47 _a (16.97)	223	0–100	29.46 _b (13.24)	126	0–100	12.84***	622
% Intimate	34.25 _a (14.10)	269	0–100	52.30 _b (17.02)	223	0–100	35.13 _a (14.58)	126	0–100	93.85***	622
% Nonintimate	28.52 _a (9.97)	269	0–100	10.12 _b (8.01)	223	0–100	35.41 _c (14.89)	126	0–100	289.50***	622

Note. Means are compared horizontally. Mean levels with the same subscript do not significantly differ from each other. Mean levels with different subscripts significantly differ from each other. NL = the Netherlands; U.S. = United States.

*** $p < .001$.

TABLE 2
Correlations Between Model Variables in Early Adolescents NL Sample

	<i>Early Adolescents NL</i>					
	1.	2.	3.	4.	5.	6.
1. Sex ^a	—					
2. Age	-.10	—				
3. Trait Loneliness	.20**	-.08	—			
4. State Loneliness	.10	-.01	.32***	—		
5. % Alone	-.25***	.07	.00	.14*	—	
6. % Intimate	.29***	-.06	.05	-.18**	-.77***	—
7. % Nonintimate	-.04	-.02	-.08	.04	-.42***	-.27***

Note. NL = the Netherlands.

^a0 = male, 1 = female.

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

TABLE 3
Correlations Between Model Variables in Late Adolescent Samples

	<i>Late Adolescents NL</i>						<i>Late Adolescents U.S.</i>					
	1.	2.	3.	4.	5.	6.	1.	2.	3.	4.	5.	6.
1. Sex ^a	—						—					
2. Age	-.05	—					-.13	—				
3. Trait Loneliness	.00	.08	—				-.02	.06	—			
4. State Loneliness	.02	.06	.35***	—			.06	-.18*	.36***	—		
5. % Alone	-.15*	.15*	.13	.19**	—		-.22*	.13	.07	-.07	—	
6. % Intimate	.10	-.19**	-.18**	-.20**	-.89***	—	-.08	-.21*	-.08	-.06	-.43***	—
7. % Nonintimate	.10	.10	.10	.00	-.23**	-.24***	.28**	.09	.01	.13	-.47***	-.60***

Note. NL = the Netherlands; U.S. = United States.

^a0 = male, 1 = female.

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

in the model. Trait levels of loneliness were significantly and positively related to state levels of loneliness in the total group ($B = .21$, $SE = .03$, $p < .001$). No differences were found between the three groups, $\Delta\chi^2(2) = 3.17$, $p > .05$.

Type of day. We examined whether type of day was related to state loneliness. In the total group, a significant relation was found between type of day and state loneliness, in that adolescents experienced higher levels of state loneliness during the week ($B = -.05$, $SE = .02$, $p < .01$). No significant differences were found between the groups, $\Delta\chi^2(2) = 5.80$, $p > .05$.

Next, we examined whether trait loneliness moderated these relations. In the total sample, this interaction was borderline significant ($B = -.03$, $SE = .02$, $p = .05$). When comparing the constrained model with the unconstrained model, no significant differences were found, $\Delta\chi^2(2) = 3.04$, $p > .05$, indicating that there were no differences in relations across the samples. Hence, trait loneliness does

not moderate the relation between type of day and state loneliness in any of the samples.

Type of company. First, we examined the relation between the dummy variable for being alone versus being in company and state levels of loneliness. In the total sample, state levels of loneliness were higher in situations alone than in situations with others ($B = .28$, $SE = 0.02$, $p < .001$). Multigroup analyses showed that this relation differed for the three samples, $\Delta\chi^2(2) = 9.41$, $p < .01$. Further comparisons between samples showed that this relation did not differ between early and late adolescents NL, $\Delta\chi^2(1) = 3.68$, $p > .05$, and the relation was stronger in late adolescents NL ($B = .35$, $SE = 0.04$, $p < .001$) compared to late adolescents U. S. ($B = .19$, $SE = 0.04$, $p < .001$), $\Delta\chi^2(1) = 9.01$, $p < .01$. These findings indicate that early and late adolescents NL showed the greatest difference in state loneliness between situations alone and in company, whereas this difference is smaller, though significant, in the late adolescent U.S. sample.

Next, we examined whether trait loneliness moderated this relation. In the total sample, this interaction was significant ($B = .08, SE = .02, p < .001$). When we compared the unconstrained model with the constrained model, significant differences were found, $\Delta\chi^2(2) = 6.93, p < .05$. Further, when we compared the results between early adolescents NL and late adolescents NL, a significant difference was found between the samples, $\Delta\chi^2(1) = 5.84, p < .05$, whereas no difference was found between the two late adolescent samples, $\Delta\chi^2(1) = 0.08, p > .05$. For early adolescents, trait loneliness did not moderate the relation between alone versus company and state loneliness ($B = .02, SE = .03, p > .05$), whereas in late adolescents NL ($B = .13, SE = .05, p < .001$) and in late adolescents U.S. ($B = .11, SE = .04, p < .01$), the interaction was significant. As can be seen in Figure 1, trait lonely adolescents in both late adolescent samples had higher levels of state loneliness when alone than nonlonely adolescents and showed greater decreases in state loneliness when they were with others. These results suggest a developmental, rather than cultural, phenomenon.

In the next model, we included a dummy variable representing situations with intimate and nonintimate company. This variable was significantly related to state loneliness in the total sample ($B = .11, SE = .02, p < .001$), and this model did not differ between the three samples, $\Delta\chi^2(2) = 5.25, p > .05$, indicating that all adolescents experienced higher levels of state loneliness when with nonintimate company compared to intimate company. Further, moderation of trait loneliness was examined, which was significant in the total sample ($B = .10, SE = .02, p < .001$). Again, no differences were found between samples for this model, $\Delta\chi^2(2) = 0.85, p > .05$. As is depicted in Figure 2, adolescents high in trait loneliness experienced a greater difference in state loneliness between situations with intimate company versus nonintimate company, whereas for

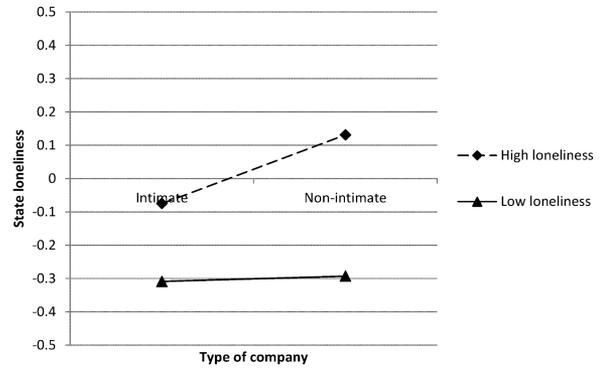


FIGURE 2 Moderation of trait loneliness in the relation between type of company (intimate vs. nonintimate) and state loneliness in the total sample.

low lonely adolescents, no difference in state loneliness was found between situations with intimate or nonintimate company.

In the final model, we examined differences in state loneliness between situations alone versus situations with intimate or nonintimate company, by including dummy variables representing intimate and nonintimate company (i.e., with situations alone as the reference group). In the total sample, we found that state loneliness was lower in situations with intimate company ($B = -.32, SE = .02, p < .001$) and nonintimate company ($B = -.20, SE = .02, p < .001$) compared to situations alone. No differences were found between samples for intimate company versus alone, $\Delta\chi^2(2) = 3.10, p > .05$, or for nonintimate company versus alone, $\Delta\chi^2(2) = 5.66, p > .05$.

Subsequently, we investigated whether trait loneliness moderated these relations. For situations alone versus intimate company, the interaction with trait loneliness was significant in the total sample ($B = -.11, SE = .02, p < .001$).

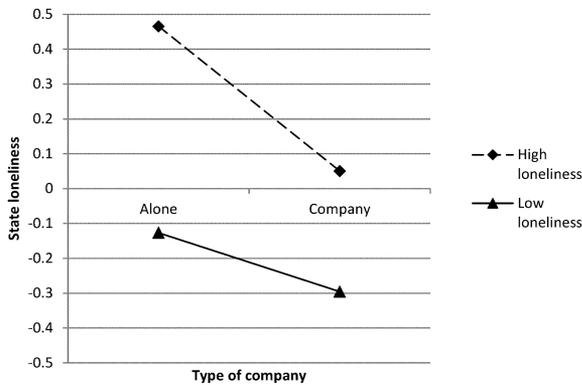


FIGURE 1 Moderation of trait loneliness in the relation between type of company (alone vs. company) and state loneliness in both late adolescent samples.

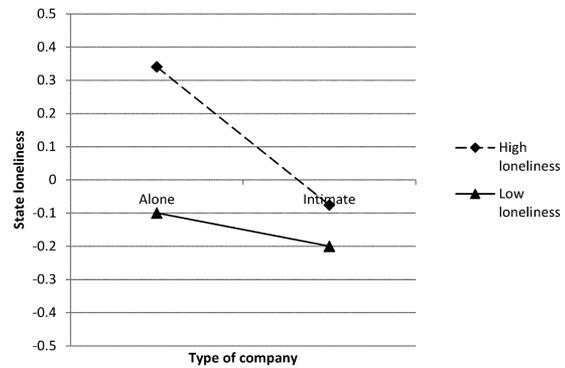


FIGURE 3 Moderation of trait loneliness in the relation between type of company (alone vs. intimate) and state loneliness in the total sample.

As can be seen in Figure 3, being alone or with intimate others has a bigger impact on lonely adolescents compared to nonlonely adolescents. Further, being with an intimate other lowers the level of state loneliness in high trait lonely adolescents to the level observed in nonlonely adolescents when they are alone. For situations alone versus nonintimate company, no moderation of trait loneliness was found in the total sample ($B = -.02$, $SE = .02$, $p > .05$). No differences were found between samples in the cross-level interaction for situations alone versus intimate company, $\Delta\chi^2(2) = 2.99$, $p > .05$, or in the interaction for situations alone versus nonintimate company, $\Delta\chi^2(2) = 2.57$, $p > .05$.¹

DISCUSSION

In the present study, we sought to examine relations between trait and state levels of loneliness in three samples. We found support for the differential reactivity hypothesis in all samples; adolescents high in loneliness had higher levels of state loneliness when they were alone and decreased more in state loneliness in situations with intimate company compared to adolescents low in loneliness. These findings show that lonely adolescents responded more negatively to being alone, but found more relief in intimate company, compared to nonlonely adolescents.

Differential Reactivity Hypothesis

We examined the differential reactivity hypothesis by analyzing whether trait lonely adolescents showed different responses to social contexts than trait nonlonely adolescents. Most of the results were similar in all samples and in line with the differential reactivity hypothesis. We found that trait lonely adolescents experienced a greater difference in state loneliness between situations with intimate and nonintimate company and greater differences in state loneliness between situations alone and with intimate company. These findings indicate that especially for lonely adolescents, being with intimate company seems to be a rewarding and

positive situation, in that they experience the lowest levels of state loneliness. These findings are in line with a previous study in the same early adolescent sample (van Roekel et al., 2013) that showed that lonely adolescents were more rewarded by higher levels of positive company than nonlonely adolescents. These findings combined may indicate that lonely people benefit more from being with intimate company, or others that they perceive positively. It is important to note that similar results were found in late adolescents with depressive symptoms, in that adolescents with more depressive symptoms reported greater decreases in negative affect and greater increases in positive affect when they perceived their company as more intimate (Brown, Strauman, Barrantes-Vidal, Silvia, & Kwapil, 2011). However, it should be mentioned that despite the greater decreases in state loneliness when with intimate company in lonely adolescents, the levels of state loneliness were still higher in the lonely group compared to the nonlonely group.

The finding that lonely adolescents have the highest levels of loneliness when alone, compared to intimate company, may also indicate that lonely adolescents use their time alone less constructively or in less rewarding ways than nonlonely adolescents. Previous studies have shown that trait loneliness is positively related to rumination (Vanhalst, Luyckx, Raes, & Goossens, 2012), that is, the repetitively and passively focusing on symptoms of distress (Nolen-Hoeksema, 1991), which in turn may increase negative emotions. As rumination may be a particularly solitary experience, it could be that lonely people ruminate more while they are alone and therefore have higher levels of state loneliness. Hence, further research should focus on how adolescents spend their time when they are alone or with others, and whether these activities affect their levels of state loneliness.

For one relation we found different results for the early adolescent NL sample compared to the two late adolescent samples. For both late adolescent samples, we found that trait lonely adolescents had greater differences in state loneliness between situations alone and with company (i.e., intimate and nonintimate combined). For early adolescents, no moderation of trait loneliness was found, indicating that high and low lonely adolescents responded similarly to situations alone and with company. These findings indicate that in late adolescence, lonely individuals respond more negatively to being alone. A possible explanation for this developmental difference may be that in early adolescence, being alone, which often occurs at home, may be less negative for lonely individuals, as family members are likely to be near. In late adolescence, being alone may be particularly stressful, as they have just made the transition to college and hence are probably really alone without a social network to fall back on.

In sum, the findings on moderation of trait loneliness in the relations between social contexts and state loneliness are

¹ As the late adolescent NL sample had an uneven gender distribution, we checked whether (a) differences in the time spent in different contexts and (b) differences in interactions between loneliness and type of company could be attributed to the differences in gender composition. As the gender composition of the late adolescent NL sample was particularly skewed, the gender differences are particularly important to explore in this sample. The results showed similar differences in time spent in different contexts for male and female participants between the late adolescent NL sample and the other samples. That is, the differences present in the total sample remained the same when we compared the percentages for male and female participants separately. Hence, the different gender distribution in this sample cannot explain the differences in time spent in different contexts. For the interactions between type of company and loneliness, no gender differences were found, indicating that our findings on differential reactivity apply to both male and female participants.

in line with the differential reactivity hypothesis, in that our findings show that trait lonely adolescents respond differently to social contexts than nonlonely adolescents.

Type of Day and State Loneliness

In all samples, we found that state loneliness was higher on weekdays than on weekend days. These findings may be explained by the variety of choice that adolescents have in whom they spent their time with during weekdays and weekend days. During weekdays, adolescents may be obligated to go to school or follow courses, study, or work, and hence they have less choice in companionship. During weekends, however, they can choose how and with whom they want to spend their leisure time, and therefore may be less lonely at those times. Our findings with regard to the time spent in different contexts support this explanation, as adolescents spent more time with intimate company and less time with nonintimate company during weekends compared to weekdays.

Type of Company and State Loneliness

The findings regarding state loneliness in different social contexts were remarkably similar in all three samples. Adolescents experienced the highest levels of loneliness when they were alone versus with company and lower levels of loneliness when they were with intimate company versus nonintimate company. These findings highlight the importance of intimate company such as family and friends in reducing feelings of loneliness in adolescents.

The only finding that differed between the samples was that early and late adolescents NL experienced a greater difference in state loneliness between situations alone and with company than the late adolescents U.S. sample, which implies that being alone was most negative for Dutch adolescents, as they showed greater increases in state loneliness when they were alone than late adolescents U.S.

Implications

Our findings on the differential reactivity hypothesis imply that trait lonely adolescents respond more positively to positive social environments (i.e., intimate company). These findings can provide starting points for intervention efforts, as increasing the time spent in intimate company might eventually reduce trait levels of loneliness both directly and indirectly. The direct consequence of spending more time with intimate company is that lonely individuals will experience less state loneliness as they feel less lonely with intimate company. An indirect consequence may be that spending more time with intimate company increases the number of positive social experiences, which could (a) boost lonely adolescents' confidence in social situations and (b) teach them skills they can use in situations with nonintimate company. Further research is needed to investigate

these hypothesized effects. In line with this, research could further explore whether the presence of a friend or family member in contexts with nonintimate company could buffer the negative effects of nonintimate company. As previous research has shown that lonely individuals are hypersensitive to negative social cues (see, e.g., Qualter et al., 2015), lonely adolescents may also need to learn adaptive coping strategies to deal with relatively negative social environments, such as nonintimate company.

Strengths and Limitations

The main strength of the present study is that we used the ESM, which made it possible to examine loneliness in the actual daily lives of adolescents. In addition, because we used data from three samples, we were able to study differences and similarities across different ages and cultures. However, some limitations need to be addressed as well.

First, some methodological issues have to be considered. There were some differences in the measurement of trait and state loneliness between the three samples. In the early adolescent sample, we used the Louvain Loneliness Scale for Children and Adolescents, as this questionnaire is developed for younger children and therefore suitable for early adolescents. In both late adolescent samples, we used the Revised-UCLA loneliness scale, which is typically used in late adolescent and older adult samples (Russell et al., 1980). Although these are different scales, we do think they tap the same construct, as the two scales correlated highly with each other in a student sample ($r = .76$; Goossens et al., 2009). In addition, we standardized the scale scores within samples. Therefore we think that this difference in measurement did not significantly influence the results. For state loneliness, we used the same item in all three samples, but the response scale differed between samples. In the Dutch samples the item was rated on a 7-point scale, whereas in the U.S. sample the item was rated on a 5-point scale. Again, we standardized the state loneliness measures within samples, so that we had comparable measures between the samples. Still, the differences in response scale could have affected how adolescents filled out the item. This should be taken into consideration when interpreting the results. Important, though, our findings were remarkably similar across the three samples, showing that even though we used different measures or response scales, this likely did not affect our results to a great extent.

In addition, there were some differences in how the social contexts were measured. In the early adolescent sample, we used open-ended questions in which adolescents had to describe who their company was, whereas for both late adolescent samples, multiple-choice answers were provided. As we did not measure how close participants were with their company in all samples, we had to divide the social contexts in intimate versus nonintimate company based on the objective categories (i.e., family, friends, classmates) rather than on subjective experiences (i.e., how close

or intimate participants were with their company). Although this means that the categories were objectively the same in all samples, there may have been differences in how close participants were with their company. For example, roommates may be considered intimate company for some adolescents, whereas other adolescents may not experience close relationships with their roommates. Yet, based on our findings, we are confident in our categorization, partly because the levels of state loneliness adolescents experienced in the different social contexts were as expected (i.e., higher loneliness in nonintimate company compared to intimate company). Further research is necessary to examine whether the objective categorization is in line with subjective levels of intimacy, and whether this affects the levels of state loneliness that are experienced in those subjective contexts.

In addition to these methodological issues, there are some limitations concerning the samples in the present study. We used normative adolescent samples and measured trait levels of loneliness only once. Although it is likely that these feelings of loneliness have persisted over a longer period (i.e., at least a few weeks), we do not know how long adolescents experienced trait loneliness. Some adolescents may have been lonely for a few weeks, whereas others may have been lonely for years. Information about the duration of loneliness or multiple assessments over a longer period are needed to examine whether the association with state loneliness differs depending on how long trait loneliness has persisted, as the duration of loneliness may affect daily life experiences. For example, Vanhalst et al. (2015) found evidence for hypervigilance to social exclusion and hypovigilance to social inclusion only in adolescents who experienced loneliness throughout adolescence, which could indicate that this group may encounter particularly negative social experiences in daily life as well. Further research should measure the duration of trait loneliness in order to examine whether the duration of loneliness affects daily life experiences. Further, the late adolescent NL sample consisted mainly of female participants, and both late adolescent samples consisted exclusively of highly educated adolescents (i.e., college students). Samples that are more balanced in terms of sex and educational levels may provide results that are generalizable to the general population.

Conclusion

In sum, our findings provide support for the differential reactivity hypothesis, as lonely adolescents responded differently to social contexts. Compared to low lonely adolescents, lonely adolescents experienced higher levels of state loneliness when alone and with nonintimate company but also benefited more from being with intimate company. The experience of loneliness in daily life was

remarkably similar across age and culture. The present study provides important insights into the daily experiences of trait lonely people, which may provide starting points for interventions.

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