Religiosity as a Resource:

Unpacking the Longitudinal Dynamics Between Religiosity and Mental Health in sub-Saharan Africa

Supplementary Material

Daniel Hofmann[1] M.Sc., Driver, Charles[1] Ph.D. Sanaa Bladh[1] B.Sc., Sumaya Laher[2] Ph.D., Luzelle Naudé[3] Ph.D., and Amber Gayle Thalmayer[1,3] Ph.D.

[1] University of Zürich
[2] University of the Witwatersrand
[3] University of the Free State

Table of Contents

Deviations from the Preregistration

We added low English proficiency and survey completion under 10 minutes as exclusion criteria. We also removed participants that were unlinkable in the longitudinal sample avoiding duplicates in the dataset. Additionally, we incorporated 20-fold cross-validation to evaluate out-of-sample (OOS) log-likelihood alongside AIC, prioritizing OOS log-likelihood when the two measures conflicted. For convergent validity we additionally correlated the mental health scales with General Self-Rated Health as this variable was available in most waves. Importantly, we removed anger from the Externalizing scale and relabelled it as Substance Abuse as prior research indicated anger is culturally moderated by country in its allocation with Internalizing and Externalizing (i.e. anger loading more on externalizing in South Africa and more on internalizing in Kenya and Namibia; Hofmann et al., under review). We also present the results of the for the Externalizing scale including anger in the Supplementary Tables 8 and 9. The main conclusions of the results remained the same, but the presence of stronger country moderation effects leads us to believe we correctly adjusted our analysis plan.

The Continuous Time Structural Equation Model and its relation to the (Random-Intercept) Cross Lagged Panel Model

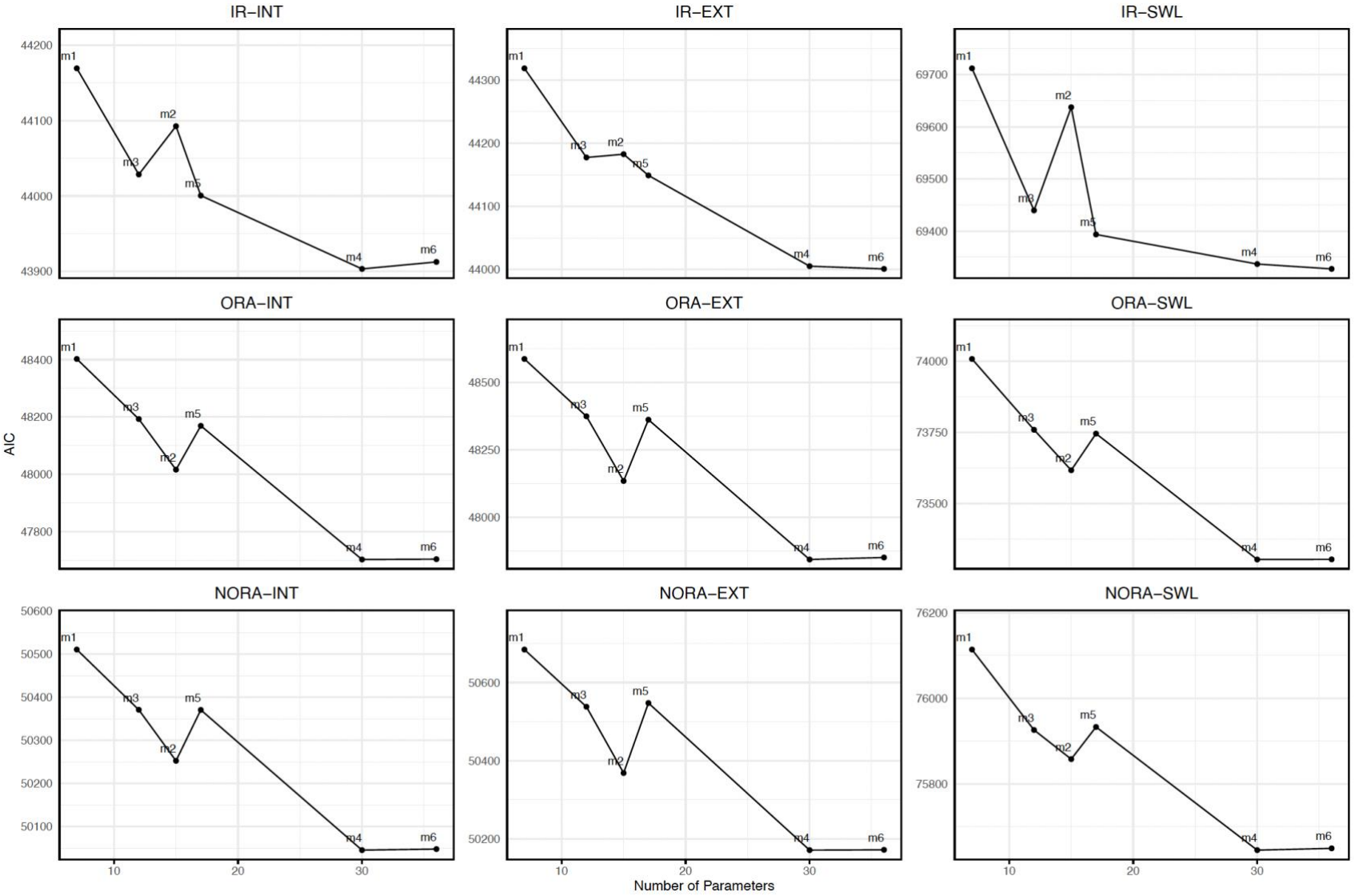
Cross-lagged panel models (CLPMs) are commonly used to study temporal relationships between variables, but they come with specific assumptions that limit their flexibility. Traditional CLPMs assume independent shocks (or disturbances) for each variable at each time point, meaning that the residuals affecting one variable are uncorrelated with those affecting another. This simplifies the model but fails to account for shared disturbances or influences that may affect multiple variables simultaneously. Additionally, CLPMs do not separate within-person and between-person variance effectively. Without this distinction, temporal relationships can become biased, as between-person differences may be conflated with within-person processes, complicating interpretations (Hamaker et al., 2015). To address these limitations, Random-Intercept Cross-Lagged Panel Models (RI-CLPMs) were developed. RI-CLPMs separate within-person and between-person variance by including a random intercept that captures stable, trait-like differences between individuals over time. However, RI-CLPMs still generally assume independent shocks at the within-person level, meaning any shared influences or correlated disturbances between variables are not explicitly modeled. For cases where researchers believe that variables are influenced by shared factors or correlated disturbances at each time point, alternative models or modifications, such as structural equation models with latent factors, may be needed.

This is where continuous-time structural equation models (ctsem) offer significant improvements over RI-CLPMs (Driver et al., 2017; Driver & Voelkle, 2018). Unlike discrete-time models like the RI-CLPM, ctsem allows for continuous-time modeling, which is particularly valuable for processes that unfold naturally over continuous time, such as psychological or physiological changes. Continuous-time modeling enables researchers to capture real-time changes and interactions that aren't confined to fixed intervals, allowing for the modeling of dynamic processes with greater accuracy. Another advantage of ctsem is its flexibility with unequal time intervals. Longitudinal data in real-world research often involve irregular measurement intervals, which CLPMs and RI-CLPMs struggle to handle due to their assumption of equal time intervals. In contrast, ctsem can easily accommodate unequal intervals, reducing the risk of inaccurate results when data are collected at varying times. Furthermore, ctsem can decompose stable and dynamic variance in real-time, separating stable, trait-like components from state fluctuations. While RI-CLPM also distinguishes between within-person and between-person variance, it does so only at fixed intervals and cannot capture continuous changes between time points as ctsem can. Finally, ctsem is highly effective in accommodating both systematic influences and random disturbances, allowing researchers to model continuous systematic interactions between variables and random shocks that may affect the system over time. This creates a more realistic representation of how variables are influenced by both regular processes and random fluctuations. RI-CLPM, on the other hand, assumes independent shocks at each interval, limiting its ability to represent continuous random disturbances.

In summary, ctsem offers significant advantages over RI-CLPM for studying complex, real-time processes, especially when flexible timing, continuous interactions, and dynamic feedback are essential. While RI-CLPM is simpler and effective for discrete, fixed-interval panel data, ctsem provides the flexibility and continuous-time insights needed to model intricate temporal relationships accurately.

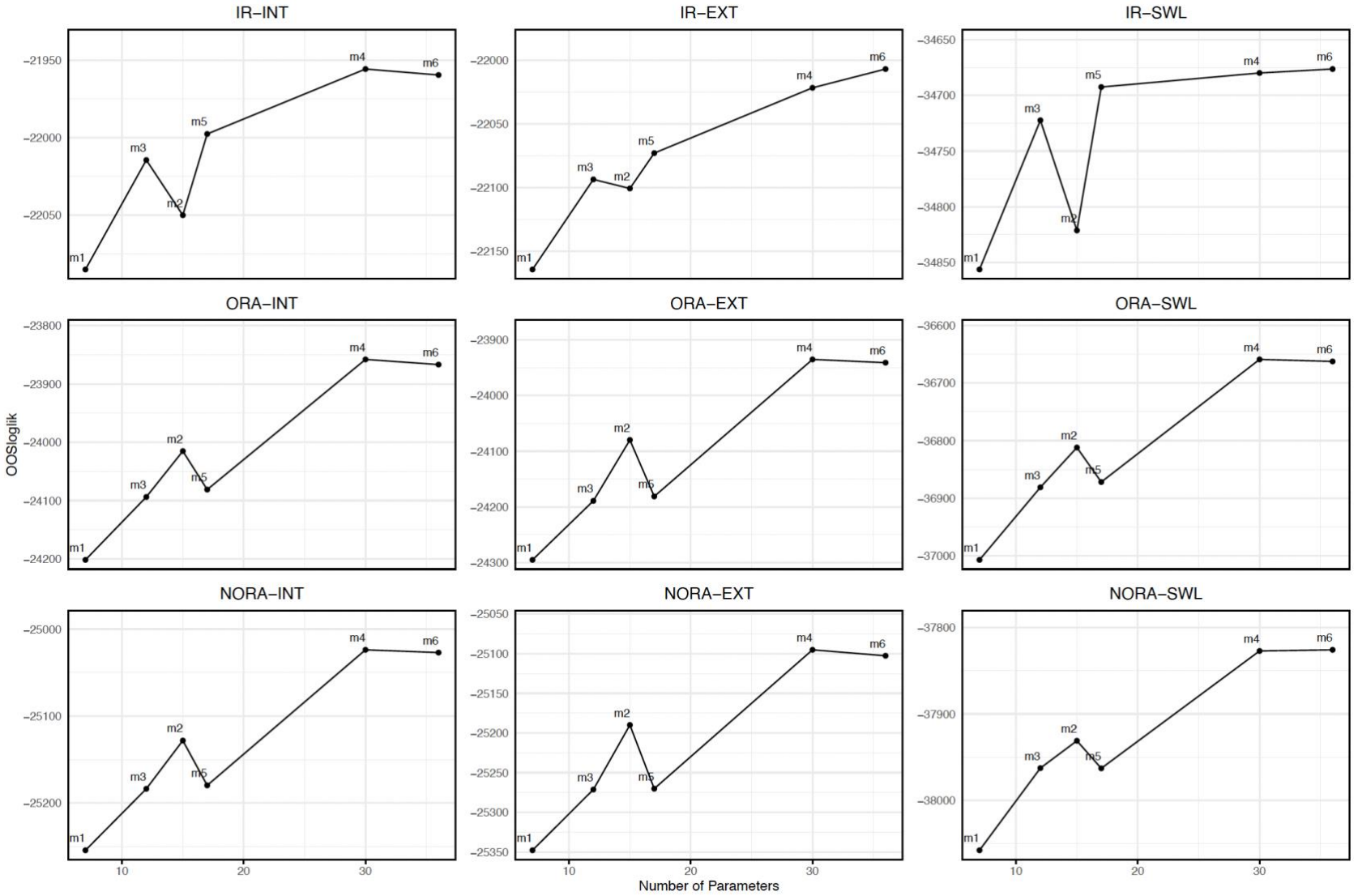
Supplementary Figures for Results

Supplementary Figure S1 Akaike Information Criterion for All Model Combinations



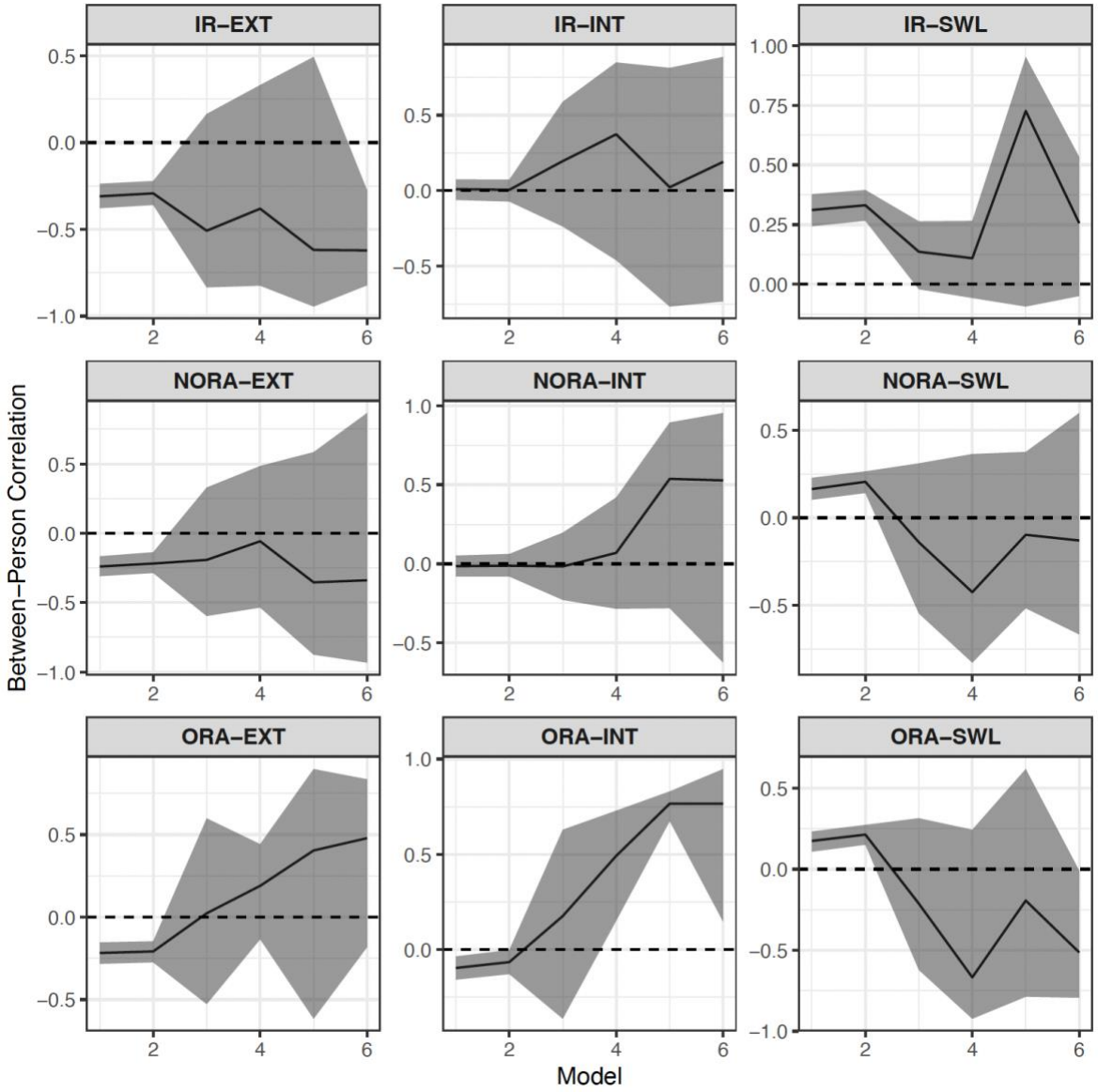
Note. m1: Correlated linear growth model including random effects; m2: Correlated linear growth model with random-effects and country moderator; m3: Auto-effects model including random effects; m4: Auto-effects model including random effects and country moderator; m5: Auto and cross-effect model including random effects; M6: Auto and cross-effect model including random effects and country moderator.

Supplementary Figure S2 Out of Sample Log Likelihood for All Model Combinations



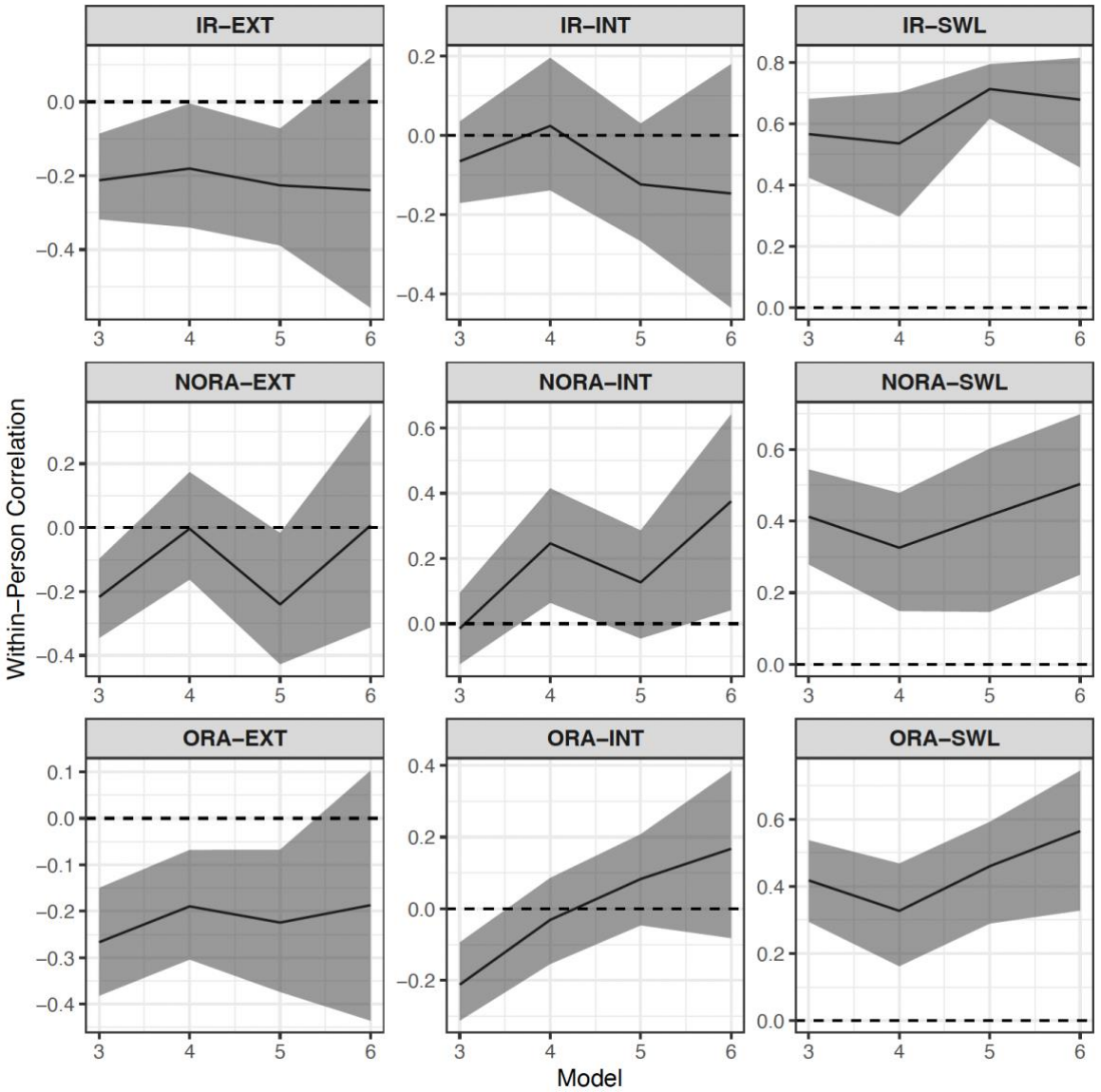
Note. m1: Correlated linear growth model including random effects; m2: Correlated linear growth model with random-effects and country moderator; m3: Auto-effects model including random effects; m4: Auto-effects model including random effects and country moderator; m5: Auto and cross-effect model including random effects; M6: Auto and cross-effect model including random effects and country moderator.

Supplementary Figure S3 Between-Person Correlations Across All Models



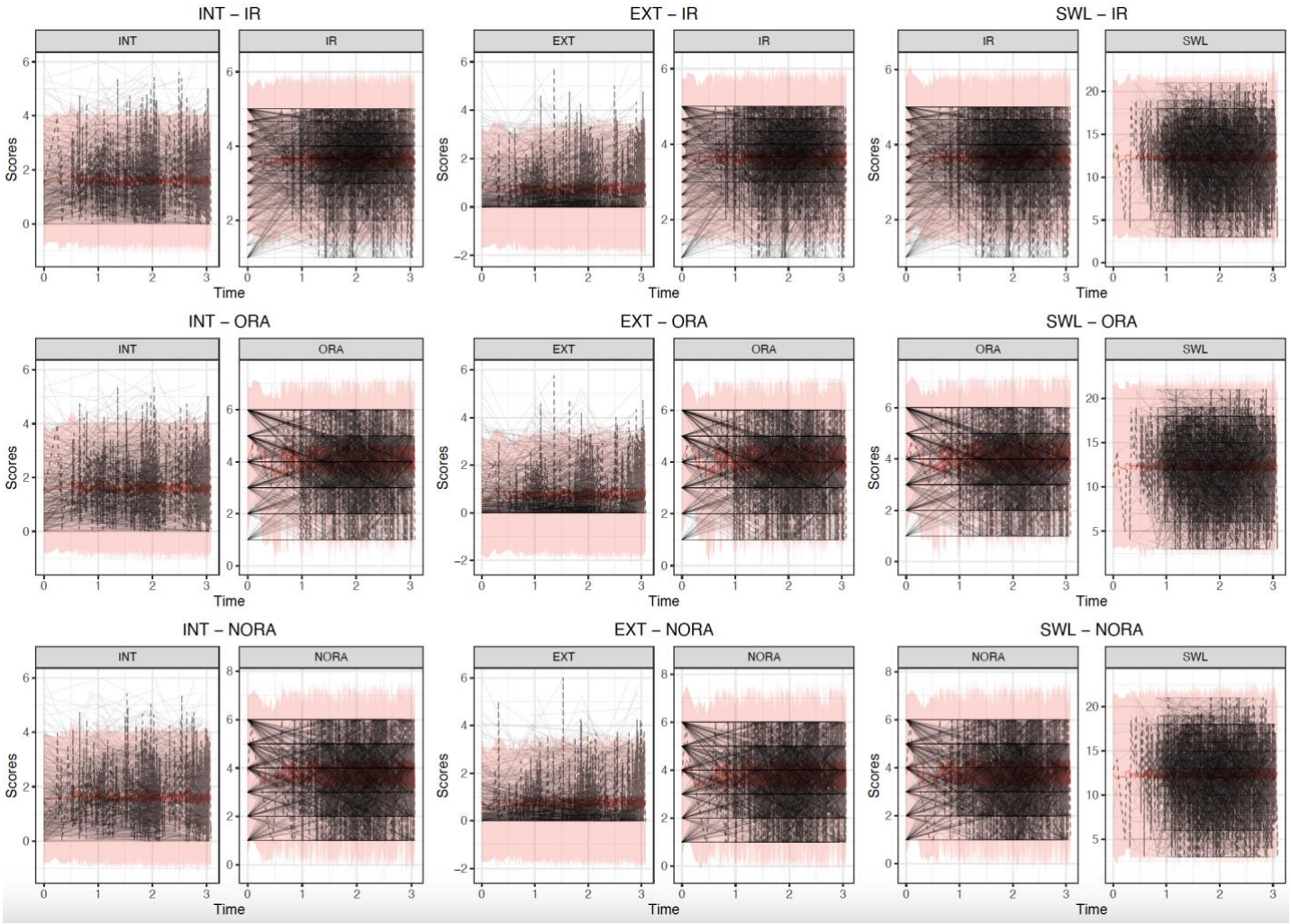
Note. Model 3: Auto-effects model including random effects; Model 4: Auto-effects model including random effects and country moderator; Model 5: Auto and cross-effect model including random effects; Model 6: Auto and cross-effect model including random effects and country moderator.

Supplementary Figure S4 Within-Person Correlations Across All Models



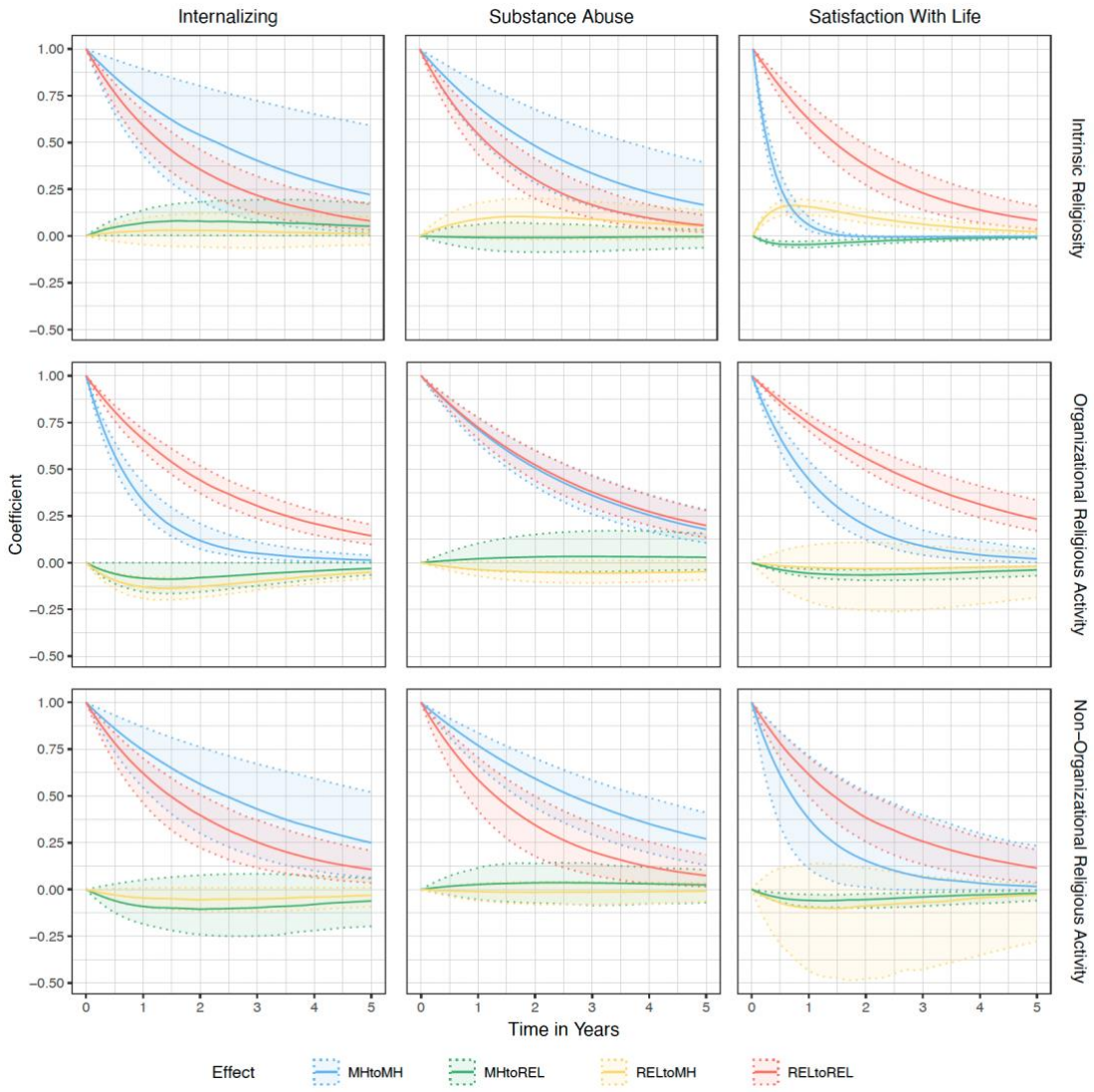
Note. Model 3: Auto-effects model including random effects; Model 4: Auto-effects model including random effects and country moderator; Model 5: Auto and cross-effect model including random effects; Model 6: Auto and cross-effect model including random effects and country moderator.

Supplementary Figure S5 Posterior Predictive Check of all the for the Best-Fitting Models: A First-Order Continuous-Time Model With Cross Effects and Individual Differences in Dynamics



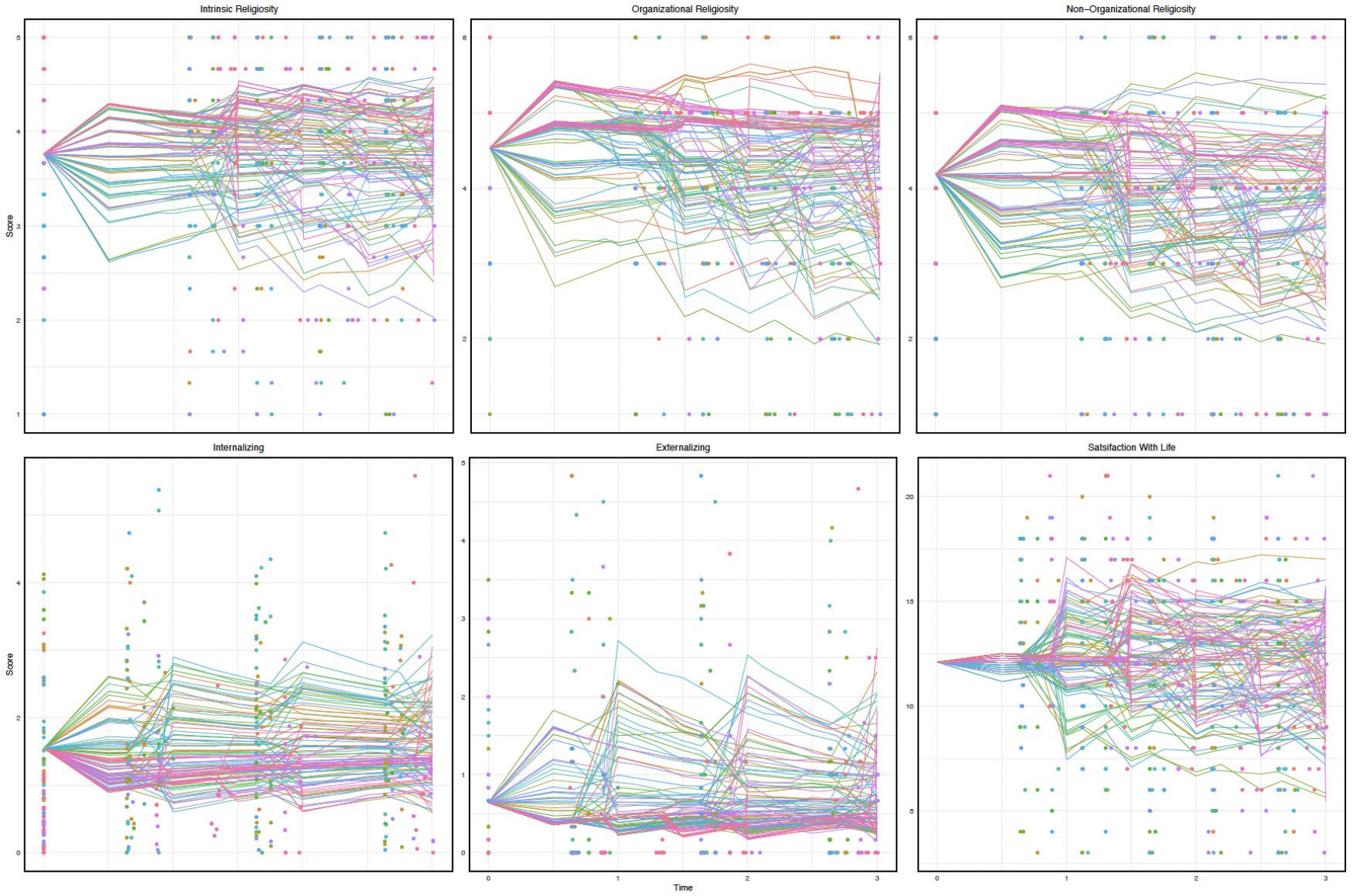
Note. The graph shows the comparison between original and generated data distributions over time, with the original data represented in black and the generated data in red. Thicker dashed and solid lines mark the means, allowing visual inspection of alignment between observed and simulated data trends.

Supplementary Figure S6 Raw Auto and Direct Cross-Effects of Religiosity and Mental Health Over the Years



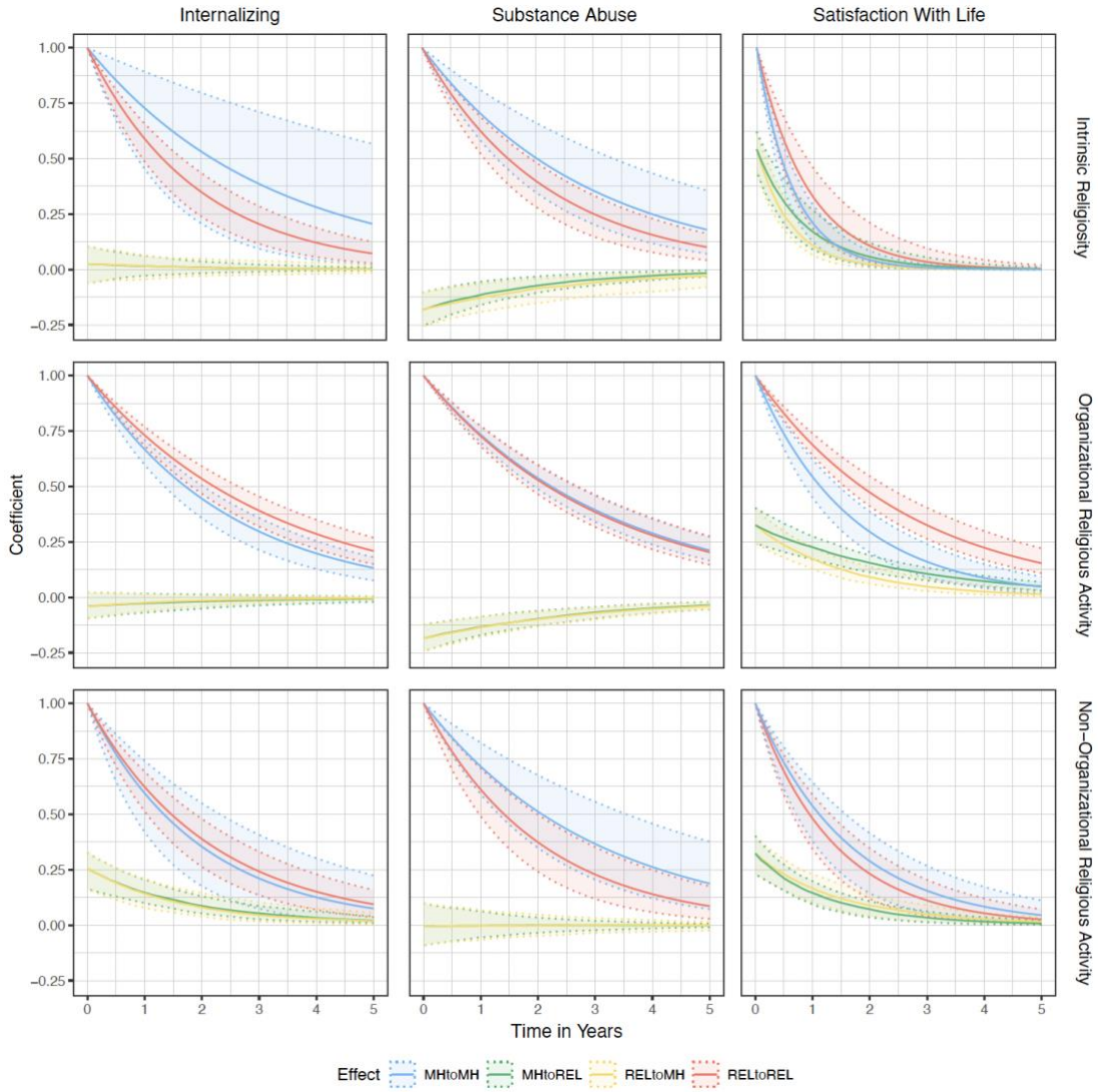
Note. Discrete-Time Auto and Cross-Regression Estimates and 95% Quantile Intervals for the Best-Fitting Model: A First-Order Continuous-Time Model With Cross Effects and Individual Differences in Dynamics and Independent Shock. MH = Mental health dimension, REL = Religiosity dimension. MHtoREL are cross-effect of mental health on religiosity. RELtoMH are cross-effects of religiosity on mental health.

Supplementary Figure S7 Interindividual Differences in the Religiosity and Mental Health Trajectories



Note. Mental Health and Religiosity Trajectories for 100 participants each.

Supplementary Figure S8 Auto-Effects and Correlated Random Fluctuations of Religiosity and Mental Health



Note. Discrete-Time Auto and Cross-Regression Estimates and 95% Quantile Intervals for the First-Order Continuous-Time Auto-Effects Model With Individual Differences in Dynamics and Correlated Shock. MH = Mental health dimension, REL = Religiosity dimension. MHtoREL are cross-effect of mental health on religiosity. RELtoMH are cross-effects of religiosity on mental health. The correlated shock allows for the possibility that disturbances (shocks) to one variable are correlated with disturbances to other variables, indicating potential shared influences or interactions in the system over time.

Supplementary Material for Measures

Supplementary Table S1 Item Names and Content

Name	Content
IMHA depression1	I had difficulty making decisions.
IMHA depression2	I lost interest or pleasure in doing things I used to like.
IMHA depression3	I felt distant or cut off from other people.
IMHA depression4	I felt sad and unhappy.
IMHA depression5	I felt hopeless about the future.
IMHA depression6	I lacked confidence in myself.
IMHA depression7	I felt guilty or had a bad conscience.
IMHA depression8	I thought I would be better off dead or thought about killing myself.
IMHA anxiety1	I felt afraid.
IMHA anxiety2	I got dizzy or lightheaded.
IMHA anxiety3	It was hard to control my worrying.
IMHA anxiety4	I avoided a situation that made me nervous or anxious.
IMHA anxiety5	My heart beat fast (not due to exercise).
IMHA anxiety6	My worrying got in the way of doing something I intended to do.
IMHA anxiety7	I felt shaky or trembly.
IMHA anxiety8	I had difficulty breathing (not due to a medical condition).
IMHA PTS1	I had an upsetting dream.
IMHA PTS2	I felt jumpy or easily startled.
IMHA PTS3	I had disturbing memories, thoughts, or images of a stressful experience from the past.
IMHA PTS4	I avoided an activity or situation that reminded me of a stressful experience from the past.
IMHA PTS5	I had physical reactions (heart pounding, trouble breathing, sweating) when something reminded me of a stressful experience from the past.
IMHA PTS6	I suddenly felt or acted as if a stressful experience were happening again (as if I were reliving it).
IMHA substance abuse1	I thought I should cut down on my drinking or drug use.
IMHA substance abuse2	I drank enough to pass out.
IMHA substance abuse3	I forgot things I did while using alcohol or drugs.
IMHA substance abuse4	I felt guilt or remorse after drinking or using drugs.

IMHA substance abuse5	Family or friends suggested I should cut down on my drinking or drug use.
IMHA substance abuse6	I failed to do what was normally expected from me because of drinking or drug use.
Life Satisfaction1	In most ways my life is close to my ideal.
Life Satisfaction2	The conditions of my life are excellent.
Life Satisfaction3	I am satisfied with my life.
DUREL1	How often do you attend church, mosque, temple, or other religious services/meetings?
DUREL2	How often do you spend time in private religious activities, such as prayer, meditation, or study of religious scriptures?
DUREL3	In my life, I experience the presence of the Divine
DUREL4	My religious beliefs are what really lie behind my whole approach to life.
DUREL5	I try hard to carry my religion over into all other dealings in life.

Supplementary Table S2 Mean and Standard Deviations of the Religiosity and Mental Health Measures Across Waves

Scales	Kenya				Namibia				South Africa				Overall			
	N	Mean	SD	Range	N	Mean	SD	Range	N	Mean	SD	Range	N	Mean	SD	Range
Internalizing W1	806	1.26	1.03	0 - 5.58	952	1.52	1.08	0 - 6	875	1.86	1.23	0 - 5.78	2633	1.55	1.14	0 - 6
Internalizing W3	1100	1.58	1.22	0 - 6	1063	1.73	1.23	0 - 6	883	2.03	1.32	0 - 6	3046	1.76	1.26	0 - 6
Internalizing W5	1010	1.63	1.19	0 - 5.96	961	1.48	1.17	0 - 6	815	1.8	1.32	0 - 6	2786	1.63	1.23	0 - 6
Internalizing W7	1050	1.71	1.28	0 - 5.88	911	1.77	1.3	0 - 6	589	1.83	1.3	0 - 5.9	2550	1.76	1.29	0 - 6
Externalizing W1	806	0.29	0.78	0 - 4.5	939	0.68	1.18	0 - 6	874	0.49	0.98	0 - 5.33	2619	0.5	1.01	0 - 6
Externalizing W3	1100	0.65	1.2	0 - 6	1062	0.83	1.31	0 - 6	878	0.91	1.39	0 - 6	3040	0.79	1.3	0 - 6
Externalizing W5	1010	0.75	1.21	0 - 6	961	0.82	1.21	0 - 6	815	0.83	1.23	0 - 6	2786	0.8	1.22	0 - 6
Externalizing W7	1050	0.82	1.26	0 - 5.83	911	1.1	1.42	0 - 6	589	0.84	1.26	0 - 6	2550	0.92	1.32	0 - 6
SWL W3	1096	13.27	4.2	3 - 21	1059	13.09	4.37	3 - 21	862	13.49	4.5	3 - 21	3017	13.27	4.35	3 - 21
SWL W4	977	12.37	4.36	3 - 21	1011	12.14	4.76	3 - 21	899	12.68	4.57	3 - 21	2887	12.39	4.57	3 - 21
SWL W5	1010	11.68	4.47	3 - 21	958	11.93	4.62	3 - 21	813	11.73	4.86	3 - 21	2781	11.78	4.64	3 - 21
SWL W6	1026	12.41	4.47	3 - 21	970	12.31	4.62	3 - 21	777	12.7	4.45	3 - 21	2773	12.46	4.52	3 - 21
SWL W7	1050	11.52	4.52	3 - 21	911	12.1	4.52	3 - 21	589	12.42	4.46	3 - 21	2550	11.93	4.52	3 - 21
IR W1	910	3.8	1.09	1 - 5	1097	3.34	1.12	1 - 5	894	3.71	1.1	1 - 5	2901	3.6	1.13	1 - 5
ORA W1	910	4.83	1.16	1 - 6	1099	3.7	1.56	1 - 6	893	3.61	1.51	1 - 6	2902	4.03	1.53	1 - 6
NORA W1	910	4.49	1.47	1 - 6	1100	3.42	1.72	1 - 6	891	3.64	1.66	1 - 6	2901	3.82	1.69	1 - 6
IR W4	982	3.74	1.02	1 - 5	1017	3.44	1.03	1 - 5	923	3.64	1.04	1 - 5	2922	3.61	1.04	1 - 5
ORA W4	983	4.52	1.21	1 - 6	1016	3.79	1.35	1 - 6	920	3.69	1.52	1 - 6	2919	4.01	1.41	1 - 6
NORA W4	876	4.01	1.52	1 - 6	917	3.31	1.62	1 - 6	647	3.8	1.59	1 - 6	2440	3.69	1.61	1 - 6
IR W5	1010	3.83	1.01	1 - 5	960	3.57	1.03	1 - 5	814	3.69	1.18	1 - 5	2784	3.7	1.07	1 - 5
ORA W5	1010	4.58	1.22	1 - 6	960	3.6	1.42	1 - 6	813	3.6	1.6	1 - 6	2783	3.96	1.48	1 - 6
NORA W5	1010	4.19	1.47	1 - 6	959	3.2	1.64	1 - 6	813	3.5	1.73	1 - 6	2782	3.65	1.67	1 - 6
IR W6	1026	3.71	1.02	1 - 5	975	3.6	1.05	1 - 5	781	3.67	1.07	1 - 5	2782	3.66	1.04	1 - 5
ORA W6	1026	4.45	1.29	1 - 6	975	3.58	1.31	1 - 6	781	3.64	1.48	1 - 6	2782	3.92	1.42	1 - 6
NORA W6	1026	4.14	1.56	1 - 6	975	3.25	1.55	1 - 6	781	3.68	1.55	1 - 6	2782	3.7	1.6	1 - 6
IR W67	1050	3.68	1.01	1 - 5	911	3.55	1.01	1 - 5	589	3.73	1.03	1 - 5	2550	3.65	1.02	1 - 5
ORA W7	1050	4.39	1.33	1 - 6	911	3.75	1.3	1 - 6	589	3.65	1.47	1 - 6	2550	3.99	1.39	1 - 6

NORA W7	1050	4.03	1.56	1 - 6	911	3.39	1.65	1 - 6	589	3.59	1.67	1 - 6	2550	3.7	1.64	1 - 6

Note. SWL = Satsifaction With Life, IR = Intrinsic Religiosity, ORA = Organzational Religious Activity, NORA = Non-Organzational Religious Activity.

Convergent Validity and Psychometric Properties

We assessed the reliability of the scales before evaluating external validity. Item-total correlations indicated strong internal consistency across countries and waves for Internalizing, Substance Abuse, and Satisfaction with Life, with all values exceeding .40 (see Supplementary Table S3). The DUREL Intrinsic Religiosity items also displayed high internal consistency. Reliability for Internalizing and Substance Abuse was strong (above .80) across all samples, while Satisfaction with Life and Intrinsic Religiosity had acceptable reliability (.60–.85) in all but one scale (see Supplementary Table S4). To assess external validity, we calculated zero-order correlations between Internalizing, Substance Abuse, and Satisfaction with Life with key external measures, including the Ostracism Short Scale (Rudert et al., 2019), General Self-Rated Health (GSRH; DeSalvo, 2005), and the subscales of the Mental Health Continuum-Short Form (MHC-SF; Keyes et al., 2009), which captures Emotional, Social, and Psychological Wellbeing. Additionally, we examined the convergent validity of religiosity measures using the Divinity scale from the Ethical Values Assessment (EVA; Padilla-Walker & Jensen, 2016).

Internalizing and Substance Abuse demonstrated moderate external validity at Wave 3, with correlations exceeding .25, except for Emotional, Social, and Psychological Wellbeing and Ostracism in one instance. Specifically, Internalizing correlated negatively with Emotional ($r = –.36$), Social ($r = –.31$), and Psychological Wellbeing ($r = –.32$), while showing a positive association with Ostracism ($r = .27$). Substance Abuse exhibited lower loadings, with negative correlations with Emotional ($r = –.17$), Social ($r = –.10$), Psychological Wellbeing ($r = –.19$) and GSRH ($r = –.22$), and a weaker positive correlation with Ostracism ($r = .11$). Satisfaction with Life demonstrated strong convergent validity, particularly with Emotional ($r = .55$), Social ($r = .50$), Psychological Wellbeing ($r = .50$), and GSRH ($r = –.11$), but had weaker associations with GSRH ($r = .21$) and Ostracism ($r = –.06$). Correlations with GSRH were generally lower than expected, remaining below .25.

Religiosity measures, assessed using the Duke University Religion Index (DUREL), showed moderate convergent validity with the Divinity scale, with the strongest associations observed at Wave 4. Intrinsic Religiosity exhibited the highest correlation ($r = .45$), while Organizational ($r = .24$) and Non-Organizational Religious Activity ($r = .26$) had more modest associations.

While external validity analyses were conducted across multiple waves, consistency over time was low, which aligns with expectations given the fluctuating nature of mental health (see Supplementary Table 5). A detailed breakdown of the associations for religiosity measures is presented in Supplementary Table 6.

Supplementary Table S3 Internal Consistency of the Religiosity and Mental Health Scales

Scale	Kenya		Namibia		South Africa		Overall	
	α	ω	α	ω	α	ω	α	ω
Internalizing W1	.92	.92	.91	.91	.92	.93	.92	.93
Internalizing W3	.94	.94	.93	.93	.93	.93	.93	.94
Internalizing W5	.94	.94	.93	.94	.94	.95	.94	.94
Internalizing W7	.95	.95	.95	.95	.93	.94	.94	.95
Substance Abuse W1	.86	.92	.88	.91	.86	.91	.87	.91
Substance Abuse W3	.91	.94	.90	.93	.90	.93	.91	.94
Substance Abuse W5	.89	.92	.88	.94	.89	.92	.89	.93
Substance Abuse W7	.91	.93	.91	.94	.89	.91	.91	.93
SWL W3	.69	.67	.67	.65	.77	.74	.70	.68
SWL W4	.70	.67	.77	.75	.77	.75	.74	.72
SWL W5	.77	.75	.77	.75	.84	.82	.79	.77
SWL W6	.78	.76	.79	.77	.79	.76	.78	.76
SWL W7	.78	.76	.79	.77	.82	.80	.79	.77
IR W1	.67	.64	.62	.59	.72	.70	.67	.65
IR W4	.70	.67	.72	.70	.71	.68	.71	.69
IR W5	.70	.67	.71	.68	.82	.80	.75	.72
IR W6	.72	.69	.73	.71	.78	.76	.74	.71
IR W7	.72	.69	.71	.68	.81	.79	.73	.71

Note. Organizational and Non-Organizational Religious Activity internal consistencies could not be caluclated due to low items numbers.

Supplementary Table S4 Item-Total Correlation of the Religiosity and Mental Health Scales Across Waves

Items	Kenya	Namibia	South Africa	Overall
		Internalizing W1		
IMHA depression1 W1	.60	.60	.60	.58
IMHA depression2 W1	.60	.60	.60	.65
IMHA depression3 W1	.66	.66	.66	.66
IMHA depression4 W1	.69	.69	.69	.67
IMHA depression5 W1	.69	.69	.69	.65
IMHA depression6 W1	.64	.64	.64	.63
IMHA depression7 W1	.61	.61	.61	.61
IMHA depression8 W1	.54	.54	.54	.57
IMHA anxiety1 W1	.59	.59	.59	.58
IMHA anxiety2 W1	.48	.48	.48	.50
IMHA anxiety3 W1	.67	.67	.67	.69
IMHA anxiety4 W1	.48	.48	.48	.52
IMHA anxiety5 W1	.56	.56	.56	.61
IMHA anxiety6 W1	.63	.63	.63	.71
IMHA anxiety7 W1	.69	.69	.69	.66
IMHA anxiety8 W1	.48	.48	.48	.52
IMHA PTS1 W1	.51	.51	.51	.48
IMHA PTS2 W1	.57	.57	.57	.55
IMHA PTS3 W1	.68	.68	.68	.70
IMHA PTS4 W1	.51	.51	.51	.53
IMHA PTS5 W1	.59	.59	.59	.59
IMHA PTS6 W1	.72	.72	.72	.67
		Internalizing W3		
IMHA depression1 W3	.61	.58	.57	.59
IMHA depression2 W3	.68	.65	.69	.68
IMHA depression3 W3	.67	.64	.65	.66
IMHA depression4 W3	.60	.60	.60	.58
IMHA depression5 W3	.68	.68	.68	.68

IMHA depression6 W3	.67	.67	.67	.66
IMHA depression7 W3	.71	.71	.71	.69
IMHA depression8 W3	.70	.70	.70	.66
IMHA anxiety1 W3	.65	.65	.65	.65
IMHA anxiety2 W3	.68	.68	.68	.65
IMHA anxiety3 W3	.60	.60	.60	.61
IMHA anxiety4 W3	.62	.62	.62	.60
IMHA anxiety5 W3	.53	.53	.53	.54
IMHA anxiety6 W3	.72	.72	.72	.69
IMHA anxiety7 W3	.58	.58	.58	.55
IMHA anxiety8 W3	.62	.62	.62	.64
IMHA PTS1 W3	.76	.76	.76	.74
IMHA PTS2 W3	.71	.71	.71	.68
IMHA PTS3 W3	.60	.60	.60	.59
IMHA PTS4 W3	.53	.53	.53	.52
IMHA PTS5 W3	.65	.65	.65	.64
IMHA PTS6 W3	.72	.72	.72	.72
		Internalizing W5		
IMHA depression1 W5	.63	.63	.63	.62
IMHA depression2 W5	.70	.70	.70	.71
IMHA depression3 W5	.71	.71	.71	.69
IMHA depression4 W5	.72	.72	.72	.73
IMHA depression5 W5	.66	.66	.66	.65
IMHA depression6 W5	.67	.67	.67	.70
IMHA depression7 W5	.63	.63	.63	.63
IMHA depression8 W5	.58	.58	.58	.59
IMHA anxiety1 W5	.67	.67	.67	.64
IMHA anxiety2 W5	.52	.52	.52	.53
IMHA anxiety3 W5	.68	.68	.68	.69
IMHA anxiety4 W5	.55	.55	.55	.58
IMHA anxiety5 W5	.64	.64	.64	.66
IMHA anxiety6 W5	.74	.74	.74	.75

IMHA anxiety7 W5	.70	.70	.70	.69
IMHA anxiety8 W5	.58	.58	.58	.59
IMHA PTS1 W5	.50	.50	.50	.51
IMHA PTS2 W5	.72	.72	.72	.72
IMHA PTS3 W5	.70	.70	.70	.72
IMHA PTS4 W5	.61	.61	.61	.62
IMHA PTS5 W5	.67	.67	.67	.66
IMHA PTS6 W5	.72	.72	.72	.72
		Internalizing W7		
IMHA depression1 W7	.63	.63	.63	.62
IMHA depression2 W7	.72	.72	.72	.72
IMHA depression3 W7	.72	.72	.72	.70
IMHA depression4 W7	.74	.74	.74	.73
IMHA depression5 W7	.74	.74	.74	.70
IMHA depression6 W7	.71	.71	.71	.70
IMHA depression7 W7	.65	.65	.65	.66
IMHA depression8 W7	.57	.57	.57	.60
IMHA anxiety1 W7	.65	.65	.65	.64
IMHA anxiety2 W7	.55	.55	.55	.57
IMHA anxiety3 W7	.71	.71	.71	.70
IMHA anxiety4 W7	.54	.54	.54	.57
IMHA anxiety5 W7	.73	.73	.73	.70
IMHA anxiety6 W7	.79	.79	.79	.76
IMHA anxiety7 W7	.76	.76	.76	.74
IMHA anxiety8 W7	.63	.63	.63	.62
IMHA PTS1 W7	.58	.58	.58	.58
IMHA PTS2 W7	.77	.77	.77	.75
IMHA PTS3 W7	.77	.77	.77	.75
IMHA PTS4 W7	.62	.62	.62	.62
IMHA PTS5 W7	.72	.72	.72	.68
IMHA PTS6 W7	.75	.75	.75	.74
		Substance Abuse W1		

IMHA substance abuse1 W1	.76	.76	.76	.78
IMHA substance abuse2 W1	.69	.69	.69	.73
IMHA substance abuse3 W1	.76	.76	.76	.78
IMHA substance abuse4 W1	.81	.81	.81	.81
IMHA substance abuse5 W1	.83	.83	.83	.83
IMHA substance abuse6 W1	.74	.74	.74	.76
		Substance Abuse W3		
IMHA substance abuse1 W3	.79	.79	.79	.79
IMHA substance abuse2 W3	.83	.83	.83	.81
IMHA substance abuse3 W3	.86	.86	.86	.85
IMHA substance abuse4 W3	.86	.86	.86	.85
IMHA substance abuse5 W3	.82	.82	.82	.83
IMHA substance abuse6 W3	.85	.85	.85	.83
		Substance Abuse W5		
IMHA substance abuse1 W5	.79	.79	.79	.76
IMHA substance abuse2 W5	.79	.79	.79	.77
IMHA substance abuse3 W5	.80	.80	.80	.81
IMHA substance abuse4 W5	.86	.86	.86	.84
IMHA substance abuse5 W5	.79	.79	.79	.81
IMHA substance abuse6 W5	.77	.77	.77	.80
		Substance Abuse W7		
IMHA substance abuse1 W7	.80	.80	.80	.78
IMHA substance abuse2 W7	.83	.83	.83	.82
IMHA substance abuse3 W7	.84	.84	.84	.84
IMHA substance abuse4 W7	.86	.86	.86	.86
IMHA substance abuse5 W7	.84	.84	.84	.84
IMHA substance abuse6 W7	.82	.82	.82	.81
		Satisfaction With Life W3		
Life Satisfaction1W3	.72	.72	.72	.74
Life Satisfaction2W3	.82	.82	.82	.83
Life Satisfaction3W3	.82	.82	.82	.81
		Satisfaction With Life W4		

Life Satisfaction1 W4	.74	.74	.74	.77
Life Satisfaction2 W4	.82	.82	.82	.85
Life Satisfaction3 W4	.80	.80	.80	.82
		Satisfaction With Life W5		
Life Satisfaction1W5	.78	.78	.78	.80
Life Satisfaction2 W4	.87	.87	.87	.87
Life Satisfaction3 W4	.83	.83	.83	.85
		Satisfaction With Life W6		
Life Satisfaction1 W6	.79	.79	.79	.80
Life Satisfaction2 W6	.87	.87	.87	.86
Life Satisfaction3 W6	.84	.84	.84	.84
		Satisfaction With Life W7		
Life Satisfaction1 W7	.78	.78	.78	.80
Life Satisfaction2 W7	.88	.88	.88	.87
Life Satisfaction3 W7	.84	.84	.84	.85
		Intrinsic Religiosity W1		
DUREL3 W1	.75	.75	.75	.75
DUREL4 W1	.83	.83	.83	.82
DUREL5 W1	.75	.75	.75	.77
		Intrinsic Religiosity W4		
DUREL3 W4	.76	.76	.76	.78
DUREL4 W4	.82	.82	.82	.82
DUREL5 W4	.79	.79	.79	.79
		Intrinsic Religiosity W5		
DUREL3 W5	.76	.76	.76	.79
DUREL4 W5	.82	.82	.82	.84
DUREL5 W5	.79	.79	.79	.82
		Intrinsic Religiosity W6		
DUREL3 W6	.79	.79	.79	.79
DUREL4 W6	.82	.82	.82	.83
DUREL5 W6	.80	.80	.80	.81
		Intrinsic Religiosity W7		

DUREL3 W7	.78	.78	.78	.78
DUREL4 W7	.84	.84	.84	.85
DUREL5 W7	.79	.79	.79	.79

Note. Organizational and Non-Organizational Religious Activity internal consistencies could not be caluclated due to low items numbers.

Supplementary Table S5 Convergent Validity of Religiosity Measures

Scale	IR W1	ORA W1	NORA W1	IR W4	ORA W4	NORA W4	IR W5	ORA W5	NORA W5	IR W6	ORA W6	NORA W6	IR W7	ORA W7	NORA W7
Divinity W4	.21	.18	.15	.45	.24	.26	.34	.20	.19	.29	.21	.20	.31	.17	.19

Note. IR = Intrinsic Religiosity, ORA = Organzational Religious Activity, NORA = Non-Organzational Religious Activity.

Supplementary Table S6 Convergent Validity of Mental Health Measures

Scale	INT W1	INT W3	INT W5	INT W7	SA W1	SA W3	SA W5	SA W7	SWL W3	SWL W4	SWL W5	SWL W6	SWL W7
EMOT WB W3	-.11	-.36	-.12	-.09	-.01	-.17	-.05	-.02	.55	.14	.17	.07	.08
SOC WB W3	-.11	-.31	-.09	-.06	.01	-.10	-.02	.00	.50	.12	.14	.07	.07
PSYCH WB W3	-.10	-.32	-.07	-.07	-.04	-.19	-.05	-.05	.50	.12	.13	.04	.05
OSTRACISM W2 W4	.18	.27	.25	.20	.05	.11	.09	.08	-.06	-.12	-.12	-.08	-.02
GSRH W1	-.03	.02	.03	-.05	-.07	-.01	-.03	-.10	-.03	.00	-.02	.03	.00
GSRH W3	-.17	-.22	-.14	-.13	-.07	-.11	-.06	-.06	.21	.08	.11	.09	.07
GSRH W4	-.11	-.21	-.19	-.14	.01	-.08	-.05	-.06	.16	.19	.14	.13	.13
GSRH W5	-.11	-.15	-.19	-.15	-.01	-.04	-.09	-.05	.12	.13	.19	.15	.12
GSRH W6	-.15	-.15	-.15	-.16	-.03	-.07	-.07	-.07	.12	.10	.13	.23	.15
GSRH W7	-.10	-.14	-.12	-.18	.02	-.04	.02	-.06	.07	.07	.11	.19	.25

Note. Emot WB = Emotional Wellbeing, Soc WB = Emotional Wellbeing, Psych WB = Psychological Wellbeing, GSRH = General Self-Rated Health, SWL = Satisfaction with Life. The mean of the ostracism scale was calculated using W2 and W4 data aggregated together.

Supplementary Table S7 Correlated Within-Person Fluctuations

Between-Person and Within-Person Correlated Fluctations of Religiosity and Mental Health

	Within-Person Correlated Random Fluctuations
	Mean Estimate 95% CI
IR–INT	0.03 [-0.14, 0.2]
IR–SA	-0.18 [-0.34, 0]
IR–SWL	**0.53 [0.3, 0.7]**
ORA–INT	-0.03 [-0.15, 0.09]
ORA–SA	**-0.19 [-0.3, -0.07]**
ORA–SWL	**0.32 [0.16, 0.47]**
NORA–INT	**0.24 [0.06, 0.42]**
NORA–SA	0 [-0.16, 0.17]
NORA–SWL	**0.32 [0.15, 0.48]**

Note. Int = Internalizing, SA = Substance Abuse, SWL = Satisfaction With Life, IR = Intrinsic Religiosity, ORA = Organizational Religious Activity, Non-Organizational Religious Activity. The parameters for the correlations between-person are from the correlated linear growth model and the parameters of within-person correlated random fluctuations from the auto-effects model. The between-person correlations are standardized. The within-person correlated random fluctuations are unstandardized.

Preregistered Results for Religiosity and Externalizing

Supplementary Table S8 Between-Person and Within-Person Correlations for Religiosity and Externalizing

	Between-Person	Within-Person Correlated Random Fluctuations
	Mean Correlation 95% CI	Mean Estimate 95% CI
IR–EXT	**-0.28 [-0.35, -0.21]**	**-0.19 [-0.34, -0.02]**
ORA–EXT	**-0.12 [-0.19, -0.06]**	-0.1 [-0.22, 0.01]
NORA–EXT	**-0.13 [-0.2, -0.06]**	0.13 [-0.04, 0.3]

Note. Int = Internalizing, SA = Substance Abuse, SWL = Satisfaction With Life, IR = Intrinsic Religiosity, ORA = Organizational Religious Activity, Non-Organizational Religious Activity. The parameters for the correlations between-person are from the correlated linear growth model and the parameters of within-person correlated random fluctuations from the auto-effects model. The between-person correlations are standardized. The within-person correlated random fluctuations are unstandardized.

Supplementary Table S9 Cross-Effects Between Religiosity and Externalizing and Their Country Moderations

Cross-Effect	Standardized Mean Estimate 95% CI	Unstandardized Mean Estimate 95% CI	Unstandardized Country Moderation Estimate Ken-Nam 95% CI	Unstandardized Country Moderation Estimate SA-Nam 95% CI
IR on EXT	0.1 [-0.08, 0.27]	0.11 [-0.09, 0.31]	-0.09 [-0.28, 0.11]	-0.14 [-0.33, 0.07]
EXT on IR	0.09 [-0.15, 0.33]	0.08 [-0.15, 0.3]	-0.03 [-0.23, 0.19]	**-0.35 [-0.64, -0.06]**
ORA on EXT	-0.13 [-0.3, 0.04]	-0.08 [-0.19, 0.03]	0.02 [-0.26, 0.29]	0.05 [-0.06, 0.16]
EXT on ORA	0.03 [-0.12, 0.18]	0.05 [-0.17, 0.29]	**-0.56 [-1.1, -0.05]**	-0.31 [-0.61, 0]
NORA on EXT	-0.06 [-0.23, 0.1]	-0.04 [-0.16, 0.08]	0.1 [-0.03, 0.23]	0.09 [-0.06, 0.24]
EXT on NORA	0.03 [-0.13, 0.18]	0.04 [-0.18, 0.26]	0 [-0.29, 0.3]	**-0.45 [-0.84, -0.04]**

Note. Ken = Kenya, Nam = Namibia, SA = South Africa. Bolded estimates show significant effects. The country moderations are unstandardized differences in effects and denote differences in of Kenya to Namibia (Ken-Nam) and South Africa to Namibia (SA-Nam). The cross-effects and country moderations are from the auto- and cross-effects model. The parameters are unstandardized for ease of interpretation.

References

DeSalvo, K. B., Bloser, N., Reynolds, K., He, J., & Muntner, P. (2006). Mortality prediction with a single general self-rated health question. *Journal of General Internal Medicine, 21*(3), 267-275. https://doi.org/10.1111/j.1525-1497.2005.00291.x

Driver, C. C., Oud, J. H. L., & Voelkle, M. C. (2017). Continuous time structural equation modeling with R package ctsem. *Journal of Statistical Software, 77*(5), 1-35. https://doi.org/10.18637/jss.v077.i05

Driver, C. C., & Voelkle, M. C. (2018). Hierarchical Bayesian continuous time dynamic modeling. *Psychological Methods, 23*(4), 774-799. https://doi.org/10.1037/met0000168

Hamaker, E. L., Kuiper, R. M., & Grasman, R. P. P. P. (2015). A critique of the cross-lagged panel model. *Psychological Methods, 20*(1), 102-116. https://doi.org/10.1037/a0038889

Hofmann, D., Hopwood, C., Laher, S., Asatsa, S., Florence, M., Shino, E., Naude, L., & Thalmayer, A. G. (2025). *The structure of psychopathology among young adults in Kenya, Namibia, and South Africa*. OSF Preprints. https://doi.org/10.31234/osf.io/cr4kv

Keyes, C. L. M. (2009). *Brief description of the Mental Health Continuum – Short Form (MHC-SF)*. Association of American Colleges & Universities. https://www.aacu.org/sites/default/files/MHC-SFEnglish.pdf

Padilla-Walker, L. M., & Jensen, L. A. (2016). Validation of the long- and short-form of the Ethical Values Assessment (EVA): A questionnaire measuring the three ethics approach to moral psychology. *International Journal of Behavioral Development, 40*(2), 181-192. https://doi.org/10.1177/0165025415587534

Rudert, S., Greifeneder, R., & Williams, K. (Eds.). (2019). *Current directions in ostracism, social exclusion and rejection research*. Routledge.