Psychometric properties of the 10-item and 25-item gerotranscendence scale: A study among young, middle-aged, and older adults in Slovenia

Otto Gerdina, May Doušak*

University of Ljubljana, Faculty of Social Sciences, Ljubljana, Slovenia

Abstract

The gerotranscendence theory posits that old age represents a profound and transformative phase, characterized by a fundamental reorientation in individuals' perceptions of life and existence. To quantify gerotranscendence in a cross-sectional context, Tornstam devised two gerotranscendence scales: a comprehensive 25-item version and a more concise 10-item version. Although the psychometric properties of the 10-item gerotranscendence scale have been examined in older populations, the comprehensive 25-item scale remains underexplored and the reliability of both scales have been seldomly tested on younger populations. The present study aims to bridge this gap by assessing the psychometric properties of both the 10-item and 25-item Slovene gerotranscendence scale in a sample of young, middle-aged, and older adults. Data for the study were derived from the third wave of the European Social Survey CRONOS 2 Web panel conducted in Slovenia, comprising 502 participants 18 to 82 years old. Both the gerotranscendence scales exhibited remarkably weak model fit in all age groups, both collectively and disaggregated. This finding renders the measurement of gerotranscendence in Slovenia using the original gerotranscendence scales unfeasible and underscores the need for further refinement and scale development.

Keywords: gerotranscendence theory, positive ageing, psychometric evaluation, European Social Survey, Cronos-2 cross-national web panel study

1. Introduction

Life expectancy has increased for about 30 years in the developed world over the last century (Philipson, 2013). This increase in longevity has generated, among other things a growing interest in empirical exploration of the social gerontological theories of positive ageing that focus on successful ageing, productive ageing and civic engagement (Johnson & Mutchler, 2014). While the aforementioned theories emphasize the maintenance of social roles and activities, another strand of theorization of positive ageing suggest that aging

*Corresponding author
  Email addresses: otto.gerdina@fdv.uni-lj.si (OG), may.dousak@fdv.uni-lj.si (MD)
  ORCID iDs: 0000-0002-0838-6484 (OG), 0000-0001-8449-6530 (MD)

individuals naturally withdraw from society, while society reciprocally disengages from them (Cumming, 1961). As Wadensten (2007) posits, numerous older adults do not aspire to maintain high levels of activity in later life and for many the process of positive aging may entail the adoption of a cosmic and transcendent worldview, a concept that Tornstam (2005) has termed "gerotranscendence".

In his seminal work Tornstam (2005) proposes that old age is a transformative period, marked by a fundamental shift in how individuals perceive life (Cozort, 2008; Jewell, 2014). Gerotranscendence signifies a process, wherein older individuals allocate time to reflection and contemplation, seeking deeper meaning and purpose in life.

The prefix "gero" refers to ageing and older people, while the term "transcendence" is used to describe "the capacity to rise above, to surmount or surpass, to go beyond the limitations and restrictions encountered in life" (Jewell, 2014, p. 112). Tornstam (2005) suggests a developmental arc where transcendence is high in childhood, declines in adulthood, and re-emerges in old age as gerotranscendence. He defines gerotranscendence as a natural shift in perspective from a more materialistic and rational view of the world to a more cosmic and transcendent one, with increased feelings of connectedness to the universe and decreased fear of death and increased life satisfaction (Abreu et al., 2023; Lewin & Thomas, 2001; Tornstam, 2005, 2011). Through a shift in metaperspective, gerotranscendent individuals may come to see themselves as having aged successfully (Cozort, 2008). The theory is structured around transformation on three key dimensions: the cosmic dimension, the dimension of the self (also known as coherence), and the dimension of personal and social relationships.

At the cosmic level, individuals experiencing gerotranscendence frequently report a shift in their perception of time and existence, describing a sense in which the boundaries between past and present become less distinct. This domain focuses on existential connectedness to the universe, akin to Zen Buddhism's non-dualistic worldview (Tornstam, 2005). For example, some interviewees in Tornstam's (2005) research described an increased sense of continuity with previous generations, perceiving themselves as part of an ongoing flow of life rather than as isolated individuals anchored in the present. This perspective is often accompanied by a reduced fear of death and a tendency to view death as a natural and integrated aspect of existence. Individuals also develop an enhanced capacity to appreciate small or seemingly insignificant elements of daily life, such as enjoying moments of solitude in nature or taking pleasure in routine tasks, reflecting a broader sense of communion with the universe and a cosmic consciousness.

In the self or coherence dimension, gerotranscendence is characterized by notable intrapersonal changes including the achievement of ego integrity and a shift away from self-centeredness. This dimension reflects E. Erikson and J. Erikson's (1998) life review process but extends to redefining selfhood. Empirical findings reveal that older adults often express less concern with their public persona and societal status, instead prioritizing self-understanding and inner growth. For instance, participants in Tornstam's (2005) study commonly reported an increased interest in introspection and a desire to comprehend their life as a coherent narrative, accompanied by a greater inclination toward altruistic behaviour. Rather than seeking external validation, these individuals demonstrate a heightened capacity for self-acceptance and are motivated by a wish to contribute to the well-being of future generations.

With respect to personal and social relationships, gerotranscendence is manifested in changes such as a diminished interest in superficial interactions and a heightened need for solitude. Tornstam's (2005) studies found that older adults experiencing gerotranscendence

often become more selective in their social engagements, focusing on meaningful and rewarding relationships while reducing participation in large or formal social gatherings. Solitude is viewed not as loneliness but as a positive and restorative experience that facilitates reflection and personal growth. This contrasts with the notion that aging requires sustained social engagement (cf. Hooyman & Asuman Kiyak, 1988); instead, cosmic transcendence prioritizes inward reflection over external productivity. Furthermore, these individuals exhibit a reduced concern with normative social roles and greater reliance on what Tornstam terms "everyday wisdom", using accumulated life experience to navigate interpersonal situations. This is often accompanied by increased tolerance and openness towards diversity, as well as an appreciation for the multiplicity of perspectives and life paths.

Tornstam (2011) suggests that gerotranscendence is a life-long, gradual process that typically becomes most pronounced in old age and occurs spontaneously in about 20 % of older adults. For others it may be obstructed by life circumstances (Abreu et al., 2023), cultural or social factors (Tornstam, 2005) that can accelerate (e.g., illness or personal crises) or retard (e.g., society's high valuation of work) psychosocial development toward gerotranscendence. This means that we may expect to find different prevalence rates of gerotranscendence in different social and cultural settings and populations.

Gerotranscendence can be therefore understood as a continuous, nonlinear process of existential, intrapersonal, and interpersonal maturation in later life. While the process is fluid, it consists of observable attributes (e.g., shifts in time perception, reduced fear of death, selective social engagement) that manifest as individuals mature. To cross-sectionally measure the gerotranscendence Tornstam (1997) developed a gerotranscendence scale (GS) consisting of 25 items and a 4-point rating system, along with a shorter 10-item version (Tornstam, 2005). He conducted several surveys to empirically test the theory and validate the instrument: in 1995 with a sample size of 2,002 participants aged 20 to 85, and again in 2001 with 1,771 participants aged 65 to 104. Both surveys underwent exploratory factor analyses, which revealed consistent factor structures. In the 1995 survey, the 25-item GS was used and in 2001 survey the 10-item GS was used. In the latter Cosmic dimension consisted of five items, the Coherence dimension of two items, and the Solitude dimension of three items. The contents of the subscales align with the theoretical definitions of gerotranscendence that emerged from in-depth interviews with 50 people recruited following a lecture on early tentative ideas about the Theory of Gerotranscendence confirming content construct validity (Cozort, 2008). In terms of alpha values, the Cosmic subscale has an alpha of 0.73, the Coherence subscale has an alpha of 0.57, and the Solitude subscale has an alpha of 0.60, meaning that the reliability of the 10-item GS was generally supported, since reliability coefficients below 0.70 are tolerable for more abstract and complex constructs, that are not easily observable (Cozort, 2008).

Since the term gerotranscendence was first used in 1989 (Tornstam, 1989), more than 138 scientific papers have been published on gerotranscendence from at least 27 different countries suggesting that the scope of the theory expanded greatly since the theory's origins in Sweden. The theory's emphasis on the individualised nature of ageing, and its practical implications for person-cantered long-term care, is an important driving force behind empirical explorations of the theory. However, most empirical studies are being conducted in the USA or Northern and Western European countries. Much less is known about the phenomenon of gerotranscendence in Central and Southern Europe. To explore gerotranscendence more thoroughly in older adults across diverse European cultural contexts, it is essential to develop and test a culturally adapted and country specific and psychometrically robust measurement tool. Examining gerotranscendence in different countries provides an

opportunity to test one of Tornstam's (1999) core assumptions-namely, that gerotranscendence represents a multifaceted process of change that is largely independent of cultural influences.

1.1. Psychometric properties and adaptations of the gerotranscendence scale

Although the gerotranscendence is a developmental process that begins in early adulthood and only reaches its zenith in old age (Tornstam, 2005), the authors of this article found only one study examining the prevalence of gerotranscendence among younger adults, apart from Tornstam's 2001 study (cf. Kalavar et al., 2015). Similarly, most international studies on gerotranscendence have utilized the shorter 10-item GS (e.g., Afacan, 2023; Brudek et al., 2024; Liu & Chen, 2022) or focused solely on the Cosmic subscale (e.g., Braam et al., 2006, 2016; Read et al., 2014). The longer 25-item GS has only been seldomly applied outside Sweden and, apart from a PhD thesis by Cozort (2008), no studies were found that would report on psychometric properties of the 25-item GS. Cozort (2008) revised the 25-item GS for southern U.S. older adults, on the population of community-dwelling individuals 60 years old or older from diverse ethnic background. While the study established preliminary psychometric properties of the revised GS, it also indicated that significant modifications in terms of rewording and scoring were necessary to ensure the scale's cultural relevance and psychometric robustness.

1.2. Psychometric properties of the 10-item gerotranscendence scale outside Sweden

While many studies outside Sweden used the 10 item GS, only a few reported on the scale's psychometric properties. In the USA, Atchley (1999) revised the English version of the GS, reducing it from 10 items to six. A factor analysis of the six-item scale identified two dimensions. The reliability of the scale was not established.

In Europe, Brudek (2021) and Bratun et al. (2024) validated a 10-item GS. Brudek (2021) created a Polish version of Tornstam's 10-item GS and tested it on 685 older adults 60−85 years old, confirming its three-factor structure and good psychometric properties among older adults in Poland. Bratun et al. (2024) used a Slovene 10-item GS, that was revised and culturally adapted by Gerdina (2020). Principal component analysis (PCA) was conducted on a specific sample of 219 people aged 60−66 years that had fulfilled the retirement criteria and continued to work. According to the authors, the PCA confirmed a low, but still acceptable degree of reliability.

In Asia, Asiri et al. (2019) and Hoshino et al. (2012) assessed the psychometric properties of the 10-item GS. The exploratory factor analysis of the Japanese 10-item GS developed by Hoshino et al. (2012) with the omission of one item confirmed a three-factor structure on 525 community-dwelling older adults in Japan that were 60−94 years old. Asiri et al. (2019) evaluated the psychometric properties of a Persian 10-item GS on a sample of 250 people older than 60 years. confirmatory factor analysis (CFA) supported the three-factor structure of the Persian version of the GS with moderate fit indices.

The inconsistent factor structure of the GS and sometimes weak reliability implies the need for further investigations into the psychometric properties of GS in different cultures and populations. This study aims to assess the psychometric properties of both 10-item and 25-item Slovene GS on a sample of young, middle-aged, and older adults.

The rationale for assessing the 25-item GS lies its theoretical depth since it captures multidimensional facets (cosmic, coherence, social) that are often oversimplified in shorter versions (e.g., coherence dimension contains only two items in the 10-item GS). The longer scale also enables more robust factor analysis and allows for more precise cross-cultural

adaptations (e.g., revising items for specific national contexts) and is therefore preferable for early explorations of the phenomenon in a new sociocultural context.

2. Methods

2.1. The translation of gerotranscendence scale into Slovene language

The translation of the 25-item GS into Slovene language started with a direct translation from the original English version of the instrument developed by Tornstam. The translation process incorporated a cultural adaptation component to ensure the relevance of the content for the Slovenian population. Subsequent to the translation process, the Slovene GS was subjected to preliminary testing employing the cognitive interviewing method. The process entailed the administration of the translated questionnaire to a varied sample of 14 respondents, distributed uniformly across gender and spanning an age range from 18 to 87. Subsequent to the cognitive pre-testing phase, nine items underwent substantial revisions owing to the presence of ambiguities, misunderstandings, or misinterpretations. For a more thorough exposition of the revision of the measurement instrument and the modifications made, consult Gerdina (2020).

2.2. Sample and data collection mode

Data were collected in the third wave of the European Social Survey (ESS) CRONOS 2 Web panel in Slovenia. ESS is an academically driven, cross national survey with a rigorous methodology that has been collecting data personally from a representative individual sample of individuals aged 15 or more every two years since the year 2001 (ESS, 2024).

The ESS has been preparing for a possible mode change (now set as switch to Web for Round 13 in 2027) by studying the trend conducting mode experiments for many years now. Among other experiments and parallel rounds, they also conducted two ESS piggybacked Web panels: CRONOS (in 2017) and CRONOS 2 (in 2022) based on ESS respondents aged over 18 years old.

A piggybacked Web panel draws sample upon the respondents who have previously completed another survey and agreed to participate in a subsequent survey: hence, the Web survey sample "piggybacks" upon main, usually face-to-face survey (Edwards et al., 2011). In case of the ESS, respondents in Rounds 8 (Cronos) and 10 (Cronos2) were asked to participate in a subsequent web panel. In neither of rounds, every ESS participant chose to participate in the subsequent panel: out of 1205 ESS Round 10 respondents, 564 over age 18 participated in the CRONOS 2 panel which contained a 25-item GS (GS25) questionnaire. Most—but not all—CRONOS 2 respondents (502, aged 18 to 82 years old) responded to all GS25 items.

While such a sample is not fully representative, it is nevertheless better[1] than many other Web panels despite having the respondent age structure skewed towards a younger population. Comparison of age structure between the main ESS (face-to-face) and CRONOS 2 in Table 1 below reveals significant differences between the two surveys.

The above result is expected given that older population is usually less inclined to participate in Web surveys due to lower digital skills, lack of device and/or internet access, dexterity and vision deficiencies, and other reasons (d'Ardenne et al., 2023). Contrary, younger and more active population prefers Web, as they can respond in privacy at any

---

[1]The participants are not conditioned respondents, having only participated in a few panel waves; they are drawn from an ESS sample which is representative of the general population across all participating countries.

Table 1. Survey respondent structure by age group.

Age group	ESS 10	CRONOS 2	GS25
18−29	187 (15.5)	108 (19.1)	99 (19.7)
30−39	173 (14.4)	114 (20.2)	103 (20.5)
40−49	207 (17.2)	117 (20.7)	112 (22.3)
50−59	228 (18.9)	112 (19.9)	96 (19.1)
60−69	189 (15.7)	74 (13.1)	62 (12.4)
70−79	160 (13.3)	32 (5.7)	25 (5.0)
80+	61 (5.1)	7 (1.2)	5 (1.0)
Total	1205 (100.0)	564 (100.0)	502 (100.0)

given time and location they choose (Callegaro et al., 2015). Still, web survey can be a feasible mode of data collection for older individuals (Kelfve et al., 2020). For representative results, poststratification weights should be used on the data in both surveys.

Assessing other two key demographic characteristics, we found 88 respondents (15.6 %) had 3-year vocational or lower education, 226 (40.1 %) had 4-year vocational or high-school education, and 248 (44 %) had higher education. Two respondents in the ESS and one in CRONOS 2 refused to answer this question. As shown in Table 2, CRONOS participants are generally more educated than main ESS survey respondents:

Table 2. Comparison of education level.

Education level	ESS 10	CRONOS 2	GS25
Vocational or lower	260 (21.7)	88 (15.6)	82 (16.4)
High school education	565 (47.1)	226 (40.1)	191 (38.1)
Higher education	374 (31.2)	249 (44.2)	228 (45.5)
Total	1199 (100.0)	563 (100.0)	501 (100.0)

Finally, 44.0 % (248) of Cronos 2 respondents in Slovenia were male which is roughly 2 percentage points lower than in the main ESS survey (Table 3).

Table 3. Comparison of gender structure.

Gender	ESS 10	CRONOS 2	GS25
Male	568 (47.1)	248 (44.0)	223 (44.4)
Female	637 (52.9)	316 (56.0)	279 (55.6)
Total	1205 (100.0)	564 (100.0)	502 (100.0)

To account for the difference between the population and ESS sample structure, ESS database provides pre-calculated poststratification weight. Cronos 2 dataset also includes pre-calculated Cronos weight, which accounts for both differences between ESS and Cronos (nonresponse), as well as differences between ESS and the population (nonresponse weight). All analysis were conducted with "Cronos" weight enabled. All analysis were conducted on Cronos 2 dataset edition 1 which is publicly available on the ESS Data portal (ESS, 2024).

2.3. Instrument and methods of analysis

Our aim was to evaluate whether our survey data aligns with Tornstam's proposed theoretical model. To achieve this, we conducted a structural equation modelling (SEM) CFA. Furthermore, to examine whether the data confirms a linear relation between age and gerotranscendence scores, we also analysed measurement invariance across different age groups of respondents. Our analytic strategy was as follows: If the data fit the model well, we concluded with an assessment of internal consistency. However, if the data did not fit the theoretically proposed model, we did not seek an alternative but proposed that an entirely new instrument be constructed to capture gerotranscendence in the Slovenian context.

The translation and adaptation process can have a significant impact on the instrument validity; therefore, despite the above description of both the original Tornstam instrument and its Slovene adaptation process, a brief presentation of the instrument is warranted prior to conducting any analyses or even data preparation. As the names imply, GS25 consists of 25 items, while the shorter GS10 comprises a subset of 10 items drawn from the GS25. Both scales are presented with English and Slovene labels in Table 4 below.

Table 4. GS25 and GS10 instruments.

Item	Description
GS_1	*Dimension*: COSMIC *GS10*: Yes *Reverse scoring*: No *Label (EN)*: I feel a strong connection with earlier generations. *Label (SI)*: Čutim močno povezanost z generacijami, ki so živele pred mano.
GS_2	*Dimension*: COSMIC *GS10*: No *Reverse scoring*: No *Label (EN)*: Knowing that life on earth will continue is more important than my individual life. *Label (SI)*: Nadaljevanje življenja kot takega mi je pomembnejše od lastnega življenja.
GS_3	*Dimension*: COSMIC *GS10*: Yes *Reverse scoring*: No *Label (EN)*: I feel connected with the entire universe. *Label (SI)*: Čutim, da sem povezan/a s celotnim vesoljem.
GS_4	*Dimension*: COSMIC *GS10*: Yes *Reverse scoring*: No *Label (EN)*: I feel that I am a part of everything alive. *Label (SI)*: Čutim, da sem del vsega živega.
GS_5	*Dimension*: COSMIC *GS10*: No *Reverse scoring*: Yes *Label (EN)*: I am afraid of death. *Label (SI)*: Bojim se smrti.

Table 4. GS25 and GS10 instruments. (Continued)

Item	Description
GS_6	*Dimension*: COSMIC *GS10*: No *Reverse scoring*: No *Label (EN)*: Some things that happen in life can't be explained by logic and science and need to be left unresolved. *Label (SI)*: V življenju se zgodijo stvari, ki jih z znanostjo in razumom ni mogoče razložiti, in nič ni narobe, če ostanejo nepojasnjene.
GS_7	*Dimension*: COSMIC *GS10*: No *Reverse scoring*: Yes *Label (EN)*: It seems unfair that I must die when life on earth just continues. *Label (SI)*: Ne zdi se mi pravično, da bom nekega dne umrl/a, medtem ko se življenje na Zemlji preprosto nadaljuje.
GS_8	*Dimension*: COSMIC *GS10*: Yes *Reverse scoring*: No *Label (EN)*: Sometimes I feel like I live in the past and present simultaneously. *Label (SI)*: Včasih čutim, da sočasno živim v preteklosti in sedanjosti.
GS_9	*Dimension*: COSMIC *GS10*: Yes *Reverse scoring*: No *Label (EN)*: I can feel a strong presence of people who are elsewhere. *Label (SI)*: Močno lahko čutim prisotnost ljudi, ki jih fizično ni tu.
GS_10	*Dimension*: COSMIC *GS10*: No *Reverse scoring*: No *Label (EN)*: Genealogy research seems interesting to me. *Label (SI)*: Raziskovanje družinskega drevesa se mi zdi zanimivo.
GS_11	*Dimension*: COHERENCE *GS10*: yes *Reverse scoring*: No *Label (EN)*: The life I have lived has coherence and meaning. *Label (SI)*: Življenje, ki sem ga preživel/a, vidim kot smiselno celoto.
GS_12	*Dimension*: COHERENCE *GS10*: yes *Reverse scoring*: No *Label (EN)*: My life feels chaotic and disrupted. *Label (SI)*: Svoje življenje občutim kot kaotično in nepovezano.
GS_13	*Dimension*: COHERENCE *GS10*: No *Reverse scoring*: Yes *Label (EN)*: I take myself very seriously. *Label (SI)*: Samega/samo sebe jemljem zelo resno.

Table 4. GS25 and GS10 instruments. (Continued)

Item	Description
GS_14	*Dimension*: COHERENCE *GS10*: No *Reverse scoring*: Yes *Label (EN)*: To be honest, I must say that I am the most important thing in the world. *Label (SI)*: Če sem iskren/a, menim, da sem najpomembnejša stvar na svetu.
GS_15	*Dimension*: COHERENCE *GS10*: No *Reverse scoring*: No *Label (EN)*: I find it easy to laugh at myself. *Label (SI)*: Zlahka se nasmejim samemu/sama sebi.
GS_16	*Dimension*: COHERENCE *GS10*: No *Reverse scoring*: No *Label (EN)*: My personality has both female and male components. *Label (SI)*: Moja osebnost ima tako moško kot žensko plat.
GS_17	*Dimension*: SOLITUDE *GS10*: Yes *Reverse scoring*: Yes *Label (EN)*: I like meeting with new people. *Label (SI)*: Rad/a srečujem in se družim z novimi ljudmi.
GS_18	*Dimension*: SOLITUDE *GS10*: Yes *Reverse scoring*: No *Label (EN)*: I like to be by myself better than being with others. *Label (SI)*: Raje sem sam/a kot z drugimi.
GS_19	*Dimension*: SOLITUDE *GS10*: No *Reverse scoring*: Yes *Label (EN)*: I need something going on all the time in order to feel good. *Label (SI)*: Da se počutim dobro, se mi mora ves čas nekaj dogajati.
GS_20	*Dimension*: SOLITUDE *GS10*: No *Reverse scoring*: Yes *Label (EN)*: I find it easy to give other people good advice. *Label (SI)*: Ni mi težko svetovati drugim ljudem.
GS_21	*Dimension*: SOLITUDE *GS10*: Yes *Reverse scoring*: No *Label (EN)*: Being at peace and philosophizing by myself is important for my well-being. *Label (SI)*: Mir in razmišljanje v samoti sta pomembna za moje dobro počutje.

Table 4. GS25 and GS10 instruments. (Continued)

Item	Description
GS_22	*Dimension*: SOLITUDE *GS10*: No *Reverse scoring*: No *Label (EN)*: I find it easy to see what's right and wrong in other people's behavior. *Label (SI)*: Zlahka ugotovim, kdaj drugi ravnajo prav in kdaj narobe.
GS_23	*Dimension*: SOLITUDE *GS10*: No *Reverse scoring*: Yes *Label (EN)*: I am often afraid of asking stupid questions and embarrassing myself in front of others. *Label (SI)*: Pogosto me je strah, da bom vprašal/a kaj neumnega in se pred drugimi osramotil/a.
GS_24	*Dimension*: SOLITUDE *GS10*: No *Reverse scoring*: Yes *Label (EN)*: For me, having a high material standard is among the most important things in my life right now. *Label (SI)*: Trenutno mi je visok materialni standard ena najpomembnejših stvari v življenju.
GS_25	*Dimension*: SOLITUDE *GS10*: No *Reverse scoring*: Yes *Label (EN)*: For me, being active in my work and other things is among the most important things in my life right now. *Label (SI)*: Trenutno je zame ena najpomembnejših stvari v življenju, da sem dejaven/a.

An important consideration for further analysis was the distribution of missing values in our dataset. If they were to be missing at random (or completely at random), we would analyse all 564 cases and estimate the missing values. Little's MCAR test results ($\chi^2 = 525$, df $= 407$, $p < 0.001$) and the missing data patterns suggest that the data is not missing at random, so we conducted SEM CFA for 502 respondents who replied to a full GS25.

To ensure the instrument's validity across different age groups, we divided our sample into three subgroups based on frequency distributions. Given that gerotranscendence is typically considered a linear process from early adulthood onwards, we anticipated that the cutoff points would not compromise construct validity. Our age-based subgroups were: 18–34 years old (29.6 %, $n = 167$); 35–49 years old (30.5 %, $n = 172$) and 50+ years old (39.9 %, $n = 225$).

After harmonizing the direction of all scales and applying Cronos 2 weights provided by the ESS, we first conducted basic descriptive statistics to make sure all the scales were correctly scored, and all the missing values were coded accordingly. Then, we assessed normality of the data and checked inter-item correlations before finally conducting SEM CFA to assess model fit.

The software used included SPSS 27 for data preparation, descriptive statistics and covariates, and Lisrel 12.4.5 for SEM CFA.

3. Results

3.1. GS25 results

Descriptive statistics for GS25 presented in the Table 5 below suggest there are no non-normality issues as all items exhibited skewness and kurtosis well below absolute 1. Furthermore, most mean values were located around the middle of the scale suggesting they weren't affected by floor or ceiling effects.

Table 5. GS25 descriptive statistics.

Item	M ± SD	S_k	K_s
GS_1	2.96±0.64	−0.25	0.29
GS_2	2.47±0.72	−0.20	−0.28
GS_3	2.29±0.85	0.22	−0.54
GS_4	2.80±0.76	−0.42	0.04
GS_5	2.61±0.83	−0.08	−0.54
GS_6	2.71±0.82	−0.38	−0.28
GS_7	2.96±0.91	−0.55	−0.49
GS_8	2.28±0.84	0.07	−0.67
GS_9	2.20±0.83	0.11	−0.73
GS_10	2.97±0.79	−0.40	−0.33
GS_11	3.03±0.64	−0.44	0.87
GS_12	3.07±0.74	−0.56	0.26
GS_13	2.03±0.65	0.45	0.77
GS_14	3.05±0.83	−0.64	−0.07
GS_15	3.11±0.69	−0.45	0.18
GS_16	2.49±0.88	−0.07	−0.69
GS_17	2.05±0.75	0.36	−0.17
GS_18	2.19±0.78	0.36	−0.15
GS_19	2.61±0.79	−0.24	−0.34
GS_20	1.78±0.61	0.29	0.18
GS_21	2.98±0.75	−0.41	−0.07
GS_22	2.98±0.61	−0.32	0.73
GS_23	2.66±0.82	−0.29	−0.36
GS_24	2.94±0.72	−0.27	−0.16
GS_25	1.93±0.57	0.19	0.89

Legend: S_k = skewness, K_s = kurtosis.

Inter-item correlations for GS25 instrument (full table is shown in Section A), however, paint a different picture about the instrument. Many inter-item correlations within the same latent variables exhibited low and negative values (the authors double-checked the scales orientations, which were indeed correct). Furthermore, high correlations between

items from different dimensions were present. Despite this cross-loadings indicating that the data can't fit the model well, we still ran the SEM CFA analysis to report on the results; the model's standardized solution is shown in Figure 1.
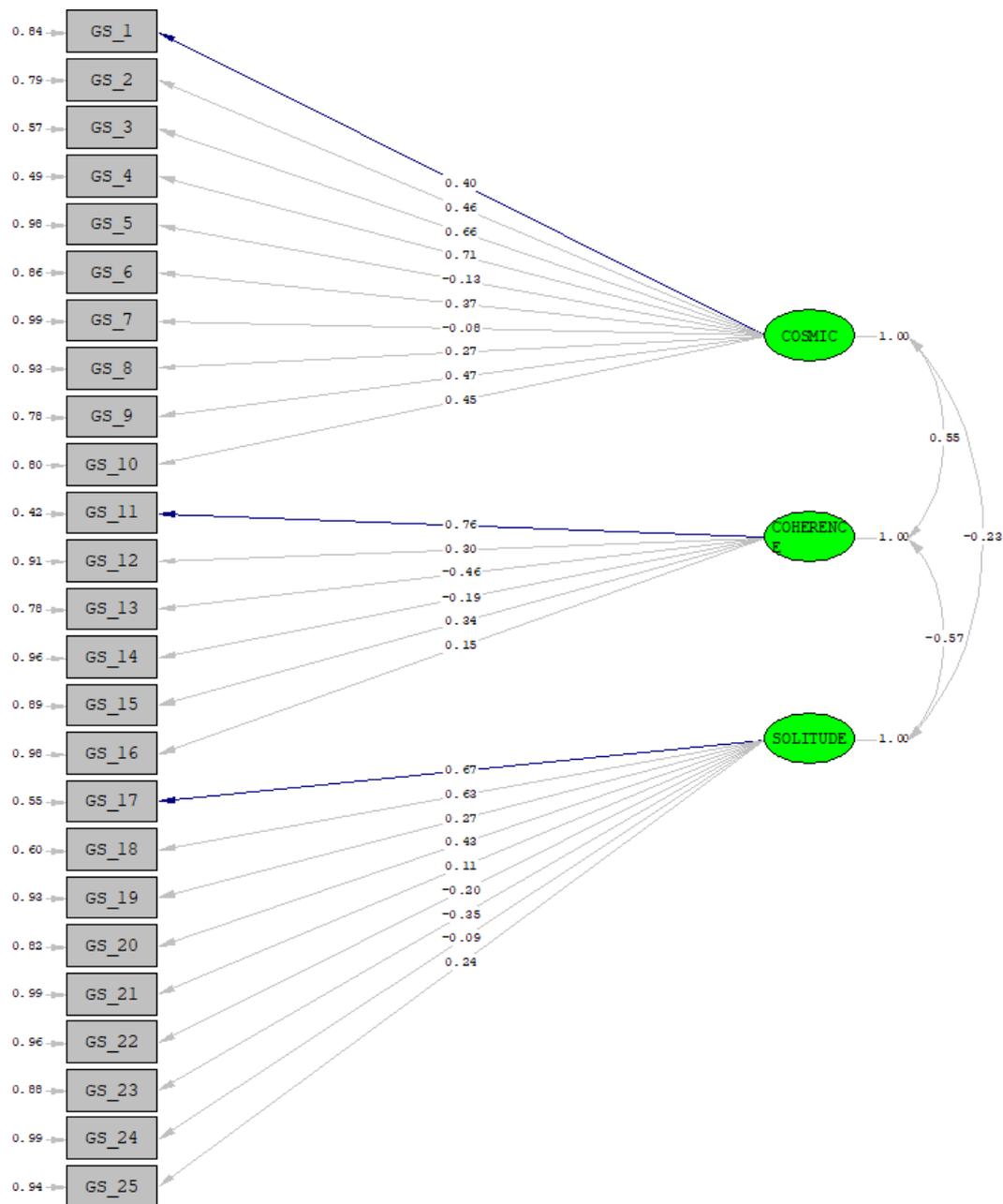

Figure 1. GS25 instrument standardized solution.

Fit indices were not adequate: $\chi^2 = 1503.556$ ($p < 0.001$); RMSEA = 0.0953; df = 272; GFI = 0.773; SRMR = 0.103; CFI = 0.459. Furthermore, there were many cross-loadings, and suggested modification indices within the theta-delta matrix, implying residual covariances between observed indicators. Top five modification indices from theta-delta and lambda-x (cross-loadings) are presented in Table 6.

Given the lack of theoretical rationale for such error covariances and cross-loadings, we decided not to try to improve the model.

A broad body of literature focused on exploring the gerotranscendence in the older population, so we were curious about the situation in our oldest group. The analysis for

Table 6. Top 5 TD (a) and LX (b) modification indices (MIs) for GS25.

(a)			(b)	
Item	MI		Item	MI
GS_21, GS_18	79.2		GS21. COSMIC	45.44
GS_8, GS_16	64.6		G10. COHERENCE	31.74
GS_8, GS_12	62.0		G21. COHERENCE	27.37
GS_8, GS_9	61.0		G3. COHERENCE	27.33
GS_5, GS_7	52.3		G18. COSMIC	23.2

each of three age-based groups (18–34; 35–49; 50+) revealed that, except for slightly more outliers in group ages 34–49 (GS_13 kurtosis = 2.4), there were no non-normality issues in any of the groups. Similarly as with full sample, correlations were, problematic in all groups.

Still, we conducted SEM CFA for each separate age group and found that none of the data fit the model, failing due similar reasons (cross-loadings, residual covariances) in all groups. Given that the full sample nor any of the subgroup data fit, there is not much meaning in testing measurement invariance. Apparently, the Slovenian GS25 instrument or/and our sample doesn't align with the GS25 theoretical model, so we abandoned analysis on GS25 and focused on GS10.

3.2. GS10 results

The shorter GS10 questionnaire retains the same three theoretical dimensions as the GS25, using a subset of its items. Specifically, the cosmic dimension is measured with five of the ten items in the original instrument, coherence dimension is measured by just two out of six items, while the solitude dimension is assessed with three out of nine items from the original GS25. Items included in GS10 are presented along with GS25 items in Table 4.

Due to internal context effects[2], scores from 10-item GS25 subset analysis cannot be directly compared to a standalone GS10. Still, we believe the difference between a standalone GS10 and a 10-item GS25 subset are not so large that they would prevent assessing the scale validity.

The descriptive statistics and correlations for GS10 are already contained within GS25 results, therefore we can directly confirm the normality of the data. To make correlations more legible, we composed a new Table 7 containing just GS10 items.

Correlations for GS10 indicate it is reasonable to assume the fit between the data and theoretically proposed model is more likely than in GS25 model. It should be noted that the GS10 model is suboptimal due to "coherence" being measured by just two indicators, but given our goals, we retained the Tornstam's proposed model.

The GS10 SEM CFA analysis results shown in Figure 2 demonstrated an ultra-Heywood case with negative variances for residuals in items 11 and 18, rendering the solution improper

---

[2]Context effects are "effect of preceding items or experiences on responses to subsequently presented items" (Deaton & Stone, 2016; Sudman et al., 1996). Uhan (1990) developed a model of global (past experiences, beliefs of both survey and respondent) and local (context while responding to the survey) context effects, and Doušak (2017) extended it further by adding a second dimension: internal (local) context effects are effects of the instrument, while external (local, global) context effects are triggers outside the questionnaire itself (e.g., microsituation while responding to the survey Doušak, 2017; Uhan, 1990)

Table 7. GS10 inter-item correlations.

	GS_1	GS_3	GS_4	GS_8	GS_9	GS_11	GS_12	GS_17	GS_18	GS_21
GS_1	1.00									
GS_3	0.20	1.00								
GS_4	0.23	0.55	1.00							
GS_8	0.01	0.20	0.13	1.00						
GS_9	0.19	0.35	0.27	0.41	1.00					
GS_11	0.27	0.19	0.32	−0.07	0.11	1.00				
GS_12	0.16	−0.07	0.12	−0.33	−0.12	0.32	1.00			
GS_17	−0.14	−0.10	−0.16	−0.04	−0.06	−0.23	−0.08	1.00		
GS_18	−0.13	0.11	0.00	0.10	0.04	−0.25	−0.21	0.48	1.00	
GS_21	0.05	0.25	0.18	0.15	0.20	0.06	−0.10	0.00	0.33	1.00

Table 8. Top 5 TD (a) and LX (a) modification indices (MIs) for GS25.

(a)		(b)	
Item	MI	Item	MI
GS_8, GS_9	62.1	GS_21 - COSMIC	35.81
GS_8, GS_12	52.1	GS_17 – COSMIC	22.36
GS_17, GS_21	17.2	GS_1 - COHERENCE	18.18
GS_4, GS_9	14.9	GS_4 - COHERENCE	17.1
GS_18, GS_21	14.9	GS_8 - COHERENCE	17.05

(Martin & McDonald, 1975; van Driel, 1978). Such results might be due to several factors, such as too few indicators per dimension, small sample size, misspecified model, outliers, and missing values (Farooq, 2022).

There were no missing values in our analysis; we cannot increase the sample size (the data has already been collected), nor do we want to add or remove indicators, to develop more homogenous scales, as we are validating the proposed instrument based on the theoretical model. The most widely used solution to Heywood cases is fixing negative residual variances to zero, which we find a superficial fix that may obscure deeper issues in model specification, measurement quality, or sample characteristics (Farooq, 2022) . Still, it was the only thing that we could do as a last-resort solution in our GS10 case given the above constraints.

When running GS10 SEM CFA with residual variances for variables GS_11 and GS_18 set to zero, our data still didn't fit the theoretically proposed Tornstam's model (χ^2 = 293.3, [$p < 0.001$]; RMSEA = 0.124; df = 34; GFI = 0.889; SRMR = 0.113; CFI = 0.706). Like Brudek (2021) observed in the Polish version of the instrument, largest modification indices were related to the residual covariances (Theta-delta), which are difficult to explain while keeping the instrument aligned with the Tornstam's theoretical model. Furthermore, quite substantial Lambda-X modification indices suggest that components load across the concepts. Top five modification indices per Theta-delta and Lambda-X matrices are shown in Table 8 below.
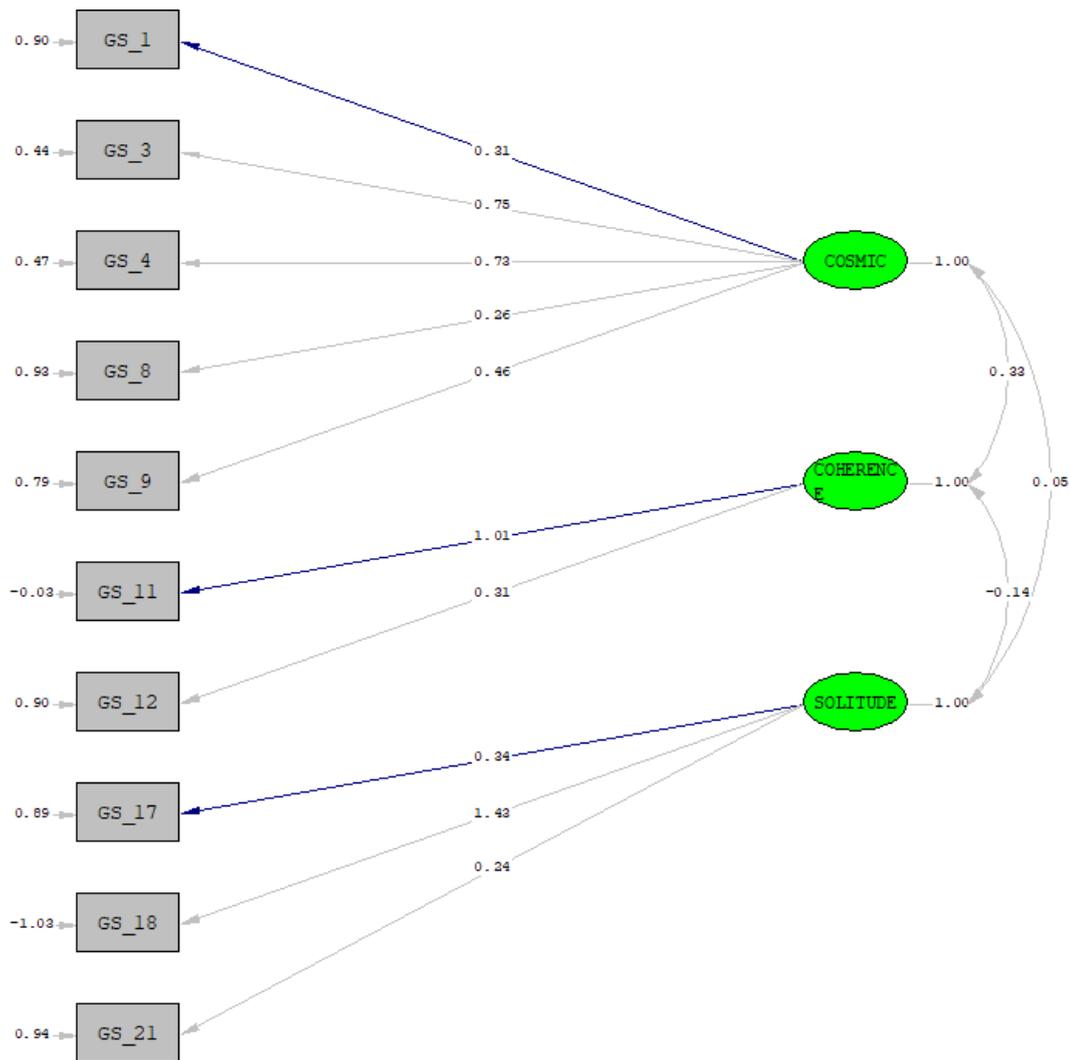
Figure 2. GS10 estimates (please note GS11 and GS18 residuals values.)

As with GS25, our goal was to validate rather than improve the model fit by altering the theoretically proposed construct.

We also conducted analyses for separate age groups to see whether the data aligns with the theoretically proposed model for any of the groups. None of the SEM CFA converged, most likely due model misspecification and low sample size. While we could, as other researchers have, construct a new Slovenian gerotranscendence scale by further adapting the GS10 instrument, that would move us away from both the "universal" theoretical model by Thorstam and our core research question, so we opted not to pursue that direction, and instead discuss on the results obtained.

4. Discussion

We had a rare opportunity to test the 25-item GS on a representative sample of individuals. Given that it was translated following established methodological standards and best practices in cross-cultural adaptation, our initial expectations for its performance were high; however, the results indicated insufficient psychometric robustness, prompting us to abandon further investigation of the 25-item GS in favour of the more widely used 10-item GS instrument. This is not an isolated issue, as Tornstam himself noted "the originally larger set of statements" required reduction due to cross-loadings (Tornstam, 2005, p. 94). Despite

this, gerotranscendence scholars have often assumed the 25-item scale to be more reliable than the 10-item scale, a belief that may stem from Tornstam's failure to report Cronbach's alpha or CFA results for the 25-item GS in his 2005 book (Asiri et al., 2019; Cozort, 2008; Hoshino et al., 2012). This raises the possibility that the 10-item scale was constructed by eliminating items with lower item-total correlations and cross-loadings, potentially enhancing its reliability relative to the 25-item version. Alternatively, if the 25-item GS had demonstrated sufficient internal consistency and alignment with the theoretical concepts in Swedish data, any observed issues may reflect cultural influences on the instrument's interpretation.

Regardless, utilising a 10-item GS as an alternative to a "full-length" scale is not necessarily detrimental to the study of gerotranscendence, particularly given that surveys can impose a burden on respondents requiring them to allocate time and effort for participation. While research offers limited conclusive evidence regarding the impact of questionnaire length on overall response rates, longer surveys tend to increase respondent burden and dropouts (Burchell & Marsh, 1992; Galesic & Bosnjak, 2009). Consequently, survey questionnaire designers often prioritize brevity whenever feasible (Schober, 2018).

The results with the 10-item instrument were, however, also not supportive of the theoretical expectations. While the inter-item correlations, though still low, suggested greater alignment with the theoretically proposed GS10 structure than with GS25, subsequent SEM CFA did not support this interpretation. Notably, our findings suggest that neither of the GS effectively measures the intended theoretical constructs.

These findings contrast with prior research utilising the same instrument, which identified distinct factors aligning well with the theoretical model (Bratun et al., 2024). However, beyond differences in samples, a key distinction lies between the two approaches: the previous study employed a data-driven PCA, whereas the current study uses a theory-driven CFA, which is the preferred method for testing whether observed data aligns with a theoretically proposed reflective model because it tests a pre-specified factor structure and explicitly models residual variances and measurement error. Conversely, PCA reduces a large set of observed variables into fewer components by maximizing explained variance without accounting for measurement error or residual variance (Fokkema & Greiff, 2017) . In essence, PCA—as a formative technique—can yield an apparently strong solution even when the underlying theoretical model is not supported.

Outside Denmark and Sweden, where the original instrument was developed and tested, researchers often had to adapt it for local contexts. In some cases, this adaptation involved what might be described as "statistical gymnastics" to support claims of universality; for example, Brudek (2021) conducted multiple SEM model fit improvements on a Polish version of the instrument and acknowledged potential cultural influences on gerotranscendence. These concerns are not new: Jewell (2014) summarized numerous doubts regarding the instrument's universality expressed in theoretical articles, empirical research across various countries, and direct communication between (Jewell, 2014; Thorsen, 1998).

Furthermore, cultural differences between Slovenia, Sweden, and other countries can be partially explained by Hofstede's model of cultural dimensions (Hofstede, 2003, 2015). According to this model, Sweden exhibits cultural characteristics as distinct from Slovenia as it does from Japan. Consequently, our results suggest that a culturally adapted version of the instrument might benefit Slovenian respondents (Hofstede, 2015), similar to adaptations developed for Japanese (Hoshino et al., 2012) and United States' (Cozort, 2008) populations.

Given that the original instrument was primarily validated on older populations (e.g., Cozort, 2008; Tornstam, 2005), we initially hypothesized that issues with the Slovenian

version might stem from a sample skewed towards younger individuals. Although this hypothesis has been repeatedly refuted, even by Tornstam's own research in Sweden, we conducted additional analyses disaggregating data by age group (Jewell, 2014; Tornstam, 2005). Even within the oldest group, the theoretically proposed model didn't fit, indicating that the observed limitations of the instrument are unlikely a consequence of age composition in our sample. The results support the notion that gerotranscendence is both a highly complex and abstract concept difficult to observe quantitatively (Asiri et al., 2019; Cozort, 2008; Tornstam, 2005).

The present study suggests that the instrument, originally designed to measure gerotranscendence, lacks robustness and requires substantial quantitative and qualitative improvements—at least within certain cultural contexts like Slovenia and among younger age groups.

4.1. Methodological limitations

While we were able to conduct a full-length 25-item GS instrument on a representative population sample, there are nevertheless some methodological limitations to our data collection.

The data were collected online in the third of seven-wave (including a "welcome wave") long Web panel. After initial 10-minutes long "welcome wave", which was implemented to keep the panellists engaged while the recruitment was taking place, 20 minutes long waves were spaced approximately every two months, and respondents were unconditionally incentivized with 5€ for each wave. In order to participate in the GS instrument, the respondents first needed to be included in the panel, and then participate in at least four waves of an online survey.

A Web-based data collection may be more suitable for younger populations and less attractive for older populations, which are typically the focus point of gerotranscendence studies. Due to skewness towards younger populations in Web surveys, we can assume that older participants in our sample might not be completely representative of the general population.

Furthermore, the panel sample is piggy-backed on an ESS survey, a one hour long face-to-face survey. Contrary to Web surveys, it is easier to attract middle-aged and older populations in face-to-face surveys, while younger and active populations often express lack of time and interest for such surveys.

In essence, while our sample is technically representative of the general population, we suspect that *all* age-based strata in our sample might be slightly different than the typical representatives of their age group given that both younger and older repeatedly participated in both survey modes.

We attempted to mitigate these concerns by prioritizing methods focused on assessing relations between items, rather than relying solely on item reduction or mean scores comparison. Consequently, and despite the limitations of the piggy-backed sample, we believe that this methodological choice strengthens the interpretability of our findings.

5. Conclusion

This was the first study to simultaneously validate and compare the psychometric properties of both 25-item and 10-item GS among young, middle-aged, and older adults.

Both the 25-item and 10-item GS exhibited remarkably weak model fit in all age groups, both collectively and disaggregated. This finding renders the measurement of gerotranscendence in Slovenia using the the Slovene GS unfeasible.

A meta-analysis of empirical studies using the GS is warranted, as findings across countries and age groups, as shown in the theoretical part of the paper as well as by our own research, reveal inconsistent psychometric properties and factor structures. Such a synthesis would clarify how often CFA confirms the original, unmodified GS, versus how often only modified or PCA-derived versions achieve acceptable validity and reliability. By systematically comparing validation methods and results, future research can better refine the instrument and advance theoretical understanding of gerotranscendence. Ultimately, this would support more robust and comparable research on ageing across diverse populations.

To conclude, this study highlights the necessity of constructing a new culturally sensitive GS to ensure its effective use in the Slovene population. This research suggests that new items should be developed to measure gerotranscendence in Slovenia. Future studies could include exploratory interviews that investigate changes in the "metaperspective" as individuals in Slovenia age, such as evolving relationships with time, space, and nature. These studies could also organize participatory co-creation sessions with young, middle-aged, and older individuals to further develop and rank gerotranscendence indicators derived from the exploratory interviews.

Funding

References

Abreu, T., Araujo, L., & Ribeiro, O. (2023). A conceptual analysis of theories on transcendence in later life. *Educational Gerontology*, *49*(6), 419–435. https://doi.org/10.1080/0360127 7.2022.2135223

Afacan, Y. (2023). Impacts of biophilic design on the development of gerotranscendence and the Profile of Mood States during the COVID-19 pandemic. *Ageing & Society*, *43*(11), 2580–2604. https://doi.org/10.1017/S0144686X21001860

Asiri, S., Foroughan, M., FadayeVatan, R., Rassouli, M., & Montazeri, A. (2019). Psychometric properties of the Persian version of the Gerotranscendence scale in community-dwelling older adults. *Educational Gerontology*, *45*(10), 636–644. https://doi.org/10.10 80/03601277.2019.1678289

Atchley, R. (1999). *Continuity and adaptation in aging: Creating positive experiences.* Johns Hopkins University Press.

Braam, A., Bramsen, I., Tilburg, T., Ploeg, H., & Deeg, D. (2006). Cosmic transcendence and framework of meaning in life: Patterns among older adults in The Netherlands. *The Journals of Gerontology Series B: Psychological Sciences and Social Sciences*, *61*(3), S121–S128. https://doi.org/10.1093/geronb/61.3.S121

Braam, A., Galenkamp, H., Derkx, P., Aartsen, M., & Deeg, D. (2016). Ten-year course of cosmic transcendence in older adults in The Netherlands. *The International Journal of Aging and Human Development*, *84*(1), 44–65. https://doi.org/10.1177/00914150166 68354

Bratun, U., Gerdina, O., & Asaba, E. (2024). Gerotranscendence and motivation for work past retirement age: A cross-sectional study. *Educational Gerontology*. https://doi.org /10.1080/03601277.2024.2372915

Brudek, P. (2021). Polish version of Lars Tornstam's Gerotranscendence Scale Type 2 (GS2-PL). *Psychiatria Polska*, *55*(6), 1305–1325. https://doi.org/10.12740/PP/120790

Brudek, P., Płudowska, M., Cichy-Jasiocha, B., Sękowski, A., & Steuden, S. (2024). Gerotranscendence and wisdom in Polish older adults. The longitudinal mediation analysis of forgiveness. *Aging & Mental Health*, *28*(6), 917–926. https://doi.org/10.1080/13607863.2023.2285915

Burchell, B., & Marsh, C. (1992). The effect of questionnaire length on survey response. *Quality and Quantity*, *26*(3), 233–244. https://doi.org/10.1007/BF00172427

Callegaro, M., Manfreda, K., & Vehovar, V. (2015). *Web survey methodology*. SAGE Publications Ltd.

Cozort, R. (2008). *Revising the gerotranscendence scale for use with older adults in the southern united states and establishing psychometric properties of the revised gerotranscendence scale* [Doctoral dissertation]. The University of North Carolina at Greensboro.

Cumming, E. H. W. (1961). *Growing old: The process of disengagement*. Basic Books.

d'Ardenne, J., Collins, D., Phillips, N., Mesplie-Cowan, S., Berteen, E., & Sexton, O. (2023). *European social survey electronic questionnaire device acceptance testing report*. NatCen.

Deaton, A., & Stone, A. (2016). Understanding context effects for a measure of life evaluation: How responses matter. *Oxford Economic Papers*, *68*(4), 861–870. https://doi.org/10.1093/oep/gpw022

Doušak, M. (2017). Survey mode as a moderator of context effects. *Advances in Methodology & Statistics / Metodoloski Zvezki*, *14*(1), 1–17.

Edwards, B., Branden, L., & Stange, M. (2011). *Piggyback survey respondents and mode: Lessons learned from design and operations*.

Erikson, E., & Erikson, J. (1998). *The life cycle completed (extended version)*. WW Norton & Company.

ESS. (2024, November 18). About ess. european social survey. https://www.europeansocialsurvey.org/about-ess

Farooq, R. (2022). Heywood cases: Possible causes and solutions. *International Journal of Data Analysis Techniques and Strategies*, *14*(1), 79–88. https://doi.org/10.1504/IJDATS.2022.121506

Fokkema, M., & Greiff, S. (2017). How performing PCA and CFA on the same data equals trouble: Overfitting in the assessment of internal structure and some editorial thoughts on it. *European Journal of Psychological Assessment*, *33*(6), 399–402. https://doi.org/10.1027/1015-5759/a000460

Galesic, M., & Bosnjak, M. (2009). Effects of questionnaire length on participation and indicators of response quality in a web survey. *Public Opinion Quarterly*, *73*(2), 349–360. https://doi.org/10.1093/poq/nfp031

Gerdina, O. (2020). Measuring gerotranscendence in slovenia – a revision of the measurement tool. *Družboslovne razprave*, *93*, 33–56.

Hofstede, G. (2003). *Culture's consequences: Comparing values, behaviors, institutions and organizations across nations* (2nd ed.). SAGE Publications, Inc.

Hofstede, G. (2015). Dimension data matrix. https://geerthofstede.com/research-and-vsm/dimension-data-matrix/

Hooyman, N., & Asuman Kiyak, H. (1988). *Social gerontology: A multidisciplinary perspective*. Allyn; Bacon, Inc.

Hoshino, K., Zarit, S., & Nakayama, M. (2012). Development of the Gerotranscendence Scale Type 2: Japanese version. *The International Journal of Aging and Human Development*, *75*(3), 217–237. https://doi.org/10.2190/AG.75.3.b

Jewell, A. (2014). Tornstam's notion of gerotranscendence: Re-examining and questioning the theory. *Journal of Aging Studies*, *30*, 112–120. https://doi.org/10.1016/j.jaging.2014.04.003

Johnson, K., & Mutchler, J. (2014). The emergence of a positive gerontology: From disengagement to social involvement. *The Gerontologist*, *54*(1), 93–100. https://doi.org/10.1093/geront/gnt099

Kalavar, J., Buzinde, C., Manuel-Navarrete, D., & Kohli, N. (2015). Gerotranscendence and life satisfaction: Examining age differences at the Maha Kumbha Mela. *Journal of Religion, Spirituality & Aging*, *27*(1), 2–15. https://doi.org/10.1080/15528030.2014.924086

Kelfve, S., Kivi, M., Johansson, B., & Lindwall, M. (2020). Going web or staying paper? The use of web-surveys among older people. *BMC Medical Research Methodology*, *20*(1), 252. https://doi.org/10.1186/s12874-020-01138-0

Lewin, F., & Thomas, L. (2001). Gerotranscendence and life satisfaction: Studies of religious and secular Iranians and Turks. *Journal of Religious Gerontology*, *12*(1), 17–41. https://doi.org/10.1300/J078v12n01_04

Liu, K., & Chen, J. (2022). The mindset, lifelong learning, and gerotranscendence of elderly women in Taiwan: An exploratory study. *Women's Studies International Forum*, *90*, 102552. https://doi.org/10.1016/j.wsif.2021.102552

Martin, J., & McDonald, R. (1975). Bayesian estimation in unrestricted factor analysis: A treatment for Heywood cases. *Psychometrika*, *40*(4), 505–517. https://doi.org/10.1007/BF02291552

Philipson, C. (2013). *Ageing*. Policy Press.

Read, S., Braam, A., Lyyra, T.-M., & Deeg, D. (2014). Do negative life events promote gerotranscendence in the second half of life? *Aging & Mental Health*, *18*(1), 117–124. https://doi.org/10.1080/13607863.2013.814101

Schober, M. (2018). The future of face-to-face interviewing. *Quality Assurance in Education*, *26*(2), 290–302. https://doi.org/10.1108/QAE-06-2017-0033

Sudman, S., Bradburn, N., & Schwarz, N. (1996). *Thinking about answers: The application of cognitive processes to survey methodology*. Jossey-Bass.

Thorsen, K. (1998). The paradoxes of gerotranscendence: The theory of gerotranscendence in a cultural gerontological and post-modernist perspective. *Norwegian Journal of Epidemiology*, *8*(2), 165–176. https://doi.org/10.5324/nje.v8i2.464

Tornstam, L. (1989). Gero-transcendence: A reformulation of the disengagement theory. *Aging Clinical and Experimental Research*, *1*, 55–63. https://doi.org/10.1007/BF03323876

Tornstam, L. (1997). Gerotranscendence in a broad cross-sectional perspective. *Journal of Aging and Identity*, *2*, 17–36.

Tornstam, L. (1999). Transcendence in later life. *Generations: Journal of the American Society on Aging*, *23*(4), 10–14.

Tornstam, L. (2005). *Gerotranscendence: A developmental theory of positive aging*. Cambridge University Press.

Tornstam, L. (2011). Maturing into gerotranscendence. *Journal of Transpersonal Psychology*, *43*(2), 166–180.

Uhan, S. (1990). *Prava in neprava mnenja: Vpliv konteksta v raziskovanju javnega mnenja*. Univerza v Ljubljani, Fakulteta za družbene vede.

van Driel, O. (1978). On various causes of improper solutions in maximum likelihood factor analysis. *Psychometrika*, *43*(2), 225–243. https://doi.org/10.1007/BF02293865

Wadensten, B. (2007). The theory of gerotranscendence as applied to gerontological nursing – Part I. *International Journal of Older People Nursing*, *2*(4), 289–294. https://doi.org/10.1111/j.1748-3743.2007.00085.x

Appendix A　Supplementary material

Table A1. GS10 inter-item correlations.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
GS2	.28																							
GS3	.20	.28																						
GS4	.23	.35	.55																					
GS5	−.04	−.13	−.01	−.07																				
GS6	.11	.13	.27	.21	−.15																			
GS7	.02	−.18	.06	−.02	.33	.03																		
GS8	.01	.07	.20	.13	−.17	.16	−.29																	
GS9	.19	.16	.35	.27	−.08	.28	−.17	.41																
GS10	.32	.15	.24	.30	−.11	.15	−.01	.09	.18															
GS11	.27	.24	.19	.32	.02	.18	.03	−.07	.11	.40														
GS12	.16	.03	−.07	.12	.17	.07	.22	−.33	−.12	.00	.32													
GS13	−.21	−.17	−.05	−.19	−.02	−.08	.08	−.09	−.07	−.22	−.36	−.13												
GS14	−.03	−.11	−.18	−.12	.04	.09	.16	−.16	−.13	−.06	−.08	.15	.24											
GS15	.10	.02	.06	.16	−.03	.07	.06	.11	.13	.09	.22	.06	−.14	−.10										
GS16	−.02	.02	.19	.12	−.23	.26	−.07	.38	.23	.08	.05	−.18	−.05	−.12	.30									
GS17	−.14	−.13	−.10	−.16	−.09	−.07	−.07	−.04	−.06	−.14	−.23	−.08	.14	.10	−.22	−.12								
GS18	−.13	−.09	.11	.00	−.08	−.05	−.01	.10	.04	−.09	−.25	−.21	.03	.03	−.07	.11	.48							
GS19	.03	−.08	.03	−.06	.01	.01	.12	−.10	−.03	−.03	−.02	.11	.09	.11	−.03	.01	.27	.15						
GS20	−.07	−.04	−.08	−.18	.01	−.11	−.04	.01	−.06	−.23	−.25	.00	.19	.05	−.21	−.13	.29	.22	.08					
GS21	.05	.01	.25	.18	.01	.24	.11	.15	.20	.15	.06	−.10	−.10	−.01	.14	.18	−.01	.33	.10	−.14				
GS22	.08	.11	.07	.23	−.07	.09	−.07	.14	.15	.20	.18	.02	−.24	−.03	.08	.10	−.07	−.03	−.05	−.30	.19			
GS23	.17	.02	.06	.11	.25	−.11	.12	−.17	−.06	.08	.28	.35	−.09	−.08	.10	−.15	−.16	−.27	.02	−.10	−.21	.05		
GS24	.11	−.05	.06	.07	.06	−.01	.02	.05	.09	.09	.09	.18	.04	.09	.12	−.02	−.02	−.11	.12	.01	−.08	−.05	.21	
GS25	−.09	−.10	.00	−.12	.01	−.11	.10	−.09	−.13	−.17	−.21	−.04	.20	.07	−.10	−.03	.14	.04	.21	.18	−.10	−.20	−.03	.08