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Does the Pollyannaish View on Life Hold during Early COVID-19 Quarantine? Modeling the Effects of Positive Emotions, Hope, Optimism and Life Meaning on Life Satisfaction

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Abstract

This study examined 1) the effects of positive emotions, hope, optimism, and life meaning, on life satisfaction during early COVID-19 quarantine; 2) the inter-relationships between hope, optimism, life meaning and positive emotions. Respondents (759 Greek adults from the general population) completed self-report measures of affectivity (SPANE-8), life satisfaction (SWLS), hope (AHS), life meaning (MLQ) and optimism (LOT-R). A Structural Equation Model (SEM) was specified. The measurement model showed good fit, model-based reliability, convergent/discriminant validity and strict measurement invariance across gender. The full SEM model had equally good fit. The effects of Positive Emotions, Presence of Life Meaning, Optimism and Hope Agency on Life Satisfaction were positive and significant, from 0.265 - 0.402 (61.5% explained variance). The effect of Positive Emotions on Hope Agency was not significant. The effects of Optimism and Presence of Life Meaning on Hope Agency were positive, significant and strong (0.484 - 0.764). The effects of Positive Emotions and Presence of Life Meaning on Optimism were positive, significant but weak. The effect of Positive Emotions on Presence of Life Meaning was positive, significant and strong. Some study limitations were the cross-sectional design, non-probability sampling, imbalanced sample regarding gender, single method of data collection. In conclusion, during COVID-19 early quarantine: 1) Positive Emotions, Hope Agency, Optimism and Presence of Life Meaning explained almost 2/3 of Life Satisfaction; 2) Optimism had the strongest positive effect on Hope Agency; 3) Positive Emotions had the second strongest positive effect on Presence of Life Meaning. Findings have implications for efforts to sustain and promote Life Satisfaction during and after COVID-19 context.

Keywords

COVID-19, Quarantine, Structural Equation Modeling (SEM), Positive Emotions, Life Satisfaction, Hope, Optimism, Life Meaning

1. Introduction

WHO (2020) urged to magnify positive, hopeful stories of individuals with COVID-19. Positive emotions, hope, optimism and life meaning were associated with increased life satisfaction (Fredrickson, Cohn, Coffey, Pek, & Finkel, 2008). This was labelled the Pollyannaish life outlook (Peterson & Seligman, 2004).

The primary goal of this study was to investigate if during the early COVID-19 quarantine positive emotions, hope, optimism and life meaning could increase life satisfaction (Fredrickson et al., 2008). A secondary goal was to examine the inter-relationships between hope, optimism, life meaning and positive emotions during COVID-19.

1.1. The Effect of Hope, Optimism, Life Meaning and Positive Emotions on Life Satisfaction (Primary Hypotheses)

Life satisfaction (LS) is a global life judgement (Pavot, 2018) and a subjective well-being component (Diener, Suh, Lucas, & Smith, 1999). Specifically, subjective well-being (SWB) includes affectivity, and cognitive life judgments (Diener et al., 1999).

Hope and optimism are distinct but related constructs, predicting LS (Bailey, Eng, Frisch, & Snyder, 2007). Equally, positive emotions and life meaning are associated with LS and SWB, the ACT well-being model (Steger, Sheline, Merriman, & Kashdan, 2013), and other well-being models (Emmons, 1986; Ryff, 1989).

1.1.1. Positive Emotions

Positive and negative emotions are short-term response tendencies (Lazarus, 1991), contributing to LS through broadened awareness (Fredrickson, 2001). Over time, broadened awareness may increase cognitive-psychological resources like hope, optimism and life meaning that in turn increase LS (Fredrickson, 2001).

Experimental work consistently found that increased positive emotions predicted LS (see Fredrickson, 2013). A study in students reported that positive emotions were more likely to predict LS the previous year than the opposite (Datu & King, 2016). Positive emotions were associated with LS through hope agency in US adults (Chang et al., 2019) and in Chinese adults experiencing intimate partner violence (Li, Gu, Ma, Liu, & Tang, 2021).

1.1.2. Hope

Hope emerges when expecting negative outcomes, boosting the intention to reverse things (Fredrickson, 2013). This taps the bidimensional definition of hope (Snyder et al., 1991) referring to goal-setting (agency) and plans to achieve goals (pathways). Agency motivates reversion and pathways taps perceived ability to generate attainable goal trajectories (Snyder, 2000).

A meta-analysis on LS (Yarcheski & Mahon, 2014), found hope had the largest mean effect from all variables associated with LS, including optimism. Hope predicted LS in adults from Spain during COVID-19 (Blasco-Belled, Tejada-Gallardo, Torrelles-Nadal, & Alsinet, 2020). Hope, like optimism amplifies resources to overcome challenging situations, increasing LS (Bailey, Eng, Frisch, & Snyder, 2007).

1.1.3. Optimism

Scheier and Carver (1985) define optimism a general expectation of favorable outcomes, mediating between the self and world interpretation (Carver, Scheier, & Segerstrom, 2010). Optimism has a self-regulatory dimension based on goal achievement through the regulation of actions and behaviors, i.e. when in hardship while trying to achieve goals, optimists will probably continue trying, whereas pessimists will probably give up (Carver & Scheier, 1998). Optimism has also an attributional dimension, explaining life events (Peterson & Seligman, 2004).

Optimism had a moderate-high correlation to LS in Western samples (Scheier & Carver, 1992). Optimism predicted LS through goal orientation in Spanish students (Supervía, Bordás, & Lorente, 2020), or through self-esteem and relationship harmony in elderly from Hong Kong (Leung, Moneta, & Mcbride-Chang, 2005), or partially through positive-negative emotions in Turkish students (Kapikiran, 2012).

1.1.4. Life Meaning

People perceive presence of life meaning when they comprehend themselves, the world, and their unique fit in the world, perceiving accomplishment (Steger, 2009a). Steger (2012) argues that this is the cognitive component of meaning (meaning comprehension), facilitating the motivational component of meaning (life purpose) which is also connected with goals like hope and optimism (Snyder, 2000). Search for meaning is another meaning component, negatively related to presence of meaning (Steger, Frazier, Oishi, & Kale, 2006).

Steger et al. (2006) reported that presence of meaning is positively associated with LS. Experimental studies showed that those who perceive high presence of meaning have more LS than those who report low presence (Steger, 2009b). Additional studies also supported the association between presence of life meaning and LS (reviewed by Steger, 2012).

1.2. The Inter-Relations between Hope, Optimism & Life Meaning and Positive Emotions (Secondary Hypotheses)

Hope and optimism involve goal-based cognitive processes when facing important outcomes (Snyder, Sympson, Michael, & Cheavens, 2000). Although both signify relatively stable future expectations, they influence behaviors differently (Bailey et al., 2007). Snyder's (2000) hope model sets individuals the major force in determining desired outcomes, linking pathways and agency with the successful goal attainment, without emphasis on expectations, like optimism (Scheier & Carver, 1985) but on agentic self-efficacy (Edwards, 2009; Gallagher, 2009). Snyder's model also distinguished hope from optimism, as conceptualized by Seligman (2006), in highlighting pursuit of specific goal-related outcomes (Snyder, 2000).

1.2.1. The Effects of Positive Emotions, Optimism and Life Meaning on Hope

Snyder et al. (1991) argue that emotions for a particular goal-related context are connected to hope. Although hope and optimism are closely associated, tapping motivation (Snyder, 2000), hope agency provides unique variance beyond optimism in predicting LS (Bailey et al., 2007; Edwards, 2009). Similarly, a meta-analysis suggested that optimism and hope were distinguishable, but both were associated with psychological well-being (Alarcon, Bowling, & Khazon, 2013). Equally, life meaning was positively related to hope (Steger et al., 2006). Individuals who perceived more life meaning perceived higher levels of hope and this relationship was particularly strong for those who scored highly in agency (Cheavens & Gum, 2000).

1.2.2. The Effects of Positive Emotions and Life Meaning on Optimism

Several studies associated both meaning and positive emotions with optimism (Compton, Smith, Cornish, & Qualls, 1996; Steger & Frazier, 2005). Bronk, Hill, Lapsley, Talib, & Finch (2009) found that youth perceiving higher meaning and purpose were more optimistic. Another study on Koreans elderly found that optimism was positively associated with life meaning, and the relationship between optimism and SWB was partially mediated by life meaning (Ju, Shin, Kim, Hyun, & Park, 2013). Moreover, experimental settings testing the Broaden-and-Build theory (Fredrickson, 2001) argued that positive emotions increase optimism (Fredrickson et al., 2008).

1.2.3. The Effects of Positive Emotions on Life Meaning

Steger et al. (2006) reported that presence of life meaning was positively associated with positive emotions. Similarly, Fredrickson (2005) also proposed that life meaning and positive emotions go hand in hand. Experiments focusing on causal mechanisms of life meaning demonstrate that raising positive emotions is consequential to higher evaluations of life meaning (Steger, 2009b). Positive emotions helped resilient people find meaning amidst adversity (Tugade & Fredrickson, 2004). King et al. (2006) also supported the effect of positive emotions on life meaning in adults from the U.S. in multiple studies. Similarly, positive emotions and meaning were reciprocally associated to one other in a longitudinal study on students from Hong Kong (Kwok & Fang, 2021).

1.3. The Present Study

In early COVID-19 outbreak, quarantined individuals limited socializing. Such measures controlled the spread of the virus (Greenstone & Nigam, 2020) but threatened LS (Holmes et al., 2020). The ongoing research about the well-being of the quarantined individuals during the early COVID-19 stages showed somewhat conflicting findings. A longitudinal study that examined changes in subjective wellbeing in early stages of the COVID-19 pandemic in a German sample (Zacher & Rudolph, 2021) showed that on average, life satisfaction, positive affect, and negative affect did not change significantly during these early stages. However, SWB decreased between March and May 2020 (Zacher & Rudolph, 2021). A different longitudinal study on UK adults (O'Connor et al., 2020) showed that the mental health and well-being of the UK adult population appears to have been affected in the early phase of the COVID-19 pandemic. Suicidal ideation increased over time. Crucially, well-being also increased. Female respondents, youngsters, individuals from socially disadvantaged backgrounds and individuals with pre-existing mental health problems had worse mental health outcomes during the pandemic (O'Connor et al., 2020).

Therefore, this study focused on protective factors of LS during early COVID-19 quarantine context: 1) the effects of positive emotions, hope, optimism, life meaning, on the LS; 2) the inter-relationships between hope, optimism, life meaning and positive emotions. Specifically, the aim of the present study was to explore how the relevance of the quarantine condition, is connected to the life satisfaction of the quarantined individuals in relation to their emotions. Furthermore, we explored the outcome of emotions—in particular, the relationship between emotions and presence of life meaning, optimism and hope agency as well as between emotions and life satisfaction. In this way, more informed positive emotions interventions could be designed based on the broaden and build theory of positive emotions (Fredrickson, 2001), and tailored to sustain and increase the depleted well-being of the quarantined individuals (Holmes et al., 2020).

Accordingly, one primary hypothesis (H1) and three secondary hypotheses (H2-H4) were specified:

H1. Positive emotions, Presence of life meaning, Optimism and Hope Agency have a significant, direct positive effect on Life Satisfaction (*paths H1a-H1d*).

H2. Positive emotions, Optimism and Presence of life meaning have a significant, direct positive effect on Hope Agency (*paths H2a-H2c*).

H3. Positive emotions and Presence of life meaning have a significant, direct positive effect on Optimism (*paths H3a-H3b*).

H4. Positive emotions have a significant, direct positive effect on Presence of life meaning (*path H4a*).

A cross-sectional study design was implemented, processing data with Structural Equation Model (SEM). See the research model in **Figure 1**.

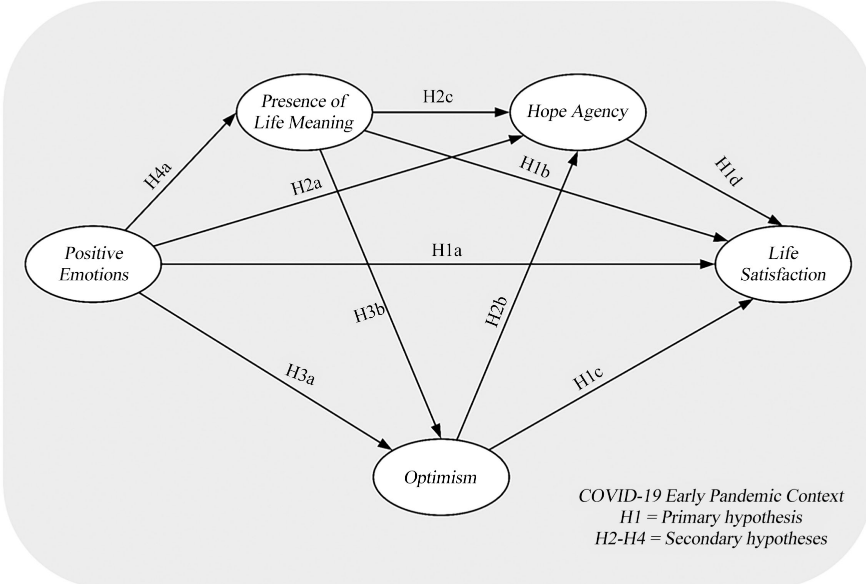

Figure 1. The hypotheses tested for each path of the research model.

2. Methods

2.1. Participants & Procedure

The inclusion criteria were to be an adult of the general population, 18 - 75 years. The sample comprised 759 Greeks (78% females). One in 4 respondents was 18 - 40 years, 42% was 41 - 60, 3% was 61 - 70 and 1% was >70 years. One in 2 respondents was single (47%), married/living together (40%), divorced/widowed (13%). Most respondents (59%) did not have children. Almost half respondents had a BA (42%), or lower (13%). The 41% had a MA or higher (5%). There were 98.8% non-COVID respondents. Participants were involved in this study with network sampling (APA, 2014). Data were collected online after obtaining inform consent. Participants did not receive any inducements. The study was available online from April, 5th to May 4th, 2020. This sample was used before (Kyriazos, Galanakis, Karakasidou, & Stalikas, 2021).

2.2. Sample Power

A priori power analysis of the SEM model with population RMSEA (MacCallum, Browne, & Sugawara, 1996), indicated the required sample size was $N = 212$ ($< N = 759$) for 80% power to reject a wrong model ($df = 179$), RMSEA misspecification = 0.05, alpha = 0.05. See the a priori power analysis graph in Figure A1 (Appendix).

2.3. Measures

2.3.1. Scale of Positive and Negative Experience 8 (SPANE-8)

SPANE-8 (Diener et al., 2010; Kyriazos, Stalikas, Prassa, & Yotsidi, 2018) is a briefer version of SPANE-12. Items are rated on a 5-point Likert scale (1 = *Very Rarely or Never* to 5 = *Very Often or Always*). Cronbach's alpha in the Greek population (Kyriazos, Stalikas, Prassa, & Yotsidi, 2018) was 0.85 for SPANE-8 P (Positive), and 0.75 for SPANE-8 N (Negative).

2.3.2. Satisfaction with Life Scale (SWLS)

The SWLS (Diener, Emmons, Larsen, & Griffin, 1985) measures perceived global life satisfaction (e.g. "I am satisfied with my life") on a 7-point scale, from 1 (*Strongly Disagree*) to 7 (*Strongly Agree*). Score ranges from 5 (Extremely dissatisfied) to 35 (Extremely satisfied). Diener et al. (1985) reported Cronbach's alpha was 0.87. In a Greek sample it was 0.88 (Kyriazos, Stalikas, Prassa, Galanakis, Flora, & Chatzilia, 2018).

2.3.3. Adult Trait Hope Scale (AHS)

Adult Hope Scale (Snyder et al., 1991) is a self-report, 12-item measure of hope (e.g. "I can think of many ways to get out of a jam"), with two factors: Agency and Pathways. Items are rated on an 8-point Likert scale (1 = *Definitely False*, 8 = *Definitely True*). Score ranges from 8 to 64. Higher scores suggest greater hope. Snyder et al. (1991) reported Cronbach's alphas from 0.74 - 0.84 and in a Greek sample it was 0.89 (Kyriazos, Stalikas, Prassa, Yotsidi, Galanakis, & Pezirkianidis, 2018).

2.3.4. Meaning in Life Questionnaire (MLQ)

The MLQ (Steger et al., 2006) is a self-report, 10-item questionnaire of life meaning (e.g. "I have a good sense of what makes my life meaningful"), with five items tapping two factors (Presence of Meaning, Search for Meaning). Items are rated on a 7-point Likert scale (1 = *Absolutely True* to 7 = *Absolutely Untrue*). Possible scores range from 5 (min) to 35 (max). Steger et al. (2006) reported Cronbach's alpha ranged from 0.81 - 0.86 for Presence and 0.84 - 0.92 for Search. For a Greek sample, Stalikas, Kyriazos, Yotsidi, & Prassa (2018) reported $\alpha = 0.85$ for the Presence and 0.86 for the Search.

2.3.5. Life Orientation Test (LOT-R)

The LOT-R (Scheier, Carver, & Bridges, 1994) is a self-report, 10-item measure of optimistic/pessimistic life-expectations. Three items are positively worded (e.g. "In uncertain times, I usually expect the best"), and three negatively (plus 4 fillers). Respondents rate items on a 5-point Likert scale (0 = *Strongly Disagree*, 4 = *Strongly Agree*). Alpha coefficient was 0.78 (Scheier et al., 1994).

2.4. Data Analysis

Data Diagnostics

A priori power analysis evaluated sample size adequacy of the full SEM model with the population RMSEA method (MacCallum, Browne, & Sugawara, 1996). There was no missing data processing because the online form had all the fields set as "required" to minimize non-response (Kyriazos, 2018a). Outliers were detected separately for each study measure and for the SEM measurement model using Mahalanobis distance criterion. Multivariate normality of all scale scores and of the measurement model was examined with multiple tests.

Analytic Strategy

Initially, a CFA confirmed the factor structure of SPANE-8, MLQ, AHS, LOT-R and SWLS separately, to ensure that their hypothesized structure was tenable in this quarantined Greek sample (essentially a special population). Note also that LOT-R structure was unverified in Greece. Model fit criteria at all instances were RMSEA [90% CI ≤ 0.06] ≤ 0.06, SRMR ≤ 0.08, CFI ≥ 0.95, TLI ≥ 0.95 (Hu & Bentler, 1999). Internal consistency reliability of all measures was at this stage evaluated with Cronbach's alpha [95% CI] and the greatest-lower-bound estimate of reliability (glb; Jackson & Agunwamba, 1977) to account for the absence of the factorial structure in Cronbach's alpha calculation (DeVellis, 2017). It holds that *glb* ≥ alpha (see Mair, 2018).

Next, a Structural Equation Model (SEM) was specified to test the study's main hypotheses adopting the two-Step Approach. The SEM measurement and the full SEM model were estimated with a robust estimator (MLR) to correct the chi-square and standard errors for non-normality. The fit of the measurement model was tested to eliminate the possibility of misspecifications. Reliability of each measured variable was also examined (indicator reliability) to reject the likelihood that the exogenous constructs of the measurement model are redundant or they have a serious multicollinearity problem.

Subsequently, model-based reliability, and model-based convergent/discriminant validity for the latent variables in the measurement model was also examined with Composite Reliability (CR; Werts, Linn, & Joreskog, 1974; ω coefficient; McDonald, 1999), Average Variance Extracted (AVE; Fornell & Larcker, 1981), Maximum Shared Variance (MSV) and Average Shared Variance (ASV). Then, to cross-validate model-based discriminant validity for the measurement model two additional methods were calculated, namely the Fornell & Larcker (1981) criterion and the Heterotrait-Monotrait (HTMT) ratio of correlation Method (Henseler, Ringle, & Sarstedt, 2015). The Fornell-Lacker (1981) criterion compares the square root of the average variance extracted (AVE) with the correlation of latent constructs (Hair, Hult, Ringle, & Sarstedt, 2014). The HTMT Ratio of Correlation Method involves comparing HTMT to a predefined threshold. A threshold of .85 was used here (Kline, 2011). The HTMT ratio of correlation Method was reported to achieve higher specificity and sensitivity compared to the Fornell-Lacker method (Henseler et al., 2015; Hamid, Sami, & Sidek, 2017). Full measurement invariance of the SEM measurement model was also tested to evaluate if the measurement model has invariant factors, factor loadings, intercepts, and residuals across male and female respondents. Subsequently, the full SEM model fit was examined. Post hoc power analysis evaluated the sample size adequacy of the full SEM model with the population RMSEA method (MacCallum, Browne, & Sugawara, 1996), to estimate the sample required for achieving a power of 80% to reject a wrong model. An alpha level of 0.05 was assumed with an RMSEA misspecification of 0.05 (MacCallum et al., 1996; see Kline, 2016). After confirming that the SEM model was robust, and it showed adequate model-based convergent-discriminant validity, satisfactory model-based reliability and measurement invariance Hypothesis testing followed (H1-H4). Ten direct paths were specified. **Table 1** lists the analysis steps, implemented with R software (R Development Core Team, 2021).

3. Results

3.1. Preliminary Analysis

There were no missing values because all fields of the online survey were set as required to eliminate non-response (Stalikas & Kyriazos, 2019). Multivariate normality tests ($p < 0.001$) and data screening for outliers (**Table A1** in the Appendix) were carried out for each measure separately and for the measurement model. Outliers were correct data entries, not impairing findings, final $N = 759$.

Table 1. Analytic strategy.

Analysis Sequence	Description	Rationale
1	Data screening	To detect Outliers with Mahalanobis distance control.
2	Multivariate Normality Test with Multiple tests	To test the multivariate normality assumption with Mardia's multivariate kurtosis and multivariate skewness test, Henze–Zirkler's consistent test, Doornik-Hansen omnibus test, and Energy test.
3	Confirmatory Factor Analysis (CFA) of the study measures	To confirm structure in this sample.
4	Descriptive Statistics	To calculate means, medians, standard deviations, and reliability coefficients (see Kyriazos, 2017), i.e. alpha and greatest lower bound estimate (glb; Jackson & Agunwamba, 1977) for the latent variables of the measurement model. It holds $glb \geq \alpha$ (Mair, 2018).
5	Test the SEM measurement model fit and indicator reliability	To evaluate the fit of the measurement model since four out of five measures were partially used. Reliability of the observed variables was evaluated to reject the likelihood that the exogenous constructs are redundant or they have a multicollinearity problem.
6	Model-based Reliability and Validity Analysis of the latent variables in the measurement model	To evaluate the Composite Reliability (CR; Werts, Linn, & Joreskog, 1974; ω coefficient; McDonald, 1999) and Average Variance Extracted (AVE; Fornell & Larcker, 1981), Maximum Shared Variance (MSV) and Average Shared Variance (ASV), evidencing model-based convergent and discriminant validity.
7	Cross-validating model-based Discriminant Validity with additional methods	To cross-validate model-based discriminant validity with the Fornell & Larcker (1981) criterion and the HTMT Ratio of Correlation Method (Henseler, Ringle, & Sarstedt, 2015).
8	Full measurement invariance of the SEM measurement model	To test if the measurement model has invariant factors, factor loadings, intercepts, and residuals across gender.
9	Test the full SEM model fit	To evaluate the structural model fit.
10	A priori & post hoc power analysis of the full SEM model with the RMSEA	To evaluate the sample required for 80% power to reject a wrong model. An alpha level of 0.05 was assumed with RMSEA misspecification 0.05 (MacCallum et al., 1996).
11	Hypotheses testing (H1-H4)	Ten direct paths were specified.

Subsequently, a CFA verified the factor structure of each measure (see Table A2 in the Appendix). A two-factor structure was supported for SPANE-8 (Diener et al., 2010; Kyriazos, Stalikas, Prassa, & Yotsidi, 2018), MLQ (Steger et al., 2006), AHS (Snyder et al., 1991) and LOT-R (Bailey et al., 2007) and SWLS was unifactorial (Diener et al., 1985). Despite the marginal RMSEA fit for some measures (see Kyriazos, 2018a), adding error covariances or omitting items to improve fit was deemed premature, before evaluating the SEM measurement model.

3.2. Descriptive Statistics

All correlation coefficients ($p < 0.001$), means, medians, standard deviations, and reliability coefficients for the latent variables of the measurement model are shown in Table 2. The latent variables of the measurement model were SPANE-8 P (Positive), MLQ-P (Presence), AHS-A (Agency), LOT-R O (Optimism) and SWLS.

3.3. Measurement Model

The measurement model to test the relationship of positive emotions, presence of life meaning, hope agency, optimism and life satisfaction fitted the data well, $\chi^2(179) = 439.352$ ($p = 0.000$), CFI = 0.960, TLI = 0.953, RMSEA = 0.044 [90% CI = 0.039, 0.048], SRMR = 0.041 (MLR estimator). All standardized factor loadings (Table A3 in the Appendix), stayed well above the 0.40 threshold (Brown, 2015), from 0.597 to 0.901, $p < 0.001$. The R^2 ranged from 0.137 to 0.777, i.e. latent variables accounted for a variance from 36% to 81% by each observed variable (Table A3 in the Appendix). Inter-factor correlations varied between 0.404 and 0.699. The factor loadings of all observed variables were higher on their assigned latent variable, suggesting reliability for the observed variables.

Table 2. Correlation coefficients (Spearman's rho), means, medians, standard deviations, and reliability for the measurement model variables ($N = 759$).

Latent Variable of the Measurement Model	α [95% *CI*]	*glb*	1	2	3	4	5
1. Positive emotions	0.88 [0.87, 0.89]	0.89	—				
2. Presence of life meaning	0.90 [0.89, 0.91]	0.91	0.38**	—			
3. Optimism	0.70 [0.66, 0.73]	0.72	0.40**	0.47**	—		
4. Hope Agency	0.83 [0.81, 0.85]	0.86	0.36**	0.59**	0.51**	—	
5. Life satisfaction	0.87 [0.85, 0.88]	0.89	0.49**	0.59**	0.48**	0.55**	—
M	—	—	12.95	5.26	8.83	24.68	24.07
SD	—	—	3.36	1.17	2.3	4.49	5.69
Median	—	—	13	5.4	9	25	25

**$p < 0.001$. *Note*. CI = Confidence Intervals, *glb* = greatest lower bound, Positive emotions = SPANE-8 P, Presence of life meaning = MLQ-P, Optimism = LOT-R O, Hope Agency = AHS-A, Life satisfaction = SWLS.

3.3.1. Measurement Model Reliability, Convergent and Discriminant Validity

Model-based, internal consistency reliability and convergent validity were adequate (Hair, Black, Babin, & Anderson, 2010), measured by Composite Reliability (CR; Werts et al., 1974) and AVE respectively (AVE; Fornell & Larcker, 1981). Specifically, CR (ω coefficient; McDonald, 1999), ranged from 0.77 (LOT-R O) to 0.89 (MLQ-P) and AVE ranged from 0.54 (LOT-R O) to 0.65 (SPANE-8 P); see **Table 3**. Measurement model latent variables were sufficiently different, as indicated by Maximum Shared Variance and Average Shared Variance (MSV; ASV; Fornell & Larcker, 1981) in comparison to AVE. Furthermore, by implementing the Fornell & Larcker (1981) criterion the square root of AVE for each latent variable in the measurement model (**Table 3** diagonals in bold) was compared to the maximum correlation between all the latent variables (**Table 3**, below-diagonal highlighted cells), also suggesting that the latent variables were sufficiently different. Finally, discriminant validity was cross-validated with the Heterotrait-Monotrait (HTMT) ratio of correlation adopting the calculation proposed by Henseler et al. (2015). Implementing the $HTMT_{0.85}$ threshold (Hamid, Sami, & Sidek, 2017), the latent variables of the measurement model differed adequately (**Table 3**, above-diagonal highlighted cells). For the Internal consistency reliability (Cronbach's alpha and *glb*) of all measures in the measurement model, see **Table 2**.

3.3.2. Measurement Model Invariance

The invariance of the measurement model was evaluated across gender (n_{MALES} = 170, $n_{FEMALES}$ = 589). The difference test thresholds were $|\Delta CFI| < 0.01$ (Cheung & Rensvold, 2002), and $|\Delta RMSEA| < 0.01$, N = 759 > 300 (Chen, 2007: p. 501). The model showed a good fit for males, $\chi^2(179)$ = 270.6779, p = 0.000, CFI = 0.952, TLI = 0.943, RMSEA = 0.055 [90% CI = 0.043, 0.066], SRMR = 0.055 and equally good for females, $\chi^2(179)$ = 448.538, p = 0.000, CFI = 0.951, TLI = 0.942, RMSEA = 0.051 [90% CI = 0.045, 0.056], SRMR = 0.048. The configural structure was verified (Model 1, **Table 4**). ΔCFI and ΔRMSEA consecutively suggested full weak, strong and strict invariance (Models 2-4, **Table 4**).

3.4. Full SEM Model

The full SEM model to study the relationship between positive emotions (SPANE-8 P), presence of life meaning (MLQ-P), optimism (LOT-R) O, Hope Agency (AHS-A) and life satisfaction (SWLS) during the COVID-19 containment measures showed a good fit to the data, χ^2 (179) = 439.319, p = 0.000, CFI = 0.960, TLI = 0.953, RMSEA = 0.044 [90% CI = 0.039, 0.048], SRMR = 0.041. Post hoc power analysis based on population the RMSEA of the full SEM model (MacCallum et al., 1996) suggested that a sample size of N = 759 was related to a power > 99.99% to reject a wrong model, df = 179, RMSEA = 0.05 on alpha = 0.05 (see Kline, 2016). **Figure A1** in the Appendix presents graphs for a priori (see method section) and post hoc power analysis.

Table 3. Estimates of model-based reliability, model-based convergent and discriminant validity for the measurement model with the Fornell & Larcker (1981) method (highlighted cells below diagonal) and the HTMT ratio of correlation method (highlighted cells above diagonal), $N = 759$.

Latent Variables	CR (ω)	AVE	MSV	ASV	Latent Variables				
					1	2	3	4	5
1. SPANE-8 P	0.88	0.65	0.32	0.22	**0.81**	0.41	0.40	0.48	0.56
2. MLQ-P	0.89	0.61	0.49	0.36	0.40	**0.78**	0.70	0.60	0.68
3. AHS-A	0.82	0.55	0.49	0.40	0.41	0.70	**0.74**	0.69	0.66
4. LOT-R O	0.77	0.54	0.45	0.35	0.48	0.58	0.67	**0.73**	0.63
5. SWLS	0.87	0.57	0.47	0.40	0.57	0.67	0.69	0.61	**0.75**

Note. Diagonals (in bold typeface) = √AVE, CR = Composite Reliability (ω, McDonald, 1999), AVE = Average Variance Extracted, MSV = Maximum Shared Variance, ASV = Average Shared Variance. 1) Convergent Validity: CR > AVE ≥ 0.50. 2) Discriminant Validity: MSV < AVE; ASV < AVE and √AVE > inter-item correlations. 3) Correlations for the Fornell & Larcker (1981) Method are in highlighted cells below diagonal and 4) HTMT: Hetero-trait-Monotrait correlation ratio. HTMT values are in highlighted cells above diagonal.

Table 4. Goodness-of-Fit for the nested models to test full measurement invariance across gender for the SEM measurement model ($N = 759$).

Nested Models	χ^2	*df*	CFI	RMSEA	Model Comparison	Difference in Fit	
						ΔCFI	ΔRMSEA
Model 1. Configural Inv.	716.61	358	0.947	0.051	–	–	–
Model 2. Full Weak Inv.	741.32	374	0.946	0.051	Model 2 vs 1	−0.001	0.000
Model 3. Full Strong Inv.	768.47	390	0.944	0.051	Model 3 vs 2	−0.002	0.000
Model 4. Full Strict Inv.	789.03	411	0.944	0.049	Model 4 vs 3	0.000	−0.002

Note. Estimator = MLR.

3.4.1. Hypotheses Testing (H1-H4)

The structural results for the relationship between positive emotions (SPANE-8 P), presence of life meaning (MLQ-P), optimism (LOT-R), Hope Agency (AHS-A) and life satisfaction (SWLS) during the COVID-19 containment measures are presented in **Table 5** (path coefficients and their 95% CI) and in **Figure 2** (structural model). The path diagram of the full SEM model along with all the measurement models is presented in the Appendix (**Figure A2**).

All path coefficients were estimated both with the constrained and unconstrained error variance (**Table 5**). Parameter estimates and their standard errors were nearly identical to alternative estimations, suggesting robustness. Nine out of 10 direct standardized path coefficients tested (**Table 5**) showed statistically significant positive effects, $p < 0.001$ and $p = 0.044$ (H1c). The effect of Positive Emotions on Hope Agency (H2a) was not significant. Positive emotions, presence of life meaning, optimism and hope agency accounted for 61.5% of the variance in life satisfaction. The accounted variance for all latent variables in the model is presented in **Figure 2** (structural model).

Table 5. Structural results for the proposed full SEM model ($N = 759$).

H path	Path Description	B	β	95% CI LL	95% CI UL	SE	z	*p*	S/R
H1a	Positive Emotions → Life Satisfaction	0.277	0.402	0.280	0.524	0.062	6.480	0.000	S
H1b	Presence of Life Meaning → Life Satisfaction	0.263	0.305	0.169	0.440	0.069	4.415	0.000	S
H1c	Optimism → Life Satisfaction	0.123	0.265	0.007	0.523	0.132	2.013	0.044	S
H1d	Hope Agency → Life Satisfaction	0.306	0.337	0.155	0.518	0.093	3.634	0.000	S
H2a	Positive Emotions → Hope Agency	0.034	0.045	−0.059	0.149	0.053	0.841	0.400	R
H2b	Optimism → Hope Agency	0.391	0.764	0.533	0.996	0.118	6.474	0.000	S
H2c	Presence of Life Meaning → Hope Agency	0.459	0.484	0.368	0.601	0.059	8.140	0.000	S
H3a	Positive Emotions → Optimism	0.292	0.197	0.132	0.262	0.033	5.948	0.000	S
H3b	Presence of Life Meaning → Optimism	0.461	0.248	0.188	0.309	0.031	8.006	0.000	S
H4a	Positive Emotions → Presence of Life Meaning	0.404	0.507	0.391	0.623	0.059	8.583	0.000	S

Note. Estimator = MLR. LL = Lower Limit, UL = Upper limit, H = Hypothesis, S = Hypothesis Supported, R = Hypothesis Rejected. Positive emotions = SPANE-8 P, Presence of life meaning = MLQ-P, Optimism = LOT-R O, Hope Agency = AHS-A, Life satisfaction = SWLS.

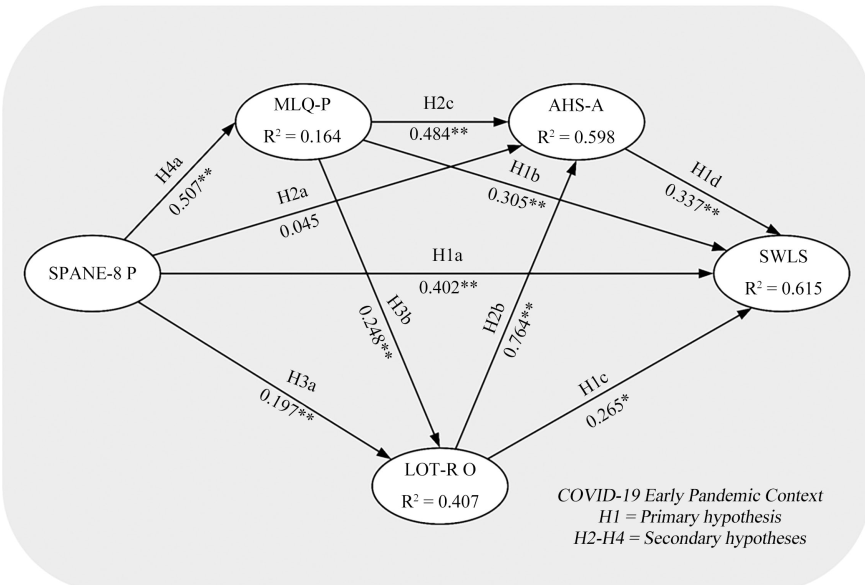

Figure 2. The path diagram of the structural model (direct standardized path coefficients, $*p < 0.05$, $***p < 0.001$). Note. SPANE-8 P = Positive emotions, MLQ-P = Presence of life meaning, LOT-R O = Optimism, AHS-A = Hope Agency, SWLS = Life satisfaction.

4. Discussion

In the early COVID-19 outbreak, quarantined individuals limited socializing. Containment measures controlled the spread of the virus (Greenstone & Nigam, 2020) but depleted LS (Holmes et al., 2020). This study focused on examining protective factors for the depleted LS of the quarantined individuals based on the Pollyannaish life outlook amidst the early COVID-19 context, *i.e.* 1) the positive effects of positive emotions, hope, optimism, life meaning, on LS, during the early

COVID-19 quarantine (primary hypothesis); 2) the positive inter-relationships between hope, optimism, life meaning and positive emotions during the quarantine (secondary hypotheses).

4.1. Support of the Hypotheses

The four primary hypothesis paths about the effects of positive emotions, hope agency, optimism and presence of life meaning on LS were supported. From the six secondary hypothesis paths about the positive inter-relation between positive emotions, hope agency, optimism and presence of life meaning, five were supported (Optimism → Hope Agency, Presence of Life Meaning → Hope Agency, Positive Emotions → Optimism, Presence of Life Meaning → Optimism, Positive Emotions → Presence of Life Meaning) and one was rejected (Positive Emotions → Hope Agency).

4.2. Interpretation

About the magnitude of the effects on LS, they suggested that increased positive emotions predicted a significant, moderately high increase in LS. An increase in presence of life meaning predicted a significant moderate increase in LS. Increased optimism predicted a low, marginally significant increase in LS. Increased hope agency moderately and significantly increased LS.

About the magnitude of the effects on hope agency, optimism and presence of life meaning, they suggested that increased positive emotions did not predict an increased hope agency. In contrast, increased optimism predicted a significant, very high increased hope agency. Increase in presence of life meaning predicted a significant, moderate to high increase in hope agency. Increase in positive emotions predicted a significant, small increase in optimism. Likewise, increase in presence of life meaning predicted a significant, low to moderate increase in optimism. Finally, positive emotions predicted a significant, high increase in presence of life meaning.

4.3. Similarity of Results

The positive relationships of positive emotions, hope, optimism and life meaning with LS were well-documented in literature. The positive effect of hope on LS was well supported before COVID-19 (Hirschi, Abessolo, & Froidevaux, 2015) and during COVID-19 (Blasco-Belled et al., 2020). Pallini et al. (2018) proposed that time-perspective dimensions predicted LS through hope in Italian adolescents. LS in elderly samples was associated with high hope levels in later life (Cheavens & Gum, 2000; Oliver, Tomás, & Montoro-Rodriguez, 2017).

Moreover, the effect of positive emotions on LS was strong, supporting that positive emotions are major components of subjective well-being (Diener et al., 1999). Similarly, optimism was reported to have moderate to high correlations to LS in Western samples (Scheier & Carver, 1992). In a similar vein, the magnitude of optimism and hope on LS was found low to moderate to other studies

(Bailey et al., 2007). Finally, several studies also supported the association between presence of life meaning and LS before COVID-19 (Steger, 2012) and during COVID-19 (Arslan, Yıldırım, Karataş, Kabasakal, & Kılınç, 2020; Yıldırım & Arslan, 2021).

The effects of optimism and life meaning on hope are well documented by a large body of research. Within the COVID-19 context, hope was positively related to life meaning and LS (Trzebiński, Cabański, & Czarnecka, 2020). Beyond COVID-19, individuals who perceived more life meaning perceived higher levels of hope (Cheavens & Gum, 2000; Feldman & Snyder, 1999) and this relationship was particularly strong for those who scored highly in agency (Cheavens & Gum, 2000). Similarly, the particularly strong association of optimism to hope agency (the strongest association of the present study), was supported by a meta-analysis suggesting that optimism and hope were strongly related but distinguishable from each other (Alarcon et al., 2013). In contrast, the insignificant relationship of positive emotions with hope agency despite the significant relationship of positive emotions with LS was also reported by Fredrickson et al. (2008) in an experimental, longitudinal study processed with latent growth models. She argued that maybe hope agency receives a consequential influence by change in positive emotions.

The effects of positive emotions and life meaning on optimism were also widely reported (Steger, 2012). Note however, that Fredrickson et al. (2008) also reported a similar pattern for optimism which may partially support the very low magnitude of the effect of positive emotions on optimism in this study.

Finally, on the large effects of positive emotions on life meaning experiments focusing on causal mechanisms of life meaning demonstrate that increased positive emotions are consequential to higher presence of life meaning (Steger, 2009b). Moreover, a longitudinal study showed that positive emotions could predispose perceived life meaning, increasing sensitivity to situation-specific life meaning (King et al., 2006). Indeed, increased positive emotions predicted the second largest increase in life meaning in this study.

4.4. Generalizability, Limitations, Implications

The statistical validity of the findings and sample size permit a relatively safe generalizability of the results. That is good model fit, highly significant effects, model-based reliability, convergent and discriminant validity.

Interpretation of the findings however should be cautious because of the non-probability sampling, and the cross-sectional design. The cross-sectional design disallows causal inferences. However, such rigid causality assumptions seem over-simplified with SEM (Kline, 2020).

One of the study limitations was the imbalanced sample in terms of gender. Additionally, some COVID-related demographics were somewhat underrepresented due to the limited and short-lived COVID-19 exposure of the general population during the early COVID-19 quarantine in Greece. Another limitation was that the study took place after the start of the early quarantine period, and initial response (if any) may be unrecorded. Moreover, the sample comprised only individuals with internet access and digital skills. Data was collected with a single method, using only self-report measures of health-related behaviors and well-being (see Pavot, 2018 for well-being measurement issues). The sample was also monocultural.

When the pandemic will be over, depleted LS could be the focus of health professionals (Fiorillo & Gorwood, 2020). Therefore, this was an attempt to examine if well-established LS promoters and sustainers could be effective during and after COVID-19 context. Crucially, during early COVID-19 quarantine context, 1) positive emotions, hope agency, optimism and presence of life meaning explained almost 2/3 of LS; 2) optimism had the highest positive effect on hope agency; 3) positive emotions had the second highest positive effect on life meaning.

The current pandemic altered the mental health agenda (Fiorillo & Gorwood, 2020). Mental health professionals eventually have to address the impact of the pandemic as extreme stressors could induce or aggravate mental health issues (Holmes et al., 2020). Therefore, this is an attempt to model protective factors against COVID-19, potentially offering more tools from the positive psychology realm for the applied COVID-19 research, to build effective interventions that can boost well-being. Hopefully, this study contributes to the literature on affective factors during quarantine, a topic that is currently in the center of psychology research. Findings have implications for efforts to sustain and promote depleted Life Satisfaction during and after COVID-19 distressful context. Findings have implications for efforts to sustain and promote depleted Life Satisfaction during and after COVID-19 distressful context.

Future research on LS and cognitive-psychological resources during COVID-19 could study different contexts like workplace, or parenting (for Greece see Kyriazos & Stalikas, 2018; Kyriazos & Stalikas, 2019a; Kyriazos & Stalikas, 2019b). Alternatively, except SEM other multivariate technique could shed light on the complex relationships of psychological distress and COVID-19 comorbidities (Holmes et al., 2020) like CFA Multitrait-Multimethod Matrices (see Kyriazos, 2018b) or Multilevel Modeling (see Kyriazos, 2019).

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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Appendix

Table A1. Multivariate normality tests, outliers and critical value for mahalanobis distance (χ^2), for each measure of the study and for the measurement model (N = 759).

Latent Variables	Multivariate Normality Tests						
	Outliers	D^2 Critical Value (*df*)*	Mardia's Skew*	Mardia's Kurtosis*	Doornik-Hansen (*df*)*	Energy Test*	Henze-Zirkler*
SPANE-8 (*k* = 8)	10	26.13 (8)	417.01	24.25	78.92 (16)	6.39	2.52
MLQ (*k* = 10)	0	29.59 (10)	2365.81	59.27	896.17 (20)	21.55	5.78
AHS (*k* = 8)	29	26.13 (8)	1397.50	52.18	556.44 (16)	17.80	4.65
LOT-R (*k* = 6)	12	22.46 (6)	495.31	19.37	208.17 (12)	7.34	3.37
SWLS (*k* = 5)	13	20.52 (5)	448.83	24.24	111.44 (10)	13.10	5.67
Measurement Model (*k* = 21) [a]	40	46.80 (21)	6648.90	80.67	462.114 (42)	2472.32	1.23

*$p < 0.001$. [a]The latent variables of the measurement model were SPANE-8 P (SPANE-8 Positive), MLQ-P (Meaning in Life Presence), AHS-A (Adult Hope Scale Agency), LOT-R O (Life Orientation Test-Revised, Optimism) and SWLS (Satisfaction with life Scale).

Table A2. Goodness of fit for the CFA to verify the factor structure of all study measures (*N* = 759).

Models of Study Measures							RMSEA 90%CI				
	x^2	*df*	*p*	CFI	TLI	RMSEA	Lower	Upper	SRMR	Loadings Range	Inter-factor Correlation
SPANE-8: 2-factor	40.17	19	0.003	0.990	0.985	0.038	0.024	0.052	0.027	0.548 - 0.859	−0.761
MLQ: 2-factor	225.84	34	0.000	0.925	0.901	0.086	0.077	0.095	0.080	0.628 - 0.905	0.221
LOT-R: 2-factor [a]	38.87	8	0.000	0.966	0.936	0.071	0.024	0.052	0.037	0.468 - 0.804	0.749
AHS: 2-factor	142.84	19	0.000	0.935	0.904	0.093	0.081	0.104	0.048	0.687 - 0.826	0.883
SWLS: Single factor	20.75	5	0.001	0.986	0.972	0.064	0.043	0.088	0.024	0618 - 0.879	–

Note. Estimator = MLR. df = Degrees of freedom; CFI = Comparative Fit Index; TLI = Tucker-Lewis index; RMSEA = Root Mean Square Error of Approximation; CI = Confidence Interval; SRMR = Standardized Root Mean Square Residual. AIC = Akaike Information Criterion, BIC = Bayesian Information Criterion. [a] LOT-R Optimism = items 1, 4, 10, LOT-R Pessimism = items 3, 7, 9 (Recoded).

Table A3. Standardized loadings (λ), and R squared for the SEM measurement model (*N* = 759).

Latent Variables	Measured Variables	λ*	R^2	Latent Variables	Measured Variables	λ*	R^2
SPANE-8 P	SPANE-8 P 2	0.839	0.705	LOT-R O	LOT-R 1	0.597	0.357
	SPANE-8 P 3	0.850	0.723		LOT-R 4	0.821	0.675
	SPANE-8 P 6	0.757	0.574		LOT-R 10	0.738	0.544
	SPANE-8 P 8	0.780	0.609	SWLS	SWLS 1	0.846	0.716
MLQ-P	MLQ-P 1	0.755	0.571		SWLS 2	0.730	0.533
	MLQ-P 4	0.830	0.689		SWLS 3	0.867	0.751
	MLQ-P 5	0.845	0.714		SWLS 4	0.764	0.583
	MLQ-P 6	0.901	0.811		SWLS 5	0.635	0.403
	MLQ-P 9	0.637	0.406				
AHS-A	AHS-A 2	0.747	0.558				
	AHS-A 9	0.624	0.389				
	AHS-A 10	0.844	0.713				
	AHS-A 12	0.751	0.564				

*$p < 0.001$. *Note.* Estimator = MLR. SPANE-8 P = SPANE-8 Positive, MLQ-P = Meaning in Life Presence, AHS-A = Adult Hope Scale Agency, LOT-R O = Life Orientation Test-Revised Optimism, and SWLS = Satisfaction with life Scale.

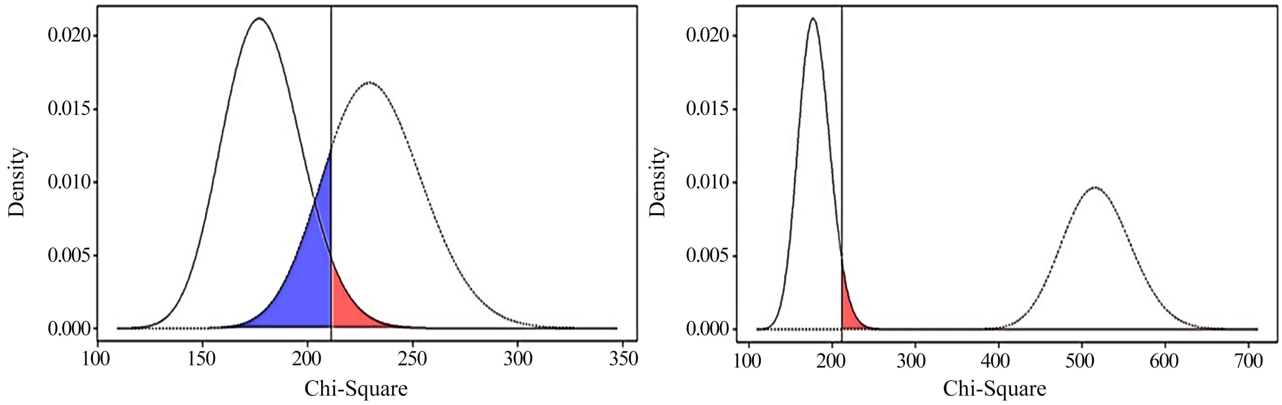

Figure A1. A priori (Left) and Post-hoc (Right) power analysis based on RMSEA for the structural SEM model.

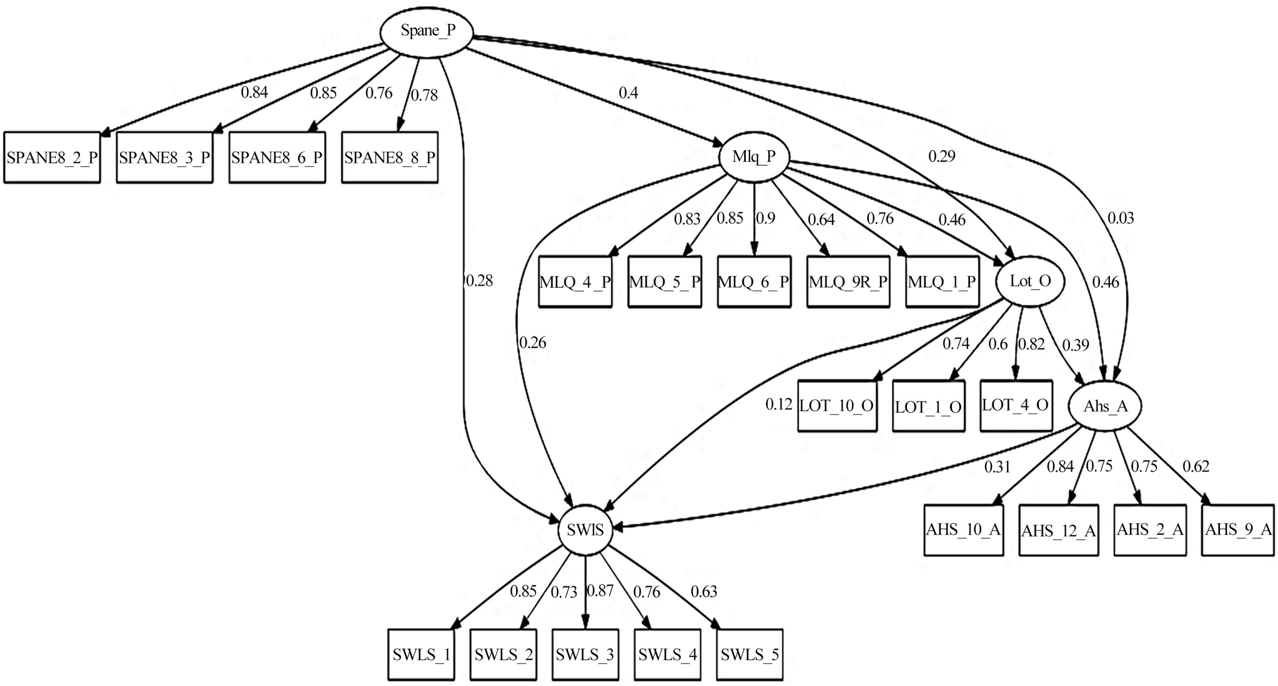

Figure A2. The path diagram of the full SEM model (direct standardized path coefficients. Positive emotions (SPANE-8 P), presence of life meaning (MLQ-P), optimism (LOT-R O), and hope agency (AHS-A) explained 61.5% of the variance in life satisfaction (SWLS).