Examining 14-year life satisfaction trajectories and associated predictors in the Dutch population; a latent class analysis

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ABSTRACT

Aim. The aim of this paper was to examine the stability of life satisfaction in the Dutch population over a 14-year period. In addition, it explores individual trajectories of life satisfaction and identifies personal factors that influence these trajectories. *Method.* The study uses a Latent Growth Model to estimate the average pattern of individual life satisfaction trajectories. A Latent Class Analysis identified distinct groups based on similar life satisfaction trajectories. Finally, Multinominal Logistic Regression Analyses were used to examine the influence of neuroticism, extraversion, age and gender on these trajectories. *Results.* The findings reveal a U-shaped mean trajectory and a three-class model. Most participants report a stable trajectory (69.2% High stable class). However, a substantial proportion of individuals (16.7% U-shape class and 14.1% Upward-curved class) experienced changes in their life satisfaction over the 14-year period. Lower age predicted membership in the U-shape class, while higher neuroticism levels predicted membership in the U-shape and Upward-curved classes. Extraversion and gender did not predict class membership. *Conclusions.* The study suggests that life satisfaction can change over time, that differences between individuals are relevant and that personal or external factors might play a role in life satisfaction levels over time. This understanding can be used for the enhancement and development of mental health interventions and policies in the Netherlands.

*Keywords***:** Life satisfaction; Trajectories; Latent Growth Model Analysis; Latent Class Analysis; Neuroticism; Extraversion; age; gender; LISS panel.

Introduction

Life satisfaction is one of the key indicators for mental well-being and is conceptualized as '*a cognitive judgemental global evaluation of one's life and the contentment with their current circumstances*' (Mehlsen, et al., 2005). It has been associated with many positive outcomes, including increased mental and physical health, increased productivity and success in the workplace, stronger interpersonal relationships and longer life expectancy (Diener, et al., 2002; Huppert & So, 2013; Liu, et al., 2012; Kim, et al., 2014; Huebner, et al., 2006). However, most of these studies are cross-sectional, while we need longitudinal studies to understand the complex dynamics of wellbeing and life satisfaction. The more scarce longitudinal studies on life satisfaction yield conflicting results. Some studies rooted in personality research suggest that life satisfaction is a stable trait. However, social cognition research argues that life satisfaction is dependent on variable external factors, leading to fluctuations in life satisfaction levels (Schimmack, et al., 2009; Diener et al., 1984; Lucas & Donnellan, 2007). Given the desire for life satisfaction is widespread among individuals, it is crucial to determine whether it is possible to maintain or alter the levels of life satisfaction over an extended period. Additionally, it is essential to identify the reasons for any changes in life satisfaction and gain a deeper understanding of the nature of these changes (Weiss, et al., 2016). Gaining knowledge on the changes in life satisfaction over time can aid in improving mental health through the development of theories and interventions. Consequently, the purpose of this paper is to investigate changes in individual life satisfaction over time in the Dutch population.

Life satisfaction change over time

The first aim of this paper is to examine is individual life satisfaction changed between 2008 and 2021 in the Dutch population. When discussing changes in life satisfaction or "life satisfaction trajectories," four theories are commonly taken into consideration. The first is that life satisfaction is primarily influenced by objective circumstances. Gana and colleagues (2013) state that with time and aging comes an increased risk of exposure to negative events and losses. They theorize that this causes an increase in negative affect and a decrease in positive affect, which would ultimately lead to individuals being less satisfied with their life (Gana, et al., 2013; Liu, et al., 2012; Amirkhan, et al., 1995). Because life satisfaction is strongly related to positive and negative affective states, this statement intuitively makes sense (Gale, et al., 2013).

The second assumption is that, as we age, we are exposed to an increased number of life events. These experiences create opportunities to learn about our best coping mechanisms. Consequently, we become better at deploying appropriate coping techniques that result in increased emotion, thought and behaviour regulation. This could in turn result in a decreased

negative affect and increase in life satisfaction (Baird, et al., 2010). This assumption was tested by Lightsey and colleagues (2013) who found that self-efficacy to regulate anger buffered the relationship between negative affect and life satisfaction.

Third, the personality trait theory that assumes life satisfaction is primarily influence by personality traits, such as extraversion and neuroticism (Andrews & Crandall, 1976; Gale, et al., 2013; Liu, Wang & Li, 2012; Costa & McCrae, 1992). According to Loewe and colleagues (2014), top down perspectives on this explanation claim that '*differences in personality and other stable traits of the person predispose people to be differentially satisfied with their lives'* (Loewe, et al., 2014). They assume that personality traits are stable over time and therefore life satisfaction as well, but differing between individuals. This theory is substantiated by Diener (1984), who found that all components of SWB (including life satisfaction) are moderately stable over time.

Finally, hedonic adaptation assumes that levels of life satisfaction always to return to its baseline level over time, meaning that people typically become accustomed to positive or negative changes in their lives and eventually return to their previous level of happiness or satisfaction (Brickman & Campbell, 1971). It is therefore assumed that life satisfaction is a stable concept over time (Fujita & Diener, 2005).

Literature thus gives us insight into three possible life satisfaction trajectories, namely it can decrease, increase or remain stable over time. Both population based and individual based longitudinal studies on life satisfaction might provide insight in which of these theories is correct.

Longitudinal results on life satisfaction changes

Despite a lack of Dutch longitudinal studies on life satisfaction trajectories, the 'World Happiness Report' reported that over the last ten years, the Netherlands was in the top seven of the happiest countries in the world. In addition, the LISS panel gathers yearly Dutch survey data that is publicly accessible. As a result, numerous studies on various topics such as life satisfaction during COVID-19, immigrant life satisfaction, and life satisfaction related to social leisure, are published annually. However, it remains unknown how life satisfaction changes in the Netherlands. Exploring these trajectories in other countries may offer valuable insights.

First, Baird and colleagues (2010) studied life satisfaction using the German Socio Economic Panel Study ($N = 20.696$) and the British Household Panel Study ($N = 21.448$). They found that in the German population, the average levels of life satisfaction are stable in the period from late teens to early seventies. After their seventies, there was a significant decrease in life satisfaction. The British sample showed that life satisfaction declines in early adulthood

to early forties. After their forties it increased and after their seventies is declined again (Baird, et al., 2010). Another study was done by Realo and Dobewall (2011). They examined life satisfaction in a 27-year study in Estonia, Finland, Latvia, and Sweden (total $N = 39.420$) and found that life satisfaction was curvilinear in Estonia and Latvia. The youngest and the oldest people reported the highest levels of life satisfaction. In Finland and Sweden however, there was almost no change in life satisfaction over time. They also found that the average level of life satisfaction was significantly different in all four countries (Realo & Dobewall, 2011). Mroczek & Spiro (2005) did a 22-yearlong panel study with men aging from 33 to 91 ($N = 1.972$) and found the opposite curvilinear trajectory. They report that life satisfaction increased until 65-70 years and declined after. On an individual level, they found that life satisfaction changed in time, but in different directions depending on extraversion, marital status and proximity to death (Mroczek & Spiro, 2005). Another 17-year person-centred German panel study ($N = 3.608$) examined the life satisfaction set point and its stability or change over time. They concluded that the life satisfaction trajectories differed between participants. For example, for almost 10% of the population, life satisfaction levels significantly decreased or increased the first five years. However, for 24% of the sample life satisfaction levels remained relatively stable (Fujita & Diener, 2005). Last, Han and Hong (2011) conducted a relatively unique 2-year study on over-50s in Korea ($N = 8.567$), where they measured life satisfaction three times. They examined whether certain groups of people have similar life satisfaction trajectories. They did this using a latent class analysis (LCA) and found that a model with three different classes was the best way of representing different (between group) and similar (within group) life satisfaction trajectories. They found one group with a relatively high and stable life satisfaction trajectory (high class). They found another group with a relatively low and stable life satisfaction trajectory (low class) and last a group in between these two classes that had a relatively moderate and stable life satisfaction trajectory. Specifically, 17.65% of participants had high satisfaction scores at all times, 48% had moderate scores, and 34.35% had low scores. While these groups showed similar patterns, their level of satisfaction varied (Han & Hong, 2011).

In conclusion, the first four papers that focused on populations all found that life satisfaction changed significantly over time. With that, personality trait theory and hedonic adaption are rejected. Similarly, neither study provides evidence in favour of a linear increase or decrease in life satisfaction over time, as there is no indication of a consistent pattern. All four assumption therefore seem insufficient for explaining life satisfaction trajectories. In addition, these studies were all done in different population and none of these papers reported

similar result, meaning that these findings cannot be generalized to the Dutch population. Based on the three person-centred studies, it can be assumed that life satisfaction trajectories vary across individuals. Among these studies, two identified three distinct clusters of people with similar life satisfaction trajectories. Consequently, to acquire a comprehensive understanding of individual changes in life satisfaction, it is imperative for research to prioritize individual-centred approaches. Hence, the second aim of this paper is to exploratively classify individual life satisfaction trajectories into classes based on similar patterns of life satisfaction.

Age, gender, neuroticism and extraversion

The final objective of this paper is examining if age, gender and the personality traits extraversion and neuroticism influence these life satisfaction trajectories. These factors have repeatedly been reported as strong predictors for life satisfaction. Joshanloo and Jovanović (2020) found that in most demographic groups, women reported higher life satisfaction levels than men, independent of their employment, income or education. Older adults generally report higher levels than young adults (Kuppens, et al., 2008). Carstensen, Isaacowitz and Charles (1999) also found that life satisfaction increases with age, peaking in the mid-70s. Another study that illustrates this was done by De Bruin (2022) who reported that younger people experienced more negative changes in life satisfaction during the COVID-19 pandemic than older people (De Bruin, 2022). In addition, neuroticism and extraversion have consistently been reported as two of the strongest predictors for life satisfaction (Andrews & Crandall, 1976; Gale, et al., 2013; Liu, et al., 2012; Costa & McCrae, 1992). Neuroticism is defined as '*the stable propensity to respond with intense negative emotions to threat, frustration, or loss'* (Goldberg, 1993; Lahey, 2009). It is adversely correlated with many positive life outcomes, including self-esteem, resilience and life satisfaction. The negative link between neuroticism and life satisfaction is found in almost every population (Liu, et al., 2012). An explanation for this could be that people high in neuroticism are often manifested in their tendency to focus on personal criticism, disbelief that they can handle negative situations (Barlow, et al., 2014), ruminate about negative experiences and have a negative worldview, which could all result in decreased life satisfaction (Liu, et al., 2012). Extraversion is defined as *''the stable propensity to experience positive emotions and sociability, talkative, assertive, warm and active tendencies''* (Jackson & Schneider, 2014). Extraversion is positively correlated with many positive life outcomes, including (mental) well-being, experience of positive life events and life satisfaction (Jackson & Schneider, 2014). The positive link between extraversion and life satisfaction could be explained by the following: people higher in extraversion are often more optimistic, experience more feelings of activity, are social (Depue & Collins, 1999) and have a

mature coping when dealing with negative events, which could lead to increased life satisfaction (Amirkhan, et al., 1995). From these cross-sectional studies, it can be concluded that life satisfaction levels are negatively associated with neuroticism and positively with extraversion (Barlow, et al., 2014; Kim, et al., 2018).

Based on the aforementioned personality trait theory, neuroticism and extraversion are stable constructs that determine life satisfaction in a stable manner (Andrews & Crandall, 1976; Gale, et al., 2013; Liu, Wang & Li, 2012; Costa & McCrae, 1992). Nonetheless, several longitudinal studies have reported evidence to the contrary. For example, Schunk and Trommsdorff (2022) examined the relationship between neuroticism and life satisfaction in the German population, using four waves of longitudinal panel data. By using cross-lagged panel models and random intercepts cross-lagged panel models, they found that elevated levels of neuroticism were associated with a decline in life satisfaction over time, while the reverse was not observed; life satisfaction did not predict levels of neuroticism. In addition, two studies reported that lower levels of neuroticism were associated with greater variability in the rates of interindividual change in life satisfaction (Luhmann and Eid, 2009; Hansson, et al., 2020). Higher levels of extraversion were found to have the same effect and increase differences in change rates of life satisfaction (Hansson, et al., 2020). Finally, Mroczek and Spiro (2005) found that higher levels of neuroticism predicted variability in change rate as well, where high levels were associated with high and stable trajectories.

Research questions

A total of three objectives is formulated. The first one is to examine if life satisfaction changed between 2008 and 2021 in the Netherlands, hypothesizing a significant and non-linear change. In addition, a decrease in 2021 due to the COVID-19 lockdown is expected (Baird, et al., 2010; Mroczek & Spiro, 2005; De Bruin, 2022). The second objective is to identify and classify individuals into groups with similar life satisfaction trajectories. It is anticipated that at least three distinct classes will emerge with at least one class with a stable life satisfaction trajectory (Han & Hong, 2011; Fujita & Diener, 2005). Finally, the third objective is to examine if these life satisfaction trajectories and class divisions are influenced by neuroticism, extraversion, age and gender. It is hypothesised that lower levels of neuroticism will cause a greater variability in life satisfaction change rates (Luhmann and Eid, 2009; Hansson, et al., 2020). In addition, higher levels of extraversion are expected to be associated with high and stable trajectories (Mroczek & Spiro, 2005). Finally, a positive correlation between age and life satisfaction changes, and a higher level of life satisfaction in women compared to men is

predicted (Schunk & Trommsdorff, 2022; Hansson, et al., 2020; Mroczek & Spiro, 2005; Kuppens, et al., 2008; Joshanloo and Jovanović, 2020).

Method

Design

Following a quantitative withing-subjects research design, this paper used LISS panel data to examine life satisfaction trajectories in a Dutch probability sample over a period of 14 years.

LISS Panel.

LISS panel stands for *'Longitudinal Internet studies for the Social Sciences'*. It is an online platform that collects information on the Dutch population, for use in social sciences. Participants are asked to fill in questionnaires monthly or annually on a variety of topics. The panel includes approximately 5000 Dutch representative households, of which approximately 7500 individuals are older than 16. Participants are collected through a true probability sample, via 'Statistics Nederland' and are paid for every questionnaire they complete. The current study specifically made use of the LISS Core Study 'Personality'. This is a yearly repeated longitudinal study that collects information about changes in individuals courses of life and living conditions (see www.lissdata.nl). Data files for this paper are listed in appendix A.

Data and analytic sample

Data on the Dutch population was collected from LISS panel on 18-10-2022. 14 Waves of data (between 2008 and 2021) on the Big-five personality questionnaire and on the Satisfaction with Life scale was used, including a file on personal participant information from 2007. The questionnaires are administered by Centerdata and are rewarded with money. LISS data is confidential and participants are informed and have provided double consent.

Data from 20554 Dutch citizens was collected, but not all participants completed all questionnaires. This potentially leads to a distorted view in life satisfaction changes, which is why participants with missing data were excluded in two steps. First, those who did not participate in the first year (2008) were removed, resulting in a remaining sample of 5,942 participants. This *'excluded sample'* consisted of 4779 participants of which 2131 were male (M_{age}= 45.47) and 2648 female (M_{age}= 43.33). The following step was to exclude participants that did not complete every relevant questionnaire between 2008 and 2021 ensure a sample with measurements at even time intervals. The included sample consisted of 1163 participants, ranging from 15 years to 79 years (M_{age} = 50.08, SD_{age} = 12.35). Of these, 580 were male (49.9%) between the age of 34 and 67 (M_{age} = 51.00, SD_{age}= 11.07) and 583 female (50.1%)

between the age of 15 and 79 (M_{age} = 49.16, SD_{age} = 12.38). Outliers on life satisfaction scores were left in. Because so much data was removed, a one-way ANOVA comparing the included and excluded sample was performed for insight. The excluded sample significantly differed from the included sample on gender (p<.001), age (p<.001), neuroticism (p=.001) and life satisfaction scores (p=.002) (See table 2). Table 1 provides additional descriptive statistics of the included sample.

Materials

Life satisfaction.

Diener's (1985) satisfaction with life scale (SWLS) was used to asses life satisfaction as an outcome measure in this study. This scale narrowly focusses on global cognitive evaluation of one's satisfaction with life, without tapping in to related constructs. It consists of five items, such as '*I am satisfied with my life'* and '*The conditions of my life are excellent'.* Participants score these items on a 7-point Likert scale ranging from 1 (completely disagree) to 7 (completely agree). Life satisfaction scores were determined by the mean of all items. A higher score indicates more satisfaction with life. The SWLS is proven to be useful with different age groups (Diener, 1984). It is shown to have favourable psychometric properties, including an good discriminant validity with emotional well-being, a good convergent validity with other scales (Arrdindel, et al., 1999), an excellent internal consistency (α =.90) and a high temporal reliability (Diener, Emmons, Larsen & Griffin, 1985). Convergent validity with Social Support Scale is *r* =.39 (p < .001, two-tailed) (Glaesmer, Grande, Braehler & Roth, 2011).

Neuroticism & extraversion.

Participant's degree of neuroticism and extraversion was determined using International Personality Item Pool (IPIP-NEO-50): a personality scale developed by Goldberg (Goldberg, 1992). This scale originally consists of five personality domains, but only measurements for neuroticism and extraversion were used in this study. For measuring neuroticism, the item scores on the scale 'emotional stability' were reversed. Emotional stability is the opposite of neuroticism on the same bipolar rating scale. This scales consists of ten either positively or negatively keyed items, that were aligned to provide a robust measure. Participants answered on a 5-point Likert scale ranging from (1) *very inaccurate* to (5) *very accurate*. An example item for neuroticism is *'I get stressed out easily'* and for extraversion '*I feel comfortable around people'.* The internal consistency of this scale is good (Goldberg, 1992).

Age, gender, neuroticism and extraversion scores were determined in 2008.

Table 1

Descriptive statistics of the included sample

Variable	*n*	Percentage (%)
Age		
15-25	57	4.9
26-35	89	7.7
36-50	379	32.6
50+	638	54.9
Gender		
Men	580	49.9
Women	583	50.1
Highest finisched education		
Primary school	32	2.8
Vmbo	320	27.5
Havo/vwo	109	9.4
MBO	271	23.3
HBO	294	25.3
WO	72	6.2
other	34	2.9
Uncompleted education	31	2.7
Monthly neat income		
0-1500	370	31.8
1501-2500	390	33.5
2501-3500	89	7.7
3501-4500	18	1.5
4501+	23	2.0
Civil status		
Married	840	72.2
Separated	2	0.2
Divorced	90	7.7
Widowed	36	3.1
Never been married	195	16.8
Domestic situation		
Single	150	12.9
Co-habitation, no children	493	42.4
Co-habitation, with children	470	40.4
Single, with children	45	3.9
Other	5	0.4

Note: All variables were measured at the baseline of 2008.

Table 2

One-way ANOVA comparing the means of the included and excluded sample

Variable	Included sample N= 1163 (19.6%)	Excluded sample N= 4779 (80.4%)	Statistic	p-value
Female gender, N (%)	583 (50.1)	2648 (55.4)	X = 13.75	<.001
Age, M (SD)	50.80 (12.35)	44.29 (16.41)	F = 127.30	<.001
Extraversion, M (SD)	3.17 (.26)	3.16 (.26)	F = .995	.319
Neuroticim, M (SD)	2.73 (.49)	2.78 (.49)	F = 10.71	.001
Life satisfaction, M (SD)	5.09 (.95)	5.18 (.92)	F = 9.47	.002

Note: X = Independent samples T-test, equal variances assumed, *F* = One-way ANOVA, variables gender, age, extraversion and neuroticism were measured at the baseline of 2008. Life satisfaction is the mean score of all mean SWLS scores between 2008 and 2021.

Data analysis

Data was downloaded from LISS panel and transported to SPSS (version 28).

Life satisfaction is a multidimensional construct, of which people may weight distinct components differently. The conventional analysis that use mean scores could overlook this multidimensionality and thereby give an incomplete picture of life satisfaction courses. For that reason, this paper utilized Latent Growth Model Analyses. This technique allowed for estimating the individual change rate and direction of life satisfaction in the Dutch population between 2008 and 2021. With this, the individual differences in life satisfaction trajectories could be examined. In addition, unlike conventional analyses that rely on average scores, the latent growth model analyses modelled non-linear trajectories. First, the assumption of normality was tested. The data distribution had a slight ceiling effect. However, the assumption of normality is not required for LGMA, as the method can be applied to both continuous and categorical data (Hagenaars & McCutcheon, 2002; Lanza, 2006). The assumption of local independence (LIA) cannot be violated with this data and is therefore met as well (Hagenaars & McCutcheon, 2002). During the first phase of the analysis, the Latent Growth Model Analysis was used to establish a baseline model that accurately represented the data, with the aim of comprehending the patterns of change in life satisfaction among the Dutch population. In order to determine the optimal baseline model, the fit indices of four models were compared: (1) a model with fixed effects on the intercept and slope, (2) a model with random intercept, (3) a model with random intercept and slope and (4) a quadratic model with random intercept and slope. The intercept refers to the initial level of life satisfaction. The slope refers to the rate of

change in life satisfaction over time. A 'fixed effect' means that the parameters are assumed to be the same for all participants, without any variation. In contrast, if the effects of the intercept and slope are "random", it means that these parameters are estimated separately for each participant, allowing for more flexibility in modelling individual differences in the trajectory of change. A quadratics effect refers to a non-linear relationship between life satisfaction and time, where the change rate can differ over time. The inclusion of a quadratic effect in the baseline model allows for a more nuanced and accurate representation of the change over time, which can be useful for capturing complex change patterns that may not be captured by a linear model. The Akaike Information Criterion (AIC) and Bayesian Information Criterion (BIC) and Integrated Complete-data Likelihood (ICL) are model selection criteria that will be used to find the model that represents the data the best. The model with the lowest values is considered the best base-line model (Côme & Latouche, 2015).

The second analysis was a Latent Class Analysis, which was used to identify groups of people, or 'classes', based on similar life satisfaction trajectories. The latent class analysis was conducted several times. First with two classes, then with three classes, then four, etc. This continued until it was estimated that a larger number of classes would no longer yield a better model. The outcomes of these analyses were compared to find the best model. The stability of each model and goodness of fit was determined by the smallest ICL (Integrated Complete-data Likelihood) scores. This fit index is often used in Latent Class Analyses and does not only look at the model itself, but also takes the entropy into account. The entropy provides insight into the disparity between the observed and expected distribution of class membership. ICL thus takes into account how likely it is that someone is assigned to the correct class, which made it relevant for this analysis. The lowest ICL represented the best model (Bertoletti, Friel & Rastelli, 2015). Both the Latent Growth Model Analysis and the Latent Class Analyses were conducted in 'R 4.2.2', using 'R-studio'. The primary package was LCMM (latent class mixture modelling).

Finally, after identifying the classes within the sample, a Multinominal Logistic Regression Analysis was performed. This analysis allowed for determining the influence of variables on a an unordered multi-category dependent variable. More specifically, it was used to determine the effects of neuroticism, extraversion, age and gender on life satisfaction trajectories of the participants. Before the multinominal regression was conducted, multicollinearity was checked by doing linear regressions with each independent variable compared to the others. VIF was no higher than 1.14. Assumptions for independence of observations, normality and large sample size were also met (Alfons & Jan 2019). The analysis

itself was conducted in SPSS (version 28) and was done twice. During the first analysis, it was determined which predictors (neuroticism, extraversion, age and gender) were associated with the life satisfaction classes, identified by the LCA. For the second analysis, the baseline of life satisfaction was included to see if the significant independent variables still explained enough variance after controlling for the baseline level life satisfaction. The most stable and easy to interpret class was used as a reference group, in this case the stable class (class 1).

Results

Table 3 displays the fit indices of each Latent Growth Model analysis, showing model 4 (quadratic model) slightly outperforming model 3 (random intercept and slope). The quadratic model corresponds the most with the observed values and is therefore considered the most suitable for understanding life satisfaction changes from 2008 to 2021 (AIC = 37301.43; BIC = 37337.83; ICL = 37337.83). It shows significant change over time with a quadratic effect ($\beta 1$ = -.02, p <.001; X^2 = 0.00, p <.001). Life satisfaction in the Dutch population has a U-shape trajectory with the highest scores in 2008 and 2021 and the lowest life satisfaction score in 2014 (Figure 1). Contrary to the expextation, life satisfaction did not seem to drop during the COVID-19 lockdown, but increased compared to the previous years.

Table 3

Comparison of fit indices of potential baseline models for mean individual life satisfaction changes 2008 and 2021 in the Netherlands

Model	AIC	BIC	ICL
1 Fixed effects on intercept and slope	56496.04	56511.64	56511.64
2 Random intercept	38750.59	38771.39	38771.39
3 Random intercept and slope	37326.70	37357.90	37357.90
4 Quadratic model with random intercept and slope	**37301.43**	**37337.83**	**37337.83**

Note: The lowest and best representative statistic is indicated by bold values. AIC = Akaike Information Criterion, BIC = Bayesian Information Criterion, ICL = Integrated Complete-data Likelihood.

The Latent Class Analysis was performed four times, showing the best AIC and BIC for the 4-class model. However, the 3-class model has a better ICL, indicating this model as the best for understanding the distinct classes (ICL = 34080.89). In addition, the 4-class model does not have a much larger entropy, meaning that the quality of the participant group devision is not much improved compared to the 3-class model (Table 4). This paper therefore utilizes the 3-class model.

Figure 1

Mean individual life satisfaction trajectory between 2008 and 2021 in the Netherlands
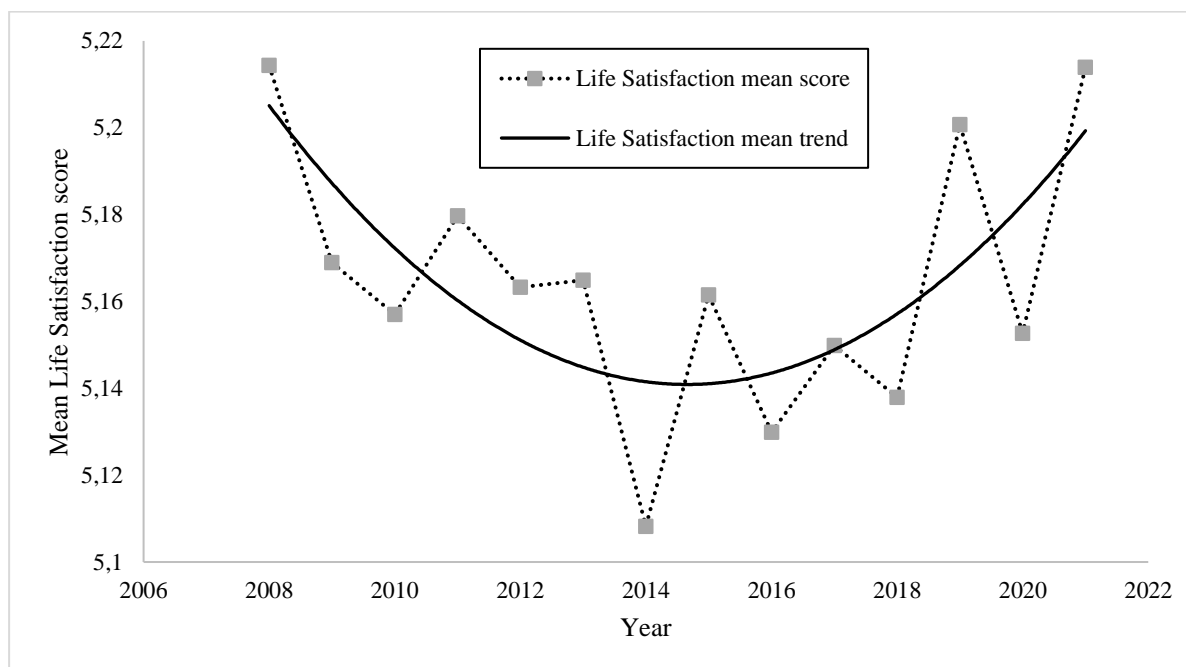
Note: This figure shows a year-on-year change in average individual life satisfaction scores in the Netherlands between 2008 and 2021. The gray dotted line indicates the actual scores. The black line is the trend line.

Using the 3-class model, 805 individuals (69.2%) are assigned to class 1, further referred to as the '*high stable class*'. Their life satisfaction is trajectory is linear ($\beta1 = -.00$) without significant changes over time ($p = .852$). The trajectory lies between life satisfaction scores 5.59 and 5.68, which corresponds to '*extremely satisfied*' (appendix B).

Class 2, further referred to as the '*U-shape class*' consists of 194 participants (16.7%). Life satisfaction levels of this class start in between the *high stable class* and *upward curved class*, after which the life satisfaction scores decrease until 2015. After 2015, their level of life satisfaction increases again, resulting in an upward curved trajectory. Life satisfaction levels in 2021 are still lower compared to 2008. This quadratic decrease in life satisfaction is significant ($\beta1 = .19$, $p <.001$; $X^2 = -.01$, $p <.001$). The trajectory lies between life satisfaction scores 3.91 and 4.65, which correspond to '*slightly satisfied - satisfied*' (appendix B).

The third class, further referred to as the *upward curved class*, contains 164 participants (14.1%). Compared to the other two classes, their trajectory generally starts off low in 2008, increases until 2015 and then decreases until 2021 again. Nonetheless, the life satisfaction level is still higher in 2021 than in 2008. This quadratic increase in life satisfaction is significant ($\beta1 = -.29$, $p <.001$; $X^2 = .02$, $p <.001$). The trajectory lies between

life satisfaction scores 3.66 and 4.73, which correspond to '*slightly satisfied - satisfied*' (appendix B) (Figure 2).

It is noteworthy that the U-shape class is the only one that follows a trajectory similar to the overall mean trajectory of the entire sample (Figure 1). The other two classes show completely deviating trends. The high stable class has much higher life satisfaction levels and a stable trajectory, while the upward curved class has the opposite trajectory compared to the mean individual trajectory. Another noteworthy and unexpected observation is that all three curvilinear relationships between life satisfaction and time changed direction in 2015.
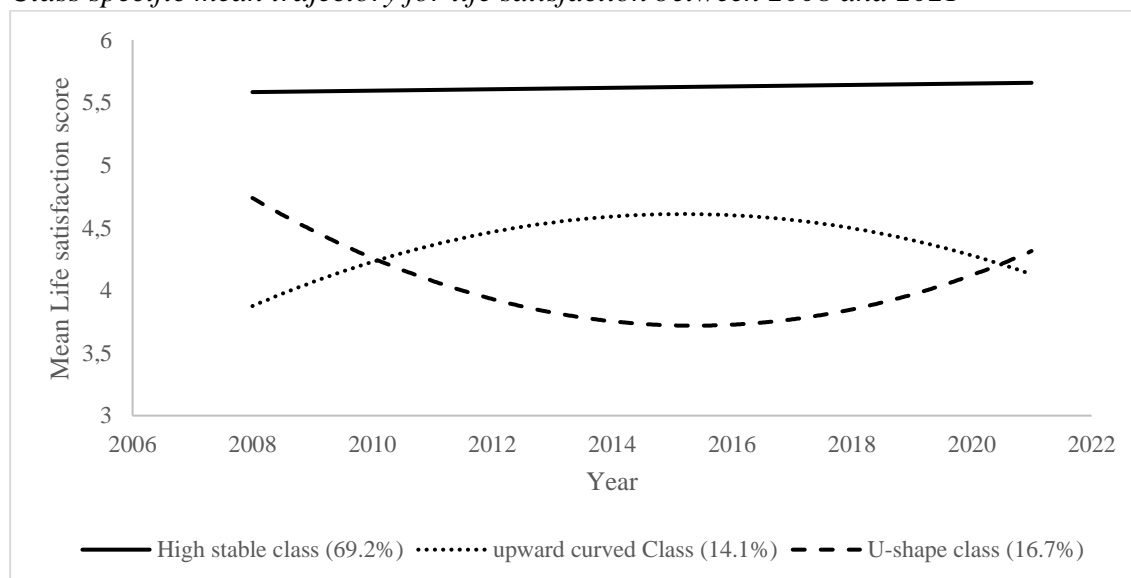
Table 4
Results of the Latent Class Analysis and fit indices for determining the best class model

Classes (*n*)	Life Satisfaction trajectories (*n* = 1163)			
	AIC	BIC	ICL	Entropy
1	37301.43	37337.83	37337.83	10.000.000
2	36698.34	36760.74	34283.49	0.7169413
3	36319.37	36407.78	**34080.89**	0.6864615
4	**36252.78**	**36367.19**	34123.99	0.6919868

Note: The bolded values indicate the best representative value. AIC = Akaike Information Criterion, BIC = Bayesian Information Criterion, ICL = Integrated Complete-data Likelihood.

Figure 2
Class specific mean trajectory for life satisfaction between 2008 and 2021

Note: this figure shows the life satisfaction trend between 2008 and 2021 for each class in the Dutch population.

The Multinominal Logistic Regression Analyses without the life satisfaction intercept showed that when comparing the stable class and the improvement class, gender and extraversion revealed no significant effect on life satisfaction trajectories (Table 6). However, younger people (B=-.02, s.e.=.01, p=.004, CI =.97-1.00) and those with higher levels of neuroticism (B=.91, s.e.=.14, p<.001, CI=1.9-3.26) were significantly more likely to be assigned to the U-shape class than to the high stable class. Every year someone is older, the odds of that person being assigned to the U-shape class decreased by a factor of .98 (OR=.98), while participants who scored higher on neuroticism were 2.5 times more likely to be assigned to the U-shape class (OR=2.49). In addition, participants higher in neuroticism were also more likely to be assigned to the Upward curved class changing than to the stable scores, with an even higher odds ratio (OR = 3.40; B=1.22, s.e = 0.15, p<001, CI= 2.54 - 4.54). Ergo, participants higher in neuroticism were more likely to have significantly changing life satisfaction scores than stable scores. The second Multinominal Logistic Regression Analysis added the life satisfaction intercept and found it to significantly determine life satisfaction trajectories for all classes (p<001). Results for age (B= -0.02, s.e.=.01, OR= .98, p=.014, CI= 0.97 – 1.00) and neuroticism (*Upward curve class*: B= 0.53, s.e.=0.15, p<001, CI= 1.26 - 2.29; *U-shape class:* B=0.44, s.e.=0.18, p<001, OR=1.55, CI= 1.08 - 2.22) were similar. The largest difference was the smaller likelihood of neurotic individuals to be assigned to the upward curve class compared to the high stable class (OR= 1.70).

Discussion

The aim of the current paper was to examine life satisfaction trajectories in the Dutch population between 2008 and 2021. First, based on the quadratic baseline model of the Latent Growth Model Analysis, life satisfaction significantly changed between 2008 and 2021, following a U-shape. No decrease of life satisfaction was measured during the COVID-19 Lockdown. In addition, the Latent Class Analysis showed that the sample is best divided into three classes: (1) *high stable class*, (2) *upward curved class* and the (3) *U-shape class*. Finally, the Multinominal Logistic Regression Analyses revealed that younger people and those higher in neuroticism were more likely to be assigned to the *upward curved class* than the *high stable class*. In addition, neurotic people were also more likely to be assigned to the *U-shape class* than to the *high stable class.*

Table 5

Information on the specifics of the life satisfaction trajectories for each class

	High stable Class (n = 805, 69.2%)			U-shape class (n = 194, 16.7%)			Upward curved class (n = 164, 14.1%)		
	Value	Se	*p*-value	Value	Se	*p*-value	Value	Se	*p*-value
Intercept	560.421	0.03259	<.001	405.231	0.12917	<.001	507.971	0.09002	<.001
Slope (β1)	-0.00124	0.00664	0.85157	0.19385	0.02040	<.001	-0.29312	0.01690	<.001
Quadratic effect (X^2)	0.00033	0.00042	0.43065	-0.01206	0.00124	<.001	0.01776	0.00098	<.001

Note: Se = Standard error

Table 6

Results of the two multinominal logistic regression analyses on variables that potentially influence life satisfaction trajectories

	U-shape class			Upward curved class		
Variables	OR	B	CI	OR	B	CI
MNLR without Life satisfaction intercept						
Age	0.98	-0.02**	0.97-0.99	1.01	0.01	0.99 - 1.02
Gender	1.03	0.03	0.74-1.43	0.98	-0.02	0.69 - 1.40
Extraversion	0.82	-0.20	0.62-1.08	0.84	-0.18	0.62 - 1.13
Neuroticism	2.49	0.91***	1.90-3.26	3.40	1.22***	2.54 - 4.54
MNLR life satisfaction intercept included						
Satisfaction intercept	0.27	-1.31***	0.21 - 0.34	0.12	-2.10***	0.09 - 0.16
Age	0.98	-0.02*	0.97 – 1.00	1.00	0.01	1.00 - 2.39
Gender	1.41	0.34	0.99 - 2.02	1.55	0.44	0.99 - 1.02
Extraversion	1.05	0.05	0.78 - 1.42	1.23	0.20	0.86 - 1.77
Neuroticism	1.70	0.53***	1.26 - 2.29	1.55	0.44*	1.09 - 2.22

CI = 95% confidence interval, OR = odds ratio, MNLR = multinominal logistic regression analysis. The reference category is: Class 1; Stable class.
* = p<.05, ** = p<.01, *** = p<.001

Individual life satisfaction trajectory classes

The present study enhances the understanding of life satisfaction trajectories in the Dutch population by using a Latent Class Analysis to identify three distinct classes, based on similar life satisfaction trajectories. The majority of the Dutch population (69.2%) experienced high and stable levels of life satisfaction between 2008 and 2021. This is consistent with the 'World Happiness Report' repeatedly ranking the Netherlands among the happiest countries worldwide over the last decade. Additionally, this finding substantiates the personality trait theory, hedonic adaptation and previous population-based research (Diener, 1984), which highlight life satisfaction as a stable construct. Moreover, Fujita and Diener (2005) reported at least one stable class in life satisfaction as well. This majority of satisfied individuals could explain why life satisfaction is moderately stable in most population-based studies.

While these studies and theories offer some insight in life satisfaction trajectories, it might not provide a complete understanding. The present study revealed that a significant minority of the Dutch population (30.8%) experienced lower and significantly changing levels of life satisfaction over the study period. One group had a upward curvilinear trajectory, while the other had a downward curvilinear trajectory. This contrasts with previous studies that reported either increasing or decreasing classes, in addition to stable classes (Fujita & Diener, 2005). It is in contrast to Han and Hong's (2011) findings as well, who reported uniform trajectories across the population with only variations in the level of satisfaction between classes. The findings of this study suggest that life satisfaction trajectories may not adhere to a uniform or linear pattern for all individuals. One possible explanation for these conflicting results is the use of different samples. Additionally, Fujita and Diender (2005) employed a different analytical approach. Although Han and Hong (2011) did use a Latent Class Analysis, the discrepancy with this study might be attributed to the disparity in the length and consistency of measuring life satisfaction. Han and Hong's (2011) research was carried out over a two-year period with only three points of measurement, while the current study covered 14 years with yearly measurements.

These findings emphasizes the need to analyse individual-level data when studying life satisfaction trajectories, rather than relying solely on population-based measurements. It is interesting to explore the factors that contribute to these differences in life satisfaction trajectories.

Explaining mean individual life satisfaction changes in the Dutch population

First, possible explanations for the significant change in the mean individual life satisfaction trajectory between 2008 and 2021 will be presented. As previously noted, some

scholars propose that life satisfaction is a stable construct that is determined by stable personality traits, while others suggest that it is an unstable, context-dependent construct based on social cognition theories (Schimmack, et al., 2009). The significant change of life satisfaction appears to support the latter, indicating that life satisfaction can change over time and can be influence by contextual factors. One possible substantiation is offered by Luhmann and Eid (2009), who found that negative life events, including divorce and unemployment, can adversely impact life satisfaction over time. Additionally, the frequency of negative life events was significantly associated with decreased life satisfaction over time (Luhmann & Eid, 2009). An alternative explanation is that the assessment of life satisfaction can be influenced by positive affective states. Individuals may rate their life satisfaction more positively when experiencing such states compared to when they are absent, leading to varying mean scores for life satisfaction (Kraiger, et al., 1989). These findings suggest that life satisfaction is an unstable construct that can significantly be influenced by external factors.

Describing variables in relation to life satisfaction

In contrast to previously mentioned studies, results showed that gender and extraversion were not associated with life satisfaction in the Dutch population. The Dutch culture, which is known for its relatively egalitarian and progressive approach to gender roles and expectations, has been found to be associated with fewer gender differences in life satisfaction (Jans & Peters, 2017). Individuals in gender equality cultures are freer to choose their roles and behaviours, which leads to decreased negative emotions and increased life satisfaction in all individuals. Regardless of their gender (Diener, et al., 2003). This might explain why gender associations were absent in the present study. Moreover, Hofstede's cultural dimensions theory states that the Netherlands is an individualistic culture that places less importance on social connectedness and group harmony. As extraversion is characterized by outgoingness, sociability, and assertiveness, the emphasis on individualism in the Netherlands may lead to a weaker relationship between extraversion and life satisfaction due to the lesser importance placed on social connectedness and group harmony (Diener, et al., 2018).

Two other interesting results were reported. Firstly, in contrary to previously discussed literature, Dutch people were averagely more satisfied in 2021 during the COVID-19 lockdown compared to previous years. However, Veenhoven and colleagues (2021) used the same LISS panel data and found a decrease of 3%. The present study only assessed life satisfaction at a single point in time, whereas Veenhoven and colleagues (2021) conducted multiple assessments throughout 2021, including during the December lockdown. This discrepancy in methodology may account for the contrasting findings regarding whether life satisfaction increased or

decreased during the pandemic. Further research is needed to better understand what happened to life satisfaction levels during COVID. Secondly, All three curvilinear relationships between life satisfaction and time changed direction in 2015. This paper lacks the sufficient details to understand this simultaneous directional changes. However, it would be interesting to know if this is a mere coincidence or a result of an unknown underlying cause. This could be a potential area of focus for future research.

Age did associate negatively with life satisfaction, which is consistent with previous literature that reports life satisfaction increasing with age (Carstensen et al., 1999; Kuppens et al., 2008; Luhmann & Eid, 2009). A first explanation could be that younger people tend to experience greater uncertainties and insecurities about their education, career and housing prospects and greater pressure to societal expectations. This can lead to increased feelings of anxiety, stress and pressure that contribute to lowered life satisfaction (Stavrova & Luhmann, 2016; Goldbeck et al., 2007). In addition, they have to face unique developmental tasks and stress, such as cognitive maturation and individual development in the social and cultural context. These challenges can result in fluctuating stress levels that negatively impact life satisfaction (Goldbeck, et al., 2007). Finally according to Kalmijn (2016), younger people may face more challenges in developing and maintaining social relationships, which can negatively impact life satisfaction as well. The negative association between age and life satisfaction may therefore be explained by a range of challenges and stressors that reduce with time.

Finally, as discussed earlier the findings suggest support social cognition theories on life satisfaction changes. However it would be inaccurate to completely dismiss the personality trait theory. The present study also found that individuals with higher neuroticism scores have less stable and lower levels of life satisfaction over time. This suggests that neuroticism may still play a role in determining an individual's life satisfaction, but in combination with other contextual factors. One explanation for this is that individuals with high neuroticism are more vulnerable to these external factors, as they tend to experience negative emotions more frequently and intensely and have a more negative outlook on life. This makes them more susceptible to the presence and impact of negative events, which can cause a significant differences in life satisfaction over time (Luhmann & Eid, 2009). This highlights the importance of considering both personality traits and contextual factors in understanding the determinants of life satisfaction. Future research should continue to explore the complex interplay between these factors to gain a better understanding of how they contribute to an individual's overall well-being. In addition to this trait theory, this finding does somewhat deviate from the discussed literature that consistently reported that elevated neuroticism levels significantly

predict declining life satisfaction (Schunk & Trommsdorff, 2022; Luhmann & Eid, 2009; Hansson, et al., 2020). The current study found that high levels of neuroticism were linked to lower overall levels of life satisfaction and an increased likelihood of significant changes in life satisfaction levels over time. The present study differs from previous research as neuroticism levels did not predict the direction of life satisfaction changes. Methodological differences, such as the use of mean-based analyses in previous studies, may account for this discrepancy. In contrast, the more advanced Latent Class Analysis used in this study allows for a more detailed understanding of individual life satisfaction trajectories. The identification of three distinct classes based on similarities in life satisfaction trajectories provides a more nuanced picture and suggests that conventional analyses may not adequately represent individual trajectories. Therefore, this study underscores the significance of researching individual life satisfaction trajectories rather than relying solely on population-based analyses.

Strengths and limitations

One key strengths of this study is the use of advanced statistical analyses, including Latent Growth Model Analysis and Latent Class Analysis. These methods allowed for a more thorough exploration of how life satisfaction, as a multidimensional construct, changes over time by identifying distinct subgroups with different trajectories of life satisfaction. This approach addressed the limitations of mean-based analyses, which often provide an incomplete understanding of life satisfaction trajectories (Vermunt & Magidson, 2004; Han & Hong, 2010). A second strength concerns the sample size of 1163 participants, which is considered large for a social science study. Although several larger longitudinal studies exist regarding life satisfaction, the current paper is unique in its use of advanced statistical analysis in such a large probability Dutch sample. The sample size increases the power and chance of detecting small but significant effects. A third strength is the representativeness of the sample. In contrast to the common practice of focusing on highly educated middle-aged women in social science studies, this research uses a sample that reflects the demographic makeup of the Dutch population. The sample includes nearly equal numbers of men and women, and participants with low-to-medium levels of education and income, which enhances the generalizability of the study's findings. This approach allows for broader applicability of the results, particularly for individuals with similar demographic backgrounds (Creswell, 2014).

Nonetheless, some limitations also need to be addressed. First, because this is a longitudinal study that took place in a unique historical context, the results might not be generalizable to all time periods. Social, cultural and political events might have influenced life satisfaction. For example, life satisfaction of the Dutch population decreased with 3% during

the COVID-19 pandemic (Veenhoven, et al., 2021). These events may have impacted the results of the study, also making it more difficult to replicate the findings. To ensure the accuracy and applicability of research findings to different time periods, future research should take historical context into account, for example by using Age–period–cohort analyses (Keyes & Li, 2012). Researchers could proactively identify and monitor potential environmental factors that may impact the outcomes of their studies from the outset. By doing so, they can mitigate the influence of confounding variables and better understand the mechanisms underlying their observations. Moreover, tracking these environmental factors could reveal opportunities for interventions or policies that may alleviate the detrimental effects of crisis situations, such as pandemics, on mental health and well-being.

A second limitation is the amount of missing data. The excluded sample differed significantly from the included sample and had a higher proportion of women, younger age, higher neuroticism scores, and higher life satisfaction levels. Neuroticism and age were significantly associated with life satisfaction, which means that there might be a sampling error that limits the study's generalizability. To increase generalizability, future research should consider imputing missing data and accounting for these differences, allowing for more robust conclusions about factors influencing life satisfaction.

Finally, a third limitations is that this study exclusively made use of self-report measures data. It might therefore be possible that the relationship between life satisfaction and neuroticism is overestimated, because of the influence of response sets and styles that are based on the personality of participants. Future research could employ alternative methods to measure life satisfaction and neuroticism, such as behavioural or physiological measures, to cross-validate the results obtained through self-report measures.

Further future research recommendations

The current paper identified age and neuroticism as predictors for lowered and significantly changing life satisfaction trajectories. In order to expand our understanding and provide assistance to individuals with such trajectories, future research could focus on including other relevant variables that can directly influence life satisfaction trajectories, such as financial security, employment status and social support (Pavot & Diener, 2008). Additionally, examining the potential mediating or moderating role of variables such as resilience, coping strategies, and gratitude could further enhance our understanding of the factors influencing life satisfaction during challenging times (Liu, Wang, & Liu, 2020). Furthermore, to improve our comprehension of the correlation between personality traits and life satisfaction, life span

research could be conducted to examine the development and stability of life satisfaction across different life stages.

Conclusion

This study identified three distinct life satisfaction trajectory classes in the Dutch population. Most people are highly satisfied in a stable manner. However, age and neuroticism predicted lower and unstable life satisfaction levels for a significant minority. These classes emphasize the importance of taking a person-centred approach to studying life satisfaction. For promoting well-being, it is important to know that life satisfaction trajectories might differ between individuals, based on age and neuroticism and possible other predictors. Future research should focus on including additional predictors, such as financial security, employment status, and social support, to better understand the complex interplay of factors that shape life satisfaction trajectories.

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Appendix A

Downloaded data files from LISS panel

Participants personal information

- Avars_200711_EN_3.0p

Life satisfaction

Core studies > personality

- Wave 1: cp08a_1p_EN.sav
- Wave 2: cp09b_1.0p_EN.sav
- Wave 3: cp10c_1.0p_EN.sav
- Wave 4: cp11d_1.0p_EN.sav
- Wave 5: cp12e_1.0p_EN.sav
- Wave 6: cp13f_EN_1.0p.sav
- Wave 7: cp14g_EN_1.0p.sav
- Wave 8: cp15h_EN_1.0p.sav
- Wave 9: cp17i_EN_1.0p.sav
- Wave 10: cp18j_EN_1.0p.sav
- Wave 11: cp19k_EN_1.0p.sav
- Wave 12: cp20l_EN_1.0p.sav
- Wave 13: cp21m_EN_1.0p.sav
- Wave 14: cp22n_EN_1.0p.sav

Appendix B

Questions, scoring and interpretation of the '*Satisfied With Life Scale'* (SWLS)

Questions

'In most ways my life is close to my ideal'

'The conditions of my life are excellent'

'I am satisfied with my life'

'So far I have gotten the important things I want in life'

'If I could live my life over, I would change almost nothing'

Scoring and interpretation

5-6 Extremely satisfied.

4-5 Satisfied.

3-4 Slightly satisfied.

2-3 Slightly dissatisfied.

1-2 Dissatisfied.

0-1 Extremely dissatisfied.

(Diener, et al., 1985)

Appendix C

R packages used for the Latent Growth Model Analysis and Latent Class Analysis

Package name	Version
Tidyverse	1.3.2
Psych	2.2.9
Summarytools	1.0.1
Corrplot	0.92
Haven	2.5.1
Lavaan	0.6-12
rstatix	0.7.1
SemTools	0.5-6
Lcmm	2.0.0
Meantables	0.1.2
Mice	3.15.0
Niniar	0.6.1
Quantpscych	1.6
Ggpubr	0.5.0
Ggplot2	3.4.0

Appendix D

Reliability statistics in SPSS

Cronbach's alfa for neuroticism (2008), extraversion (2008) and life satisfaction

Scale	Cronbach's alfa
Neuroticism	.85
Extraversion	.90
Life satisfaction 2008	.86
Life satisfaction 2009	.91
Life satisfaction 2010	.90
Life satisfaction 2011	.90
Life satisfaction 2012	.89
Life satisfaction 2013	.89
Life satisfaction 2014	.89
Life satisfaction 2015	.90
Life satisfaction 2016	.89
Life satisfaction 2017	.91
Life satisfaction 2018	.83
Life satisfaction 2019	.90
Life satisfaction 2020	.90
Life satisfaction 2021	.88