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SYSTEMATIC REVIEW

Factor Structure of the Shortened Six-Item Version of the de Jong Gierveld Loneliness Scale (DJGLS-6)

A Systematic Review and Testing Factor Models in a Nationally Representative Sample

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Introduction: Loneliness is linked to negative physical and mental health outcomes. Therefore, it is important to employ reliable and valid screening measures for early detection and treatment. A widely used scale for assessing loneliness is the shortened six-item Jong Gierveld Loneliness Scale (DJGLS-6).
Aims: To review and evaluate the factor structure of the DJGLS-6.
Methods: Study 1 was a systematic review. To examine the factor structure of the DJGLS-6, peer-reviewed studies were reviewed in accordance with PRISMA guidelines. Study 2 tested the factor analytic models found in Study 1. Confirmatory factor analysis (CFA) was performed using data from a nationally representative sample of adults to assess the latent structure of the six-item scale.
Results: In Study 1, findings from the two papers reviewed suggested that the scale measures two correlated dimensions: social and emotional loneliness. This finding was consistent with the results of Study 2. However, the fit statistics for the one and two-factor CFA models were not acceptable. Modification indices indicated that adding a cross-factor loading to allow item 2 ("I miss having people around") of the social loneliness factor, to load on both the emotional and social factor, to load on both the emotional and social factors would significantly improve the fit of the model.
Conclusions: The analysis failed to support previous findings concerning the robustness of the subscales. We recommend performing future evaluations of the scale and for the authors to consider changing item 2 accordingly.

Keywords: loneliness; systematic review; factor structure; confirmatory factor analysis; de Jong Gierveld scale for loneliness

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Introduction

Loneliness pertains to negative affectivity stemming from the subjective feeling that the quantity and quality of one's relationships are not satisfying one's social needs (Hawkley & Cacioppo, 2010). Research has long demonstrated that loneliness constitutes a major contributing factor to developing both negative mental and physical health issues, including cognitive decline (Boss et al, 2015), hypertension (Hawkley et al., 2010), and coronary heart disease (Thurston & Kubzansky, 2009). Also, a strong association exists between loneliness and poor work performance (Amarat et al., 2019), depression (Liu, Gou, & Zuo, 2016), anxiety (Danneel et al., 2019), and suicide (Chang et al., 2017; Goldsmith et al., 2002). Due to the negative impact that loneliness may have on an individual's wellbeing, employing reliable and valid screening measures remain essential for early detection and treatment.

In recent decades, several instruments to assess loneliness have been developed for various purposes, including research and service use (e.g., University of California, Los Angeles Loneliness Scale; UCLA). The de Jong Gierveld 11-item loneliness scale (DJGLS-11: de Jong Gierveld & Kamphuis, 1985; de Jong Gierveld & Van Tilburg, 1999) is one of the most commonly used measures for assessing loneliness. The 11 items were formed based on the theory that social loneliness and emotional loneliness are distinct yet related concepts, as proposed by Weiss (1973). Weiss argued that social loneliness develops through lack of a broader group of contacts (e.g., work colleagues), while emotional loneliness develops through failure to form a close emotional attachment (e.g., a spouse). Researchers can employ the emotional subscale (six items), social subscale (five items) or the overall loneliness scale depending on their research question. To date, few studies exist that evaluate the DJGLS-11. Nevertheless, evaluations of the scale, performed by the developers, have reported reliability coefficients typically ranging from .80 to .90, which suggests good internal consistency. This has been found mostly among samples of older-aged adults with whom it has been used most often (de Jong Gierveld & Van Tilburg, 1999).

In order to be useful in large-scale epidemiological surveys where short measures are preferable, a reduced six-item version was constructed (de Jong Gierveld & Van Tilburg, 2006). The developers produced the scale with the aim of maintaining the original threefold application (the total loneliness scale and the social and emotional subscales). For the construction of the scale, they used data from the Dutch Living Arrangements and Social Networks of Older Adults Survey (NESTOR-LSN: see Knipscheer et al., 1995). From the original set of six items for the emotional loneliness subscale, three items with the highest factor loadings were selected. Similarly, from the five items representing social loneliness, the three items with the highest factor loadings were selected. The six item scale includes three positively worded items; "There are plenty of people that I can lean on in case of trouble", "There are many people that I can count on completely" and "There are enough people that I feel close to", and three negatively worded items; "I experience a general sense of emptiness", "I miss having people around" and "Often, I feel rejected". A three-point Likert scale was used for each item as suggested by the scale authors; "no," "more or less" and "yes". CFA was then employed to verify the specification of the two latent factors. They reported that the shortened scale produced both valid and reliable scores for overall loneliness and the two subscales. They also reported that the scale works suitably for use in large surveys and has been validated in Chinese (Leung et al., 2008) German, Russian, Bulgarian, Georgian, Japanese, French (all countries included in de Jong Gierveld & Van Tilburg, 2010) and Malaysian (Jaafar et al., 2020). However, although the shortened scale has gained more popularity in recent times, when compared to the original 11-item scale, research concerning the scale's factor structure is concerningly limited. Therefore, a thorough review of the DJGLS-6 structure remains warranted in order to determine that it is reliable, valid, and the factor structure is consistent with the original scale.

The purpose of this present study is to review and evaluate the psychometric properties of the latent structure of the DJGLS-6. First, a systematic review of the available literature regarding the DJGLS-6's factor structure will be conducted (Study 1). The review will follow the PRISMA 2009 protocol with the aim of providing evidence on whether the abbreviated form of the scale measures the same two dimensions of emotional loneliness and social loneliness as the 11-item scale. Second, based on the findings from the systematic review, CFA will be performed using a nationally representative sample aged 18-70 years old from the United States (US) to test the scale's factor structure (Study 2).

STUDY 1: A SYSTEMATIC REVIEW

Method

Search Terms

Table 1. shows the search terms used for variations in (1) the name of the author, (2) the term "loneliness", (3) the description of the questionnaire, (4) the abbreviated version of the questionnaire, and (5) the use of "factor" analysis.

Table 1. Search Terms Used for the Systematic Review

Keyword:	de Jong Gierveld	AND Loneliness	AND Scale	AND Shortened	AND Factors
	de Jong	Lone*	Scale	Short*	Factor
	or dejong		*or* Measur*	*or* 6 item	*or* Structure
	or DJGLS		*or* Questionnaire	*or* 6-item	*or* Construct
	and Gierveld		*or* Test		*or* Propert*
			or Instrument		
			or Assessment		
			or Tool		

Variations in spelling were applied during the search process to ensure the inclusion of all relevant reports; * To capture various suffixes that may follow the terms.

Databases

Eight of the most appropriate databases were identified using both the advice from an academic librarian and USearch, in order to determine the approximate number of studies relevant to the review question and the most appropriate databases to use for the main search. The databases selected were (1) Scopus; (2) Medline; (3) JSTOR; (4) PubMed; (5) EMBASE; (6) Web of Science; (7) PsycINFO; and (8) Science Direct. Additional papers were gathered via a snowball search technique; i.e., trawling the reference lists of relevant articles.

Limiters were applied in the databases that allowed for the inclusion of every filter. These were whether a publication was a review, a meta-analysis, or a double-published paper; should the article be published in a language other than English; and if any article was published prior to the year 2006. The nine databases were searched within a three-week period in August 2018. Criteria are presented in Table 2.

No exclusion criteria relating to the participants were used. Both clinical and non-clinical participants of any age, sex, occupation, or country who completed the de Jong questionnaire were considered in this review. Studies that meet the presented inclusion criteria were included regardless of the setting or context. The second stage involved reviewing the resulting article's abstracts and methods for studies that evaluated the shortened DJGLS-6.

According to Taylor and colleagues (2007), sensitivity allows researchers to identify the most articles available – relevant to one's research question – as possible. Table 3 expresses precision as the number of relevant studies found in one database shown as a percentage of the total number of studies identified from that same database.

Table 2. Inclusion and Exclusion Criteria

Inclusion Criteria	Exclusion Criteria
1. Publication is a peer-reviewed empirical article	1. Publication is a review, meta-analysis, or double published papers
2. Publication is a dissertation, book or chapter	2. Publication in a language other than stated in the inclusion criteria
3. Publication is an intervention	
4. Qualitative and quantitative studies	
5. Full studies and abstracts published in English	
6. Publication in the time span from when the shortened scale was first published to this current year 2006-2018	
7. Studies that investigate the factor structure	
8. Studies that investigate the psychometrics of the scale	

Table 3. Results of Database Searches

Database	Total Retrieved	Relevant Articles	Sensitivity (%)	Precision (%)
JSTOR	92	23	7	25
Pubmed	2	0	0	0
Embase	6	10	3	60
Medline	4	0	0	0
Psych Info	34	3	1	9
World of Science	5	0	0	0
Science Direct	129	4	1	3
Scopus	49	11	3	22

Note: For sensitivity rating, percentages are calculated on the basis of total articles which, excluding duplicates, came to 51.

The results found that both JSTOR and SCOPUS stood low in sensitivity; however, they stood both moderately good in terms of precision. A very high level of precision was found for EMBASE, alongside a very low degree of sensitivity. Both Psych Info and Science Direct scored low in precision and sensitivity, whilst Pubmed, Medline, and World of Science databases produced a no score for both sensitivity and precision.

Results

Two papers that examined the factor structure of the DJGLS-6 were identified. Using data from seven European and Asian countries (Germany, Netherlands, France, Bulgaria, Russia, Georgia, and Japan), the first paper (de Jong Gierveld & Van Tilburg, 2010) tested the shortened DJGLS-6's criterion and construct validity. The aim of the second paper (de Jong Gierveld & Van Tilburg, 2006) was to build and test the DJGLS-6. It did so using three separate, but related, studies: The aim of Study 1 was to build the shorter scale from the original 11-item version, and the aim of Study 2 and 3 was to test the shortened scale's psychometric properties. Both studies' participants, models stated, criterion variables used, reliability scores, and models compared (if any) are as follows:

Paper 1: de Jong Gierveld and Van Tilburg (2010)

Participants

This study was conducted across seven countries and used probability sampling to capture non-institutionalized members of the adult population (N = 69,749) with an age range of 18 to 79 years. The sample sizes in the study ranged from 8,158 (Netherlands) to 12,828 (Bulgaria) The authors chose to study both older adults (60–79 years) and younger adults (18–59 years) separately and compare the groups; as to date, most research in this area has suggested that loneliness is an older-adult-specific issue; however, Dykstra (2009), argued that support for this assumption is quite limited.

Models

The models specified two correlated dimensions and were tested using CFA. For this study, Weighted Least Squares (WLS) estimation was used and tetrachoric correlations were computed as items were dichotomously scored. The factor loadings were tested for invariance for the seven countries included prior to the estimates specific to each country being computed. To assess the model fit, the authors used the Standardized Root Mean Square Residual (< .08) and Comparative Fit Index (>95). Results for the older aged adults reported a correlation between the two latent factors ranging from moderate (r = .36) to high (r = .68). Similarly, results ranged from r = .32 to r =70 for the younger aged group (18-59 years). An acceptable model fit was found for all countries investigated, both for the younger and older-aged participants. These results suggest that both the social and emotional subscales are two solid constructs of the loneliness concept. The test for factor loadings invariance failed for both groups, which suggests that across the countries, correlations between items are different. For example, the factor loadings in France were satisfactory (.70 – .80) for the older aged group whilst the correlation between the factors stood relatively high (r = .64), indicating that the items of the two loneliness dimensions share a meaning. However, the correlation between the factors in Bulgaria came

out low (r = .36) while the factor loadings were quite high (.78 – .98), suggesting a sharper distinction between social and emotional items. That said, the results from all country-specific analyses supported the bi-dimensional structure.

Criterion variables

The authors selected four predictors based on past research to test the convergent validity of loneliness (age and gender, partner living with them, subjective health, current financial situation, and the number of children). They applied LISREL multiple group model testing, to test the predictors for invariance. The regression coefficients for the social and emotional loneliness predictors were estimated as equal for all countries. Therefore, outcomes are similar for those living in different countries but with similar characteristics in regard to both social and emotional loneliness. Convergent validity in both the younger and older-aged adults was supported by these results and notably adults are more vulnerable to experiencing both social and emotional loneliness if they report poor health. The relationship between financial difficulties and the two loneliness subtypes also proved to be significant for each country.

Reliability

Reliability coefficients for emotional loneliness, as estimated using Cronbach's alpha, ranged from α = .81 (France) to α = .91 (Bulgaria), while for social loneliness, the coefficients ranged from α = .85 (France) to α = .95 (Bulgaria). For the younger adults, group coefficients ranged from α = .82 (France) to α = .95 (Netherlands) for emotional loneliness, while social loneliness ranged from α = .85 (France) to α = .94 (Bulgaria). These results demonstrate the good psychometric characteristics of the two loneliness subscales; however, this study did not test the reliability of the overall six-item loneliness scale. Overall test outcomes suggested reliable and valid scores for both emotional and social loneliness for each of the countries investigated in this study.

Paper 2: de Jong Gierveld and Van Tilburg (2006)

Participants

For Paper 2, the first study obtained data from the 'Dutch Living Arrangements and Social Networks of Older Adults Survey' (Nestor – LSN). Participants were chosen from the 'Netherlands Kinship Panel Study' (NKPS; Dykstra & de Jong Gierveld, 2004) (N = 8,154), aged between 18 and 79 for Study 2. For Study 3, the researchers used data from a mail survey conducted by the regional health services in the Netherlands. The respondents ranged in age from 21 to 99 years old (N = 3,260).

Models

Initially, the researchers applied a principal component factor analysis with varimax-rotated factors for the selection process, leading to the shortened version of the scale. From this, two factors emerged containing three items representing the six emotional items and three items representing the five social items. Then, CFA was used to examine the two-factor model. Following this, the maximum likelihood estimation method was used as unrelated error terms and equal variances of error terms were assumed in this analysis. All items from the shortened six-item scale were then assigned to their distinct proposed subscales. An acceptable model fit was found through CFA for the two data sets. These findings suggest both subscales were two dimensions of the overall loneliness concept. Paper 1: Emotional loadings (.49 – .75), Social loadings (.60 – . 67) and factor correlation (r = .43), Paper 2: Emotional loadings (.49 – .75) Social loadings (.60 – .67) and factor correlation (r = .43), Study 3: Emotional loadings (.64 – .74) Social loadings (.64 - .74) and factor correlation of (r = .42).

Criterion variables

In investigating the validity of the DJGLS-6, the authors used numerous variables considered important determinants of loneliness; i.e. absence of a partner and subjective health (VanderWeele et al., 2012). Regarding whether the participant had an intimate partner, our results found that for emotional loneliness, correlations stood much higher (r = .30 - .34) than for social loneliness (r = .03 – .09) supporting previous research (e.g., de Jong Gierveld and Van Tilburg, 2006). Furthermore, when examining the association between subjective health and loneliness in relation to their correlation coefficients, similar patterns were observed for emotional (r = .23 – .24) and social correlations

(r = .14 – .16). These findings were notably similar to the original 11-item scale indicating that the shortened six-item scale is a good scale which contains the main features of loneliness similarly to that found in the original scale.

Comparisons

The authors compared the correlations between the original 11-item scale and subscales with the shortened scale and three-item subscales. The correlation stood very high, ranging from r = .93 to r = .95 between the shortened and the original 11-item scale in the surveys. Similarly, the correlation was also quite high (r = .88) between the original six-item emotional subscale and the shortened three-item emotional scale. The correlation between the original and shortened social loneliness scales ranged very high also, with correlation coefficients of r = .93. The correlation coefficients between the three-item subscales and the DJGLS-6 were relatively good, varying between r = .77 and r = .87. In addition, regarding the age groups investigated, correlation coefficients for congruent validity did not differentiate.

Reliability

For the total adult population, reliability coefficients for the shortened six-item scale ranged from α = .70 to α= .76, and stood lower for the subscales (α =.67 – .74 emotional loneliness scale, α = .70 – .73 social loneliness).

Discussion

Study 1 aimed to conduct a systematic review on the factor structure of the shortened, six-item scale. Whilst only two full-text publications were found, we would argue here that this is an important finding on its own. Considering the wide use of the scale for there being such few studies authored by the developers which examine the factor structure is concerning and highlights the need for further testing to ensure results produced from using the scale are valid. That said, from the two publications found, the results of alpha coefficients for each study showed quite good reliability with coefficients ranging from α = .70 to α = .76 for the DJGLS-6 total score which is supported by researchers such as Cortina (1993), who suggest that a given level of α > .70, is adequate. The alpha values for the subscales ranged from good α = .67 to excellent α = .95 for the emotional subscale and from α = .70 to α = .95 for the social subscale. As the review included a total of 79,197 adults with ages ranging from 18–99 years from seven different countries. One can therefore suggest that the DJGLS is a sound instrument that produces reliable scores for assessing both emotional and social loneliness for both young and older adults across various cultural settings. Multivariate regression analyses further found that the congruent validity of both subscales was supported.

For de Jong Gierveld and Van Tilburg's (2006) study, the authors first compared the shortened six-item scale and each of the three-item subscales with the original 11-item scale and the subscales. Correlation coefficients between the two overall loneliness scales and the subscales were quite high. CFA found that the three-item emotional scale and the three-item social scale were two unique constructs of the overarching loneliness concept. Using two determinants (subjective health and partner status), the validity of the original scale and subscales and the shortened scale and subscales were compared. Those with intimate partners scored significantly less on loneliness than those without intimate partners. Mirroring results in de Jong and Van Tilburg's (2010) study, the correlations were much weaker for social loneliness than for emotional loneliness. Similar patterns of correlation coefficients were also reported for the association between subjective health and loneliness. Overall, the validity of the shortened scale and subscales stands strikingly similar to the original scales in this respect.

Strenghts and Limitations

This study had a number of strengths. First, the literature review was systematic and rigorous and involved the searching of eight different databases. Second, the selected studies were summarised in detail. The studies examined have several limitations. First, although both studies in this review set out to confirm the specification of the two latent factors, de Jong and Van Tilburg's (2010) tested only one model, the two-factor model. In validating the scale, we recommend that future researchers compare the 2-factor model with the 1-factor model, particularly as the correlations among the factors were all quite high. Moreover, Cronbach's alpha was employed in both studies to estimate the reliability of the total scale and subscales. Future research may estimate the reliability of the DJGLS-6 using alternative composite reliability to retrieve a more accurate estimate. In addition, the minimum reliability scores for both the overall loneliness scale and the social subscale stood at α= .70 and the emotional subscale

was α= .67. Nunnally (1978), however, suggests that reliabilities of α= .70 are only acceptable at the very early stages of research. In contrast with instruments used in applied settings, a reliability of α= .80 may not even be high enough. He argues that where important decisions about the fate of individuals are made based on test scores, reliability should be at least α= .90, preferably α= .95. Employing and interpreting alpha incorrectly can potentially cause a scale or test to be criticised wrongfully for not generating results deemed trustworthy and furthermore, it can cause a scale to be mistakenly discarded. Overall, the number of studies that met the search criteria was small.

STUDY 2: TESTING THE MODELS OF THE DJGLS-6 IN A NATIONALLY REPRESENTATIVE SAMPLE

In Study 1, the results of the review supported both the 1 and 2-factor models. Based on these findings, Study 2 will test these models through CFA, using a large sample of U.S. adults to investigate the structure of the DJGLS-6 further.

Method

Participants

A nationally representative sample of United States adults was randomly recruited via an online research panel using probability-based sampling. Data were collected in March 2017 with the aim of examining the construct validity of Posttraumatic Stress Disorder (PTSD) and Complex Posttraumatic Stress Disorder (CPTSD) for the 11th International Classification of Diseases (*ICD-11*) (please see Cloitre et al., 2019). Inclusion criteria required participants to have experienced at least one traumatic incident at some point during their lifetime and were aged between 18 and 70 years when they participated. A total of 1,839 participants qualified from the initial 3,953 screened (eligibility rate = 46.3%). As females and members of racial minority groups (here Hispanic and African American participants) are more likely to be exposed to trauma and be diagnosed with a trauma disorder (McCutchen et al., 2022), these groups were intentionally oversampled (each at a 2:1 ratio). To adjust this, the data were weighted in order to more accurately represent the United States' adult population. The age of respondents ranged from 18 to 70 years old, and all surveys were completed online. Demographic characteristics of the sample are reported in Table 4.

Table 4. Demographic characteristics of the sample

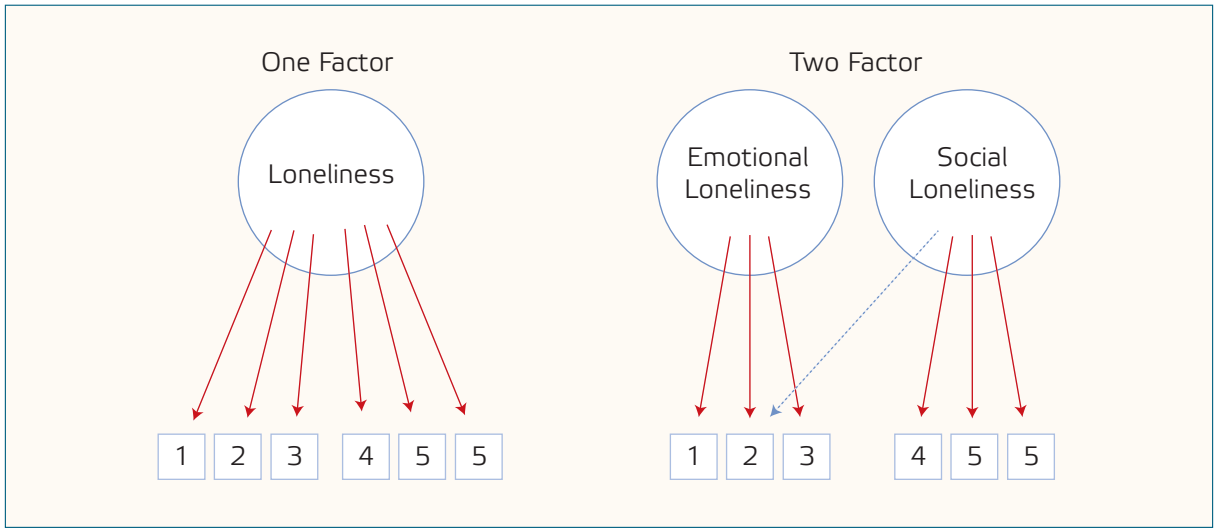
Database	N	%
Gender		
Male	883	48%
Female	956	52%
Relationship Status		
Married	1016	55.3%,
Cohabiting with a partner	149	8.1%
Single	428	23.3%,
Divorced	202	10.9%
Widowed	44	2.4%,
Ethnicity		
White	1173	6.4%
Hispanic	310	16.9%
Black	217	11.8%
Other (including 2+ races)	139	7.6%
Education		
Bachelor's degree or higher	585	31.8%
College	558	30.3%
Finished high school	528	28.7%
Did not finish high school	168	9.1%
Salary		
US$75,000+	891	48.5%
US$35,000-US$74,999	547	29.8%
US$20,000-US$34,999	202	11.0%
US$0-US$19,999	199	10.8%
	Mean	*SD*
Age	44.55	14.89

Note: For sensitivity rating, percentages are calculated on the basis of total articles which, excluding duplicates, came to 51.

Analytical Plan

Using Mplusv7 (Asparouhov & Muthen, 2012), two factor analytic models were tested within a CFA structure. These are shown in Figure 1. The models specified and tested were based on the original three-fold application of the measure proposed by de Jong Gierveld and Kamphuis (1985). A one-factor solution to where the six items of the DJGLS load onto a single latent variable

Figure 1. Diagram of Factor Analytic Models of the Loneliness Items



Note: Dashing factor loading represents the "modified Two Factor" modell.

(Loneliness) was inputted for Model 1. A two-factor model correlation solution was inputted for Model 2 whereby the two latent variables are represented by either Social Loneliness (items: 4, 5 & 6) or Emotional Loneliness (items: 1, 2 & 3).

According to Jackson and colleagues (2009), it is best practice to assess the model fit using numerous fit statistics including the chi-square statistic, the comparative fit index (CFI; Bentler, 1990), the root mean square error of approximation (RMSEA; Steiger, 1990), SRMR and the Tucker–Lewis index (TLI; Tucker & Lewis, 1973). These guidelines were followed for this analysis. In addition, to estimate all models tested, the weighted least squares mean variance adjusted (WLSMV) estimator was employed.

Results

Descriptive statistics at the item level are presented in Table 5. The mean scores were all similar, between 1 (Likert label "No") and 2 (Likert label "more or less").

The fit statistics are reported in Table 6 for all models. Chi-square values were high relative to the degrees of freedom for all models produced, however, although the chi-square was statistically significant, according to Tanaka (1987), the sample size was large and therefore this score should not lead to the models getting rejected. The highest TLI and CFI values were found for the two-factor model, which exceeded the .90 cut-off. The lowest chi-square values and RMSEA were also produced for the two-factor model. Further, the upper RMSEA confidence interval was smaller than the lower confidence interval for the next best-fitting model, which suggests the two-factor model was considered the best model.

However, the RMSEA was too high for the model to be considered acceptable. Based on this, the modification indices were inspected to determine whether there were theoretically defensible model modifications that would significantly improve the model. Modification indices (MI) for each fixed parameter in the model indicate the expected decrease in the chi-square of that parameter was included in the model; a MI greater than 3.84 suggests that including that parameter would significantly improve the model. The MI indicated that adding a cross-factor loading, to let item 2 ("I miss having people around") load on the social factor, as well as the emotional factor, would improve the model. The factor loadings and correlations

Table 5. Descriptive Statistics for the DJGLS-6 Items

Item	Mean	*(SD)*
General sense of emptiness	1.43	.65
Miss having people around	1.56	.67
Often feel rejected	1.39	.63
People to rely on	1.78	.77
Trust many people	1.91	.79
Feel close to people	1.70	.74

Note: For sensitivity rating, percentages are calculated on the basis of total articles which, excluding duplicates, came to 51.

Table 6. Comparison of Alternative Models and Fit Indices

Model	χ^2	df	*P*	*CFI*	*TLI*	*RMSEA (90% CI)*
One Factor	881.447	9	< .001	.943	.905	.231 (.218 – .244)
Two Factor	111.903	8	< .001	.993	.987	.085 (.071 – .099)
Two Factor Modified	53.512	7	< .001	.997	.993	.061 (.046 – .076)

Note: CFI = comparative fit index; TLI = Tucker Lewis index; RMSEA = root mean square error; CI = confidence interval

for the modified model are presented in Table 7. Factor loadings for model 1 and model 2 were all high and statistically significant. However, item 2 for emotional loneliness was considerably lower when compared to item 1 and 3 of emotional loneliness, and for social loneliness, to items 4–6. The reliability of the emotional items stood at (α= .74), for social items at (α= .87), and for the full scale at (α= .81); these were all high.

Table 7. Factor Loadings for the Modified de Jong Gierveld & Van Tilburg's (2006) Model of the DJGLS-6

Model	Factor 1: Emotional	Factor 2: Social
1. General sense of emptiness	.87 (.02)	
2. Miss having people around	.76 (.03)	.22 (.04)
3. Often feel rejected	.89 (.02)	
4. People to rely on		.91 (.01)
5. Trust many people		.92 (.01)
6. Feel close to people		.89 (.01)
Factor 1: Emotional	1.00	
Factor 2: Social	.60 (.02)	1.00

Note: All factor loadings are statistically significant (p < .010).

Discussion

The primary aim of Study 2 was to test alternative factor analytical models of the DJGLS-6. Based on previous research (de Jong Gierveld & Van Tilburg, 2006), two models were specified and analyzed, and the two-factor model was considered the best model. However, not all the items loaded significantly onto their assigned factors. The factor loading for Item 2 ("I miss having people around me") on the emotional loneliness factor was positive, high, and statistically significant. However, it also loaded on the social factor, albeit the loading was modest (.22, $p < .050$). A reason for this could be simply how Item 2 is worded. As presented in Table 5, the three social items were developed to capture an individual's wider social connections (e.g., work colleagues) and the emotional items developed to capture one's feelings towards more intimate relationships (e.g., a spouse). Item 2 is phrased in such a way that it could be reflecting the satisfaction the respondent feels with the number of relationships as opposed to the quality of the relationships. De Jong Gierveld and Van Tilburg (1999) have acknowledged that the scale's homogeneity is quite weak and factors can emerge which possibly reflect both a response bias associated with item wording and the dimensions of emotional and social loneliness.

That said, both the total DJGLS-6 scale scores and subscale scores indicated high levels of internal consistency and for these models; all the factor loadings were both positive and statistically significant. However, the two factors only had a moderate relationship ($r = .60$), as did de Jong Gierveld and Van Tilburg's (2006; Study 2) study ($r = .42 – r = .53$) indicating that these factors have acceptable discriminant validity. Overall, although the modified two-factor solution was found to be the best-fitting model, this result should not be used to reject the use of a single summed DJGLS-6 score. The factors were correlated, albeit modestly, but we suggest using both the overall scale score and the modified subscales for future research.

Strenghts and Limitations

This study had a number of strengths. First, the sample size for the analysis was large and the data were representative of the US general population. Second, the analytic methods were optimal for the ordered-categorical nature of the data. Study 2 also had several limitations. First, the scale encompasses three negatively formulated items (emotional subscale) and three positively formulated items (social subscale) and possesses moderate correlations between factors; therefore, caution should be used when interpreting findings. Second, the RMSEA of the two-factor model was found to be too high for the model to be considered acceptable, and as item 2 loads poorly on both the social and emotional scale, it would be expected that future studies consider such findings and consider changing the item accordingly.

Conclusion, Implications, and Future Directions

The valid and reliable assessment of both emotional and social loneliness is an important tool for predicting how each dimension may uniquely affect mental and physical health issues, and in turn, it may allow researchers and clinicians to identify and assist those who are more vulnerable to experiencing loneliness.

As loneliness has shown to have such adverse effects on both physical and mental health, the need for a reliable and robust measurement to capture this for research and clinical settings is imperative. Growing evidence is now supporting the bi-dimensional nature of loneliness and as such, recent focus has shifted towards tools that acknowledge this distinction. Employing a valid measurement that captures both emotional and social loneliness will not only provide rich and important guidance for future prevention, intervention, and treatment strategies but also can provide additional knowledge and clarification for research. This review and analysis provide evidence that the DJGLS-6 is a reliable and valid scale for such uses. However, as one item (item 2 of the emotional loneliness scale) has shown to weaken the strength of the scale, more work is needed to ensure that all items are optimally capturing social and emotional loneliness.

Our findings from both studies found the DJGLS-6 to be a measure of loneliness, which is brief and bi-dimensional. This measurement can also be used as a unidimensional model, depending on the research question. However, the analysis failed to support previous findings concerning the robustness of the subscales and due to the lack of studies currently available that evaluate the validity and reliability of the DJGLS-6, further analysis is needed to ensure the strict and sufficient bi-dimensionality of the shortened de Jong Gierveld loneliness scale. We advise that the authors look to reconsider item 2 of the emotional scale and evaluate the factor structure in order to provide a scale that captures the loneliness subtypes which can be used for both research and clinical purposes.

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Declaration of interest statement

The authors have no conflicts of interest to disclose.

Ethical statement

This manuscript is the authors' original work. The studies involving human participants were reviewed and approved by Institutional Review Board of Department of Psychology, Maynooth University, Kildare, Ireland (#2016-00-001).
All participants engaged in the research voluntarily and anonymously, and provided their written informed consent to participate in this study.
Data are stored in coded materials and databases without personal data, and the authors have policies in place to manage and keep data secure.

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