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# **Content Specificity of Interpretation Bias Related to Social and Emotional Loneliness in Emerging Adulthood**

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According to cognitive theories, loneliness is associated with biased cognitive processes. However, studies investigating interpretation bias (IB) related to feelings of loneliness are scarce. The current study aimed to investigate (a) whether emotional loneliness (perceived absence of intimacy) and social loneliness (perceived absence of satisfying connections) are associated with a negative IB while controlling for related psychosocial symptoms, and (b) whether these two types of loneliness show content-specific IB. Sample 1 included an unselected university sample ( $N = 138$ , 81.9% female,  $M = 20.8$  years,  $SD = 4.4$ ), and Sample 2 utilized a preselected university

sample with elevated anxiety/depression levels ( $N = 315$ , 69.5% female,  $M = 23.8$  years,  $SD = 4.3$ ). Participants completed questionnaires on emotional and social loneliness, social isolation, social anxiety, depression, hostility, and an ambiguous scenarios task measuring IB. The results showed that emotional and social loneliness were uniquely associated with a negative IB related to the unavailability of social network. Social loneliness was additionally positively related to an IB for rejection and negatively to an IB for hostility in Sample 2. These results provide evidence for a content-specific negative IB in both types of loneliness. Future studies are needed to replicate these findings as it could aid in developing an effective treatment program for loneliness targeting underlying cognitions in young adults.

**Keywords:** interpretation bias; content-specificity; loneliness; social isolation; social anxiety; depression

**L**oneliness is a negative emotional state in which people feel disconnected because of a perceived mismatch between the desired and actual quality or quantity of their social connections (Ferreira, 1962). The essence of this definition is “perception,” differentiating loneliness from social isolation, the objective measure of having a small social network (Coyle & Dugan, 2012). Two dimensions of loneliness can be differentiated, namely emotional and social loneliness (Weiss, 1973). Emotional loneliness refers to the perceived absence of a close social connection, whereas social loneliness is related to the perceived lack of a satisfying social network. Earlier studies have shown that emotional and social loneliness share a common negative affective experience but are distinct constructs and need to be distinguished when investigating loneliness (e.g., Dahlberg & McKee, 2014).

Social connections serve different functions according to the theory of the functional specificity of relationships (Weiss, 1974). The perceived lack of these relationships comes in different forms (i.e., emotional and social loneliness), with different underlying mechanisms. Feelings of loneliness are often temporary and fade over time, but in some cases feelings of loneliness become chronic, which leads to numerous negative consequences. For example, loneliness has been demonstrated to increase negative mood and to lower self-esteem and sleep quality, and has been related to negative health outcomes, higher mortality, social anxiety, depression, and suicidality (Cacioppo et al., 2006). Especially during emerging adulthood (18–29 years of age), young adults are at risk for feelings of loneliness due to an increase in autonomy and social changes (Auerbach et al., 2018). Indeed, common mental health symptoms, such as loneliness, depression, and social anxiety, emerge during this phase of life (Kessler et al., 2007). Considering the far-reaching negative health outcomes of loneliness (Lee et al., 2020), it is important to gain a better understanding of the processes driving emotional and social loneliness in emerging adulthood.

## COGNITIVE BIASES AND LONELINESS

According to cognitive theories, individuals who feel lonely show cognitive biases in all information processing stages (i.e., attention, interpretation, and memory). These cognitive biases are theorized to maintain feelings of loneliness (Cacioppo & Hawkley, 2009; Qualter et al., 2015; Spithoven et al., 2017). For example, the social cognitive theory by Cacioppo and Hawkley (2009), recently revised by Qualter et al. (2015), states that loneliness results in a state of hypervigilance for social threats that can turn into negatively biased cognitive processes. Moreover, these biases are thought to be *content-specific*, meaning that only stimuli associated with the content of one’s main concern/issues are biased (content specificity hypothesis; Amir et al., 1998; Beck, 1976), such as threat for anxiety disorders, personal failure/hopelessness for depression, and unavailability

of social network for loneliness (Cacioppo & Hawkley, 2009). As cognitive biases such as biased interpretations might play an important role in the etiology and maintenance of loneliness and can serve a crucial role in developing effective treatments, investigating these relations is imperative (Mathews & MacLeod, 2005). The current study investigated biased interpretation and its content specificity in relation to loneliness in young adults.

To the best of our knowledge, only three studies so far have investigated interpretation bias and loneliness in younger people. Studies so far have used written vignettes of ambiguous social situations with multiple possible interpretations that participants rate on likelihood (i.e., ambiguous scenario task, AST). Two studies included children (Prinstein et al., 2005; Qualter et al., 2013) and only one study examined young adults (18–24 years old; Lau et al., 2021). Qualter et al. (2013) found that lonely children were more likely to choose a negative interpretation in response to socially *rejecting* ambiguous scenarios than children who did not feel lonely. Similarly, Lau et al. (2021) investigated interpretation bias related to social threat in young adults by including ambiguous scenarios related to *rejection* and *fear of negative evaluation* and their relation to loneliness over time. They found a positive relationship between social threat bias and loneliness, with moderate to strong correlations between loneliness and social threat bias at different time points ( $.45 \leq r \leq .61$ ). Prinstein et al. (2005) did not find a significant relation between *hostility* bias and loneliness in children and young adolescents. Thus, previous studies found some evidence for the presence of an interpretation bias in loneliness related to different ambiguous social situations, but results may differ depending on the specific content of the ambiguous scenarios. None of these studies included ambiguous scenarios that specifically pertained to the (un)availability of social network, nor have they controlled for social anxiety and depression levels. Moreover, it might very well be that the results were explained by heightened social anxiety or depression as these symptoms often present simultaneously (Kessler et al., 2007; Lee et al., 2020; Santini et al., 2020).

The heightened implicit sensitivity to social threat that characterizes loneliness is theorized to drive social anxiety symptoms. Also, both loneliness and social anxiety are associated with similar negative social cognitions (Cacioppo & Hawkley, 2009; Cacioppo et al., 2006). The conceptual differences between depression and social anxiety on the one side and loneliness on the other side have often been questioned (e.g., Lim et al., 2016). However, the difference between these constructs has been demonstrated in several studies (e.g., Cacioppo et al., 2006; Danneel et al., 2020; Fung et al., 2017). Nonetheless, the strong overlap between all three constructs and related dysfunctional cognitions makes the content specificity of interpretation bias unclear. Furthermore, loneliness, social anxiety, and depression are related to objective social isolation (Cacioppo et al., 2006). Therefore, it is important to control for the objective lack of social connections (social isolation) while examining content specificity of interpretation bias related to perceived lack of availability of social network (loneliness). Clarifying whether loneliness, depression, social anxiety, and social isolation are characterized by unique and content-specific interpretation biases allows for theoretical specifications (e.g., content specificity hypothesis), maintaining cognitive factors in loneliness, and resulting suggestions for possible adjustments for interventions that target the alarming, recent increase in loneliness in young adults (Lee et al., 2020). Therefore, it is important to investigate the content specificity of interpretation biases in loneliness, social anxiety, depression, and social isolation while controlling for related constructs (Wilson & Rapee, 2005).

## CURRENT STUDY

The overall goal of this study was to investigate the relation between (the content specificity) negative interpretation bias and loneliness. More specifically, the first aim was to examine biased

interpretation in relation to loneliness and its content specificity in young adults using an AST. The second aim was to investigate the differences in interpretation biases related to emotional and social loneliness. Third, we aimed to investigate the content specificity of interpretation biases related to emotional and social loneliness while controlling for the effects of possible overlapping distorted cognitions by social anxiety, depression, and social isolation. Fourth, sensitivity analyses were conducted to assess the content specificity of the interpretation biases related to social anxiety, depression, and social isolation while controlling for emotional and social loneliness and social isolation (depending on the dependent variable included). These aims were tested in two independent samples: (a) an unselected group of university students and (b) a preselected university sample of young adults with elevated symptoms of anxiety and/or depression. This allows for a more thorough test of our hypotheses, as well as replication of our study in a sample with elevated anxiety and/or depression.

The following hypotheses were formulated as follows: (a) Higher levels of emotional and social loneliness are positively associated with a more negative interpretation bias after controlling for social anxiety, depression, and social isolation; (b) in line with the content specificity hypothesis, we expected to find a unique match between the type of symptom and the content of the interpretation bias: higher levels of emotional and social loneliness are related to higher levels of a negative interpretation bias specifically for social network-related scenarios, and not for other anxiety- and depression-related scenarios; and with regard to the sensitivity analyses: (c) higher levels of social isolation are associated with a negative bias related to scenarios of the social network, higher levels of social anxiety are related to a negative interpretation bias related to rejection and fear of negative evaluation, but not to the social network, and finally, higher levels of depression are related to a negative interpretation bias related to hopelessness, but not to the social network.

## METHODS

### Participants

**Sample 1.** We recruited an unselected convenience sample of university students enrolled at the University of Amsterdam, the Netherlands. An online survey was distributed among university students after they announced interest in participating in the study. For sample 1, 203 university students were invited to participate, and 138 participants provided study data. The mean age of the total sample ( $N = 138$ ) was 20.8 years ( $SD = 4.4$ ). The majority of the sample were female ( $n = 113$ , 81.9%).

**Sample 2.** Sample 2 included 315 university students with elevated symptoms of general anxiety and/or depression symptoms. Elevated symptoms were defined as scoring a 4 or higher on the Seven-Item Generalized Anxiety Disorder scale (Spitzer et al., 2006), or with a score of 15 or higher on the Center for Epidemiological Studies–Depression (CES-D) scale (Radloff, 1977). The mean age of the sample was 23.8 ( $SD = 4.3$ ) years old. The majority of the sample were women ( $n = 219$ , 69.5%). See Table 1 for the descriptive statistics of both samples.

### Materials

*Loneliness* was measured in both samples with the De Jong Gierveld Loneliness Scale (DJGLS; de Jong-Gierveld & Kamphuis, 1985). The 11-item DJGLS consists of two sub-scales: six items on emotional loneliness and five items on social loneliness. An example item is: “I miss having a really close friend.” Participants provide their answers on a 5-point scale ranging from “yes! (all of the time)” to “no! (none of the time).” Total scores were calculated after dichotomizing the answers (yes! [all of the time] and yes [often] = 1; more

**TABLE 1. DESCRIPTIVE STATISTICS OF PARTICIPANTS IN SAMPLE 1 ( $N = 138$ ) AND SAMPLE 2 ( $N = 315$ )**

	Sample 1		Sample 2	
	<i>n</i>	%	<i>n</i>	%
Gender				
Female	113	81.9	219	69.5
Male	25	18.1	91	28.9
Other	0	0.0	5	1.6
International student	95	68.8	145	46.1
Survey in English	124	89.9	142	45.1
Relationship status				
Single	85	61.6	153	48.6
In a relationship	51	37.0	112	35.7
Civil partnership	1	0.7	15	4.8
Married	1	0.7	22	6.9
Other	0	0.0	12	3.9
Ethnicity				
African	1	0.7	0	0.0
Asian	23	16.7	29	9.3
Eastern European	19	13.8	28	8.8
North American	0	0.0	18	5.7
South American	9	6.5	22	7.0
Western European	85	61.6	177	56.2
Other	0	0.0	41	13.0
Living situations				
Alone	48	34.8	86	27.3
With parent(s)	20	14.5	40	12.8
With partner	13	9.4	62.8	20.0
With roommates	54	39.1	109	34.7
Other	3	2.2	16.6	5.3
Employment status				
Currently employed <20 hours/week	46	33.3	116	36.7
Currently employed $\geq$ 20 hours/week	7	5.1	39	12.3
Currently unemployed	30	21.7	87	27.5
No employment history	55	39.9	74	23.6

or less [some of the time], no [rarely], and no! [none of the time] = 0, depending on whether the items were formulated negatively/positively). The total score for the emotional loneliness and social loneliness subscales ranges between 0 and 6, and between 0 and 5, respectively. A higher score indicates more loneliness. The DJGLS, and its subscales, revealed good internal consistency and validity (based on the 11-item total scale:  $\alpha = .84$ ;

based on the 6-item scale: emotional loneliness:  $\alpha = .90$ , social loneliness:  $\alpha = .88$ ; De Jong Gierveld and Van Tilburg, 2010; Maes et al., 2022). In Sample 1, the internal consistency was  $\alpha = .77$  for social loneliness and  $\alpha = .81$  for emotional loneliness. In Sample 2, the internal consistency was  $\alpha = .80$  for emotional loneliness and  $\alpha = .85$  for social loneliness.

*Social isolation* was assessed in both samples with the Six-Item Lubben Social Network Scale (LSNS-6; Lubben, 1988). The LSNS-6 consists of six items, with three items related to the number of family members and three items related to the number of friends. Participants answered on a 6-point scale ranging from 0 (*no relatives/friends*) to 5 (*nine or more relatives/friends*). All items were reverse-scored for clarity reasons; a higher score on the LSNS-6 scale indicates more social isolation. The total score ranges from 0 to 30. The LSNS-6 reports good psychometric properties in older adults ( $\alpha = .83$ ) and has recently been used in young adult samples, as well as good internal consistencies (with  $\alpha$  ranging between .78 and .84; e.g., Lim et al., 2019; Nandi et al., 2012; Rice et al., 2020; Watabe et al., 2015). In Sample 1, the internal consistency was  $\alpha = .76$  for the family subscale and  $\alpha = .81$  for the friends subscale. In Sample 2, the internal consistency was  $\alpha = .75$  for the family subscale and  $\alpha = .82$  for the friends subscale.

*Depression* was administered in both samples using the CES-D-20 (Radloff, 1977). Participants provided answers on a 4-point scale ranging from 0 (*rarely or none of the time*) to 3 (*most of all the time*). Item 14, "I felt lonely," was removed from the questionnaire to avoid confounding effects. The total score for the CES-D-20 ranges between 0 and 57. A higher score indicates more severe symptoms of depression. The questionnaire showed good psychometric properties and internal consistency in student samples (with  $\alpha$  ranging between .67 and .91; Blodgett et al., 2021; Garrison et al., 1991; Hales et al., 2006). The internal consistency of CES-D-19 in Samples 1 and 2 was  $\alpha = .89$  and  $\alpha = .87$ , respectively.

*Social anxiety* was measured in both samples with the Social Interaction Anxiety Scale (SIAS-6; Peters et al., 2012). Participants provided answers on all six items using a 4-point scale, ranging from 0 (*not at all characteristic of me*) to 4 (*extremely characteristic of me*). The total score of the SIAS-6 ranges between 0 and 24. A higher score reflects more severe social anxiety symptoms. The SIAS-6 appeared to be valid in both clinical and research applications (Mattick & Clarke, 1998). The internal consistency of the SIAS-6 was  $\alpha = .79$  in Sample 1 and  $\alpha = .82$  in Sample 2.

*Hostility* was assessed in Sample 1 using the hostility subscale of the Short-Form Buss-Perry Aggression Questionnaire (BPAQ-SF; Buss & Perry, 1992). This subscale, consisting of three items, was administered in the current study. Participants were asked to rate their answer on a 5-point scale from 1 (*extremely uncharacteristic of me*) to 5 (*extremely characteristic of me*). The total score on the hostility subscale ranges from 3 to 15, with higher scores indicating more severe hostile feelings. Validation research showed acceptable test-retest reliability (intraclass correlation coefficient = .63) for the hostility subscale (Webster et al., 2014). The internal consistency of the BPAQ-SF in the current study was  $\alpha = .69$ . The BPAQ-SF was not administered in Sample 2 as the variables of interest were part of a larger assessment and we wanted to reduce participant burden.

*Interpretation bias* was assessed in both samples using an AST. The AST was administered to assess interpretation bias in varying social ambiguous situations. For the current study, we developed ambiguous scenarios related to five sociocognitive themes: (a) rejection, (b) fear of negative evaluation, (c) unavailability of social network, (d) hopelessness, and (e) hostility. The AST included 25 scenarios, with 5 scenarios reflecting each theme. The scenarios related to social anxiety, depression, and hostility bias themes were adapted from existing materials used in previous studies (Berna et al., 2011; Dillon et al., 2016; Klein et al., 2015, 2018). The ambiguous scenarios related to the unavailability of social network were created by the authors

with clinical expertise in assessing and treating loneliness and with experience in developing ASTs to measure interpretation bias in mental health disorders. Several informal pilots were conducted to ensure the ambiguity and likeliness of the scenarios and interpretations. In the pilot studies, participants were presented with the vignettes and were asked to rate the ambiguity of the scenario on a scale from 0 (*very negative*) to 4 (*very positive*). Next, they were asked to rate the probability of encountering a similar situation in daily life on a scale from 0 (*very unlikely*) to 4 (*very likely*). After reading the scenario, participants were presented with one negative and one positive interpretation associated with the described situation. Participants were asked to rate the valence of both interpretations on a scale from 0 (*very negative*) to 4 (*very positive*). Participants were then asked to choose the interpretation that would most likely come to mind. Finally, they were asked how likely they would interpret the situation as described in the chosen interpretation on a scale from 0 (*very unlikely*) to 4 (*very likely*). The scenarios and interpretations were adapted until all 25 scenarios were rated as ambiguous ( $M = 1.7$ ,  $SD = .5$ ) and likely ( $M = 2.5$ ,  $SD = .5$ ); the positive endings were rated as positive ( $M = 3.0$ ,  $SD = .3$ ), the negative endings were rated as negative ( $M = .6$ ,  $SD = .3$ ), and the endings were evaluated as likely ( $M = 2.5$ ,  $SD = .6$ ). See Table 2 for examples of scenarios and endings for all five themes.

Participants were presented with written vignettes and were instructed to imagine that the scenario was happening to them as vividly as possible. They were then asked to choose the ending that would most likely come to mind in that particular situation. Answers were recoded into “1” for negative interpretations and “0” for positive interpretations. The average scores of the selected interpretations were computed for five scenarios per theme, which resulted in an interpretation bias score per theme. Interpretation bias scores ranged between 0 and 1, with a higher score indicating a more negative interpretation bias. The internal consistencies of the bias themes in Sample 1 were the following: On average, the scenarios of the AST were negatively interpreted for 29.0% of the answers in the unselected sample and 32.6% in the sample with elevated symptoms.

## Procedures

Sample 1 was collected between December 2019 and February 2020, and Sample 2 was collected from November 2019 to August 2020. In Sample 1, participants received an invitation email including a link to the online survey. The questionnaire took approximately 15–20 minutes. After completion, participants received either academic credits or a financial compensation of €7.50. In Sample 2, all undergraduate university students of the University of Amsterdam were invited to participate in an online screening survey to assess (mental) health indices as part of a larger project that focused on the mental health of university students. University students with mild to severe complaints of general anxiety and/or depression were invited via email to participate in a randomized controlled trial (RCT) providing an e-health intervention to reduce symptoms of general anxiety and depression. Participants completed the AST and the questionnaire as part of the baseline measure prior to the intervention. A more detailed description of the study protocol is published elsewhere (for details, see Klein et al., 2021). The Ethics Review Board of the University of Amsterdam approved the procedure for Sample 1 (2019-DP-11170). The procedure for Sample 2 was approved by the Medical Ethics Review Committee (METC) of the Academic Medical Centre, Amsterdam, the Netherlands (NL64929.018.18).

## Statistical Analysis, Missing Data, and Power Analysis

**Power Analysis.** For Sample 1, a medium effect size of  $f^2 = .15$  was expected based on meta-analyses on interpretation bias in anxiety and depression (Everaert et al., 2017; Stuijzand et al.,

**TABLE 2. EXAMPLE SCENARIOS OF ALL THEMES IN THE AMBIGUOUS SCENARIO TASK**

Theme	Scenario	Thoughts
Rejection	Neighbor	Positive: My neighbor must have been lost in her thoughts or she would have waved.
	It is Saturday morning and you go out shopping, when you see a neighbor further down the street. You wave at her but she does not respond.	Negative: My neighbor does not want to say hi to me in the streets.
Fear of negative evaluation	Laughing	Positive: One of them just made a joke.
	You met up with two friends for a cup of coffee.	Negative: They are laughing at me.
	You see that your friends are already sitting inside. When they notice you, they start laughing.	
Unavailability of social network	Doctor	Positive: My best friend is always available to come with me.
	You have an appointment at the doctor for a medical check-up.	Negative: I do not know who to ask, no one cares.
	The doctor advised you to take someone with you for the appointment. Now you have to ask someone if they are available to come with you.	
Hopelessness	Good weather	Positive: The forecast was good, so it will probably clear up soon enough.
	For the past 2 weeks it has been raining quite a lot.	Negative: I had better go home because bad things keep happening.
	Today the forecast is great, hence you planned a trip to the city. When you walk out the door, it starts to drizzle.	
Hostility	Grocery shopping	Positive: The person pushing me is an old acquaintance trying to get my attention.
	You are in the supermarket getting your weekly groceries.	Negative: This person is trying to hurry me up.
	Suddenly you feel a push from the side. You notice someone bumps his shopping cart into you.	

2018). A statistical power ( $1-\beta$ ) of .8 and an  $\alpha$  of .05 were determined. The number of tested predictors was set at 5 (corresponding with the number of themes). Based on these assumptions, a sample size ( $n$ ) of 92 participants was needed. For Sample 2, we only calculated power for the full RCT and asked all participants to also complete the AST.

**Missing Data.** Data collection in Sample 1 resulted in missing data on the self-report measures of loneliness, social isolation, depression, and social anxiety ( $\leq 2.9\%$ ). Considering the low percentage of missings, listwise deletion was used to handle missing data in all analyses. In Sample 2, the data collection resulted in missing data on the depression questionnaire and AST ( $\leq 14.6\%$ ) and sociodemographics ( $\leq 15.2\%$ ). To handle missing data, multiple imputation

( $m = 5$ ) was used (Rubin, 1987). Also, as only five participants indicated that their gender was “other,” this group was too small for the analyses and were therefore excluded.

**Data Analysis.** Pearson correlations were calculated to explore the expected medium associations between emotional and social loneliness, social isolation, social anxiety, depression, hostility, and the different interpretation bias themes. Next, five, two-step hierarchical regression analyses were conducted to examine the presence and content specificity of negative interpretation biases in emotional and social loneliness, social isolation, social anxiety, and depression. No evidence was found for nonlinearity and multicollinearity between the variables included in all regression analyses (Sample 1:  $1.015 \leq$  variance inflation factor [VIF]  $\leq 1.789$ ,  $.559 \leq$  tolerance  $\leq 0.985$ ; Sample 2:  $1.013 \leq$  VIF  $\leq 1.405$ ,  $.712 \leq$  tolerance  $\leq 0.987$ ). Skewness and kurtosis values showed that residuals were normally distributed (Sample 1: skewness  $-.615$  to  $0.879$ , kurtosis  $-1.404$  to  $.391$ ; Sample 2: skewness  $-.214$  to  $.779$ , kurtosis  $-1.415$  to  $.238$ ).

In the first two regression analyses, emotional and social loneliness were the respective dependent variables. In the first step, age and gender (0 = female, 1 = male), self-reported social isolation related to family, social isolation related to friends, social anxiety, depression, and hostility variables were entered as predictors. In the second step, the five interpretation bias scores were entered as predictors to test if these biases predicted variance over and above the variance explained by the effects of the social isolation, social anxiety, depression, and hostility measures.

Finally, sensitivity analyses were performed using three hierarchical regressions with social anxiety, depression, and social isolation as dependent variables. For all regression analyses, age, gender, emotional and social loneliness, and—depending on the dependent variable—social anxiety, depression, and social isolation were added as predictors in the first step. In the second step, the interpretation bias scores were entered. In Sample 2, some technical difficulties, unrelated to the content of the AST, occurred when administering one of the hostility scenarios of the interpretation bias task. Therefore, all analyses including the hostility bias theme data were based on only four out of five scenarios. For all analyses, IBM SPSS Statistics version 25 was used. The Holm–Bonferroni correction (Holm, 1979) was applied to all regression models to control for type I error related to multiple testing, while avoiding an increased risk for type II error, which is referred to as  $p_{corr}$ .

## RESULTS

### Correlations

In Samples 1 and 2, emotional and social loneliness were significantly and positively related. Emotional and social loneliness were also significantly and positively correlated with all self-report measures (see Table 3 for all correlations). As expected, higher levels of emotional and social loneliness were moderately associated with a more negative interpretation of ambiguous scenarios related to the unavailability of social network. As expected, social anxiety was significantly and positively correlated with rejection and fear of negative evaluation bias, and depression with hopelessness bias. Further, self-reported hostility was significantly correlated with hostility bias (in Sample 1). Finally, social isolation from friends and relatives were both significantly related to the unavailability of the social network bias.

### Interpretation Bias and Loneliness Types

**Social Loneliness.** With regard to social loneliness, the first step of the regression model including age, gender, social anxiety, depression, and hostility (only Sample 1) was significant in Samples 1 and 2 ( $F[7, 126] = 18.990$ ,  $p_{corr} < .001$ ,  $R^2 = .486$ ;  $F[6, 303] = 43.413$ ,  $p_{corr} < .001$ ,

**TABLE 3. PEARSON CORRELATIONS BETWEEN LONELINESS TYPES, SOCIAL ISOLATION, SOCIAL ANXIETY, DEPRESSION, AND INTERPRETATION BIAS THEMES**

Variable	1	2	3	4	5	6	7	8	9	10	11	12
1. Emotional loneliness	–	.60**	.28**	.46**	.42**	.37**	–	.24**	.24**	.45**	.19*	.09
2. Social loneliness	.61**	–	.42**	.61**	.43**	.37**	–	.28**	.24**	.54**	.24**	.05
3. SI–family	.43**	.65**	–	.45**	.28**	.25**	–	.11*	.07	.34**	.09	.03
4. SI–friends	.28*	.36**	.43**	–	.28**	.39**	–	.15*	.17*	.34**	.15*	.11
5. Social anxiety	.51**	.38**	.35**	.16*	–	.31**	–	.28**	.40**	.38**	.20**	.14*
6. Depression	.60**	.42**	.42**	.39**	.41**	–	–	.28**	.32**	.30**	.38**	.16*
7. Hostility	.36**	.34**	.25*	.08	.27*	.43**	–	–	–	–	–	–
8. Rejection bias	.32**	.14	.09	.12	.26**	.26*	.26*	–	.54**	.27**	.31**	.31**
9. FNE bias	.24*	.25*	.17*	.16	.30**	.30**	.29*	.38**	–	.34**	.32**	.27**
10. USN bias	.51**	.50**	.44**	.36**	.44**	.33**	.18*	.21*	.28*	–	.30**	.09
11. Hopelessness bias	.22*	.18*	.08	.25*	.23	.32**	.28*	.17*	.26*	.25*	–	.36**
12. Hostility bias	.11	.11	–.02	.10	.17	.19*	.22*	.20*	.32**	.20*	.19*	–

**Note.** Correlations below the diagonal represent Sample 1, and correlations above the diagonal represent Sample 2.

FNE = fear of negative evaluation; SI = social isolation; USN = unavailability of social network.

\* $p < .05$ . \*\* $p < .001$ .

$R^2 = .462$ , respectively). In Sample 1, gender, social isolation from family, social anxiety, and hostility were significant predictors of social loneliness. In Sample 2, social isolation from family as well as from friends, social anxiety, and depression were significant predictors of social loneliness (see Tables 4 and 5 for all estimates).

The second and most interesting model including the biases was also significant in Samples 1 and 2 ( $F[12, 121] = 11.666$ ,  $p_{corr} < .001$ ,  $R^2_{change} = .023$ ;  $F[11, 298] = 31.472$ ,  $p_{corr} < .001$ ,  $R^2_{change} = .075$ , respectively). Interestingly, in Sample 1, only higher social isolation from family remained a significant predictor of higher social loneliness in this step. Additionally, a higher negative interpretation bias pertaining to unavailability of social network significantly predicted higher social loneliness, while controlling for all other bias themes and over and above all predictors in step 2. In Sample 2, higher social isolation from friends, social anxiety, and depression remained significant predictors of higher levels of social isolation. Of the negative interpretation biases, higher levels of rejection bias, unavailability of the social network bias, as well as lower levels of hostility bias significantly predicted higher levels of social loneliness.

**Emotional Loneliness.** With regard to emotional loneliness, in Samples 1 and 2, the first model including age, gender, social anxiety, depression, social isolation, and hostility (only Sample 1) was significant,  $F(7, 126) = 16.076$ ,  $p_{corr} < .001$ ,  $R^2 = .442$ ;  $F(6, 303) = 23.449$ ,  $p_{corr}$

**TABLE 4. HIERARCHICAL REGRESSION ANALYSES PREDICTING EMOTIONAL AND SOCIAL LONELINESS IN SAMPLE 1**

Step	Variables	Social loneliness					Emotional loneliness				
		$\beta$	B	SE	<i>t</i>	<i>p</i>	$\beta$	B	SE	<i>t</i>	<i>p</i>
1	Age	.009	.004	.026	.136	0.892	.041	.020	.033	.597	.551
	Gender	.164	.736	.295	2.496	.014	.071	.391	.378	1.036	.302
	SI-family	.540	.329	.047	7.001	<.001	.152	.114	.060	1.889	.061
	SI-friends	.052	.035	.048	.716	.475	-.005	-.004	.062	-.068	0.946
	Social anxiety	.143	.056	.028	2.046	.049	.287	.137	.036	3.829	<.001
	Depression	.084	.016	.015	1.045	.298	.392	.089	.019	4.693	<.001
	Hostility	.143	.087	.042	2.046	.043	.087	.065	.054	1.198	.233
2	Age	.027	.011	.026	.405	.686	.079	.038	.032	1.186	.238
	Gender	.131	.589	.303	1.946	.054	.033	.184	.372	.495	.621
	SI-family	.486	.296	.050	5.869	<.001	.064	.048	.062	.774	.440
	SI-friends	.022	.014	.050	.286	.776	-.046	-.037	.061	-.605	.546
	Social anxiety	.085	.033	.030	1.105	.271	.202	.097	.037	2.641	.009
	Depression	.075	.014	.015	0.919	.360	.380	.087	.019	4.666	<.001
	Hostility	.140	.084	.044	1.919	.057	.090	.067	.054	1.240	.217
	Rejection bias	-.030	-.251	.594	-.423	.673	.131	1.376	.731	1.882	.062
	FNE bias	.042	.271	.474	.572	.568	-.055	-.432	.583	-.740	.460
	USN bias	.178	1.112	.492	2.259	.026	.276	2.123	.605	3.508	<.001
Hopelessness bias	-.006	-.050	.628	-.080	0.936	-.012	-.129	.772	-.167	0.867	
	Hostility bias	.005	.045	.573	.079	0.937	-.082	-.835	.705	-1.184	.239

$\beta$  = standardized regression coefficient; FNE = fear of negative evaluation; SE = standard error; SI = social isolation; USN = unavailability of the social network.

**TABLE 5. HIERARCHICAL REGRESSION ANALYSES PREDICTING EMOTIONAL AND SOCIAL LONELINESS IN SAMPLE 2**

Step	Variables	Social loneliness					Emotional loneliness				
		$\beta$	B	SE	<i>t</i>	<i>p</i>	$\beta$	B	SE	<i>t</i>	<i>p</i>
1	Age	.006	.003	.020	.127	0.899	.019	.009	.024	.376	.707
	Gender	-.030	-.057	.186	-.305	.760	-.010	-.021	.227	-.094	0.925
	SI-family	.138	.103	.036	2.831	.005	.034	.028	.044	.623	.533
	SI-friends	.438	.278	.032	8.634	<.001	.284	.196	.039	4.982	<.001
	Social anxiety	.182	.071	.019	3.755	<.001	.256	.109	.023	4.700	<.001
	Depression	.148	.029	.009	3.106	.002	.193	.041	.011	3.567	<.001
2	Age	-.023	-.010	.019	-.539	.590	.000	.000	.024	-.008	0.994
	Gender	.033	.063	.194	.323	.747	.038	.080	.237	.336	.737
	SI-family	.077	.057	.035	1.646	.100	-.019	-.016	.044	-.352	.725
	SI-friends	.401	.254	.031	8.136	<.001	.242	.167	.039	4.238	<.001
	Social anxiety	.113	.044	.020	2.231	.026	.199	.084	.025	3.435	<.001
	Depression	.095	.019	.009	2.023	.043	.169	.036	.012	3.016	.003
	Rejection bias	.119	0.912	.409	2.228	.027	.082	.680	.497	1.369	.172
	FNE bias	-.067	-.395	.333	-1.187	.236	-.053	-.341	.426	-.799	.425
	USN bias	.274	1.731	.328	5.283	<.001	.256	1.759	.430	4.089	<.001
	Hopelessness bias	.067	.454	.332	1.369	.171	-.029	-.212	.449	-.472	.638
Hostility bias	-.098	-.703	.342	-2.060	.040	-.006	-.049	.437	-.113	0.910	

$\beta$  = standardized regression coefficient; FNE = fear of negative evaluation; SE = standard error; SI = social isolation; USN = unavailability of the social network.

< .001,  $R^2 = .317$ , respectively. In Sample 1, social anxiety and depression significantly predicted emotional loneliness. In Sample 2, higher levels of social isolation from friends, social anxiety, and depression significantly predicted higher levels of emotional loneliness.

The second and most interesting model including the biases explained significant additional variance in Samples 1 and 2,  $F(12, 121) = 11.712$ ,  $p_{corr} < .001$ ,  $R^2_{change} = .066$ ;  $F(11, 298) = 15.397$ ,  $p_{corr} < .001$ ,  $R^2_{change} = .045$ , respectively. In Sample 1, higher levels of social anxiety and depression remained significant predictors of higher emotional loneliness. Of the biases, only unavailability of the social network bias predicted higher emotional loneliness in Sample 1. In Sample 2, higher levels of social isolation from friends, social anxiety, and depression remained significant predictors of higher emotional loneliness. Additionally, higher levels of unavailability of the social network bias predicted higher emotional loneliness scores.

### Interpretation Bias in Social Anxiety, Depression, and Social Isolation

**Social Anxiety.** With regard to social anxiety, the first step of the model including age, gender, depression, hostility (only Sample 1), emotional and social loneliness, and social isolation was significant in Samples 1 and 2,  $F(8, 125) = 7.774$ ,  $p_{corr} < .001$ ,  $R^2 = .290$ ;  $F(7, 302) = 17.141$ ,  $p_{corr} = .504$ ,  $R^2 = .284$ , respectively. In Sample 1, age and emotional loneliness were the only significant predictors of social anxiety, and in Sample 2, age, emotional and social loneliness, and social isolation from friends significantly predicted social anxiety.

The second model, where the interpretation biases were included, explained significant additional variance in both samples,  $F(13, 120) = 5.731$ ,  $p_{corr} < .001$ ,  $R^2_{change} = .051$ ;  $F(12, 297) = 14.153$ ,  $p_{corr} < .001$ ,  $R^2_{change} = .079$ . In Sample 1, higher levels of emotional loneliness remained the only significant predictor from step 1. Of the biases, unavailability of the social network bias explained variance over and above all other variables in the model. In Sample 2, age, gender, higher levels of emotional loneliness, and social isolation from friends remained significant predictors of higher social anxiety levels. Additionally, higher fear of negative evaluation bias was a significant predictor of higher social anxiety. See Tables 6 and 7 for all estimates.

**Depression.** With regard to depression, the first step in the model was significant for both samples,  $F(8, 125) = 15.111$ ,  $p_{corr} < .001$ ,  $R^2 = .492$ ;  $F(7, 302) = 12.517$ ,  $p_{corr} < .001$ ,  $R^2 = .207$ . In Sample 1, emotional loneliness, hostility (only Sample 1), and social isolation from friends were significant predictors of depression. For Sample 2, emotional loneliness was a significant predictor of depression.

The second model with all interpretation bias themes explained significant additional variance in both samples,  $F(13, 120) = 9.786$ ,  $p_{corr} < .001$ ,  $R^2_{change} = .023$ ;  $F(12, 297) = 11.392$ ,  $p_{corr} < .001$ ,  $R^2_{change} = .090$ . In Sample 1, higher levels of emotional loneliness, hostility, and social isolation from friends remained significant predictors, and none of the interpretation bias themes significantly predicted depression over and above the variance already explained by the predictors in step 1. In Sample 2, next to higher levels of emotional loneliness, the hopelessness bias significantly predicted higher levels of depression.

**Social Isolation.** With regard to social isolation, the first step of the model included age, gender, social anxiety, depression, hostility (only Sample 1), and emotional and social loneliness. The first model was significant for Samples 1 and 2,  $F(7, 126) = 15.829$ ,  $p_{corr} < .001$ ,  $R^2 = .438$ ;  $F(6, 303) = 36.754$ ,  $p_{corr} < .001$ ,  $R^2 = .421$ , respectively. This first step revealed age, social loneliness, and depression as significant predictors of social isolation in Sample 1. In Sample 2, social loneliness and social anxiety significantly predicted social isolation.

Step 2 of the model, where the interpretation biases were included, significantly explained additional variance over and above the predictors in step 1,  $F(12, 121) = 10.647$ ,  $p_{corr} < .001$ ,  $R^2_{change} = .046$ ;  $F(11, 298) = 22.117$ ,  $p_{corr} < .001$ ,  $R^2_{change} = .028$ , for Samples 1 and 2, respectively. In Sample 1, the second model showed that higher levels of age, social loneliness, and depression remained significant predictors. However, higher levels of social isolation were also uniquely predicted by higher levels of unavailability of social network bias over and above all predictors in step 1. In Sample 2, higher levels of social loneliness and social anxiety remained significant predictors of higher levels of social isolation. However, none of the interpretation bias themes were unique predictors of social isolation.

## DISCUSSION

The overall goal of this study was to investigate the relation between loneliness and negative interpretation bias (and its content specificity). This goal was investigated in two young adult samples: an unselected sample of university students and a selected sample with heightened anxiety and/or depressive symptoms. More specifically, the first aim of the article was to investigate whether lonely young adults have a higher negative interpretation bias than young adults with lower levels of loneliness, as suggested by cognitive theories of loneliness (e.g., Cacioppo & Hawkey, 2009; Qualter et al., 2015). As a second aim, it was investigated whether a negative interpretation bias would relate differently to self-reported emotional and social loneliness as these types are thought to be separate concepts that share a common experience of loneliness (Dahlberg & McKee, 2014).

**TABLE 6. HIERARCHICAL REGRESSION ANALYSES PREDICTING SOCIAL ANXIETY, DEPRESSION, AND SOCIAL ISOLATION IN SAMPLE 1**

Step	Variables	Social anxiety					Depression					Social isolation				
		$\beta$	B	SE	t	p	$\beta$	B	SE	t	p	$\beta$	B	SE	t	p
1	Age	-.172	-.173	.077	-2.257	.026	-.003	-.007	.143	-.048	0.962	.157	.164	.070	2.336	.021
	Gender	-.085	-.0982	0.911	-1.079	.283	-.099	-2.407	1.658	-1.452	.149	-.062	-.742	.810	-0.917	.361
	Social loneliness	.055	.142	.294	.483	.630	-.081	-.439	.536	-.819	.414	.522	1.393	.226	6.166	<.001
	Emotional loneliness	.342	.715	.220	3.248	.001	.408	1.790	.387	4.623	<.001	-.093	-.202	.210	-0.962	.338
	Social anxiety	-	-	-	-	-	.083	.174	.163	1.072	.286	.062	.064	.082	.781	.436
	Depression	.109	.052	.049	1.072	.286	-	-	-	-	-	.314	.155	.043	3.650	<.001
	Hostility	.044	.069	.130	.530	.597	.229	.747	.229	3.269	.001	-.102	-.165	.119	-1.391	.167
	SI-family	.139	.217	.167	1.300	.196	.087	.287	.307	0.937	.351	-	-	-	-	-
	SI-friends	-.023	-.040	.147	-.271	.787	.243	0.865	.257	3.361	.001	-	-	-	-	-
	Age	-.122	-.123	.077	-1.591	.114	-.002	-.005	.145	-.035	0.972	.180	.187	.069	2.701	.008
2	Gender	-.118	-1.367	0.909	-1.504	.135	-.099	-2.408	1.691	-1.424	.157	-.085	-1.017	.814	-1.250	.214
	Social loneliness	.013	.034	.293	.116	0.90	-.083	-.450	.543	-.829	.409	.452	1.206	.231	5.214	<.001
	Emotional loneliness	.265	.554	.233	2.380	.019	.430	1.886	.408	4.628	<.001	-.169	-.366	.215	-1.702	.091
	Social anxiety	-	-	-	-	-	.066	.137	.169	.812	.418	.008	.008	.083	.100	0.921
	Depression	.083	.040	.049	.812	.418	-	-	-	-	-	.312	.154	.043	3.616	<.001
	Hostility	.006	.010	.134	.075	0.94	.172	.562	.243	2.313	.022	-.079	-.127	.121	-1.056	.293
	SI-family	.123	.193	.171	1.128	.262	.139	.456	.317	1.441	.152	-	-	-	-	-
	SI-friends	-.080	-.135	.149	-0.912	.364	.215	.768	.268	2.865	.005	-	-	-	-	-
	Rejection bias	.039	0.848	1.809	.469	.640	.002	.108	3.363	.032	0.974	.013	.305	1.655	.184	0.854

(Continued)

**TABLE 6. HIERARCHICAL REGRESSION ANALYSES PREDICTING SOCIAL ANXIETY, DEPRESSION, AND SOCIAL ISOLATION IN SAMPLE 1 (CONTINUED)**

Step Variables	Social anxiety				Depression				Social isolation						
	$\beta$	B	SE	t	p	$\beta$	B	SE	t	p	$\beta$	B	SE	t	p
FNE bias	.076	1.252	1.418	0.883	.379	.059	2.062	2.636	.782	.436	-.002	-.034	1.302	-.026	0.979
USN bias	.191	3.068	1.522	2.015	.046	-.101	-3.415	2.858	-1.195	.235	.257	4.284	1.360	3.150	.002
Hopelessness bias	.063	1.449	1.870	.775	.440	.104	5.010	3.452	1.451	.149	.039	0.942	1.684	.559	.577
Hostility bias	.056	1.204	1.720	.700	.485	.069	3.109	3.189	0.975	.331	-.083	-1.834	1.555	-1.180	.240

$\beta$  = standardized regression coefficient; FNE = fear of negative evaluation; SE = standard error; SI = social isolation; USN = unavailability of social network.

**TABLE 7. HIERARCHICAL REGRESSION ANALYSES PREDICTING SOCIAL ANXIETY, DEPRESSION, AND SOCIAL ISOLATION IN SAMPLE 2**

Step	Variables	Social anxiety					Depression					Social isolation				
		$\beta$	B	SE	t	p	$\beta$	B	SE	t	p	$\beta$	B	SE	t	p
1	Age	-.143	-.162	.058	-2.799	.005	.015	.033	.156	.214	.832	.060	.066	.051	1.287	.199
	Gender	.178	0.877	.543	1.614	.106	-.242	-2.398	1.276	-1.879	.063	.173	.825	.476	1.735	.083
	Social loneliness	.143	.366	.183	2.001	.045	.138	.714	.398	1.793	.073	.491	1.221	.144	8.458	<.001
	Emotional loneliness	.214	.505	.148	3.424	<.001	.174	.826	.330	2.507	.012	.048	.109	.132	.828	.407
	Social anxiety	-	-	-	-	-	.126	.253	.129	1.961	.051	.134	.130	.050	2.599	.009
	Depression	.112	.056	.029	1.951	.052	-	-	-	-	-	.097	.047	.027	1.753	.083
	SI-family	.050	.095	.107	0.884	.377	.092	.354	.256	1.328	.170	-	-	-	-	-
	SI-friends	.147	.238	.105	2.274	.023	.059	.192	.235	.818	.414	-	-	-	-	-
	Age	-.128	-.144	.056	-2.602	.009	.005	.011	.156	.070	0.945	.056	.061	.051	1.199	.231
	Gender	.313	1.541	.547	2.820	.005	-.159	-1.575	1.239	-1.271	.206	.144	.688	.494	1.392	.164
2	Social loneliness	.085	.218	.188	1.158	.247	.080	.412	.395	1.044	.297	.466	1.158	.156	7.418	<.001
	Emotional loneliness	.171	.404	.143	2.822	.005	.163	.776	.316	2.452	.014	.024	.054	.133	.408	.683
	Social anxiety	-	-	-	-	-	.041	.083	.129	.643	.520	.145	.140	.054	2.615	.009
	Depression	.037	.018	.029	.643	.521	-	-	-	-	-	.128	.062	.028	2.221	.029
	SI-family	.051	.097	.104	.933	.351	.107	.412	.246	1.672	.098	-	-	-	-	-
	SI-friends	.142	.230	.101	2.288	.022	.077	.251	.222	1.131	.258	-	-	-	-	-
	Rejection bias	.022	.426	1.242	.343	.732	.049	1.926	2.761	.697	.488	-.042	-.795	1.058	-7.752	.452

(Continued)

**TABLE 7. HIERARCHICAL REGRESSION ANALYSES PREDICTING SOCIAL ANXIETY, DEPRESSION, AND SOCIAL ISOLATION IN SAMPLE 2 (CONTINUED)**

Step	Variables	Social anxiety					Depression					Social isolation				
		$\beta$	B	SE	t	p	$\beta$	B	SE	t	p	$\beta$	B	SE	t	p
	FNE bias	.295	4.442	1.042	4.265	<.001	.129	3.903	2.124	1.838	.068	-.063	-0.918	0.884	-1.038	.300
	USN bias	.067	1.081	1.255	0.862	.398	-.049	-1.589	2.129	-.747	.456	.130	2.036	1.075	1.895	.067
	Hopelessness bias	-.005	-.099	1.003	-.099	0.921	.260	9.121	2.138	4.266	<.001	-.092	-1.548	.909	-1.703	.089
	Hostility bias	-.020	-.379	1.000	-.379	.705	-.020	-.759	2.376	-.320	.750	.084	1.503	0.977	1.539	.127

$\beta$  = standardized regression coefficient; FNE = fear of negative evaluation; SE = standard error; SI = social isolation; USN = unavailability of social network.

As expected, we found that young adults who reported higher levels of loneliness interpreted social situations as more negative than adults who reported lower levels of loneliness (Crick & Dodge, 1994). We found this relation in both unselected university students (Sample 1) and university students with heightened anxiety/depression (Sample 2). Moreover, we found that both self-reported emotional and social loneliness were significantly associated with a negative interpretation bias in both samples. This means that both emotionally and socially lonely young adults tend to interpret ambiguous situations in a negative manner. If these results are replicated in future studies, this might indicate that negative interpretation biases toward ambiguous social situations form a core element of the social cognitive model of loneliness, similar to cognitive models of social anxiety and depression (Clark & Clark, 1995; Mathews & MacLeod, 2005). These results are also in line with previous studies that found a relation between a negative interpretation bias and loneliness in children and young adults (Lau et al., 2021; Qualter et al., 2013) and extend these results to young adults with heightened anxiety and depression.

With regard to the third aim of the study, we tested whether the interpretation bias was specific toward the content of the ambiguous scenarios as theorized by the content specificity hypothesis (Amir et al., 1998; Beck, 1976). Interestingly, we found that emotional and social loneliness were significantly associated with a unique, content-specific interpretation bias, namely unavailability of the social network bias, while controlling for related psychosocial symptoms including social isolation, social anxiety, depression, and interpretation bias themes. This finding is not in line with cognitive theories that suggest that loneliness is associated with unfriendly or hostile attitudes toward the social environment (Cacioppo et al., 2015), rejection, and negative self- and other-evaluation (Spithoven et al., 2017). Indeed, lonely individuals often experience feelings of self-doubt (“am I less likeable?” and “am I less worthy?”) and lower self-esteem (Cacioppo & Hawkey, 2009; Cacioppo et al., 2006). This had led prior studies to investigate loneliness in relation to interpretation bias themes, such as rejection (Qualter et al., 2013), hostility (Prinstein et al., 2005), and fear of negative evaluation biases (Lau et al., 2021), rather than investigating loneliness related to a content-specific bias toward the unavailability of social connections, as proposed by Cacioppo et al. (2015). Our data showed that emotional and social loneliness may be characterized by the beliefs that their social network does not care about them or that they do not feel supported or valued by others. Theoretically, this could indicate that ambiguous social events related to the perceived lack of available social connections are negatively interpreted and in turn experienced as threatening and lonely. If replicated in future studies, these findings could indicate that an interpretation bias with regard to a perceived lack of available social connections could be another important element of loneliness that should be considered and compared with other driving elements of loneliness in future studies.

Additionally, in the sample with elevated anxiety/depression, our findings showed that higher levels of social loneliness were also related to a more negative interpretation of ambiguous situations triggering rejection experiences. This finding is in line with the loneliness theory (Spithoven et al., 2017) and with previous findings (Lau et al., 2021; Qualter et al., 2013). For example, Lau et al. (2021) found correlations between fear of negative evaluation and rejection situations on the one hand and loneliness on the other hand in young adults. Unique to the current study is that we replicated this relationship between loneliness and rejection bias specifically for social loneliness and not for emotional loneliness, in the sample with elevated symptoms. It could be that socially lonely individuals hold expectations of rejection by others as possible future experiences of social loneliness, while emotionally lonely adults are not triggered by these types of ambiguous stimuli. Given that social loneliness is closely related to the feeling of not belonging, its relationship with rejection bias might not be that surprising (Weiss, 1974). In addition, previous studies have tested this link between rejection experiences,

distorted cognition, and its impact on affect (loneliness) using rejection sensitivity paradigms and found evidence for an association between higher levels of loneliness and higher anticipated rejection (e.g., Ferguson & Zimmer-Gembeck, 2014). However, majority of these studies were conducted in child or adolescent samples. Future studies are needed to replicate our findings for the different types of loneliness in emerging adulthood. Furthermore, although this study provided important insights into the associations between interpretation bias, loneliness, depression, social anxiety, and social isolation, the design did not allow for testing temporal directionality between constructs. Future studies should include longitudinal designs that may show directionality and insights into possible causal links between variables.

## Sensitivity Analyses

Sensitivity analyses were performed with social anxiety, depression, and social isolation in order to assess the content specificity of the interpretation bias related to loneliness. We found that depression was not significantly predicted by the social network scenarios bias, confirming that the bias found for loneliness is indeed unique and not overlapping with the bias related to depressive symptoms. In the current study, depression was significantly related to a more negative interpretation of ambiguous situations triggering hopelessness in the sample with elevated symptoms, which is in line with previous studies (Wisco, 2009). Two potential reasons for the lack of a significant relationship between any of the interpretation bias themes and depression in the unselected sample might be that (a) the subjects did not endorse a negative interpretation bias related to any of the ambiguous social and nonsocial scenarios due to lack of (severe) depressive symptoms (i.e., a floor effect); or (b) the hopelessness bias scenarios were not sensitive enough to measure an interpretation bias related to depressive symptoms because of the low internal consistency. To rule these effects out, future research should utilize clinical samples and investigate depression and content specificity using an improved and psychometrically validated AST task.

Similar to depression, social anxiety was also not significantly related to the social network scenarios in the sample with elevated symptoms, strengthening the uniqueness of the interpretation bias related to loneliness. We found that young adults with symptoms of social anxiety endorsed a more negative interpretation for situations related to fear of negative evaluation. Not surprisingly, fear of negative evaluation is seen as a core feature of social anxiety (Rapee & Heimberg, 1997), and the tendency to negatively interpret ambiguous information in relation to the fear of negative evaluation is consistently associated with social anxiety (for a review, see, e.g., Chen et al., 2020). However, it should be noted that social anxiety was significantly associated with ambiguous social network situations in the unselected student sample. This finding can be supported by the proposed link between social anxiety and loneliness due to a state of hypervigilance toward the social environment (Cacioppo & Hawkley, 2009), and implies an overlap between the cognitive processes of social anxiety and loneliness. Finally, social isolation was associated with a content-specific interpretation bias related to the unavailability of social network situations in the unselected student sample only. It is difficult to explain these findings at present as the sample with elevated anxiety/depression did not show the same result. This is not in line with our expectations nor with previous studies (Cacioppo et al., 2015). This finding, therefore, warrants more research looking into interpretation bias related to the unavailability of social network and social isolation.

Despite the strong overlap between loneliness, social isolation, social anxiety, and depression, our data demonstrated distinct negatively biased information processes. Even though loneliness was once treated as an aspect of depression (Cacioppo et al., 2015) and comorbidity with anxiety and depression is high (e.g., Kessler et al., 2005), these mental health problems may be distinct and characterized by unique, content-specific, underlying cognitive processes.

## Implications and Future Directions

The current study provided novel empirical evidence supporting cognitive theories of loneliness. It is very important to test these theories as currently little is known about the exact cognitive processes involved in emotional and social loneliness. The current study found first evidence for the existence of a relationship between emotional and social loneliness and a negative interpretation bias related to social network above and beyond variance explained by other variables, including social isolation, social anxiety, and depression. When replicated, these findings could have clinical implications for the prevention and treatment of loneliness in university students. Until now, majority of loneliness interventions address behavioral aspects (e.g., improve social skills, increase opportunities for social contact, improve social connections) with only moderate success (Masi et al., 2011). Lonely young adults who show distorted cognitive information processes might also benefit from an intervention program addressing cognitive biases related to social network.

To the best of our knowledge, retraining cognitive biases using cognitive behavioral therapy or cognitive bias modification techniques has not yet been investigated in relation to loneliness. Recent studies evaluated cognitive bias modification of interpretation (CBM-I) techniques targeting symptom-linked interpretation biases related to social anxiety and depression, which showed promising results (e.g., Peters et al., 2011). Given the high comorbidity between loneliness, social anxiety, and depression, CBM-I might be effective in treating loneliness as well. In line with the social cognitive theory of loneliness, addressing cognitive biases might be the most direct way of targeting the vicious cycle of loneliness (Cacioppo & Hawkey, 2009).

The current study also provides directions for future research. As a first next step, it is important that our findings for the two loneliness dimensions are replicated in future research with an improved AST measuring interpretation bias. Second, interpretation bias in loneliness should be investigated using clinical samples and in longitudinal studies to better understand how these processes develop and play a role in different samples. Third, biased cognitive processes are thought to play a causal role and in turn function to maintain emotional disorders (Beck, 1976); however, causality of cognitive biases and feelings of loneliness is yet to be established. Finally, examining the potential overlap in cognitive processes for social anxiety and social loneliness is imperative to gain a better understanding of how these concepts relate to each other.

## Limitations

The current study has several limitations that should be considered. First, the internal consistencies of the rejection, hopelessness, and hostility bias themes were low in both samples, even though the set of ambiguous scenarios was adapted from existing materials and the negative and positive interpretations were tested through informal pilots. The original materials reported internal consistencies of  $\alpha = .82$  and  $\alpha = .87$  (Berna et al., 2011; Dillon et al., 2016). One possible explanation is that the original studies used significantly more items ( $N = 24$  and  $N = 32$  respectively; Berna et al., 2011; Dillon et al., 2016) per interpretation bias theme compared with the five items per bias theme in the current study. Increasing the number of items per subscale could thus improve the internal consistency. Further, comparisons with previous studies are difficult as the internal consistencies are rarely reported, with the exception of a few studies showing a Cronbach's coefficient  $\alpha$  (alpha) of between .80 and .85 in the social anxiety literature (Amir et al., 1998). Given the low internal consistencies for the rejection, hopelessness, and hostility bias themes, the findings for these themes should be interpreted with caution. Second, even though we ran several pilots before we used the AST for the current study, we have not specifically validated this AST version. An important suggestion for future studies that are interested in examining the link between cognitive biases and loneliness is to further develop

a more valid and reliable version of the AST and to also report these values. Despite this limitation, the internal consistency for the unavailability of social network bias theme showed acceptable results considering the low number of items and was the most relevant bias theme to test the aim of the current study. Therefore, we conclude that our results retain their relevance for future studies investigating loneliness. Third, the AST paradigm used in this study is known to be prone to response biases. This could influence the reliability of our findings. Future studies should replicate our findings in combination with indirect paradigms (e.g., reaction time task). Simultaneously, an advantage of the AST paradigm is a higher face validity.

Fourth, both samples showed an overrepresentation of female participants (>70%), which means that both samples were not fully representative of the targeted population. This is most likely due to the overrepresentation of females in university samples. Fifth, we originally planned to also include an older adult sample as Sample 2. Unfortunately, due to COVID-19, we were not able to recruit this older adult sample. Alternatively, we decided to include a selected university student sample as Sample 2. Sixth, we did not calculate an a priori power analysis for Sample 2. Future studies should replicate the current results to draw stronger conclusions. Seventh, part of the participants in Sample 2 enrolled during the first rise of the COVID-19 pandemic. It may be the case that this has resulted in higher loneliness and/or psychopathology levels, as has been found in other studies; however, we do not expect this to have an influence on the way these variables relate to each other (e.g., Courtney et al., 2020). Even though they cannot be directly compared, this was confirmed by the correlations between the constructs in both samples (see Table 3). Finally, both samples used participants in emerging adulthood, where loneliness has risen drastically over the last years (e.g., Alam et al., 2023). However, loneliness is well-known to be associated with all ages, and these results limit us to draw any conclusions regarding other age groups. Previous studies have suggested that older age might be associated with a more positive biased interpretation of ambiguous or even negative situations (Tadic et al., 2015). For this reason, it is not possible to assume that the same results will be found in other age groups.

## CONCLUSION

The current study provided empirical evidence for the existence of negatively biased interpretation processes related to emotional and social loneliness in young adults. Additionally, our findings indicate overlapping as well as unique cognitive processes underlying emotional and social loneliness dimensions in emerging adulthood. Specifically, emotional loneliness was related to the content-specific unavailability of the social network bias, while social loneliness was additionally associated with a negative interpretation bias related to rejection situations. These results provide a first insight into the underlying cognitive processes of loneliness in emerging adulthood. Future research should consider these novel findings and increase our understanding of cognitive biases and their involvement in the onset, maintenance, and prevention of loneliness.

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