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Cross-Temporal Exploration of the Relationship Between Wisdom-Related Cognitive Broadening and Subjective Well-Being: Evidence From a Cross-Validated National Longitudinal Study

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Abstract

How do intraindividual changes in wisdom-related characteristics of cognitive broadening—open-minded reflection on challenging situations, consideration of change, and epistemic humility—relate to subjective well-being over time? To test this relationship, we performed cross-lagged panel analyses from three waves of the national U.S. sample taken across 20 years, utilizing a cross-validation approach: (i) conduct exploratory analyses on a random subset of data, (ii) preregister hypotheses and methods, and (iii) cross-validate preregistered hypotheses on the other random subset of the data. We found that broadening attitudes predicted greater affect balance and life satisfaction in later years, but not vice-versa. The effect was robust when controlling for trait-level broadening well-being associations, as well as sociodemographic characteristics, openness, and general cognitive abilities. The direction of the positive longitudinal relationship between broadening attitudes and subjective well-being has implications for major existing theories of adult development and subjective well-being.

Keywords

affect balance, broaden-and-build, life satisfaction, cognitive broadening, subjective well-being, longitudinal analysis, cross-validation, wisdom

Think of a person embodying wisdom, and a range of archetypes come to mind. On the one hand, there are religious and literary portrayals of suffering martyrs, people facing dramatic challenges and adversity—gains in wisdom appears to come at a cost (e.g., Glück & Bluck, 2013; Jayawickreme & Blackie, 2016). Such costs may include traumas and post-traumatic stress (e.g., Aldwin & Levenson, 2004; Blackie & Jayawickreme, 2014). On the other hand, archetypes of wisdom also appear to include portrayals of content or even blissful holy persons and sages, who are not only demonstrating a breadth and flexibility in their thinking but also show a deep appreciation and satisfaction with their lives (Weststrate et al., 2016).

How does wisdom-related cognitive breadth relates to subjective well-being (SWB; e.g., prevalence of positive over negative affect or life satisfaction; cf. Kahneman et al., 1999)? Despite the centrality of this question to much research on personal growth and SWB, relevant prior research has been cross-sectional, involved single-shot experiments, or involved samples of limited range, preventing a large-scale investigation of intraindividual change in characteristics of cognitive broadening that are central to philosophical portrayals of wisdom and SWB over time. The present research aims to fill this gap, utilizing a cross-validation approach to three waves of the national U.S. sample taken across 20 years.

Cognitive Broadening at the Center of Empirical Wisdom Construct

Though there are many faces of wisdom (Sternberg & Glück, 2019), practical wisdom or "phronesis" often involves pragmatic attitudes to life matters (Darnell et al., 2019; Grossmann

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et al., 2020; Tanesini, 2016). According to the common wisdom model shared across the majority of empirical wisdom scientists, central to practical wisdom are psychological processes linked to *cognitive broadening* (cf. Fredrickson, 2001)—perspectival flexibility, open-minded reflection on the situation at hand, appreciation of varied, exploratory thoughts, and ability to go beyond one's immediate knowledge and its limits (Grossmann et al., 2020). Philosophers have long speculated that such characteristics are critical for successful navigation of life's difficulties, suggesting that wisdom-related broadening attitudes contribute to SWB (Kekes, 1995; Tiberius, 2008).

Relationship of Cognitive Broadening and SWB Over Time

Building on philosophical and clinical ideas, the last three decades of experimental and cross-sectional research in psychology have documented a range of ways in which SWB may be related to wisdom-related cognitive broadening. Notably, the direction of the relationship between cognitive broadening and SWB appears inconclusive. On the one hand, wisdom scholars have suggested that broadening-related attitudes can provide deeper reflection (Tiberius, 2008; Weststrate & Glück, 2017) and a greater sense of meaning (Webster et al., 2018), which in turn relate to greater life satisfaction and contentment (Adler & Fagley, 2005; Ardelt & Jeste, 2016; Ho et al., 2010). Similarly, emotion researchers (e.g., Gross & Thompson, 2007; Lazarus & Folkman, 1984) have discussed features of cognitive broadening (e.g., exploration beyond one's focal perspective; acknowledgment of one's limited viewpoint) as central elements of the "cognitive reappraisal" process, which concerns the use of reasoning to reframe and reinterpret the meaning of a stressful stimulus to downregulate negative emotions. By modifying one's emotional reactions to challenging, anxiety-provoking experiences, reappraisal can sustain SWB (Gross & Thompson, 2007). Indeed, prior research has shown that wisdom-related cognitive broadening is associated with cognitive reappraisal (Brienza et al., 2018; Grossmann et al., 2016), which in turn was associated with SWB when working through challenging life experiences (Denny & Ochsner, 2014; Dorfman et al., 2019).

On the other hand, several models suggest the reverse directionality of the relationship. Izen's pioneering work (Baas et al., 2008; Isen et al., 1987) and more recent broaden-and-build theory of positive emotions (Fredrickson, 2001) suggest that positive emotions can broaden one's awareness and encourage novel, varied, and exploratory thoughts and actions, and buffer against narrowing effects of post-traumatic stress (Garland, Fredrickson, Kring, Johnson, Meyer, & Penn, 2010). In particular, the broaden hypothesis of the broad-and-build theory posits that greater SWB in the form of heightened positive emotions widens the array of thoughts, actions, and percepts that come to mind, with supporting evidence coming from experimental and individual-difference studies (for a review, see Fredrickson, 2013). The broaden-and-build hypothesis also dovetails with research on post-ecstatic growth, which suggests that positive emotions facilitate growth toward broadening-related meaning-making after positive experiences (e.g., Mangelsdorf & Eid, 2015; Roepke, 2013). Together, these theoretical models suggest that the changes in SWB, positive affect in particular, promote changes in cognitive broadening. Notably, the broad-and-build theory also suggests an "upward spiral" (Fredrickson, 2013): positivity-enhanced broadening fosters greater resilience and meaning, in turn producing greater experience of positive emotions. The notion of an "upward spiral" suggests a reciprocal relationship of SWB and cognitive broadening over time.

Limitations of Prior Research

Juxtaposing these perspectives raises the question about the relationship of intraindividual change in cognitive broadening and SWB over time. Despite the centrality of this question to much research on wisdom, cognition, and SWB, pertinent evidence appears inconclusive. Empirical tests of the relationship between cognitive broadening and SWB have chiefly focused on cross-sectional or experimental studies. Some of these cross-sectional studies suggest a positive relationship (e.g., Ardelt, 2016; Bergsma & Ardelt, 2012; Jayawickreme et al., 2017). For example, participants reporting more cognitive broadening in reflections on specific scenarios as assessed by trained observers also reported greater life satisfaction and less depressive rumination (Grossmann et al., 2013). However, other cross-sectional studies have found null or negative relationships (e.g., Brugman, 2000; Mickler & Staudinger, 2008; Wink & Helson, 1997). For instance, Kunzmann and Baltes (2003) found that participants whose reflections were classified as cognitive broader reported lower positive *and* negative affect.

Experimental studies have also shown both an effect of cognitive broadening on SWB (e.g., Denny & Ochsner, 2014; Dorfman et al., 2019; Kross et al., 2005) and an effect of positive emotions on cognitive broadening (e.g., Fredrickson & Branigan, 2005; Rowe et al., 2007; Wadlinger & Isaacowitz, 2006). Notably, some of this work was underpowered (e.g., $n = 24$; Rowe et al., 2007). Moreover, both cross-sectional and experimental studies operate on a different level of analysis than necessary to estimate a relationship between broadening and SWB *over time*. To avoid Simpson's paradox (Kievit et al., 2013), hypothesized longitudinal relationship of broadening and SWB requires prospective longitudinal methods (Blackie et al., 2016; Hamaker et al., 2007).

To our knowledge, only a handful of studies have examined the longitudinal relationship between wisdom-related cognitive broadening and SWB. Most of these studies have focused on limited time (3-weeks-to-10-months) or sample range (older adults: Ardelt, 2016; college students: Burns et al., 2008; Cohn et al., 2009; Fredrickson & Joiner, 2002). Moreover, the majority of the samples was small (median $N = 130$) and assessed the relationship only at two time points, preventing formal testing of recursive paths between broadening and SWB (Fredrickson & Joiner, 2018).

Hypotheses and Study Overview

The current study sought to provide a longitudinal test of the relationship between characteristics related to cognitive broadening and SWB (affect balance—i.e., the relative experience of positive over negative affect, and life satisfaction). To reduce the potential for biased decision-making when using secondary data (Weston et al., 2019), we followed a cross-validation approach that involved developing the analytic model with half of the data and then preregistering the confirmatory analytic models that would be conducted with the other half of the data. First, we expected that attitudes related to cognitive broadening would be associated with greater affect balance and life satisfaction at each time point (Hypothesis 1). As philosophers and some wisdom scientists promote the idea that cognitive broadening affords SWB (e.g., Ardelt, 2016; Tiberius, 2008), we also expected that broadening would predict increased SWB 10 years later (Hypothesis 2A). Following the broad-and-build theory (Fredrickson, 2001), we also tested whether SWB would predict broadening 10 years later (Hypothesis 2B). In exploratory analyses, we further tested the "upward spiral" notion of the broaden-and-build theory, examining the reciprocal nature of the broadening-SWB relationship over time (i.e., whether cross-temporal effect of SWB on broadening is followed by an effect of broadening on SWB at a later time point and vice versa).

Method

Hypotheses and methods were preregistered and are available with data and code on Open Science Framework (https://osf.io/r4zq2).

Participants

We analyzed data from the national longitudinal study of Midlife Development in the United States, started in 1995/96 by the MacArthur Foundation Research Network on Successful Midlife Development (MIDUS; Brim et al., 1999; Ryff et al., 2007, 2015). The chief goal of the study was to explore the role of behavioral, psychological, and social factors in accounting for variations in health and well-being in a national sample of Americans (for more detail, see http://midus.wisc.edu). We aimed to use all available data with a longitudinal component (i.e., participants completed at least two waves; see Table 1), available from the Inter-university Consortium for Political and Social Research repository (www.icpsr.umich.edu). Our sample included 4,963 participants who completed the first (1995–1996) and the second waves of the study (2005–2006). Of them, 3,294 completed the third wave (2013–2014).

Table 1. Demographic Information at Time 1.

	Training Set	Test Set
Mean age	46.34	46.32
Sex (% female)	54.88	53.64
Ethnicity (%)		
African American	4.96	4.27
Asian American	0.79	0.68
European American	92.95	92.50
Native American	0.52	0.31
Multiracial	0.21	0.68
Other	1.18	1.57
Educational attainment (%)		
Less than high school	7.15	6.68
High school diploma or GED	31.71	33.13
Some college/vocational degree	25.81	26.32
4-year college degree	23.22	21.51
Graduate or professional degree	12.12	12.36
N at Times 1 and 2	2,481	2,416
N at Time 3	1,675	1,602

Note. One participant in the test set did not indicate age.

Measures

Cognitive broadening. Surveys included three questions tapping into cognitive broadening: (i) "In a bad situation, it helps to find a different way of looking at things" (perspectival flexibility; 1 = *not at all* to 4 = *a lot*); (ii) "I think it is important to have new experiences that challenge how I think about myself and the world" (epistemic humility); (iii) "Life has been a continuous process of learning, changing, and growth" (recognition of a changing world; 1 = *strongly disagree* to 7 = *strongly agree*). The rationale to focus on these variables concerned their family resemblance of items in the construct of wise reasoning (Grossmann, 2017). The three variables were interrelated at each wave (rs = .23–.57).

Affect balance. Participants rated the degree to which they experienced six positive feelings ("cheerful," "in good spirits," "extremely happy," "calm and peaceful," "satisfied," and "full of life") and six negative feelings ("so sad nothing could cheer you up," "nervous," "restless or fidgety," "hopeless," "that everything was an effort," and "worthless") over the past 30 days (1 = *all of the time* to 5 = *none of the time*). Items were reverse scored so that higher values indicated more frequent experiences of positive and negative affect. The items measuring positive and negative affect were reliable at each wave and in both training and test sets (positive affect αs = .91; negative affect: .85 < αs < .87), and we collapsed them into positive and negative affect scores. To look at the relative experience of positive as opposed to negative affect, we used the difference between the two mean scores (Kahneman et al., 1999) in our models. Positive values represent more positive affect overall. For additional analyses including separate positive and negative affect components, see Supplementary Online Materials (SOM).

Life satisfaction. Participants rated their "life overall," "health," "work situation," "overall relationship with [their] children," and "marriage or close relationship" these days (from 0 = *worst possible* to 10 = *best possible*). We used a composite score created by MIDUS (Brim et al., 1999), which involved first averaging the relationship with children and close relationship items into an overall relationship satisfaction score, and

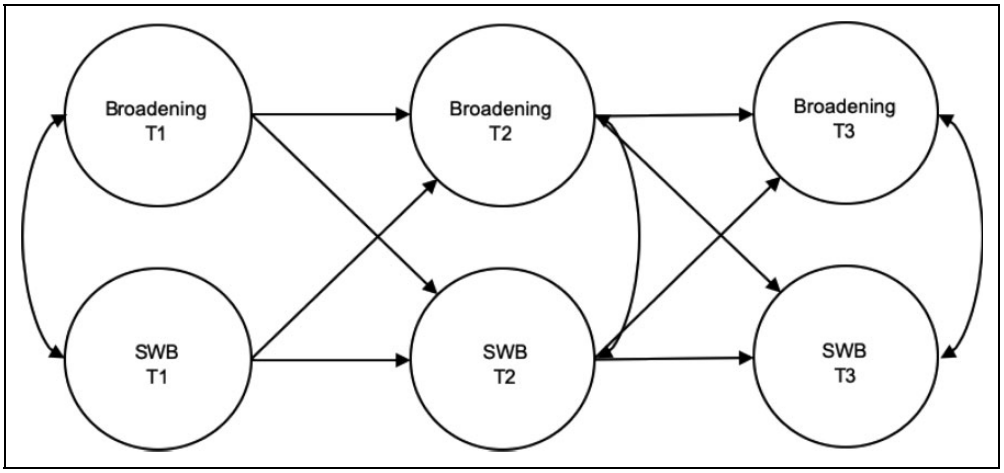

Figure 1. Conceptual path model of cognitive broadening and subjective well-being variables across three time points (T1, T2, and T3). Circles represent latent variables. The straight arrows represent regression paths, and the curved arrows represent correlations between the residuals of the latent variables.

then averaging life overall, health, work, and relationship scores (αs =.63–.67 across the three time points).

Reliability and Validation of Cognitive Broadening

We estimated the reliability and validity of the three cognitive broadening items by performing a psychometric study ($N = 151$), simultaneously assessing individual differences in holistic cognitive thinking style (Choi et al., 2007), active-open-minded thinking (Stanovich & West, 1997), wise reasoning (Brienza et al., 2018), psychological well-being (Ryff & Keyes, 1995), and social desirability (Stöber, 2001). As reported in the SOM, cognitive broadening instrument has shown good reliability ($\alpha = .74$), was statistically unrelated to social desirability, moderately associated with personal growth/psychological well-being, and has shown unique (compared to personal growth psychological well-being) association with holism, active-open-minded thinking, and wise reasoning (see Table S1 in the online supplement), providing support for a distinct nomological network of cognitive broadening.

Analytic Procedure

We performed analyses in two phases: exploration and confirmation. We randomly split the data into a training and a test data set using the *R* caret package (Kuhn, 2017). We performed the exploratory analyses and modifications to the model of affect balance in the training set ($N = 2{,}481$). We preregistered the confirmatory analyses for affect balance and conducted only once in the test data set ($N = 2{,}482$). This approach is consistent with recent recommendations for secondary data analyses (Weston et al., 2019), which involves preregistering concrete specifications for a statistical model and testing their robustness on a separate part of the data set, thereby avoiding overfitting.[1]

As we expected the life satisfaction model to be similar to the affect balance model, we preregistered this model and conducted the analysis only once in the test data set. We also conducted control analyses on the test-set controlling for the Big Five personality traits.

We set up a cross-lagged panel model in *Lavaan* package in *R* (Rosseel, 2017). For each of the three waves, cognitive broadening and SWB predicted each other (see Figure 1). At each time point, cognitive broadening is a latent variable consisting of three items. To establish the cross-temporal stability of the variables, we allowed t variables to predict their $t + 1$ counterparts. We allowed the variables to covary at each wave to rule out the possibility that a cross-lagged effect is an artifact of a correlation between broadening and SWB. Following established guidelines (Enders & Bandalos, 2001), we used full information maximum likelihood estimation to deal with missing values and used RMSEA < .08, PCLOSE > .05, and CFI > .95 as criteria for an acceptable model fit (Meyers et al., 2006).

Results

Cognitive Broadening and Affect Balance

Both the training and test sets showed a good model fit, training: RMSEA = .04, PCLOSE = .99, CFI = .97; test: RMSEA = .05, PCLOSE = .93, CFI = .97, and the cognitive broadening items loaded onto one latent construct[2] (see Table 2). Supporting Hypothesis 1, at each time point cognitive broadening and affect balance were positively correlated, training: rs = .36–.38; test: rs = .28–.34.We examined how cognitive broadening relates to affect balance over time. In the training set, both cognitive broadening and affect balance predicted their counterparts 10 years later, suggesting moderate-high cross-temporal stability of these variables (see Figure 2A). Furthermore, this model suggested that increased cognitive broadening led to greater affect balance 10 years later. We confirmed both observations on the test set (see Figure 2B).Subsequently, we estimated overall effects across all three time points by constraining the T1 → T2 and T2 → T3 crossed paths

Table 2. Factor Loadings for the Cognitive Broadening.

Data Set	Latent Factor	Indicator Item	*B* (*SE*)	β
Training set	Cognitive broadening T1 (n = 2,481)	Epistemic humility	—	.71
		World in flux and change	1.14 (.05)	.80
		Perspectival flexibility	0.39 (.02)	.40
	Cognitive broadening T2 (n = 2,481)	Epistemic humility	—	.48
		World in flux and change	1.29 (.09)	.65
		Perspectival flexibility	0.50 (.04)	.43
	Cognitive broadening T3 (n = 1,675)	Epistemic humility	—	.47
		World in flux and change	1.30 (.11)	.68
		Perspectival flexibility	0.51 (.05)	.41
Test set	Cognitive broadening T1 (n = 2,482)	Epistemic humility	—	.66
		World in flux and change	1.22 (.06)	.81
		Perspectival flexibility	0.43 (.03)	.43
	Cognitive broadening T2 (n = 2,482)	Epistemic humility	—	.50
		World in flux and change	1.20 (.08)	.67
		Perspectival flexibility	0.46 (.03)	.43
	Cognitive broadening T3 (n = 1,618)	Epistemic humility	—	.50
		World in flux and change	1.16 (.10)	.68
		Perspectival flexibility	0.46 (.04)	.41

Note. Affect balance and life satisfaction are single-item variables in their respective models and do not have loading information. *B* (*SE*) = unstandardized factor loadings and standard errors; β = standardized factor loadings; T1 = Time 1; T2 = Time 2; T3 = Time 3.

to be equal. Adding this constraint did not significantly affect the model (compared to the unconstrained model), training set: $\chi 2\ diff(1) = 0.02$, *ns*; test set: $\chi^2\ diff(1) = 0.85$, *ns*, justifying overall analyses. In support of Hypothesis 2A, cognitive broadening led to significantly greater affect balance over time, training set: $B = 0.11$, $SE = 0.03$, $z = 3.51$, β = .07, 95% CI [0.05, 0.16], $p < .001$; test set: $B = 0.12$, $SE = 0.03$, $z = 4.24$, β = .08, 95% CI [0.07, 0.19], $p < .001$. In both data sets, the reverse (broadening → affective balance) relationship was not significant.

Preregistered analyses with positive and negative affect as separate components in the same model yield a significant effect of cognitive broadening predicting shifts in positive but not negative affect both for T1 → T2 and T2 → T3 crossed paths (see Table S2 in the online supplement). Similar to the affect balance findings, evidence of a reverse relationship was less systematic (i.e., a T1 → T2 crossed path, but no significant T2 → T3 crossed path).

Cognitive Broadening and Life Satisfaction

Given our observed results with affect balance, we preregistered the prediction that cognitive broadening would lead to greater life satisfaction over time, using the test data set for confirmatory analyses. This model showed good fit, RMSEA = .04, PCLOSE = .99, CFI = .97.

At each time point, cognitive broadening and life satisfaction were positively correlated, *r*s = .28–.31. Also, both variables predicted their counterpart 10 years later (see Figure 3). Moreover, cognitive broadening led to greater life satisfaction 10 years later (see Figure 3). Additionally, life satisfaction at Time 1 predicted higher cognitive broadening at Time 2. However, this effect was of small magnitude and inconsistent across waves.

As with the previous study, we found that constraining the T1 → T2 and T2 → T3 paths to be equal did not significantly affect the model, $\chi^2 diff(1) = 0.24$, *ns*, justifying analyses of overall cross-temporal effects. Cognitive broadening significantly predicted life satisfaction, $B = 0.13$, $SE = 0.03$, $z = 4.03$, β = .08, 95% CI [0.07, 0.20], $p < .001$. When looking at the effect of life satisfaction on cognitive broadening, we found that the T1 → T2 and T2 → T3 paths were significantly different, $\chi^2 diff(1) = 5.13$, $p = .02$. This observation suggests that the significant effect of T1 life satisfaction on T2 cognitive broadening is specific to the periods between Time Points 1 and 2 and does not extend to the relationship between Time 2 and Time 3.

Robustness Checks

We performed exploratory (nonpreregistered analyses) in which we (i) systematically compared average-based and latent-model-based cross-lagged estimates of broadening and SWB; (ii) performed random-intercept cross-lagged panel models (RICLPM; see Figure S1 in the online supplement), allowing the separate trait versus within-person variance and control for cross-temporal stability of each construct, and (iii) controlled for a range of covariates, reported in full in the online supplement.

Examining average broadening scores instead of latent-based scores yields similar results: broadening systematically predicted SWB over time, with weaker reverse (SWB → broadening) paths. Similarly, examining latent-model estimates of broadening (3 items) and SWB (3 items: positive affect, negative affect, life satisfaction) yields a significant

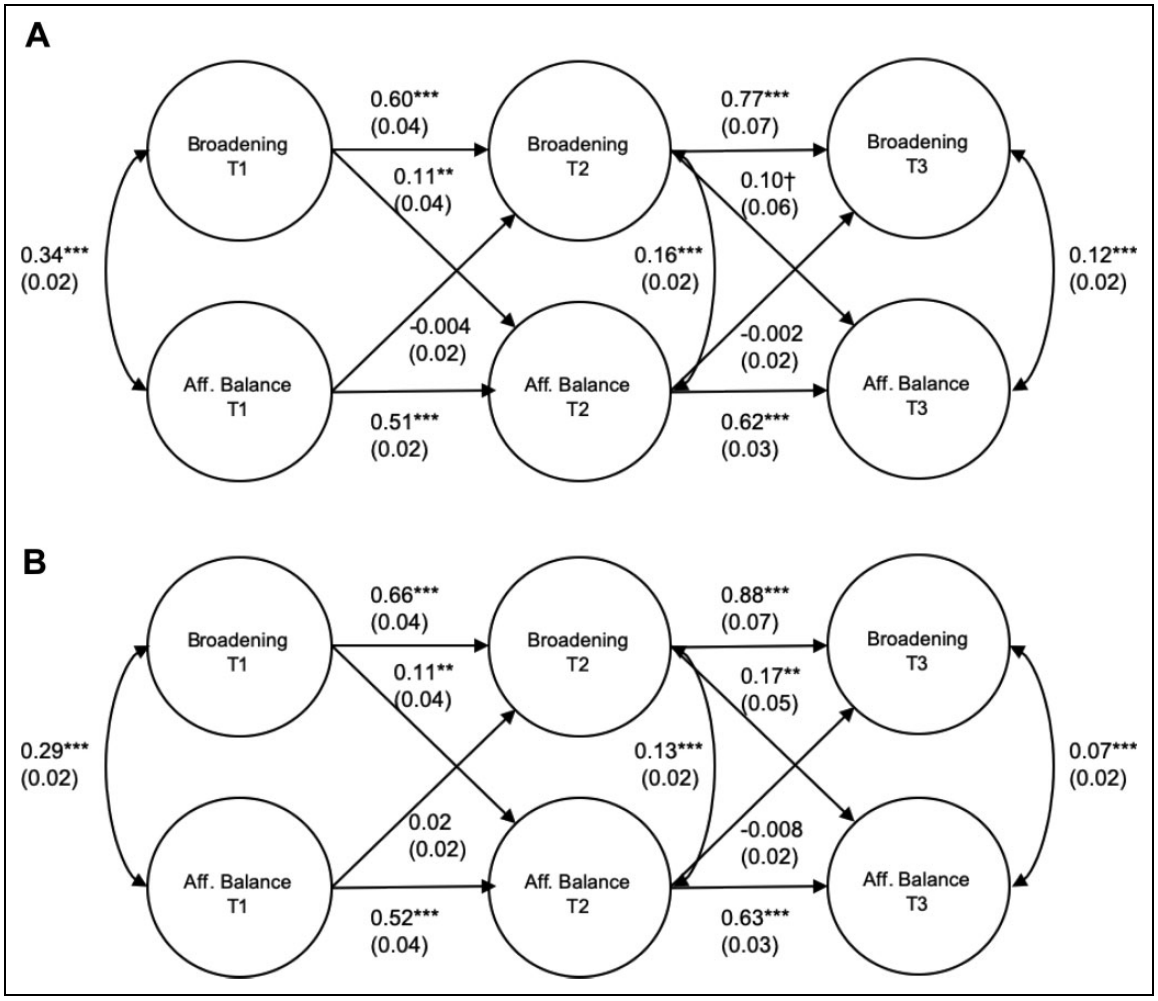

Figure 2. Path model of cognitive broadening and affect balance across three time points (T1, T2, and T3). Circles represent latent variables. Unstandardized estimates and significant errors for the training and test set data are shown. The straight arrows represent regression paths, and the curved arrows represent correlations between the residuals of the latent variables. $^{\dagger}p < .08$, $^{*}p < .05$, $^{**}p < .01$, $^{***}p < .001$.

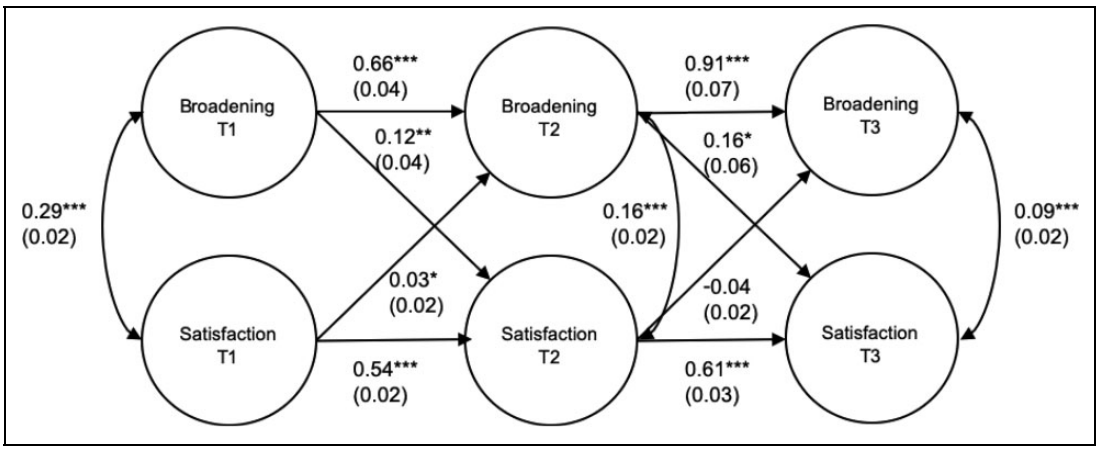

Figure 3. Path model of cognitive broadening and life satisfaction across three time points (T1, T2, and T3). Analyses were conducted in the test set. Circles represent latent variables. Unstandardized estimates and significant errors are shown. Analyses were only conducted on the test set. Straight arrows represent regression paths, and curved arrows represent correlations between the residuals of the latent variables. $^{\dagger}p < .08$, $^{*}p < .05$, $^{**}p < .01$, $^{***}p < .001$.

cross-lagged broadening → SWB effect, but no significant SWB → broadening effect.

RICLPM analyses in the SOM further showed significant trait and within-person state associations of broadening and SWB (both affective balance, life satisfaction, and average SWB score). Notably, the RICLPM effects were more nuanced than the traditional CLPM results reported earlier: Whereas RICLPM showed both trait-level and wave-specific associations between cognitive broadening and SWB for each time point, the unbiased cross-lagged broadening → SWB effects were only significant from T1 to T2, and not significant thereafter (see Table S2 in the online supplement; also note an exception to this general pattern for positive affect that showed a stronger cross-lagged effect between T2 and T3).

Moreover, when controlling for trait-level association, we observed significant cross-lagged effects of broadening on SWB and no significant reverse (SBW → broadening) paths. When controlling for income, education, physical health, mental health, and participant attrition, the reported relationships for affective balance remained significant (see Table S3 in the online supplement). Equivalent robustness analyses for life satisfaction analyses indicated that the effect of cognitive broadening remained significant from Time 1 to Time 2; the path from Time 2 to Time 3 was no longer significant but was still trending in the positive direction. In contrast, the effect of life satisfaction on cognitive broadening was no longer significant.

Finally, we showed that the effects of cognitive broadening on life satisfaction held when controlling for participants' domain-general cognitive abilities and Big Five openness. Notably, contrary to the suggestions that cognitive broadening afford SWB in part due to greater openness (Weststrate & Glück, 2017; Zacher & Staudinger, 2018), we failed to observe an indirect effect of cognitive broadening on well-being via openness (see Figure S2 and Table S4 in the online supplement).

Discussion

In the present work, we examined 20 years of longitudinal data to investigate the relationship between wisdom-related cognitive broadening and SWB. Based on prior theory and research (Fredrickson, 2013; Gross & Thompson, 2007; Roepke, 2013; Tiberius, 2008; Weststrate & Glück, 2017), we identified two alternative hypotheses concerning the directionality of the broadening-SWB relationship. On the one hand, cognitive broadening could help people manage conflicts in their lives and sustain SWB over time. On the other hand, SWB may afford growth in broadening, widening one's psychological repertoire and providing an opportunity to reach beyond one's habitual ways of thinking. We tested these two hypotheses on a national sample of Americans, who reported their broadening and SWB tendencies across three waves spread 20 years apart. The results indicated that the longitudinal path from cognitive broadening (open-mindedness to diverse perspectives, recognition of a changing world, epistemic humility) to SWB is more likely than vice versa. We preregistered this hypothesis along with analytic procedures, obtaining converging results from the test set. The results hold when controlling for trait-level association and stability of cognitive broadening and markers of SWB, and when including a range of cognitive, health, and personality covariates. In particular, the observed relationship between cognitive broadening and SWB appears distinct from the relationship between SWB and personality variables such as openness. This finding is consistent with prior observations of cognitive broadening measures (based on assessment of reasoning and reflection on life's challenges) showing distinct pattern of results from adjective-based measurement of openness (e.g., Brienza et al., 2018; Grossmann et al., 2013).

Overall, longitudinal analyses indicated that cognitive broadening predicted greater affect balance and life satisfaction later in life, in line with the broadening → SWB hypothesis. Contrary to the claims from the broaden-and-build theory (Fredrickson, 2001), we found limited support for the SWB → broadening hypothesis. Though on some markers of SWB, we found a positive cross-temporal effect for broadening, this effect was always weaker than the effect of broadening on SWB and disappeared when we controlled for trait-level stability in RICLPM analyses. Moreover, we observed little evidence of the "upward spiral" (Fredrickson, 2013), which suggests that initial positivity promotes broadening over time, which in turn promotes greater SWB: Across most analytic procedure we employed, initial-level SWB did not impact subsequent change in broadening 10 years later. The only exception was evident in the classic CLPM, showing a positive cross-lagged effect of T1 life satisfaction for T2 broadening (but even here the reverse broadening → life satisfaction effect was double in size). Supplementary analyses further showed weak evidence for markers of openness to new experiences statistically accounting for the relationship between cognitive broadening and SWB (see Tables S7 and S8 in the supplement), which are related but distinct constructs relative to cognitive broadening (as we established in the supplementary psychometric analyses, see Table S1), suggesting that the reported SWB-related findings are specific to cognitive broadening.

Though the present results are consistent with theorizing on wisdom (Tiberius, 2008) and empirical evidence concerning effects of broadening-related strategies for regulating one's emotions (e.g., Denny & Ochsner, 2014; Dorfman et al., 2019; Gross & Thompson, 2007; Kross et al., 2005), the observed pattern of results on the surface appear inconsistent with some of the prior empirical evidence within the body of research on the broaden-and-build theory (for a review, see Fredrickson, 2013). There are several reasons for the ostensible inconsistency. First, experimental and cross-sectional evidence of positivity promoting broadening in situ does not have to correspond to *intraindividual change* in broadening as a function of changes in SWB. Second, only a handful of studies so far have examined the question how positivity influences intraindividual growth in broadening, chiefly focusing on small samples of undergraduates at elite American colleges. It is therefore possible that prior observations don't generalize to

a broader population. Third, none of prior research has examined associations across more than two cross-temporal points and have controlled for trait-level associations (and rank-order stability) of cognitive broadening and SWB. Consequently, the previously observed cross-lagged associations between positivity and broadening may be statistical artifacts (Hamaker et al., 2015).

Notably, beyond providing partial support for a cross-lagged relationship between cognitive broadening and SWB, supplementary RICLPM analyses for the first time established not only a moderate-level trait-level association between cognitive broadening and SWB but also a systematic state-specific (intraindividual) positive association in a small-moderate range between these constructs. Consequently, it is possible that broadening and SWB show bidirectional relationships in a given moment or over shorter time span (Fredrickson, 2013; Weststrate & Glück, 2016), even though only broadening impacts growth in SWB over longer time periods.[3]

The present research dovetail with an emerging body of research on wisdom-related processes, supporting some of the previous observations of a positive relationship between wisdom-related characteristics and well-being (e.g., Ardelt, 2016; Bergsma & Ardelt, 2012; Jayawickreme et al., 2017). The present work extends this scholarship, for the first time providing longitudinal evidence from a representative sample of Americans studied over time. Theoretically, our findings support the philosophical contention that cognitive broadening help people achieve a better life (e.g., Baltes & Smith, 2008; Kekes, 1995; Tiberius, 2008). The present work also dovetails with studies observing that a sense of meaning in life can promote happiness (see King et al., 2016, for a review), suggesting that cognitive broadening may play a role linking eudaimonic and hedonic aspects of well-being.

Before concluding, a few caveats are in order. As is typical with secondary data sources, the longitudinal study we used was not designed to capture all aspects of cognitive broadening and focused on attitudinal measures. Further, the present work utilized data from the same participants assessed 10 years apart. Examining a lag of 10 years is a conservative test of our hypotheses, as the lag assumes that cognitive broadening has long-lasting effects. Other studies with shorter intervals may reveal different theorized patterns that we did not find in the current study (but see Ardelt, 2016, for a consistent pattern with our results), as well as examine day-to-day fluctuations in wisdom-related characteristics in daily life (e.g., Grossmann et al., 2016). Finally, we focused on SWB broadly, and future work may benefit from examining relationship between specific emotions and broadening-related cognitive processes.

We also note that future studies can improve the implementation of the cross-validation method. For instance, while we preregistered our revised model and hypotheses after completing the training phase, we did not upload a time-stamped syntax of the training analysis code before analyzing the test set. A more streamlined cross-validation may benefit from an automated data splitting process performed by data repositories, which could automatically partition the data into train and test sets before analyses, making the test set available after a time-stamped preregistration plan is uploaded to the same repository. These additions can reduce the chance for various forms of self-deception and hindsight bias. As with most secondary data, we have also been aware of patterns previously documented on the data we utilized (e.g., Ryff, Miyamoto, et al., 2015), which may impact our preference for analytic procedures. To address this issue, other methods that encourage transparent analyses, such as multiverse analyses (Steegen, Tuerlinckx, Gelman, & Vanpaemel, 2016), can be integrated with the cross-validation method, applying a wide range of possible analytical procedures on the training set. As with all preregistration procedures, these and other efforts ultimately rely on the researcher's honesty (van't Veer & Giner-sorolla, 2016).

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Supplemental Material

The supplemental material is available in the online version of the article.

Notes

1. Though the preregistered model did not account for twin/sibling dependencies in the MacArthur Foundation Research Network on Successful Midlife Development data, accounting for interdependence in post hoc analyses yield virtually identical results to those reported in the manuscript.
2. As the item tapping into the recognition of different perspectives had a relatively low loading compared to the other items, we conducted further analyses without this item in supplementary analyses (see Tables S5 and S6). The findings without this item were similar to those reported here.
3. Contrary to some adult developmental perspectives on wisdom (e.g., Grossmann et al., 2013; Labouvie-Vief, 2003), we also found little evidence of age-related differences in the relationship between wisdom-related cognitive broadening and well-being,

suggesting that the relationship is functional both for younger and older adults (see online supplement).

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