Article

Loneliness in Gender-Diverse and Sexual Orientation–Diverse Adolescents: Measurement Invariance Analyses and Between-Group Comparisons

Assessment
2023, Vol. 30(3) 706–727

DOI: 10.1177/10731911211065167
journals.sagepub.com/home/asm
SAGE

Riley McDanal[1], Jessica L. Schleider[1], Kathryn R. Fox[2], and Nicholas R. Eaton[1]

Abstract

Youth loneliness is a risk factor for myriad adverse psychosocial outcomes, making it a potentially informative construct for assessment and treatment research. Minority stressors may place LGBTQ+ (lesbian, gay, bisexual, transgender, and queer) youths at high risk of loneliness. However, the prevalence of loneliness across gender and sexual identities cannot be precisely estimated or compared without establishing that common measures assess the construct equivalently across groups. In a preregistered study, we determined the optimal structure of the UCLA Loneliness Scale and investigated whether it showed invariance across gender and sexual identities in a national U.S. sample of adolescents with elevated depressive symptoms ($N = 2{,}431$; https://osf.io/52ctd). Results supported strict invariance, indicating that loneliness scores can be meaningfully compared across groups in this sample. Exploratory analyses indicated that loneliness levels and LGBTQ+ identity predicted levels of depression and anxiety. We discuss implications for research on loneliness, health disparities, and psychopathology in high-symptom youths.

Keywords

loneliness, LGBTQ+, measurement invariance, health disparities, minority stress

A variety of minority stressors place LGBTQ+ youths at higher risk of psychopathology compared with cisgender heterosexual youths, including discrimination, stigma, and peer rejection (Baams et al., 2018). Loneliness is strongly associated with mental distress in LGBTQ+ individuals, and it is a possible mediator in the relationship between minority stress and psychological distress (Mereish et al., 2017; Mereish & Poteat, 2015), as well as the relationship between anxiety and depression (Ebesutani et al., 2015). Self-reported loneliness often peaks in early adolescence—a developmental period marked by rapid social, biological, and relational transitions—highlighting this time period as critical in the study of loneliness and health (Barreto et al., 2021; Heinrich & Gullone, 2006). Accordingly, loneliness could be especially problematic for LGBTQ+ individuals in this developmental period. As a result, determining whether LGBTQ+ adolescents experience more loneliness than cisgender heterosexual adolescents could help clarify whether loneliness is a suitable target for intervention work related to minority stress and mental health. However, measurement issues can complicate interpretations of existing data related to loneliness in LGBTQ+ youths.

Minority Stress, LGBTQ+ Identity, and the COVID-19 Pandemic

Minority stress theory posits that LGBTQ+ youths, like other people from minoritized groups, experience psychological stress related to stigmatization, discrimination, and prejudice toward their identity (Meyer, 1995), above and beyond general stressors shared across the larger population. During COVID-19, general stressors increased across the population, including increased nationwide or international distress. Beyond these broad stressors, COVID-19 likely exacerbated minority stressors for LGBTQ+ youths; for instance, distancing measures forced many youths to quarantine in potentially unsupportive environments within family homes, a trend associated with increased psychological distress among LGBTQ+ youths relative to

[1]Stony Brook University, NY, USA
[2]University of Denver, CO, USA

Corresponding Author:
Riley McDanal, Department of Psychology, Stony Brook University, 100 Nicolls Rd., Stony Brook, NY 11794, USA.
Email: riley.mcdanal@stonybrook.edu

cisgender and heterosexual youths (Salerno et al., 2021). Thus, while loneliness levels appeared to increase among the general youth population during early isolation measures (Loades et al., 2020), loneliness may have been further impacted for LGBTQ+ youth during the COVID-19 pandemic by unique minority stress processes. However, accurately comparing loneliness levels across LGBTQ+ and cisgender heterosexual youths requires measurement invariance, a metric reflecting equivalence of a measure's performance across groups.

The Need for Invariance Testing When Investigating Health Disparities

Comparisons of self-reported loneliness levels between LGBTQ+ and cisgender heterosexual individuals cannot be assumed as defensible unless the assessment instrument at hand is subjected to invariance testing across the groups being compared. Invariance tests reveal whether a construct is measured the same way across different respondent groups, *or* whether cross-group comparisons may be confounded by systematic group differences (Gregorich, 2006)—such as minority stress. For example, LGBTQ+ adolescents are more likely than their cisgender heterosexual peers to endorse myriad loneliness-related experiences linked to their identity, such as minority stress, discrimination, and peer rejection, which implies that self-reported loneliness levels in LGBTQ+ youths might be confounded by overlap with other constructs (Meyer & Frost, 2013). In other words, perhaps increased self-reported loneliness levels in LGBTQ+ youths in fact reflect their increased experiences of minority stress or identity-based discrimination relative to cisgender heterosexual youths.

As a result, although some studies have compared loneliness levels in LGBTQ+ and cisgender heterosexual individuals (Gillig et al., 2020; Hsieh & Liu, 2021), these findings cannot be interpreted defensibly absent measurement invariance testing. Nevertheless, to the best of our knowledge, no scales designed to assess loneliness have been subjected to full invariance testing across LGBTQ+ and cisgender heterosexual groups. As a result, the field's understanding of differences in loneliness across LGBTQ+ and cisgender heterosexual youths remains limited.

The UCLA Loneliness Scale as a Candidate for Invariance Testing

The UCLA Loneliness Scale (ULS) is frequently used in psychological research; the latest version of the ULS has received more than 3,500 citations as indexed by Google Scholar at the time of writing, and it is commonly employed with adolescent participants. As such, the ULS is a good candidate for invariance testing, as results will inform the interpretation of other research that employs this scale (e.g., the previously mentioned work by Gillig and colleagues in 2020). Previous testing of a one-factor model of a reduced 7-item version of the ULS has indicated that the scale shows metric invariance across assigned sex, marital status, race, employment status, age, income, and education in adults, which implies that the ULS has the same factor structure across groups in these categories (Allen & Oshagan, 1995). Similarly, testing of a three-factor model of the full 20-item ULS has shown that the scale demonstrates metric invariance across assigned sex and teaching level in adult teachers (Dussault et al., 2009). Another investigation of the ULS, which tested a unidimensional model with correlated error terms to correct for item wording, revealed strong invariance across assigned sex (Maes et al., 2017). However, to our knowledge, no studies have tested ULS invariance across gender (including trans and other gender-diverse individuals) or sexual orientation groups; in addition, no studies have tested ULS invariance in an adolescent sample. Furthermore, the ULS has not been subjected to *strict* invariance testing in any context, despite the fact that accurate comparisons of group means cannot be reliably made with only metric invariance (Gregorich, 2006). In addition, the two previously mentioned studies that assessed other forms of ULS measurement invariance used two different factor structures of the scale in their analyses, further complicating any conclusions about invariance. As such, although the ULS is a good candidate for invariance testing, the optimal factor structure of the scale must be determined first. A review of the literature suggests that there is no current consensus on the best-fitting factor structure of the ULS. Overall, models identified in the literature differ in the number of factors identified (ranging from 1 to 3), the nature of the model (bifactor or not), and the specific item loadings for each factor. The factors identified included global loneliness, a variety of specific types of loneliness, and positively and negatively valenced method factors (Austin, 1983; Dodeen, 2014; Hartshorne, 1993; Knight et al., 1988; Lasgaard, 2007; McWhirter, 1990; Russell, 1996; Shevlin et al., 2014; Wilson et al., 1992; Zakahi & Duran, 1982). As tested by Russell (1996), the positively and negatively valenced method factors represent both the direction in which items are keyed and the valence of the items themselves, such that negatively keyed items have more negatively valenced item text relative to positively keyed items (which have positively valenced item text) and that some items loading on each method factor appear more strongly valenced than others loading onto the same method factor.

Current Study

Accordingly, the current investigation addresses both the conflict surrounding the factor structure of the ULS and the question of the scale's measurement invariance across gender identity and sexual orientation groups. We used a large,

national sample of LGBTQ+ and cisgender heterosexual adolescents who completed the ULS during the COVID-19 pandemic to assess the scale's invariance across gender identities and sexual orientations. This analytic plan involved first determining the best-fitting factor structure of the ULS, followed by a series of invariance tests on the selected model across LGBTQ+, and cisgender heterosexual groups. Through post hoc exploratory analyses, we compared ULS loneliness factor levels and observed scores across the same groups, and we examined the role of loneliness and gender identity in predicting depression and anxiety.

In the current study, we statistically tested six different models of the ULS factor structure which we identified in a literature search that aimed to be maximally inclusive of potential models. Although some studies used the same number and labels of factors as each other, they selected a slightly different structure of item loadings, resulting in slightly different tests for the same conceptual model. Consequently, these six different conceptual models and their variations resulted in a total of nine models that we subjected to testing (see Appendix A for details on each model). We tested the fit of the factor structure for each model and then compared results based on common fit indices to determine the best-fitting structure. We next submitted this selected factor structure to a series of invariance tests across cisgender/heterosexual, cisgender/sexual minority, and gender minority/sexual minority group ULS scores. We then compared ULS loneliness factor scores and observed scores across these same groups. Finally, we investigated whether loneliness levels, LGBTQ+ identity, and their interaction predict levels of depression and anxiety.

Materials and Method

Participants

This preregistered, secondary analysis study (https://osf.io/52ctd) used baseline (preintervention) data from 13- to 16-year-old adolescents (N = 2,431) within a web-based randomized controlled trial of three free, online single-session mental health interventions tested during the COVID-19 pandemic (ClinicalTrials.gov identifier: NCT04634903). Participants were included if they provided their gender identity and sexual orientation and completed at least 10 of 20 items in the ULS. During the data collection period between November 2020 and March 2021, 6,884 participants completed the study screener, 3,851 participants met inclusion criteria and were included in the study, 2,452 completed the baseline survey, and 2,431 of these participants provided the data needed for the current analyses.

In the baseline assessment, participants self-reported their racial/ethnic identity, their assigned sex, their gender, and their sexual orientation. Participants included in this study were 3.99% American Indian, 12.75% Asian, 10.57% Black, 19.29% Hispanic, 1.60% Native Hawaiian, and 66.31% White (categories were not mutually exclusive). Adolescents assigned female sex at birth composed 87.82% of the sample, adolescents assigned male sex at birth composed 10.61% of the sample, and the remaining 1.56% selected "other" or declined to respond. LGBTQ+ adolescents composed 78.86% of the sample, including 34.47% who identified as a gender minority (GM; transgender, nonbinary, or other non-cisgender identity) and 78.86% who identified as a sexual minority (SM; lesbian, gay, bisexual, queer/questioning, or other nonheterosexual identity). There were an additional 12 participants in the original sample who identified as a gender minority and as heterosexual, but these participants were not included in the final analytic sample due to insufficient subsample size for forming a GM/heterosexual demographic group; multigroup confirmatory factor analyses (CFAs) are recommended to have at least 100 individuals per group (T. Kline, 2005). The resulting groups were cisgender/heterosexual (n = 514), cisgender/SM (n = 1,079), and GM/SM (n = 838) groups.[1] Because the few youths who identified as a heterosexual gender minority were not included in the current analyses, the number of LGBTQ+ adolescents included in the current study is equivalent to the number of SM adolescents included in the study.

Procedure

The University institutional review board (IRB) approved all study procedures prior to participant enrollment, and all adolescents provided online assent prior to beginning of the study (see Schleider et al., 2021, for original study procedures). The study was advertised through Instagram posts indicating that participants could receive up to US$20 in gift cards across a 3-month period for participating in a confidential, online psychological study. Interested adolescents were directed to a Qualtrics survey linked in the advertisement to complete a screener assessing eligibility criteria. Adolescents were able to complete the study without parent permission, which was waived by the IRB to maximize anonymity and minimize access barriers. Participants then provided informed assent prior to participation. They were subsequently able to initiate the study at any time and in any location using any internet-equipped electronic device. The study began with a baseline questionnaire battery, which is detailed in the study registration (NCT04634903). Items and questionnaires relevant to the present study are described subsequently.

Measures

Demographics. Participants self-reported their race, ethnicity, age, assigned sex, gender, and sexual orientation. Of particular interest to the current study was LGBTQ+ identity.

Participants were excluded from the current analyses if they did not provide their gender and/or sexual orientation. For sexual orientation, participants were asked to choose the single best-fitting response among the following options: heterosexual/straight, gay/lesbian/homosexual, bisexual, pansexual, queer, asexual, other/not listed, unsure/questioning, no label use, or prefer not to respond. For gender, participants were asked to choose any and all that fit their identity among the following options: man/boy, woman/girl, transgender, female-to-male transgender, male-to-female transgender, trans male, trans female, genderqueer, gender expansive, androgynous, nonbinary, two-spirited, third gender, agender, not sure, and/or other. Participants who endorsed a nonheterosexual orientation and any noncisgender identity were categorized in the current study as GM/SM. Participants who endorsed a nonheterosexual orientation and a cisgender identity only were categorized as cisgender/SM. Participants who endorsed a heterosexual orientation and a cisgender identity only were categorized as cisgender/heterosexual.

ULS. The ULS (Russell, 1996) is a 20-item scale designed to evaluate loneliness. Participants completed the ULS at baseline using a 4-point Likert-type scale (1 = "never," 2 = "rarely," 3 = "sometimes," 4 = "often"). Possible total scores on the ULS range from 20 to 80. In the most commonly used categorization of ULS scores, a sum between 20 and 34 indicates low loneliness, 35 and 49 indicates moderate loneliness, 50 and 64 indicates moderately high loneliness, and 65 and 80 indicates high loneliness (Deckx et al., 2014). Participants were included in the current analyses if they completed at least 10 of 20 of the ULS items. Complete ULS data were obtained for 99.92% of the final sample, and full information maximum likelihood estimation was used to address missingness (FIML). The ULS has been demonstrated to have high internal consistency and test–retest reliability, as well as convergent and construct validity (Russell, 1996). At baseline, alpha was .91.

Children's Depression Inventory–Short Form. The Children's Depression Inventory–Short Form (CDI-SF) is a reliable and validated 12-item measure of youth depression severity over the previous 2 weeks (Kovacs, 2011). Items are scored from 0 to 2, with higher summed scores reflecting greater overall depression severity. We included data for this measure to conduct exploratory analyses on the associations between loneliness, LGBTQ+ identity, and depression. Alpha was .77 at baseline (Schleider et al., 2021).

Generalized Anxiety Disorder-7. The Generalized Anxiety Disorder-7 (GAD-7) is a reliable and validated 7-item measure of anxiety symptom severity over the previous 2 weeks (Spitzer et al., 2006). Items are scored from 0 to 3 scale, with higher summed scores reflecting greater overall anxiety severity. We included data for this measure to conduct exploratory analyses on the associations between loneliness, LGBTQ+ identity, and anxiety. Alpha was .89 at baseline (Schleider et al., 2021).

Analyses

Preregistered Analyses. Prior to any analyses, we preregistered our data plan on OSF (https://osf.io/52ctd). In addition, both the deidentified data used in the current study and the R syntax used to generate results are openly accessible via OSF (https://osf.io/bs2f8/). All CFAs and invariance tests were performed in accordance with our preregistered plan to test our primary research question: whether observed ULS mean scores and variances can be meaningfully compared across diverse gender identities and sexual orientations. Analyses were conducted using the *lavaan* package (v. 0.6-9) in *R* (v. 1.2.1335) with maximum likelihood estimation (Rosseel, 2012).

Indices Used to Assess Model Fit and Differences Between Models. For all CFA model evaluations, we assessed model fit using the comparative fix index (CFI), Tucker–Lewis index (TLI), the root mean squared error of approximation (RMSEA), and information-theoretic fit indices of the Akaike and Bayesian information criteria (AIC and BIC). These fit indices are used to determine the quality of model fit, as well as to compare the fit of two different models to determine whether one is an improvement over the other. CFI/TLI values of around $>.90$ and RMSEA values $<.08$ were used to suggest minimally acceptable model fit, with benchmarks of CFI/TLI $>.95$ and RMSEA values of $<.06$ being favored (e.g., Hu & Bentler, 1999). A CFI difference between two models of $>.01$ was used to test whether the addition of more freely estimated parameters leads to an improved model fit of models that do not meet our benchmarks (Cheung & Rensvold, 2002). We previously agreed to discount chi-square goodness-of-fit tests and difference tests, given the relatively large sample size and the resulting high power of that test to reject a null hypothesis of no residual covariance (Brown, 2015). Prior to performing our analyses, we identified the need to investigate possible correlated errors. In doing so, authors R.M. and N.R.E. independently reviewed all possible item pairs for potential residual correlation based on item content. Those authors identified 4 items with "likely" correlated errors (2.1% of the total possible pairwise correlations) and "12" items as "somewhat likely" correlated errors (6.3% of the total possible pairwise correlations; see Appendix C). This identification was done a priori to inform any subsequent investigation of correlated errors in models and to avoid overfitting.

What is the Best-Fitting Factor Structure of the ULS? Because there appears to be no general consensus on the best-fitting

Table 1. Model Fit Statistics.

Source	χ^2	*df*	*p* value	CFI	TLI	AIC	BIC	RMSEA	# free
Cisgender/heterosexual group									
Hartshorne (1993); Lasgaard (2007)	1,076.9	170	<.001***	.801	.778	22,819.1	23,073.6	.102	60
Knight et al. (1988)	759.6	169	<.001***	.871	.855	22,503.7	22,762.5	.082	61
Wilson et al. (1992)	842.3	169	<.001***	.853	.834	22,586.5	22,845.2	.088	61
Zakahi & Duran (1982)	1,010.9	169	<.001***	.816	.793	22,755.1	23,013.9	.098	61
Austin (1983)	717.3	166	<.001***	.879	.862	22,467.5	22,739.0	.080	64
McWhirter (1990)	781.7	167	<.001***	.865	.847	22,529.8	22,797.1	.085	63
Shevlin et al. (2014)	658.3	167	<.001***	.892	.878	22,406.5	22,673.7	.076	63
Russell (1996)	491.2	152	<.001***	.926	.907	22,269.3	22,600.2	.066	78
Dodeen (2014)	487.8	150	<.001***	.926	.906	22,270.0	22,609.3	.066	80
Correlated error model	441.1	151	<.001***	.936	.920	22,221.3	22,556.4	.061	79
Cisgender/SM group									
Hartshorne (1993); Lasgaard (2007)	2,100.2	170	<.001***	.772	.745	46,858.2	47,157.2	.103	60
Knight et al. (1988)	1,460.9	169	<.001***	.847	.828	46,220.9	46,524.9	.084	61
Wilson et al. (1992)	1,693.9	169	<.001***	.820	.797	46,453.9	46,757.9	.091	61
Zakahi & Duran (1982)	1,947.5	169	<.001***	.790	.764	46,707.5	47,011.5	.099	61
Austin (1983)	1,294.9	166	<.001***	.867	.847	46,060.8	46,379.8	.079	64
McWhirter (1990)	1,436.2	167	<.001***	.850	.829	46,200.2	46,514.2	.084	63
Shevlin et al. (2014)	1,202.7	167	<.001***	.878	.861	45,966.7	46,280.7	.076	63
Russell (1996)	888.9	152	<.001***	.913	.891	45,682.9	46,071.6	.067	78
Dodeen (2014)	884.5	150	<.001***	.913	.890	45,682.5	46,081.2	.067	80
Correlated error model	762.2	151	<.001***	.928	.909	45,558.2	45,951.9	.061	79
GM/SM group									
Hartshorne (1993); Lasgaard (2007)	1,556.7	170	<.001***	.799	.775	35,649.0	35,932.9	.099	60
Knight et al. (1998)	962.3	169	<.001***	.885	.870	35,056.7	35,345.3	.075	61
Wilson et al. (1992)	1,153.2	169	<.001***	.857	.839	35,247.6	35,536.1	.083	61
Zakahi & Duran (1982)	1,486.0	169	<.001***	.809	.785	35,580.4	35,869.0	.096	61
Austin (1983)	1,055.6	166	<.001***	.871	.852	35,155.9	35,458.7	.080	64
McWhirter (1990)	1,097.0	167	<.001***	.865	.846	35,195.3	35,493.4	.082	63
Shevlin et al. (2014)	879.9	167	<.001***	.892	.882	34,978.2	35,276.3	.071	63
Russell (1996)	639.6	152	<.001***	.929	.911	34,768.0	35,137.0	.062	78
Dodeen (2014)	632.0	150	<.001***	.930	.911	34,764.4	35,142.9	.062	80
Correlated error model	550.1	151	<.001***	.942	.927	34,680.4	35,054.2	.056	79

Note. *** indicates significance at the $p < 0.001$ level. CFI = comparative fix index; TLI = Tucker–Lewis index; AIC = Akaike information criterion; BIC = Bayesian information criterion; RMSEA = root mean squared error of approximation; SM = sexual minority; GM = gender minority.

factor structure of the ULS, we statistically tested nine total versions of six different factor structures of the ULS that have been proposed in the previous literature: (a) one-factor global loneliness; (b) two-factor positive items and negative items; (c) two-factor intimate other and social other; (d) three-factor intimate other, social other, and belonging/affiliation; (e) three-factor isolation, related connectedness, and collective connectedness; and (f) bifactor model consisting of global loneliness and positive items and negative items methods factors (Appendix A). The factor structure of each model is detailed in the introduction and included in Table 1 of the results section. We selected the best-fitting model using the fit indices described above.

Is the Factor Structure of the ULS Invariant Across Adolescents With Varying Gender Identities and Sexual Orientations? To be able to meaningfully compare group means and variances of ULS scores, the scale must first be determined to be invariant across gender and sexual orientation identities (i.e., the magnitude of the model parameters must not vary across groups; Gregorich, 2006). We first assessed for configural invariance or equality of the factor structure across groups. We then assessed for metric invariance or equality of factor loadings across groups. Meeting both of these benchmarks implies that the relationship between the factors in the model and the observed scores on the scale is equal across gender and sexual orientation groups (Gregorich, 2006). We then proceeded to test for strong factorial invariance, which requires equality of factor means represented as invariant intercepts across groups (Meredith & Teresi, 2006). Meeting this benchmark indicates that the means of the factors in the model can be meaningfully

compared across gender and sexual orientation groups. We last evaluated strict factorial invariance, which requires equal residual variances across groups. Meeting this criterion implies full model invariance, which indicates that the observed scale means and variances can be meaningfully compared across gender and sexual orientation groups (Gregorich, 2006).

Do Any Adjustments Notably Improve the Fit of the Model? After selecting the best-fitting model, adjustments were made based on correspondence between a priori predicted correlated errors and empirical standardized residual correlated error output. If predicted a priori, large correlated residuals were added to the model. The resulting model was then compared against the original model to determine whether the inclusion of the errors improved the model, given the benchmarks noted previously. We subjected any resulting models, and added parameters, to invariance testing.

Exploratory Analyses. We conducted exploratory (non-preregistered) population heterogeneity tests by independently constraining group factor means, variances, and correlated errors to equality and comparing each resulting model fit with the corresponding unconstrained model. We conducted group mean factor comparisons by fixing a reference group mean to zero and testing the significance of the other group means, which were freely estimated. We compared observed scale sum scores across the three groups using three independent *t* tests. Finally, we tested the association of loneliness and SGM identity with sum score depression and anxiety levels derived from the CDI-SF and the GAD-7. To complete these analyses, we conducted a series of sequential regressions in which the first regression contained only mean-centered loneliness as a predictor, which was compared against the next regression containing loneliness and dummy-coded cisgender/SM and GM/SM identity variables (relative to the cisgender/heterosexual group) as predictors. This second model was then compared with a third model with the same predictors as well as a term testing the interaction between loneliness levels and SGM identity; mean-centered loneliness was used to avoid nonessential multicollinearity.

Results

What is the Best-Fitting Factor Structure of the ULS in Adolescents?

Each model's fit in the three subsamples (cisgender/heterosexual, cisgender/SM, and GM/SM) is displayed in Table 1. Notably, almost all models fit worst among the cisgender/SM group. The use of CFI, TLI, AIC, BIC, and RMSEA revealed that two models achieved adequate or near-adequate fit in each group (Table 1). These two models were the bifactor models used by Russell in 1996 and Dodeen in 2014, which each consisted of a global loneliness factor, a positively valenced items methods factor, and a negatively valenced items methods factor. Dodeen's (2014) bifactor model is nearly identical to that of Russell in 1996, except that the former has two additional factor loadings on the positively valenced items factor; Russell and colleagues found that Items 16 and 17 did not significantly load on either method factor and thus were not sufficiently saturated with either positive or negative affect variance to be included as indicators of such method factors. The two models had overall a very similar fit, which was expected given that the two models are nearly equivalent. However, due to consistently lower BIC values in Russell's model, we determined Russell's bifactor model to be the best fitting (Figure 1). The remainder of the models tested (single-factor, two-factor, and three-factor) did not display adequate fit across the subsamples. Both because of the improved fit of the current bifactor model relative to the other models and the apparent utility of bifactor models in other investigations of loneliness (Grygiel et al., 2013), we used Russell's (1996) bifactor model for invariance testing in this sample. Invariance testing of this model assesses whether global loneliness factor scores, responses to positively valenced items, and responses to negatively valenced items differ across gender and sexual orientation groups. Items and their varying factor loadings for this model are listed in Appendix B. In this model, omega (an internal reliability estimate of the multidimensional composite) was .926 for the general factor, .861 for the positively valenced items factor, and .876 for the negatively valenced items factor. Relative omega (the percentage of reliable variance in the composite score that reflects variance of the given factor) was .855 for the general factor, .012 for the positively valenced items factor, and .430 for the negatively valenced items factor (Dueber, 2017).

Is the Factor Structure of the ULS Invariant Across Adolescents With Varying Gender Identities and Sexual Orientations?

The bifactor model's TLI, BIC, and RMSEA all favored the strict invariance model (Table 2). The CFI favored the configural invariance model, but no difference between CFI values across the four models (configural, metric, strong, and strict) exceeded the difference threshold of $>.01$. Chi-square fit analyses indicated a significant difference in fit across each of the model pairs (configural with metric, metric with strong, and strong with strict). Considering the CFI, TLI, BIC, RMSEA, and change-in-CFI values, we determined the strict model to fit comparably to the configural model for the multigroup analysis and consequently determined the bifactor model to meet criteria for full invariance across groups of adolescents with diverse gender identities and sexual orientations, such that adolescents' mean ULS

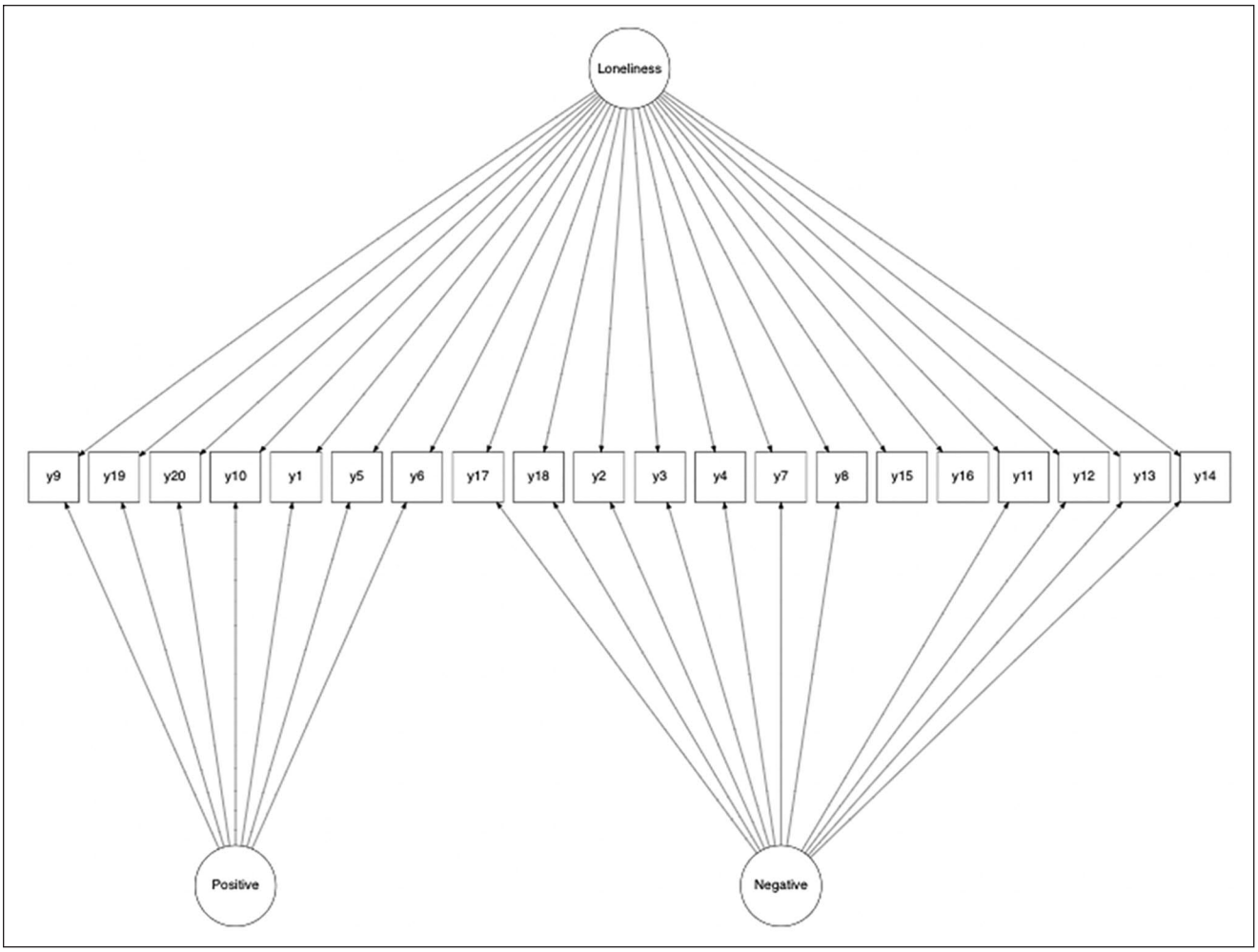

Figure 1. The Loneliness Bifactor Model (Russell, 1996).
Note. The structure includes general factor Global Loneliness, a Positive Items methods factor, and a Negative Items methods factor. For simplicity, factor variances and indicator error variances are not depicted. All factor loadings were freely estimated.

scores may be considered *directly comparable* across these groups (Table 2).

Do Any Adjustments Notably Improve the Fit of the Model?

We found one of our a priori predicted "likely" correlated errors, between Item 9 ("How often do you feel outgoing and friendly?") and Item 17 ("How often do you feel shy?"), to be a particularly large empirical correlated error (Appendix B). In an exploratory analysis, we therefore included this correlated error in the model and examined its fit (Table 3; Figure 2). Overall and in each group, the CFI increased by more than the threshold of $>.01$ with the addition of this single correlated error, suggesting a notable improvement in model fit. In addition, the TLI showed a consistent increase, and the AIC, BIC, and RMSEA showed consistent decreases across groups. This model (hereafter referred to as the "correlated error model") also demonstrated the property of strict invariance, suggesting that the correlated error model may also be used to meaningfully compare observed group loneliness means (Table 4). We similarly completed population heterogeneity tests for this model, this time also constraining the covariance between the errors of Items 9 and 17 to be equal across groups to assess for equivalence (Table 5). Changes in fit between the unconstrained correlated error models and the constrained correlated error models were minimal (Table 5). These results suggest that the correlated error model fits nearly as well when the group means, group variances, and the correlated error covariance are each equal across groups as compared with when they are each allowed to vary across groups. To facilitate the calculation of model-based omega values using the Bifactor Indices Calculator (Dueber, 2017), the correlated error was parameterized as a third specific factor (vs. a single freely estimated covariance between

Table 2. Multigroup Fit Statistics for Invariance Models.

Invariance model	χ^2	*df*	*p* value	CFI	TLI	AIC	BIC	RMSEA
Multigroup fit statistics for invariance models.								
Configural	2019.7	456	<.001***	.921	.902	102,720.1	104,076.4	.065
Metric	2113.2	526	<.001***	.920	.914	102,673.7	103,624.3	.061
Strong factorial	2181.4	560	<.001***	.919	.917	102,673.9	103,427.4	.060
Strict factorial	2299.3	600	<.001***	.915	.919	102,711.8	103,233.5	.059
Invariance model comparison	$\Delta\chi^2$	Δdf	*p* value	ΔCFI	ΔTLI	ΔAIC	ΔBIC	ΔRMSEA
Difference between Invariance Models								
Metric–Configural	90.707	70	.032*	−.001	.012	−46.4	−452.1	−.004
Strong–Metric	71.654	34	<.001***	−.002	.003	0.20	−196.9	−.001
Strict–Strong	124.587	40	<.001***	−.004	.002	37.9	−193.9	−.001

Note. *** indicates significance at the $p < 0.001$ level; ** indicates significance at the $p < 0.01$ level; * indicates significance at the $p < 0.05$ level.
CFI = comparative fix index; TLI = Tucker–Lewis index; AIC = Akaike information criterion; BIC = Bayesian information criterion; RMSEA = root mean squared error of approximation.

Table 3. Comparison of Original Strict Invariance Model With Modified Model Allowing a Correlated Error (y9 and y17).

Group	Model	CFI	TLI	AIC	BIC	RMSEA	# free
Full sample	Original model	.929	.911	102,788.02	103,240.11	.062	79
	With correlated residual	.942	.927	102,522.78	102,980.67	.057	78
	Difference	**.013**	**.016**	**−265.245**	**−259.448**	**−.005**	**−1**
Cisgender heterosexual	Original model	.926	.907	22,269.323	22,600.216	.066	78
	With correlated residual	.936	.920	22,221.27	22,556.41	.061	79
	Difference	**.010**	**.013**	**−48.050**	**−43.807**	**−.005**	**−1**
Cisgender SM	Original model	.913	.891	45,682.851	46,071.586	.067	78
	With correlated residual	.928	.909	45,558.17	45,951.89	.061	79
	Difference	**.015**	**.018**	**−124.681**	**−119.696**	**−.006**	**−1**
GM & SM	Original model	.929	.911	34,767.973	35,136.993	.062	78
	With correlated residual	.942	.927	34,680.42	35,054.17	.056	79
	Difference	**.013**	**.016**	**−87.55**	**−82.82**	**−.006**	**−1**

Note. CFI = comparative fix index; TLI = Tucker–Lewis index; AIC = Akaike information criterion; BIC = Bayesian information criterion; RMSEA = root mean squared error of approximation; SM = sexual minority; GM = gender minority.

two indicators) with two loadings constrained to equality.[2] Omega was .930 for the general factor, .872 for the positively valenced items factor, .882 for the negatively valenced items factor, and .578 for the correlated error factor. Relative omega was .846 for the general factor, .011 for the positively valenced items factor, .433 for the negatively valenced items factor, and .727 for the correlated error factor.

Did Loneliness Factor Levels Differ Across Adolescents With Diverse Gender Identities and Sexual Orientations?

Because the ULS demonstrated configural, metric, strong, and strict invariance, we proceeded to complete tests for population heterogeneity. These tests indicate whether the model fits as well when factor means and variances are freely estimated as compared with when they are constrained to equality across groups, and results from such analyses offer insight into whether the groups show different values on means and variances within the same structure. These tests were results-driven and exploratory (not preregistered). Changes in fit between the unconstrained models and the constrained models were minimal (Table 5). These results suggest that Russell's (1996) bifactor model fits nearly as well when the group means and variances are each constrained to equality across groups as compared with when they are freely estimated.

We then supplemented these overall fit-based findings with statistical analyses related to specific group scores. To do so, we directly compared group factor and observed means for the ULS across sexual minority (versus heterosexual) and gender minority (versus cisgender) adolescents in the correlated error model. Because we did not initially

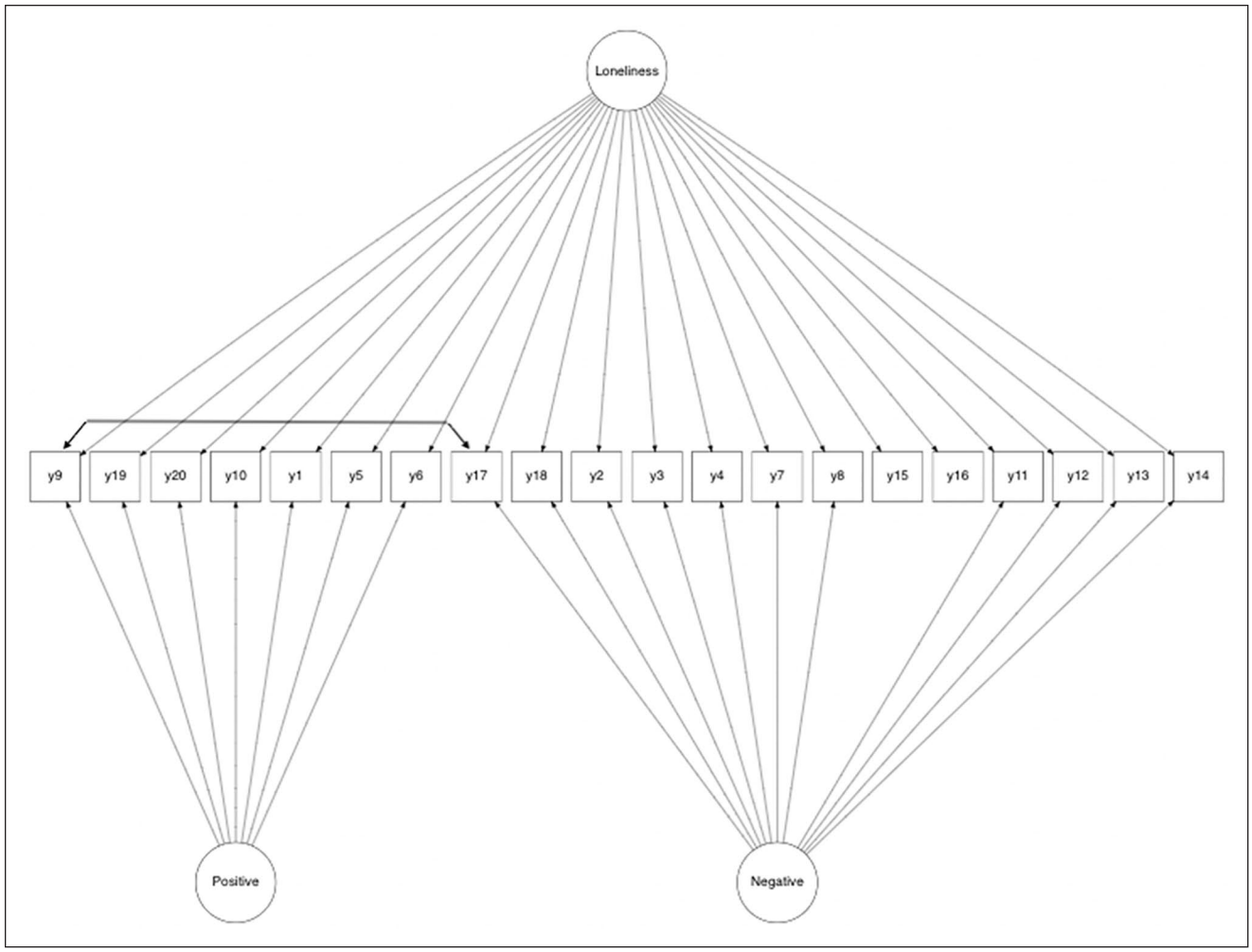

Figure 2. The Correlated Error Bifactor Model.
Note. Following Russell's (1996) model, the structure includes the general factor Global Loneliness, a Positive Items methods factor, and a Negative Items methods factor. In addition, this model allows the errors of theoretically similar Items 9 and 17 to correlate. For simplicity, factor variances and indicator error variances are not depicted. All factor loadings were freely estimated.

Table 4. Multigroup Fit Statistics for Invariance Models Allowing a Correlated Error (Item 9 and Item 17).

Invariance model	χ^2	*df*	*p* value	CFI	TLI	AIC	BIC	RMSEA
Configural	1753.373	453	<.001***	.935	.918	102,459.864	103,833.529	.060
Metric	1849.711	523	<.001***	.933	.927	102,416.202	103,384.144	.056
Strong factorial	1914.743	557	<.001***	.932	.930	102,413.234	103,184.110	.055
Strict factorial	2033.104	597	<.001***	.928	.931	102,451.594	102,990.628	.054

Note. *** indicates significance at the $p < 0.001$ level. CFI = comparative fix index; TLI = Tucker–Lewis index; AIC = Akaike information criterion; BIC = Bayesian information criterion; RMSEA = root mean squared error of approximation.

expect to find evidence for full invariance, these analyses were exploratory. Relative to the cisgender/heterosexual group's standardized mean, which was fixed to zero for ease of comparison, the GM/SM group's standardized mean loneliness level was significantly elevated ($M = 0.277$; $p < .001$), whereas the cisgender/SM group's standardized mean was not significantly elevated ($M = 0.096$, $p = .103$). We recoded the reference group as the GM/SM group to ascertain a significant difference ($M = 0.198$, $p < .001$) between the cisgender/SM and the GM/SM groups, with the cisgender/SM group scoring on average 0.198 lower on the loneliness factor than the GM/SM group (Table 6).

Table 5. Multigroup Strict Invariance Model Population Heterogeneity Tests.

Model	Constraint	χ^2	*df*	*p* value	CFI	TLI	AIC	BIC	RMSEA
Original	None	2299.350	600	<.001***	.915	.919	102,711.841	103,233.486	.059
	Equal means	2377.613	606	<.001***	.911	.916	102,778.104	103,264.973	.060
	Equal variances	2314.757	606	<.001***	.914	.919	102,715.248	103,202.116	.059
Allows y9 and y17 errors to correlate	None	2033.104	597	<.001***	.928	.931	102,451.594	102,990.628	.054
	Equal means	2111.004	603	<.001***	.924	.928	102,517.495	103,021.752	.056
	Equal variances	2047.843	603	<.001***	.927	.931	102,454.334	102,958.591	.054
	Equal errors	2033.168	599	<.001***	.928	.931	102,447.658	102,975.100	.054

Note. *** indicates significance at the $p < 0.001$ level. CFI = comparative fix index; TLI = Tucker–Lewis index; AIC = Akaike information criterion; BIC = Bayesian information criterion; RMSEA = root mean squared error of approximation.

Table 6. Group Factor Mean Comparisons.

Group	Model	Relative factor mean (a)	*p* value (a)	Relative factor mean (b)	*p* value (b)
Loneliness					
Cisgender heterosexual	Original	0.000	—	−0.277	<.001***
	Allows y9 and y17 errors to correlate	0.000	—	−0.275	<.001***
Cisgender SM	Original	0.097	.100	−0.199	<.001***
	Allows y9 and y17 errors to correlate	0.096	.103	−0.198	<.001***
GM and SM	Original	0.279	<.001***	0.000	—
	Allows y9 and y17 errors to correlate	0.277	<.001***	0.000	—
Negatively valenced items					
Cisgender heterosexual	Original	0.000	—	−0.426	<.001***
	Allows y9 and y17 errors to correlate	0.000	—	−0.427	<.001***
Cisgender SM	Original	0.365	<.001***	−0.115	.035*
	Allows y9 and y17 errors to correlate	0.365	<.001***	−0.115	.036*
GM and SM	Original	0.498	<.001***	0.000	—
	Allows y9 and y17 errors to correlate	0.496	<.001***	0.000	—
Positively valenced items					
Cisgender heterosexual	Original	0.000	—	−0.003	.967
	Allows y9 and y17 errors to correlate	0.000	—	0.003	.964
Cisgender SM	Original	−0.048	.482	−0.051	.377
	Allows y9 and y17 errors to correlate	−0.051	.455	−0.048	.407
GM and SM	Original	0.003	.967	0.000	—
	Allows y9 and y17 errors to correlate	−0.003	.964	0.000	—

Note. *** indicates significance at the $p < 0.001$ level; ** indicates significance at the $p < 0.01$ level; * indicates significance at the $p < 0.05$ level. (a) = cisgender/heterosexual reference group; (b) = GM/SM reference group; SM = sexual minority; GM = gender minority.

Therefore, adolescents who identified as both a GM and an SM reported significantly greater loneliness relative to cisgender/heterosexual adolescents and cisgender/SM adolescents, but cisgender/SM adolescents reported loneliness levels that did not differ from those reported by cisgender/heterosexual adolescents. Factor scores derived from the original strict invariance model were highly similar to those reported above (Table 6).

In terms of observed scale scores, GM/SM participants had the highest average loneliness sum score at 60.214, followed by cisgender/SM participants with a mean sum score of 57.980, followed by cisgender/heterosexual participants with a mean sum score of 55.760 (Table 7). Three *t* tests revealed that each group's observed mean was significantly different from the others (Appendix D). Mean loneliness factor scores and observed loneliness sum scores correlated at $r = .931$.

Table 7. Group Observed Loneliness Mean Comparisons.

Group	Observed sum score group mean	*SD*
cisgender/heterosexual	55.760	11.113
cisgender/SM	57.980	10.021
GM/SM	60.214	10.171

Note. SM = sexual minority; GM = gender minority.

Table 8. Predicting Depression Levels.

Model	Predictor	Estimate	*SE*	*t* value	Predictor *p* value	R^2_{adj}	ΔR^2_{adj}	ΔR^2_{adj} *p* value
Loneliness only	(Intercept)	14.176	0.070	201.87	<.001***	.295	—	—
	Loneliness	0.214	0.007	31.88	<.001***			
Loneliness and LGBTQ+ identity	(Intercept)	12.943	0.150	86.05	<.001***	.327	.032	<.001***
	Loneliness	0.203	0.007	30.55	<.001***			
	Cisgender/SM	1.176	0.182	6.46	<.001***			
	GM/SM	2.060	0.192	10.73	<.001***			
Loneliness, LGBTQ+ identity, and their interaction	(Intercept)	13.021	0.153	85.09	<.001***	.329	.002	.007**
	Loneliness	0.234	0.013	17.46	<.001***			
	Cisgender/SM	1.098	0.184	5.95	<.001***			
	GM/SM	2.029	0.194	10.47	<.001***			
	Loneliness × cisgender/SM	−0.030	0.017	−1.76	.079			
	Loneliness × GM/SM	−0.055	0.018	−3.14	.002**			

Note. ***indicates significance at the $p < 0.001$ level; **indicates significance at the $p < 0.01$ level; *indicates significance at the $p < 0.05$ level. Loneliness levels are mean-centered, and the cisgender/heterosexual group is used as the reference group for SGM (sexual and gender minority) status. SM = sexual minority; GM = gender minority.

Are Loneliness Levels, SGM Identity, and Their Interaction Predictive of Other Psychosocial Outcomes?

Because we found evidence for differential levels of loneliness based on SGM identity, we investigated the association of loneliness and SGM identity with depression and anxiety symptom severity. Specifically, we sought to assess how much variance in depression and anxiety was accounted for by loneliness levels and SGM identity. These tests were exploratory (not preregistered), as we did not initially expect to find strict invariance of the ULS across groups. We conducted a series of sequential regression analyses that tested, in order, (a) whether loneliness scores significantly predicted depression/anxiety scores, (b) whether the addition of SGM identity as a predictor significantly improved the model's predictive abilities, and (c) whether the interaction between loneliness scores and SGM identity significantly improved the model's predictive abilities. In the first regression, mean-centered loneliness was a significant predictor for both depression and anxiety scores ($R^2_{adj} = .2953$ and $.1393$, respectively). In both cases, the second regression ($R^2_{adj} = .3268$ and $.1645$ for depression and anxiety, respectively) showed a significant improvement over the first regression; for the improvement in the depression model: $p < .001$, $\Delta R^2_{adj} = .0315$, and for the improvement in the anxiety model: $p < .001$, $\Delta R^2_{adj} = .0252$. The third regression ($R^2_{adj} = .3290$ and $.1671$ for depression and anxiety, respectively) showed a significant improvement over the second regression, but the change in adjusted R^2 was minimal (for depression, $p = .007$, $\Delta R^2_{adj} = .0022$; for anxiety, $p = .010$, $\Delta R^2_{adj} = .0026$). These results suggest that loneliness levels, SGM identity, and the interaction between these two variables significantly predict both depression (Adjusted $R^2 = .3290$; Table 8) and anxiety (Adjusted $R^2 = .1671$; Table 9) levels, although the interaction term explained only 0.2% more variance in both cases. The resulting regression equation for predicting depression was

$$\begin{aligned} depression = {} & 13.02 + 0.234(loneliness) \\ & + 1.098(cisgender\ /\ SM) + 2.029(SM\ /\ GM) \\ & - 0.030(loneliness \times cisgender\ /\ SM) \\ & - 0.055(loneliness \times GM\ /\ SM) \end{aligned}$$

The resulting regression equation for predicting anxiety was

$$\begin{aligned} anxiety = {} & 19.56 + 0.255(loneliness) \\ & + 1.409(cisgender\ /\ SM) + 2.260(SM\ /\ GM) \\ & - 0.067(loneliness \times cisgender\ /\ SM) \\ & - 0.068(loneliness \times GM\ /\ SM) \end{aligned}$$

We next decomposed the interactions for the models predicting depression and anxiety into simple regression lines (Tables 10 and 11; Figure 3). The resulting intercepts indicate that when loneliness is at its mean for all groups, GM/SM adolescents have the highest baseline levels of depression (15.05) and anxiety (21.82), followed by cisgender/SM adolescents (14.12 for depression and 20.97 for anxiety), and finally cisgender heterosexual adolescents with the lowest baseline levels (13.02 for depression and 19.56 for anxiety); all comparisons of intercepts across groups were significant at $p < .001$. For the cisgender heterosexual group, the simple slope for loneliness predicting depression was 0.234, and the simple slope for loneliness predicting anxiety was 0.225. For the cisgender sexual minority group,

Table 9. Predicting Anxiety Levels.

Model	Predictor	Estimate	*SE*	*t* value	*p* value (predictor)	R^2_{adj}	ΔR^2_{adj}	ΔR^2_{adj} *p* value
Loneliness only	(Intercept)	20.928	0.100	208.60	<.001***	.139	—	—
	Loneliness	0.187	0.010	19.51	<.001***			
Loneliness and LGBTQ+ identity	(Intercept)	19.430	0.217	89.70	<.001***	.165	.026	<.001***
	Loneliness	0.174	0.010	18.24	<.001***			
	Cisgender/SM	1.542	0.263	5.87	<.001***			
	GM/SM	2.356	0.276	8.53	<.001***			
Loneliness, LGBTQ+ identity, and their interaction	(Intercept)	19.559	0.220	88.73	<.001***	.167	.002	.010*
	Loneliness	0.225	0.019	11.72	<.001***			
	Cisgender/SM	1.409	0.266	5.30	<.001***			
	GM/SM	2.260	0.279	8.11	<.001***			
	Loneliness × cisgender/SM	−0.067	0.024	−2.75	.006**			
	Loneliness × GM/SM	−0.068	0.025	−2.69	.007**			

Note. *** indicates significance at the $p < 0.001$ level; ** indicates significance at the $p < 0.01$ level; * indicates significance at the $p < 0.05$ level. Loneliness levels are mean-centered, and the cisgender/heterosexual group is used as the reference group for SGM (sexual and gender minority) status. SM = sexual minority; GM = gender minority.

Table 10. Simple Slopes for Depression Regressed on Loneliness and LGBTQ+ Identity.

Group	Simple slope	Intercept
Cisgender heterosexual	0.234 (loneliness)	13.021
Cisgender/SM	0.204 (loneliness)	14.119
GM/SM	0.179 (loneliness)	15.050
Simple slope comparison	**Difference**	***p* value**
Cisgender SM—Cisgender heterosexual	−0.030	.079
GM/SM—Cisgender heterosexual	−0.055	.002**
GM/SM—Cisgender SM	−0.025	.095

Note. ** indicates significance at the $p < 0.01$ level. Comparisons of unstandardized simple slopes of loneliness predicting depression for cisgender heterosexual, cisgender sexual minority, and gender and sexual minority groups. All cross-group comparisons of intercepts were significant at $p < .001$. SM = sexual minority; GM = gender minority.

Table 11. Simple Slopes for Anxiety Regressed on Loneliness and LGBTQ+ Identity.

Group	Simple slope	Intercept
Cisgender heterosexual	0.225 (loneliness)	19.559
Cisgender/SM	0.158 (loneliness)	20.968
GM/SM	0.157 (loneliness)	21.819
Simple slope comparison	**Difference**	***p* value**
Cisgender SM—Cisgender heterosexual	−0.067	0.006**
GM/SM—Cisgender heterosexual	−0.068	0.007**
GM/SM—Cisgender SM	−0.001	0.957

Note. ** indicates significance at the $p < 0.01$ level. Comparisons of unstandardized simple slopes of loneliness predicting anxiety for cisgender heterosexual, cisgender sexual minority, and gender and sexual minority groups. All cross-group comparisons of intercepts were significant at $p < .001$. SM = sexual minority; GM = gender minority.

the simple slope for loneliness predicting depression was 0.204, and the simple slope for loneliness predicting anxiety was 0.158. For the gender and sexual minority group, the simple slope for loneliness predicting depression was 0.179, and the simple slope for loneliness predicting anxiety was 0.157. Thus, for both outcomes, increasing loneliness was most strongly associated with increasing depression and anxiety in the cisgender heterosexual group. With regard to the significance of these slope differences, (a) the simple slope of the cisgender heterosexual group was significantly

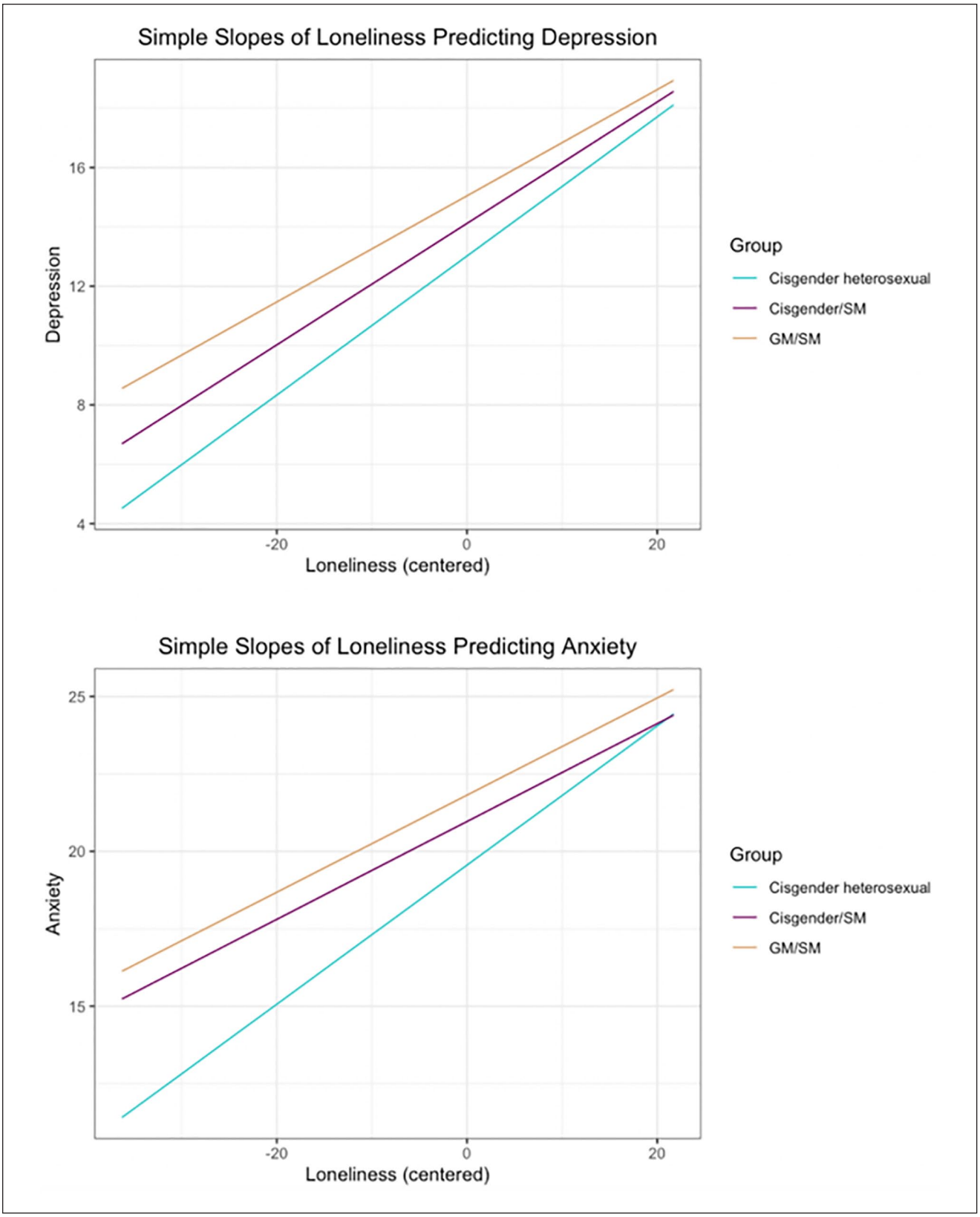

Figure 3. Simple Slopes of Loneliness Predicting Depression and Anxiety for LGBTQ+ Identity Groups.
Note. Loneliness, depression, and anxiety levels are represented as sum scores, and loneliness is mean-centered. Groups include cisgender heterosexual, cisgender/SM (cisgender sexual minority), and GM/SM (gender and sexual minority).

higher than the simple slope of the GM/SM group for the depression outcome (Table 10) and (b) the simple slope of the cisgender heterosexual group was significantly higher than the simple slopes of both the cisgender/SM group and the GM/SM group (Table 11) for the anxiety outcomes. See Figure 3 for a visual representation of the simple slopes and intercepts.

We then repeated the same set of depression analyses, this time controlling for anxiety in the model. Similarly, we repeated the set of anxiety analyses, this time controlling for depression. The results were overall similar to those without the controls, although in these analyses the contribution of the interaction term was no longer significant in either the depression prediction model or the anxiety prediction model (Appendix E).

Discussion

In the current study, we aimed to determine the optimal factor structure of the ULS; then, using the optimal model, we tested whether the ULS assessed loneliness equivalently (i.e., showed invariance) across gender diverse and sexual orientation diverse youth with elevated depressive symptoms. Finding evidence for strict invariance, we proceeded to conduct exploratory analyses that directly compared ULS means of both observed and factor loneliness scores across groups of cisgender/heterosexual, cisgender/SM, and GM/SM adolescents. Overall, the results suggested that GM adolescents experienced more loneliness than cisgender adolescents, whereas SM adolescents in the sample did not report experiencing more loneliness than did heterosexual adolescents. Also as an exploratory test, we investigated the extent to which loneliness scores and SGM identity predict levels of depression and anxiety. We found that loneliness scores, SGM identity, and the relationship between SGM identity and loneliness significantly predict levels of depression and anxiety in the current sample. Overall, the results imply several conclusions: first, that the ULS is likely an appropriate measure for loneliness comparisons based on LGBTQ+ identity, at least in this age group; second, that gender minority adolescents likely experience more loneliness than cisgender adolescents; and third, that loneliness may be useful to assess alongside depression and anxiety in characterizing mental health disparities.

Sample Characteristics

One feature of our sample was the relatively high endorsement of LGBTQ+ identities relative to samples reported in other adolescent-focused studies, which allowed for analyses across three sexual orientation- and gender identity-related groups. Over three-quarters of youths in the current sample self-identified with a sexual minority identity, and over a third self-identified with a gender minority identity. In contrast, the estimated prevalence of LGBTQ+ identity within high school students is 15.6% for sexual minority youths (Centers for Disease Control and Prevention, 2020) and 1.8% for transgender youths (Johns et al., 2019), although this latter statistic does not take into account frequencies of other forms of gender diversity, which is notable given that most of our study's gender minority participants identified as gender nonbinary. When gender minority status is instead conceptualized as a gender nonconforming or androgynous presentation, 27% of Californian adolescents aged 12 to 17 are considered a gender minority (Wilson et al., 2017). Furthermore, the rate of LGBTQ+ identification varies with age, with youths much more frequently reporting an LGBTQ+ identity relative to older adults (J. M. Jones, 2021). Because the current study utilized a youth sample, it is reasonable to expect higher rates of LGBTQ+ identification in this sample compared with the national average. Other possible contributing factors to this high portion of LGBTQ+ youths include (a) a heightened desire for mental health support relative to cisgender heterosexual youths (Williams & Chapman, 2011); (b) the ability of SSI-type interventions (including those offered in the trial youths were participating in) to bypass common barriers to mental health access among LGBTQ+ youths, such as provider discrimination, fear of being outed, and difficulty gaining support from parents (Acevedo-Polakovich et al., 2013; Williams & Chapman, 2011); and/or (c) the study's inclusion criterion of heightened depressive symptoms, because LGBTQ+ youths are more likely to experience depression than cisgender heterosexual youths, due in part to minority stress processes (D'augelli, 2002; Hatzenbuehler et al., 2008; Shearer et al., 2016). For all of these reasons, it follows that a trial offering anonymous, online, free mental health resources for depression and anxiety might draw high numbers of LGBTQ+-identifying youths.

The Structure of the ULS

Because of a lack of consensus in the literature over the factor structure of the ULS, we first attempted to address this disagreement. Of the models we tested, the bifactor model specified by Russell in 1996 had the best fit. However, its fit in each group was only adequate (cisgender/heterosexual and GM/SM) or near-adequate (cisgender/SM), and in no case did Russell's model reach the cutoffs of the preferred fit index values (CFI/TLI $>.95$ and RMSEA values of $<.06$). These results imply that even the best fitting of the currently recommended factor structures of the ULS does not have a particularly good fit. Similarly, the relative omega values give pause to interpreting method factor scores. While there does not appear to be a specific consensus for omega benchmarks, Reise (2012) suggests that omega values should meet the same

standards as are expected of alpha values. Thus, the omega values for this model, which are all above .80, indicate a sufficiently high level of model-based reliability. However, the high relative omega for the general factor (>.80), paired with the low relative omegas for the method factors (<.50), indicate that most of the reliable variance of the composite scores is due to the general factor. These results preclude strong inferences regarding the interpretation of the method factor scores.

Upon the addition of an a priori identified single correlated error, the fit of the model improved substantially (increase in CFI/TLI >.01 in all groups and RMSEA value of <.06 in the full sample model; Table 3). We therefore recommend future models of the ULS to consider the correlated error bifactor model in Figure 2 when investigating questions related to the ULS factor structure in adolescents. However, caution should be used before the general adoption of this model for several reasons. For one, the CFI/TLI values of the correlated error model remain below .95, which is the preferred cutoff level for a good model fit. Second, while the relative omega value for the specific factor representing this correlated error (.727) indicates reliable variance is explained by the addition of this factor, the relative omega values for the positive and negative items method factors remain low (<.50). Third, bifactor models by nature have a higher fitting propensity (i.e., artificially heightened fit), and thus the bifactor models recommended by Russell and Dodeen would likely display somewhat higher fit levels than the non-bifactor models with all else equal (Reise et al., 2016). However, the best-fitting non-bifactor model (Shevlin and colleagues' (2014) Isolation, Related Connectedness, and Collective Connectedness three-factor model) fits worse than the bifactor models (CFI/TLI values >.02 lower than the bifactor model in all cases), so the overfitting of the bifactor model would need to be substantial for the superior model fit to be solely a statistical artifact. Accordingly, the current results do suggest the potential future utility of the correlated error bifactor model (Figure 2).

Invariance of the ULS Across Gender Identities and Sexual Orientations

The ULS fit indices did not change substantially (according to our preregistered cutoffs) across any of the invariance tests on Russell's bifactor model or on our correlated error model. However, in both cases, chi-square tests indicated consistent significant differences as invariance constraints were added. Traditionally, these significant values would imply that the model is not sufficiently invariant; however, because chi-square tests have a high degree of power in large sample sizes and test a null hypothesis that two models are precisely equal (R. B. Kline, 2015), we determined that the lack of substantial change in any of the other fit indices was a better indicator of invariance/noninvariance than the chi-square tests were. The conclusion that the ULS is invariant across gender and sexual orientation groups implies that group observed mean scores on the ULS can be meaningfully compared. Consequently, significant group differences in observed test scores can be assumed to relate to true population differences as opposed to confounding factors related to group membership.

Cross-Group Loneliness Levels in the Sample

Per previously established score interpretation recommendations, observed scale scores between 20 and 34 indicate low loneliness, 35 and 49 indicate moderate loneliness, 50 and 64 indicate moderately high loneliness, and 65 and 80 indicate high loneliness (Deckx et al., 2014). Based on commonly used categorization, all three groups displayed a moderately high degree of loneliness (Perry, 1990; Sevil et al., 2006; Yildirim & Kocabiyik, 2010), which is consistent with the study inclusion criterion requiring elevated depression levels for participation.

Adolescents who identified with both a gender and sexual minority identity (GM/SM) displayed higher loneliness factor levels than both adolescents who identified as cisgender heterosexual and adolescents who identified as cisgender SM. Sexual minority youths, however, did not display higher loneliness factor levels than did heterosexual youths. These results are consistent with evidence suggesting transgender youths experience more minority stress than do sexual minority youths (Carmel & Erickson-Schroth, 2016; T. Jones & Hillier, 2013). However, without a comparison group of gender minority and heterosexual youths, we cannot ascertain whether the observed difference in loneliness for GM/SM youths compared with cisgender/SM and cisgender/heterosexual youths is related to the presence of a gender minority identity alone or rather to the combination of having both gender and sexual minority identities.

Observed scale scores, on the other hand, differed significantly for each group comparison. That is, GM adolescents had significantly higher observed scale loneliness scores than did cisgender adolescents, and SM adolescents had significantly higher observed loneliness scores than heterosexual adolescents. Although group comparisons of factor levels and observed scores can both index differences in loneliness levels, these indices operationalize loneliness in different ways, which likely contributed to the partial discrepancy between the factor analytic and the *t* test results. To derive factor levels, each scale item is differentially weighted based on the estimated contribution of the item to the factor (in this case, loneliness). By contrast, observed scores are unweighted sums, and each item contributes equally to the outcome (loneliness). Furthermore, variance is partitioned differently in the bifactor model than in the sum-score model, with the addition of two specific factors.

Accordingly, the question of which approach provides the better representation of loneliness levels (and thus, which score type should be used in research and clinical practice) depends on which of the scores is a more accurate representation of loneliness in youth. Because confirmatory factor analysis is by design meant to estimate loneliness levels without measurement error and other nonloneliness variance sources (in this case, positive and negative wording), the loneliness factor scores are likely to be a more accurate representation than unweighted observed scores, which may be confounded by extraneous variance. Therefore, the results of the current study suggest most strongly that GM adolescents in this sample had higher loneliness levels than cisgender adolescents, while SM and heterosexual adolescents may have similar levels. Nevertheless, because observed scores and factor scores were highly correlated, and because the measure was determined to be invariant based on LGBTQ+ identity, the observed scores can also be used as a generally accurate measure of loneliness in these groups.

Correlates of Loneliness and SGM Identity

Exploratory analyses revealed that observed loneliness levels, SGM identity, and the interaction between the two were associated with levels of both depression and anxiety in the sample. These results indicate that higher loneliness predicts higher anxiety and depression levels, that identity as a sexual and/or gender minority predicts higher anxiety and depression levels, and that the relationship between loneliness and SGM identity in predicting depression/anxiety is different at different levels of loneliness. Notably, the strength of the regression coefficients indicates that the presence of GM/SM identity had a stronger relationship with depression and anxiety levels than did the presence of cisgender/SM identity. This result corroborates the earlier conclusion that youth loneliness differs more across gender minority status than it does across sexual minority status. The interaction term indicates that differences in depression and anxiety levels across the three groups (cisgender/heterosexual, cisgender/SM, GM/SM) are greater when loneliness levels are low and smaller when loneliness levels are high, suggesting that there is no synergistic effect between loneliness and SGM identity in predicting depression. However, the contribution of the interaction term to the prediction was minimal, and so this interaction may have been affected by ceiling effects related to the high depression levels in the recruitment sample—consequently, the role of the interaction between loneliness and SGM in predicting depression and anxiety is questionable. In addition, the accuracy of these overall predictions is uncertain given the lack of invariance testing across gender and sexual orientation groups for the depression and anxiety scales used in the current study. Nevertheless, these relationships do suggest the importance of loneliness and SGM identity as key factors related to higher levels of depression and anxiety.

Limitations and Future Directions

A notable limitation of the current study is the lack of a group of adolescents who identified as a gender minority and as heterosexual. Because only 12 adolescents fit these criteria, we did not have sufficient statistical power to be able to use this subsample in current analyses. That being said, GM youths tend to represent their sexual orientation through nonbinary terminology, indicating that they may be relatively unlikely to endorse a heterosexual identity in general (Dargie et al., 2014). A similar limitation regarding categorization is that the broad categorization of GM and SM youths obscures potential group differences across specific gender and sexual minority identities. While the current data did not allow for justified sub-identity invariance analyses, it is noteworthy that, while specific minority stress processes may impact different identity groups, the general principle of minority stress applies to all of these marginalized groups. Furthermore, known manifestations of minority stress during the COVID-19 pandemic (such as being quarantined in unsupportive home environments) impact LGBTQ+ individuals regardless of a specific gender or sexual identity. Nevertheless, further research that can model more nuanced groupings (and their intersections) will be critical to advance the study of loneliness across various sexual and gender minority populations. Another limitation worth noting is that even the best-fitting model that was tested, the correlated error bifactor model, did not reach preferred cutoff levels for good model fit (although it did reach preferred cutoff levels for adequate fit). In addition, the reliability of the specific factors in this model was low, limiting interpretations of scores on these factors in isolation. Future investigations could incorporate techniques such as exploratory factor analysis to generate or rule out the possibility of better-fitting models. Another drawback of the current study is that interpretations of loneliness in the sample are confounded by factors such as the high rate of comorbid depression and the occurrence of the COVID-19 pandemic; consequently, caution should be used before extending the results to other samples. Even so, the context of these data allows for unique insight into levels of loneliness in LGBTQ+ and cisgender heterosexual adolescents with elevated depression symptoms during the COVID-19 pandemic. Furthermore, the national recruitment and large size of the current sample enhance the generalizability of the results. Finally, while the representation of LGBTQ+ youths is a strength of the study, the relative proportion of LGBTQ+ to cisgender heterosexual youths in the sample may have been influenced by the social media-based recruitment method. However, without better assessment and representation of LGBTQ+ identity in

youth samples, norms for the prevalence of LGBTQ+ identity from different sampling techniques are yet to be established. Replication using other samples that assess LGBTQ+ identity can clarify the extent of generalizability of the current sample.

We hope others will consider expanding on the results of the current investigation through additional research on the associations between loneliness, LGBTQ+ identity, and psychopathology. We additionally hope that researchers will consider conducting invariance testing on a variety of other commonly used scales in clinical research, which will contextualize the host of previous work using such assessments. In addition, with some evidence of the ULS showing invariance across gender identities and sexual orientations in high-symptom youth having now been established, investigators may consider conducting invariance testing across these groups in other points of the lifespan, such as older adulthood. Psychopathology risk appears to be highest for LGBTQ+ people in youth and older age, relative to middle adulthood (Semlyen et al., 2016); in addition, older LGBTQ+ adults are at high risk of social isolation and frequently report a fear of feeling alone (Espinoza, 2014; Kim & Fredriksen-Goldsen, 2016). Consequently, future research on loneliness in LGBTQ+ individuals should incorporate invariance testing and subsequent group comparisons across the lifespan. Invariance testing and group comparisons in community samples without clinically elevated symptoms, as well as in outpatient or inpatient settings, could additionally clarify the association of psychopathology with LGBTQ+ identity and loneliness.

We also encourage investigators to perform invariance testing within their samples when conducting research related to health disparities. Currently, cross-group comparisons of many constructs, such as *Diagnostic and Statistical Manual of Mental Disorders* (*DSM*)-type diagnostic criteria, are confounded by measurement biases (Balsis et al., 2007; Eaton, 2020; Eaton et al., 2021). Due to a broad lack of cross-group psychometric comparisons, interpretation of group-based health disparities remains clouded by questions of measurement noninvariance, among other sources of variance. In guiding prevention and intervention efforts related to minority stressors, it is imperative to determine to what extent observed differences in health reflect true score differences or measurement artifacts. As such, the current article highlights the need for invariance testing of key constructs to identify disparities, produce defensible group comparisons and justifiably include such measures in broader minority stress models.

Conclusion

Ultimately, results suggested that the ULS is likely invariant across youth gender identities and sexual orientations, that gender minority youths are at particular risk for high levels of loneliness, and that loneliness may be an informative construct in clinical assessment and treatment research (especially among gender minority youths). Sexual minority youths may also be at increased risk for loneliness relative to heterosexual youth, but the effect of sexual minority status on loneliness does not appear to be as strong as that of gender minority status. Loneliness and SGM identity also significantly predicted levels of depression and anxiety in the sample, providing further evidence for the importance of loneliness as a clinically relevant construct for LGBTQ+ youths. Future research on loneliness in other LGBTQ+ age groups and in samples with different clinical characteristics can further clarify the role of loneliness in psychopathology and treatment. Finally, more widespread invariance testing in general can provide grounds for confidence in other findings within health disparities research.

Appendix A

Table A1. Models Subjected to Statistical Testing.

Model	Author	# factors	First factor	Second factor	Third factor
1	Hartshorne, 1993; Lasgaard, 2007	1	global loneliness	—	—
2	Knight et al, 1998	2	positive items	negative items	—
3a	Wilson et al., 1992	2	intimate other	social other	—
3b	Zakahi & Duran, 1982	2	intimate other	social other	—
4a	Austin, 1983	3	intimate other	social other	belonging/affiliation
4b	McWhirter, 1990	3	intimate other	social other	belonging/affiliation
5	Shevlin et al., 2014	3	isolation	related connectedness	collective connectedness
6a	Russell, 1996	bifactor	global loneliness	positive items	negative items
6b	Dodeen, 2014	bifactor	global loneliness	positive items	negative items

Note. Models that have the same latent factor structure across groups but differ in their number of item loadings are denoted with "a" and "b."

Appendix B

Table B1. Item Content of the UCLA Loneliness Scale.

Item	Item content	Loading on loneliness	Loading on positive items	Loading on negative items
1	How often do you feel that you are "in tune" with the people around you?	0.538	0.297	—
2	How often do you feel that you lack companionship?	0.474	—	0.362
3	How often do you feel that there is no one you can turn to?	0.592	—	0.387
4	How often do you feel alone?	0.482	—	0.489
5	How often do you feel part of a group of friends?	0.584	0.232	—
6	How often do you feel that you have a lot in common with the people around you?	0.663	0.291	—
7	How often do you feel that you are no longer close to anyone?	0.546	—	0.457
8	How often do you feel that your interests and ideas are not shared by those around you?	0.463	—	0.334
9	How often do you feel outgoing and friendly?	0.429	0.206	—
10	How often do you feel close to people?	0.709	0.193	—
11	How often do you feel left out?	0.454	—	0.460
12	How often do you feel that your relationships with others are not meaningful?	0.485	—	0.434
13	How often do you feel that no one really knows you well?	0.544	—	0.385
14		0.489	—	0.553
15	How often do you feel you can find companionship when you want it?	0.541	—	—
16	How often do you feel that there are people who really understand you?	0.695	—	—
17	How often do you feel shy?	0.198	—	0.140
18	How often do you feel that people are around you but not with you?	0.417	—	0.468
19	How often do you feel that there are people you can talk to?	0.804	−0.352	—
20	How often do you feel that there are people you can turn to?	0.820	−0.358	—

Appendix C

Table C1. Predicted Correlated Residuals.

Item	How often do you feel . . .	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	. . . that you are "in tune" with the people around you?																				
2	. . . that you lack companionship?																				
3	. . . that there is no one you can turn to?																				
4	. . . alone?		X																		
5	. . . part of a group of friends?		X																		
6	. . . that you have a lot in common with the people around you?																				
7	. . . that you are no longer close to anyone?		X																		
8	. . . that your interests and ideas are not shared by those around you?						X														
9	. . . outgoing and friendly?																				
10	. . . close to people?							**X**													
11	. . . left out?																				
12	. . . that your relationships with others are not meaningful?	X																			

(continued)

Table C1. (continued)

Item	How often do you feel . . .	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
13	. . . that no one really knows you well?												X								
14	. . . isolated from others?		X		X																
15	. . . you can find companionship when you want it?		X																		
16	. . . that there are people who really understand you?												X	X							
17	. . . shy?									**X**											
18	. . . that people are around you but not with you?												X								
19	. . . that there are people you can talk to?																				
20	. . . that there are people you can turn to?			**X**																**X**	

Note. Predicted correlated residuals: Pairs marked with an "X" were predicted a priori to have notable correlated residuals. Bolded pairs were predicted to have particularly strong correlated residuals. The bolded and underlined pair (Items 17 and 9) was demonstrated to be the strongest correlated residual after testing.

Appendix D

Table D1. Welch t Test—Observed Mean Loneliness Scores.

Group 1	Group 2	*df*	*t* value	*p* value
cisgender/heterosexual	cisgender/SM	916.69	−3.84	<.001***
cisgender/SM	GM/SM	1784.40	−4.80	<.001***
GM/SM	cisgender/heterosexual	1007.10	−7.37	<.001***

Note. *** indicates significance at the $p < 0.001$ level. SM = sexual minority; GM = gender minority.

Appendix E

Table E1. Predicting Depression Levels With Anxiety as a Control.

Model	Predictor	Estimate	*SE*	*t* value	Predictor *p* value	R^2_{adj}	ΔR^2_{adj}	ΔR^2_{adj} *p* value
Predicting depression levels with anxiety as a control								
Loneliness only	(Intercept)	7.366	0.280	26.26	<.001***	.445	—	—
	Loneliness	0.153	0.007	23.53	<.001***			
	Anxiety	0.326	0.013	24.99	<.001***			
Loneliness and LGBTQ+ identity	(Intercept)	6.938	0.289	23.98	<.001***	.458	.013	<.001***
	Loneliness	0.149	0.006	23.09	<.001***			
	Anxiety	0.309	0.013	23.61	<.001***			
	Cisgender/SM	0.724	0.168	4.32	<.001***			
	GM/SM	1.333	0.178	7.49	<.001***			
Loneliness, LGBTQ+ identity, and their interaction	(Intercept)	7.011	0.292	23.99	<.001***	.459	.001	.070
	Loneliness	0.167	0.013	13.38	<.001***			
	Anxiety	0.308	0.013	23.47	<.001***			
	Cisgender/SM	0.681	0.170	4.01	<.001***			
	GM/SM	1.326	0.179	7.39	<.001***			
	Loneliness × cisgender/SM	−0.014	0.015	−0.90	.37			
	Loneliness × GM/SM	−0.036	0.016	−2.24	.025*			
Predicting anxiety levels with depression as a control.								
Loneliness only	(Intercept)	11.768	0.377	31.18	<.001***	.320	—	—
	Loneliness	0.048	0.010	4.76	<.001***			
	Depression	0.646	0.026	24.99	<.001***			

(continued)

Table E1. (continued)

Model	Predictor	Estimate	*SE*	*t* value	Predictor *p* value	R^2_{adj}	ΔR^2_{adj}	ΔR^2_{adj} *p* value
Loneliness and LGBTQ+ identity	(Intercept)	11.379	0.393	28.95	<.001***	.325	.005	<.001***
	Loneliness	0.048	0.010	4.72	<.001***			
	Depression	0.622	0.026	23.61	<.001***			
	Cisgender/SM	0.794	0.238	3.33	<.001***			
	GM/SM	1.073	0.254	4.22	<.001***			
Loneliness, LGBTQ+ identity, and their interaction	(Intercept)	11.489	0.397	28.92	<.001***	.326	.001	.111
	Loneliness	0.078	0.018	4.26	<.001***			
	Depression	0.620	0.026	23.47	<.001***			
	Cisgender/SM	0.717	0.241	2.98	.003**			
	GM/SM	1.007	0.257	3.93	<.001***			
	Loneliness × cisgender/SM	−0.046	0.022	−2.09	.037*			
	Loneliness × GM/SM	−0.032	0.023	−1.42	.157			

Note. *** indicates significance at the $p < 0.001$ level; ** indicates significance at the $p < 0.01$ level; * indicates significance at the $p < 0.05$ level. Loneliness levels are mean-centered, and the cisgender/heterosexual group is used as the reference group for SGM (sexual and gender minority) status. SM = sexual minority; GM = gender minority.

Acknowledgments

We thank Dr. Ashley Greene and Dr. David Dueber for their generous help with calculating omega values for the factor analytic models.

Author Contributions

R.M. and N.R.E. conceptualized the project. R.M. wrote the analytic code, created tables and visualizations, conducted the formal analysis, and wrote the initial manuscript draft with contributions from N.R.E. J.L.S. acquired funding for the project. J.L.S. and K.R.F. contributed to data curation. J.L.S., K.R.F., and N.R.E. provided supervision and mentorship. All authors contributed to methodology and study design, as well as the review and editing of the final manuscript.

Declaration of Conflicting Interests

The author(s) declared the following potential conflicts of interest with respect to the research, authorship, and/or publication of this article: J.L.S. receives grant support from the National Institutes of Health (DP5OD28123), the Klingenstein Third Generation Foundation, the American Psychological Foundation, the Society for Clinical Child and Adolescent Psychology, and Limbix, Inc. J.L.S. and K.R.F. receive grant support from the Upswing Fund for Adolescent Mental Health. J.L.S. has co-authored and received royalties from sales of a therapeutic workbook for adolescents, published by New Harbinger. J.L.S. is under contract with Oxford University Press to co-edit a book on low-intensity mental health interventions for youth. The authors report no other financial conflicts.

Funding

The author(s) disclosed receipt of the following financial support for the research, authorship, and/or publication of this article: This study was supported by the Office of the Director, National Institutes of Health under an "Emergency COVID-19 Competitive Revision Award" linked with grant DP5OD028123 (PI: Schleider).

ORCID iD

Riley McDanal https://orcid.org/0000-0002-4607-4131

Data Availability

Anonymized participant-level data are available on the Open Science Framework (osf.io/bs2f8/)

Code Availability

Analytic code is available on the Open Science Framework. (osf.io/bs2f8/)

Notes

1. The overall sample size and subgroup sample sizes are slightly smaller than those estimated in the preregistration due to data cleaning updates on the original dataset from which the current data were drawn.
2. This solution was provided by Dr. Dueber in personal communication.

References

Acevedo-Polakovich, I. D., Bell, B., Gamache, P., & Christian, A. S. (2013). Service accessibility for lesbian, gay, bisexual, transgender, and questioning youth. *Youth & Society*, *45*(1), 75–97.

Allen, R. L., & Oshagan, H. (1995). The UCLA loneliness scale: Invariance of social structural characteristics. *Personality and Individual Differences*, *19*(2), 185–195.

Austin, B. A. (1983). Factorial structure of the UCLA Loneliness Scale. *Psychological Reports*, *53*(3), 883–889.

Baams, L., Dubas, J. S., Russell, S. T., Buikema, R. L., & van Aken, M. A. (2018). Minority stress, perceived burdensomeness, and depressive symptoms among sexual minority youth. *Journal of Adolescence*, *66*, 9–18.

Balsis, S., Gleason, M. E., Woods, C. M., & Oltmanns, T. F. (2007). An item response theory analysis of DSM-IV

personality disorder criteria across younger and older age groups. *Psychology and Aging*, *22*(1), 171–185.

Barreto, M., Victor, C., Hammond, C., Eccles, A., Richins, M. T., & Qualter, P. (2021). Loneliness around the world: Age, gender, and cultural differences in loneliness. *Personality and Individual Differences*, *169*, 110066.

Brown, T. A. (2015). *Confirmatory factor analysis for applied research*. Guilford Press.

Carmel, T. C., & Erickson-Schroth, L. (2016). Mental health and the transgender population. *Journal of Psychosocial Nursing and Mental Health Services*, *54*(12), 44–48.

Centers for Disease Control and Prevention. (2020). *Youth risk behavior survey data*. www.cdc.gov/yrbs

Cheung, G. W., & Rensvold, R. B. (2002). Evaluating goodness-of-fit indexes for testing measurement invariance. *Structural Equation Modeling*, *9*(2), 233–255.

Dargie, E., Blair, K. L., Pukall, C. F., & Coyle, S. M. (2014). Somewhere under the rainbow: Exploring the identities and experiences of trans persons. *The Canadian Journal of Human Sexuality*, *23*(2), 60–74.

D'augelli, A. R. (2002). Mental health problems among lesbian, gay, and bisexual youths ages 14 to 21. *Clinical Child Psychology and Psychiatry*, *7*(3), 433–456.

Deckx, L., van den Akker, M., & Buntinx, F. (2014). Risk factors for loneliness in patients with cancer: A systematic literature review and meta-analysis. *European Journal of Oncology Nursing*, *18*(5), 466–477.

Dodeen, H. (2014). The effects of positively and negatively worded Items on the factor structure of the UCLA Loneliness Scale. *Journal of Psychoeducational Assessment*, *33*(3), 259–267.

Dueber, D. M. (2017). *Bifactor indices calculator: A Microsoft Excel-based tool to calculate various indices relevant to bifactor CFA models*. https://doi.org/10.13023/edp.tool.01

Dussault, M., Fernet, C., Austin, S., & Leroux, M. (2009). Revisiting the factorial validity of the Revised UCLA Loneliness Scale: A test of competing models in a sample of teachers. *Psychological Reports*, *105*(3), 849–856.

Eaton, N. R. (2020). Measurement and mental health disparities: Psychopathology classification and identity assessment. *Personality and Mental Health*, *14*(1), 76–87.

Eaton, N. R., Rodriguez-Seijas, C., & Pachankis, J. E. (in press). Transdiagnostic approaches to sexual- and gender- minority mental health. *Current Directions in Psychological Science*. https://doi.org/10.1177/09637214211043918

Ebesutani, C., Fierstein, M., Viana, A. G., Trent, L., Young, J., & Sprung, M. (2015). The role of loneliness in the relationship between anxiety and depression in clinical and school-based youth. *Psychology in the Schools*, *52*(3), 223–234.

Espinoza, R. (2014). *Out & visible: The experiences and attitudes of lesbian, gay, bisexual and transgender older adults, ages 45-75*. SAGE. https://www.sageusa.org/wp-content/uploads/2018/05/sageusa-out-visible-lgbt-market-research-full-report.pdf

Gillig, T. K., Valente, T. W., & Baezconde-Garbanati, L. (2020). Depressive symptoms and parental support-seeking in Latinx adolescents: Analyzing variation based on LGBT identity. *Journal of LGBT Youth*, *17*, 1–16.

Gregorich, S. E. (2006). Do self-report instruments allow meaningful comparisons across diverse population groups? Testing measurement invariance using the confirmatory factor analysis framework. *Medical Care*, *44*(11 Suppl. 3), S78.

Grygiel, P., Humenny, G., Rebisz, S., Świtaj, P., & Sikorska, J. (2013). Validating the Polish adaptation of the 11-item de Jong Gierveld Loneliness Scale. *European Journal of Psychological Assessment*. https://www.growkudos.com/publications/10.1027%25252F1015-5759%25252Fa000130/reader

Hartshorne, T. S. (1993). Psychometric properties and confirmatory factor analysis of the UCLA Loneliness Scale. *Journal of Personality Assessment*, *61*(1), 182–195.

Hatzenbuehler, M. L., McLaughlin, K. A., & Nolen-Hoeksema, S. (2008). Emotion regulation and internalizing symptoms in a longitudinal study of sexual minority and heterosexual adolescents. *Journal of Child Psychology and Psychiatry*, *49*(12), 1270–1278.

Heinrich, L. M., & Gullone, E. (2006). The clinical significance of loneliness: A literature review. *Clinical Psychology Review*, *26*(6), 695–718.

Hsieh, N., & Liu, H. (2021). Social relationships and loneliness in late adulthood: Disparities by sexual orientation. *Journal of Marriage and Family*, *83*(1), 57–74.

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

Johns, M. M., Lowry, R., Andrzejewski, J., Barrios, L. C., Demissie, Z., McManus, T., Rasberry, C. N., Robin, L., & Underwood, J. M. (2019). Transgender identity and experiences of violence victimization, substance use, suicide risk, and sexual risk behaviors among high school students—19 states and large urban school districts, 2017. *Morbidity and Mortality Weekly Report*, *68*(3), 67–71.

Jones, J. M. (2021). *LGBT identification rises to 5.6% in latest US estimate*. Politics.

Jones, T., & Hillier, L. (2013). Comparing trans-spectrum and same-sex-attracted youth in Australia: Increased risks, increased activisms. *Journal of LGBT Youth*, *10*(4), 287–307.

Kim, H. J., & Fredriksen-Goldsen, K. I. (2016). Living arrangement and loneliness among lesbian, gay, and bisexual older adults. *The Gerontologist*, *56*(3), 548–558.

Kline, R. B. (2015). *Principles and practice of structural equation modeling*. Guilford Press.

Kline, T. (2005). *Psychological testing: A practical approach to design and evaluation*. SAGE.

Knight, R. G., Chisholm, B. J., Marsh, N. V., & Godfrey, H. P. D. (1988). Some normative, reliability, and factor analytic data for the revised UCLA Loneliness scale. *Journal of Clinical Psychology*, *44*(2), 203–206.

Kovacs, M. (2011). *Children's Depression Inventory–2* (2nd ed). Multi-Health Systems.

Lasgaard, M. (2007). Reliability and validity of the Danish version of the UCLA Loneliness Scale. *Personality and Individual Differences*, *42*(7), 1359–1366.

Loades, M. E., Chatburn, E., Higson-Sweeney, N., Reynolds, S., Shafran, R., Brigden, A., Linney, C., McManus, M. N.,

Borwick, C., & Crawley, E. (2020). Rapid systematic review: The impact of social isolation and loneliness on the mental health of children and adolescents in the context of COVID-19. *Journal of the American Academy of Child & Adolescent Psychiatry*, *59*(11), 1218–1239.

Maes, M., Vanhalst, J., Van den Noortgate, W., & Goossens, L. (2017). Intimate and relational loneliness in adolescence. *Journal of Child and Family Studies*, *26*(8), 2059–2069.

McWhirter, B. T. (1990). Factor analysis of the revised UCLA loneliness scale. *Current Psychology*, *9*(1), 56–68.

Meredith, W., & Teresi, J. A. (2006). An essay on measurement and factorial invariance. *Medical Care*, *44*(11 Suppl. 3): S69–S77.

Mereish, E. H., Katz-Wise, S. L., & Woulfe, J. (2017). Bisexual-specific minority stressors, psychological distress, and suicidality in bisexual individuals: The mediating role of loneliness. *Prevention Science*, *18*(6), 716–725.

Mereish, E. H., & Poteat, V. P. (2015). A relational model of sexual minority mental and physical health: The negative effects of shame on relationships, loneliness, and health. *Journal of Counseling Psychology*, *62*(3), 425.

Meyer, I. H. (1995). Minority stress and mental health in gay men. *Journal of Health and Social Behavior*, *36*, 38–56.

Meyer, I. H., & Frost, D. M. (2013). Minority stress and the health of sexual minorities. In C. J. Patterson & A. R. D'Augelli (Eds.), *Handbook of psychology and sexual orientation* (pp. 252–266). Oxford University Press.

Perry, G. R. (1990). Loneliness and coping among tertiary-level adult cancer patients in the home. *Cancer Nursing*, *13*(5), 293–302.

Reise, S. P. (2012). The rediscovery of bifactor measurement models. *Multivariate Behavioral Research*, *47*(5), 667–696.

Reise, S. P., Kim, D. S., Mansolf, M., & Widaman, K. F. (2016). Is the bifactor model a better model or is it just better at modeling implausible responses? Application of iteratively reweighted least squares to the Rosenberg Self-Esteem Scale. *Multivariate Behavioral Research*, *51*(6), 818–838.

Rosseel, Y. (2012). Lavaan: An R package for structural equation modeling and more. Version 0.5–12 (BETA). *Journal of Statistical Software*, *48*(2), 1–36.

Russell, D. W. (1996). UCLA Loneliness Scale (Version 3): Reliability, validity, and factor structure. *Journal of Personality Assessment*, *66*(1), 20–40.

Salerno, J. P., Doan, L., Sayer, L. C., Drotning, K. J., Rinderknecht, R. G., & Fish, J. N. (2021). Changes in mental health and well-being are associated with living arrangements with parents during COVID-19 among sexual minority young persons in the U.S. *Psychology of Sexual Orientation and Gender Diversity*. Advance online publication. http://dx.doi.org/10.1037/sgd0000520

Schleider, J. L., Mullarkey, M. C., Fox, K., Dobias, M., Shroff, A., Hart, E., & Roulston, C. A. (2021). A randomized trial of online single session interventions for adolescent depression during COVID-19. *Nature Human Behaviour*. https://doi.org/10.31234/osf.io/ved4p

Semlyen, J., King, M., Varney, J., & Hagger-Johnson, G. (2016). Sexual orientation and symptoms of common mental disorder or low wellbeing: Combined meta-analysis of 12 UK population health surveys. *BMC Psychiatry*, *16*(1), 1–9.

Sevil, Ü. M. R. A. N., Ertem, G., & Kavlak, Ç. O. B. A. N. A. (2006). The loneliness level of patients with gynecological cancer. *International Journal of Gynecologic Cancer*, *16*(Suppl. 1). https://ijgc.bmj.com/content/16/Suppl_1/472

Shearer, A., Herres, J., Kodish, T., Squitieri, H., James, K., Russon, J., Atte, T., & Diamond, G. S. (2016). Differences in mental health symptoms across lesbian, gay, bisexual, and questioning youth in primary care settings. *Journal of Adolescent Health*, *59*(1), 38–43.

Shevlin, M., Murphy, S., & Murphy, J. (2014). The latent structure of loneliness. *Assessment*, *22*(2), 208–215.

Spitzer, R. L., Kroenke, K., Williams, J. B., & Löwe, B. (2006). A brief measure for assessing generalized anxiety disorder: The GAD-7. *Archives of Internal Medicine*, *166*(10), 1092–1097.

Williams, K. A., & Chapman, M. V. (2011). Comparing health and mental health needs, service use, and barriers to services among sexual minority youths and their peers. *Health & Social Work*, *36*(3), 197–206.

Wilson, B. D. M., Choi, S. K., Herman, J. L., Becker, T. L., & Conron, K. J. (2017, December). *Characteristics and mental health of gender nonconforming adolescents in California* [Health Policy Fact Sheet]. Williams Institute. https://williamsinstitute.law.ucla.edu/publications/gnc-youth-ca/

Wilson, D., Cutts, J., Lees, I., Mapungwana, S., & Maunganidze, L. (1992). Psychometric properties of the revised UCLA Loneliness Scale and two short-form measures of loneliness in Zimbabwe. *Journal of Personality Assessment*, *59*(1), 72–81.

Yildirim, Y., & Kocabiyik, S. (2010). The relationship between social support and loneliness in Turkish patients with cancer. *Journal of Clinical Nursing*, *19*(5–6), 832–839.

Zakahi, W. R., & Duran, R. L. (1982). All the lonely people: The relationship among loneliness, communicative competence, and communication anxiety. *Communication Quarterly*, *30*(3), 203–209.