Journal of Psychiatric Research 108 (2019) 40–47

Contents lists available at ScienceDirect

Journal of Psychiatric Research

journal homepage: www.elsevier.com/locate/psychires

A new scale for assessing wisdom based on common domains and a neurobiological model: The San Diego Wisdom Scale (SD-WISE)

Michael L. Thomas [a, b], Katherine J. Bangen [a, b], Barton W. Palmer [a, b, c], Averria Sirkin Martin [a, c], Julie A. Avanzino [a, c], Colin A. Depp [a, b, c], Danielle Glorioso [a, c], Rebecca E. Daly [a, c], Dilip V. Jeste [a, c, d, *]

[a] Department of Psychiatry, University of California San Diego, La Jolla, CA, United States
[b] Veterans Affairs San Diego Healthcare System, San Diego, CA, United States
[c] Sam and Rose Stein Institute for Research on Aging, University of California San Diego, La Jolla, CA, United States
[d] Department of Neurosciences, University of California San Diego, La Jolla, CA, United States

A R T I C L E I N F O

Article history:
Received 3 July 2017
Received in revised form
29 August 2017
Accepted 1 September 2017

A B S T R A C T

Wisdom is an ancient concept that has gained new interest among clinical researchers as a complex trait relevant to well-being and healthy aging. As the empirical data regarding wisdom have grown, several measures have been used to assess an individual's level of wisdom. However, none of these measures has been based on a construct of wisdom with neurobiological underpinnings. We sought to develop a new scale, the San Diego Wisdom Scale (SD-WISE), which builds upon recent gains in the understanding of psychological and neurobiological models of the trait. Data were collected from 524 community-dwelling adults age 25–104 years as part of a structured multi-cohort study of adult lifespan. Participants were administered the SD-WISE along with two existing measures of wisdom that have been shown to have good psychometric properties. Factor analyses confirmed the hypothesized measurement model. SD-WISE total scores were reliable, demonstrated convergent and discriminant validity, and correlated, as hypothesized, negatively with emotional distress, but positively with well-being. However, the magnitudes of these associations were small, suggesting that the SD-WISE is not just a global measure of mental state. The results support the reliability and validity of SD-WISE scores. Study limitations are discussed. The SD-WISE, with good psychometric properties, a brief administration time, and a measurement model that is consistent with commonly cited content domains of wisdom based on a putative neurobiological model, may be useful in clinical practice as well as in bio-psycho-social research, especially investigations into the neurobiology of wisdom and experimental interventions to enhance wisdom.

© 2017 Elsevier Ltd. All rights reserved.

1. Introduction

Wisdom is an ancient concept (Birren and Svensson, 2005; Jeste and Vahia, 2008) that has gained new interest among clinical researchers as a complex trait relevant to general physical and mental health (Ardelt, 2000, 2003; Jeste et al., 2013; Roharikova et al., 2013; Thomas et al., 2017; Webster et al., 2014), well-being (Ardelt and Jeste, 2016), happiness (Bergsma and Ardelt, 2012; Etezadi and Pushkar, 2013; Thomas et al., 2017; Zacher et al., 2013), life satisfaction (Ardelt, 1997, 2000; Ferrari et al., 2011; Le, 2011; Thomas et al., 2017), personal mastery (Ardelt, 2003; Etezadi and Pushkar, 2013; Thomas et al., 2017), and resilience (Jeste et al., 2013). These studies suggest that wisdom is a useful construct with important implications for individuals as well as society. For empirical studies of a personality trait, it is necessary to define it, measure it in a reliable and valid manner, and understand its underlying bio-psycho-social basis. Below we summarize evolution of the concept of wisdom, including attempts to define and measure it and to decipher its underpinnings.

The concept of practical (as opposed to theoretical) wisdom has been discussed since the times of Aristotle (McKeon, 1941), but is used in recent years to refer to knitting together the cognitive,

* Corresponding author. Stein Institute for Research on Aging, University of California–San Diego, 9500 Gilman Drive, #0664, La Jolla, CA 92093-0738, United States.
E-mail address: djeste@ucsd.edu (D.V. Jeste).

http://dx.doi.org/10.1016/j.jpsychires.2017.09.005
0022-3956/© 2017 Elsevier Ltd. All rights reserved.

social, and emotional processes involved in everyday decision making – i.e., actual decisions and choices one might make rather than the abstraction of a 'wise' person (Nusbaum, 2016). Erikson (1959) proposed the last stage of psychosocial development culminating in wisdom. Beginning in the 1970s, Baltes and others initiated empirical research on wisdom, focusing on cognitive abilities (Baltes et al., 1992; Clayton and Birren, 1980). Subsequently, several investigators drew attention to the importance of emotional regulation (Ardelt, 2003; Staudinger and Glück, 2011; Sternberg, 1990), and Vaillant, Cloninger, and Blazer stressed the potential role of wisdom in well-being (Blazer and Kinghorn, 2015; Cloninger, 2012; Vaillant and Mukamal, 2001).

1.1. Defining wisdom

Based on a review of empirically based definitions of wisdom published in peer-reviewed journals (Bangen et al., 2013), mostly from western countries, we identified six most commonly included components of wisdom: (1) *general knowledge of life and social decision making* - ability to give good advice, life knowledge, and life skills; (2) *emotional regulation* - affect regulation and self-control; (3) *pro-social behaviors* - e.g., empathy, compassion, altruism, and a sense of fairness; (4) *insight* - the ability and desire to understand oneself and one's actions at a deep level; (5) *value relativism* (*tolerance for divergent values)* - being nonjudgmental and accepting of other value systems; and (6) *decisiveness* - the ability to make quick and effective decisions (Bangen et al., 2013; Meeks and Jeste, 2009). Current thinking in wisdom research considers the entity of wisdom not as a collection of distinct traits, but rather as a higher-order construct that includes various domains such as prosocial behaviors, emotional regulation, and others listed above (Ardelt, 2003; Bangen et al., 2013). Thus, overall wisdom is greater than the sum of its parts in terms of its utility to the self and the society.

In a separate survey study using the Delphi method, international researchers in the field agreed that the components mentioned above were key to defining wisdom (Jeste et al., 2010). Finally, a mixed-methods study of wisdom in the Bhagavad Gita, a scripture written in India several thousand years ago, suggested that most of those components had also characterized the ancient Indian construct of wisdom (Jeste and Vahia, 2008). The same seems to hold true for the Books of Wisdom in the Bible and documents in most other religions. Whereas the relative emphasis on specific components of wisdom has varied across cultures and times, there have been more similarities than differences among different postulated concepts of wisdom over the centuries and around the world, suggesting that there is an underlying biological substrate of wisdom that influences and is influenced by life experiences.

1.2. Putative neurobiological basis

By examining the neurobiology of consistently identified components of wisdom, one can begin to hypothesize how such a complex human characteristic may be orchestrated within the human brain. Accordingly, we reviewed studies focusing on neuroimaging/brain localization and neurotransmitters associated with individual components of wisdom (Meeks and Jeste, 2009). Prefrontal cortex and amygdala seemed to be the main brain regions related to all of these components. The prefrontal cortex figures prominently in emotional regulation, social decision making, and value relativism, primarily via top-down regulation of limbic (amygdala) and striatal regions. The dorsolateral prefrontal cortex facilitates calculated, reason-based decision making, whereas the ventromedial prefrontal cortex is implicated in emotional valence and prosocial attitudes/behaviors. Reward neurocircuitry (ventral striatum, nucleus accumbens) also appears important for promoting prosocial attitudes/behaviors.

We also approached the putative neurobiology of wisdom by examining behavioral effects of localized brain damage (Meeks and Jeste, 2009). Severe damage to the above-mentioned areas, especially the prefrontal cortex, either through trauma or disease, results in a loss of personality characteristics associated with wisdom. A number of cases have been described, starting with the well-known case of Phineas Gage, in whom damage to frontostriatal and frontolimbic circuits resulted in loss of behaviors listed as components of wisdom (Cato et al., 2004). A noteworthy example is the behavioral variant of frontotemporal dementia, with brain atrophy restricted to anterior portions of the prefrontal lobes (Miller et al., 2001), which is associated with dramatic changes in personality as the patients become impulsive, socially inappropriate, and emotionally inept, with behaviors antithetical to wisdom.

1.3. Measuring wisdom

Our review of wisdom measures showed nine published scales (Bangen et al., 2013). Each measure has strengths and limitations. Measures with significant strengths include the Three-Dimensional Wisdom Scale (3D-WS) (Ardelt, 2003) with its rigorous development and good psychometric properties and the Self-Assessed Wisdom Scale (SAWS) (Webster, 2003) with demonstrations of several types of validity across samples. However, these scales are only moderately correlated (Taylor et al., 2011), and focus on different domains of wisdom.

1.4. Aim of the current study

We aimed to develop a new scale (San Diego Wisdom Scale or SD-WISE) that more closely aligns with the existing body of empirical research on wisdom by assessing each of the above-mentioned six commonly cited content domains with postulated neurobiological basis. We hypothesized that these six lower-order factors representing the content domains would indicate a single, higher-order wisdom factor. Our model of wisdom is based on a multidimensional structure, and thus, we attempt to acknowledge fine-grained components while focusing our overall measure on the more general construct. Our second aim was to determine whether the subscales of this new measure, along with subscales from existing measures of wisdom (3D-WS and SAWS) measure the same general trait. We also hypothesized that SD-WISE total scores would correlate with several measures of well-being.

2. Method

2.1. Design and sample

Participants were recruited from the University of California, San Diego (UCSD) Successful AGing Evaluation (SAGE) study (Jeste et al., 2013; Thomas et al., 2016), a structured multi-cohort investigation of community-dwelling adults recruited using list-assisted random digit dialing. Exclusion criteria were: 1) residence in a nursing home or need for daily skilled nursing care, 2) self-reported diagnosis of dementia, 3) terminal illness or need for hospice care, and 4) lack of fluency in English. SAGE participants were emailed a request to complete an online survey which included candidate items for the SD-WISE as well as several measures of convergent and discriminant validity. Invitations were sent to 1108 individuals currently active in the SAGE study, who had email addresses on file. Of these, 524 (47%) responded to the survey. The study was approved by the UCSD Human Research Protections Program.

2.2. Measures

Convergent and discriminant measures: Although the SD-WISE has been designed to assess unique constructs, the measure ought to correlate more strongly with existing measures of wisdom in comparison to measures of positive psychological traits believed to be distinct from wisdom. Therefore, measures of convergent validity included the 12-item Three-Dimensional Wisdom Scale (3D-WS-12) (Thomas et al., 2017), with cognitive, reflective, and affective (compassionate) subscales, and the 40-item Self-Assessed Wisdom Scale (SAWS) (Webster, 2003, 2007), with experience, emotional regulation, reminiscence/reflection, humor, and openness subscales. The 3D-WS-12 is an abbreviated version of the 39-item 3D-WS (Ardelt, 2003). Both the SAWS and the 3D-WS (and 3D-WS-12) have demonstrated acceptable reliability and validity (Gluck et al., 2013; Taylor et al., 2011; Thomas et al., 2017).

To assess discriminant validity, the Balanced Inventory of Desirable Responding - Short Form (BIDR-16) (Hart et al., 2015) was administered. It includes subscales that assess Self-Deceptive Enhancement (SDE), a measure of one's belief in the truth of own positive self-image, and Impression Management (IM), a measure of one's conscious attempts to favorably influence others' views of one's image. Taylor and colleagues (Taylor et al., 2011) have argued that wisdom scores should be positively correlated with Self-Deceptive Enhancement scores because positive self-deception is linked to positive traits; on the other hand, Impression Management scores, which are more strongly associated with deceit, should not be correlated with wisdom.

Mental health and general well-being measures: These included: the Cognitive Failures Questionnaire (Broadbent et al., 1982), the Brief Symptom Inventory Anxiety Scale (Derogatis, 1993), the Patient Health Questionnaire Depression Module (Kroenke et al., 2001), the Medical Outcomes Study 36-Item Short-Form Health Survey - Mental Component (Ware and Sherbourne, 1992), self-rated successful aging, the Personal Mastery Scale (Pearlin and Schooler, 1979), the 10-item Connor-Davidson Resilience Scale (Campbell-Sills and Stein, 2007), the CES-D Happiness Scale (Fowler and Christakis, 2008), and the Satisfaction with Life Scale (Diener et al., 1985).

2.3. Analyses

Item writing: Candidate items were written for each of the six content domains, emphasizing that they should avoid complex words and jargon, double-negatives, items which pose two questions as one, and leading or presumptive questions, equally balance positive and negative keying, and minimize word and syllable counts to improve readability. After reviewing items for grammar, those with significant content overlap were eliminated from consideration, which resulted in a pool of 55 candidate items (see Supplemental Table 1). Candidate items were written by MLT, KJB, BWP, AS, JAA, and DVJ.

Latent variable models were used to select the final items. The sample of 524 participants was split into two, creating a training dataset (N = 350) and a validation dataset (N = 174), stratified over age, gender, and race, to allow us to perform a (single sample) cross validation. Beginning in the training dataset, parallel analysis based on the polychoric item correlation matrix was used to determine the number of factors to retain (Horn, 1965; Mulaik, 2010). An exploratory factor analysis was then conducted, based on principal axis factoring with promax rotation (Mulaik, 2010). Parameter estimates were used to eliminate items that failed to demonstrate a large loading (approximately $\geq$ 0.50) on any factor or showed moderate to large loadings on multiple factors (approximately $\geq$ 0.30) (Harlow, 2014). Next, using the reduced item pool in the validation dataset, confirmatory factor analysis (Brown, 2006) was used to test the fit of the refined model as well as further reduce the item pool. Modification indices (analogous to the change in the overall model fit χ^2 [with 1 *df*]) were examined to identify areas of strain that might violate assumptions of the measurement model. For every residual correlation between items with a significant modification index (conservatively defined with $\alpha = 0.001$), one item from the pair was removed. Estimation relied on mean- and variance-adjusted weighted least squares (WLSMV). Model fit was based on comparative fit index (CFI), Tucker-Lewis index (TLI), and root mean square error of approximation (RMSEA) statistics. CFI and TLI values of approximately 0.95 or greater and RMSEA values of approximately 0.06 and lower are typically considered excellent, with values above 0.90 and below 0.08, respectively, considered adequate (Brown, 2006; Hu and Bentler, 1999).

To select the final subset of items for the SD-WISE, items within each domain were rank-ordered by: (1) largest, absolute factor loading (component of reliability); (2) largest, absolute average correlation with the SAWS and 3D-WS-12 (convergent validity); and (3) smallest, absolute correlation with the BIDR-16 IM scale (discriminant validity). Rankings were then averaged to create a composite rank for each item, which was ultimately used to determine which four items to retain for each subscale.

Reliability was determined using both an index of variance associated with all common (non-error) factors (omega; ω), and an index of variance associated with the general wisdom factor (omega hierarchical; ω_H) (McDonald, 1999; Reise, 2012; Reise et al., 2010). We also report internal consistency coefficient α. Values of 0.70 and greater are generally considered acceptable (Haynes et al., 2011). Finally, Pearson correlations between all subscales from the SD-WISE, 3D-WS-12, and SAWS were entered into a parallel analysis to determine the number of common factors measured across the three scales.[1] An exploratory factor analysis of the subscale correlations with a bifactor rotation was used to determine whether, after accounting for methodological artifacts (Brown, 2006), the scales all indicated a single common factor. All analyses were conducted in R using the psych (Revelle, 2011) and lavaan (Rosseel, 2012) packages.

3. Results

3.1. Demographics of the sample

The mean age of participants was 58 years (*SD* = 19) with a range of 25–104 years; 51% (269) were women. Seventy-six percent (397) reported their race/ethnicity as non-Latino white, 16% (86) as Latino, 7% (35) as Asian-American, 4 (1%) as African American, and 3 (1%) as another ethnic background. Twenty-seven percent (133) participants had a post-graduate degree, 63% (308) had some college education or had a bachelor's degree, and 10% (47) reported completing education through a high school diploma or no degree. Survey responders did not meaningfully differ from non-responders except on race (online Supplemental Table 1). Responders tended to be somewhat less representative of racial minorities compared to non-respondents.

[1] To determine whether there were non-linear relationships between wisdom, depression, anxiety, and other mental health measures, we fitted polynomial regression models to the data and found that the quadratic and cubic trends were non-significant.

3.2. San Diego Wisdom Scale (SD-WISE)

Dimensionality and Item Selection: The parallel analysis indicated that seven factors should be retained (online Supplemental Fig. 1). Rotated loadings for a seven-factor model (online Supplemental Table 3) suggested that 5/6 constructs targeted for measurement (emotional regulation, pro-social behaviors, insight, tolerance for divergent values, and decisiveness) were recovered. Items written for the sixth construct, general knowledge of life and social decision making, however, loaded onto several factors. Nonetheless, a component of this construct, hereafter referred to as "social advising", was recovered. The seventh factor from the exploratory factor analysis did not have any large item loadings and was dropped from further analysis. Using the loadings, 20 of the original 55 items were eliminated (online Supplemental Table 2). Some items were retained despite meeting one of the elimination criteria, either to retain some negatively keyed items or because the ratio of the largest to the second largest loading was high. We next ran a second exploratory factor analysis extracting six factors from a polychoric item correlation matrix based on the reduced item set in the training data. The factor loadings for this solution (online Supplemental Table 4), suggested that one additional item should be eliminated due to a large cross loading.

Next, a confirmatory factor analysis model was fitted to the reduced item set within the validation data assuming six lower-order factors and the pattern of item indicators fixed according to results from the exploratory factor analysis in the training dataset. Items could load onto only one factor. The model additionally assumed a higher-order wisdom factor indicated by the six lower-order factors. The model provided marginally acceptable fit for the data ($\chi^2(521) = 771.46$, $p < 0.001$, CFI = 0.90, TLI = 0.89, RMSEA = 0.05). Nine significant modification indices (see Supplemental Methods) were identified. After eliminating one item from each pair, which, due to overlap, meant eliminating just five items (online Supplemental Table 2), the model provided acceptable fit for the data ($\chi^2(371) = 431.66$, $p = 0.02$, CFI = 0.94, TLI = 0.94, RMSEA = 0.04). Final parameter estimates (factor loadings) were obtained by fitting the model to the combined dataset (i.e., all 524 participants). The model again provided acceptable fit for the data ($\chi^2(371) = 899.31$, $p < 0.001$, CFI = 0.94, TLI = 0.93, RMSEA = 0.05). Online Supplemental Fig. 2 shows parameter estimates for this model.

The final items for the SD-WISE were chosen by rank ordering items within each domain according to loadings, correlations with the SAWS and 3D-WS-12, and correlations with the BIDR-16 IM

Table 1
Items chosen for the San Diego Wisdom Scale.

#	Factor	Key	Item	Endorsement of Response Categories					Item Correlations		
				C1	C2	C3	C4	C5	3D-WS-12	SAWS	IM
1	Social Advising	+	I am good at perceiving how others are feeling.	6 (1%)	20 (6%)	120 (23%)	257 (49%)	111 (21%)	0.31	0.45	0.09
8	Social Advising	+	Others look to me to help them make choices.	6 (1%)	26 (7%)	139 (27%)	261 (50%)	82 (16%)	0.21	0.31	−0.06
13	Social Advising	+	Others say I give good advice.	2 (0%)	13 (2%)	116(22%)	286 (55%)	107 (20%)	0.21	0.32	0.04
50	Social Advising	−	I often don't know what to tell people when they come to me for advice.	79 (15%)	203 (58%)	96 (18%)	42 (8%)	4 (1%)	−0.28	−0.21	−0.03
5	Decisiveness	−	I have trouble making decisions.	151 (29%)	199 (38%)	69 (13%)	82 (16%)	23 (4%)	−0.23	−0.23	−0.14
16	Decisiveness	+	I usually make decisions in a timely fashion.	4 (1%)	49 (9%)	77 (15%)	205 (58%)	89 (17%)	0.25	0.23	0.14
23	Decisiveness	−	I tend to postpone making major decisions as long as I can.	102 (19%)	224 (43%)	102 (19%)	77 (15%)	19 (4%)	−0.30	−0.21	−0.21
26	Decisiveness	−	I would rather someone else make the decision for me if I am uncertain.	112 (21%)	224 (43%)	102 (19%)	76 (15%)	10 (2%)	−0.17	−0.17	−0.11
12	Emotional Regulation	−	I have trouble thinking clearly when I am upset.	57 (11%)	181 (35%)	134 (26%)	126 (24%)	26 (5%)	−0.27	−0.21	−0.16
20	Emotional Regulation	+	I remain calm under pressure.	2 (0%)	29 (6%)	81 (15%)	258 (49%)	154 (29%)	0.31	0.36	0.17
22	Emotional Regulation	+	I am able to recover well from emotional stress.	5 (1%)	26 (5%)	74 (14%)	286 (55%)	133 (25%)	0.28	0.32	0.16
53	Emotional Regulation	−	I cannot filter my negative emotions.	110 (21%)	274 (52%)	95 (18%)	29 (7%)	5 (1%)	−0.44	−0.25	−0.17
27	Insight	+	I take time to reflect on my thoughts.	5 (1%)	25 (5%)	79 (15%)	221 (61%)	94 (18%)	0.21	0.43	0.00
24	Insight	−	I avoid self-reflection.	157 (30%)	234 (45%)	87 (17%)	25 (7%)	11 (2%)	−0.34	−0.39	−0.01
40	Insight	+	It is important that I understand the reasons for my actions.	0 (0%)	15 (3%)	57 (11%)	210 (59%)	142 (27%)	0.17	0.29	0.10
47	Insight	−	I don't analyze my own behavior.	139 (27%)	245 (47%)	76 (15%)	49 (9%)	15 (3%)	−0.29	−0.39	−0.02
7	Pro-Social Behaviors	−	I have a difficult time keeping friendships.	198 (38%)	229 (44%)	54 (10%)	29 (6%)	14 (3%)	−0.28	−0.28	−0.14
11	Pro-Social Behaviors	−	I avoid situations where I know my help will be needed.	164 (31%)	285 (54%)	56 (11%)	17 (3%)	2 (0%)	−0.31	−0.32	−0.22
28	Pro-Social Behaviors	+	I would stop a stranger who dropped a twenty-dollar bill to return it.	2 (0%)	5 (1%)	14 (3%)	176 (34%)	227 (62%)	0.21	0.15	0.24
39	Pro-Social Behaviors	+	I treat others the way I would like to be treated.	0 (0%)	3 (1%)	9 (2%)	242 (46%)	270 (52%)	0.16	0.24	0.26
22	Tolerance for Divergent Values	+	I enjoy learning things about other cultures.	6 (1%)	19 (4%)	56 (11%)	237 (45%)	205 (39%)	0.25	0.39	0.08
29	Tolerance for Divergent Values	+	I am okay with others having morals and values other than my own.	2 (1%)	29 (6%)	80 (15%)	254 (48%)	158 (30%)	0.21	0.29	0.02
43	Tolerance for Divergent Values	+	I generally learn something from every person I meet.	2 (1%)	20 (6%)	103 (20%)	273 (52%)	115 (22%)	0.26	0.37	0.11
46	Tolerance for Divergent Values	+	I enjoy being exposed to diverse viewpoints.	5 (1%)	25 (7%)	104 (20%)	257 (49%)	123 (23%)	0.33	0.42	0.01

Note: 3D-WS-12 = 12-item Three-Dimensional Wisdom Scale; SAWS = Self-Assessed Wisdom Scale; IM = Balanced Inventory of Desirable Responding Short Form Impressive Management Scale. Response categories are C1 = strongly disagree, C2 = disagree, C3 = neutral, C4 = agree, and C5 = strongly agree.

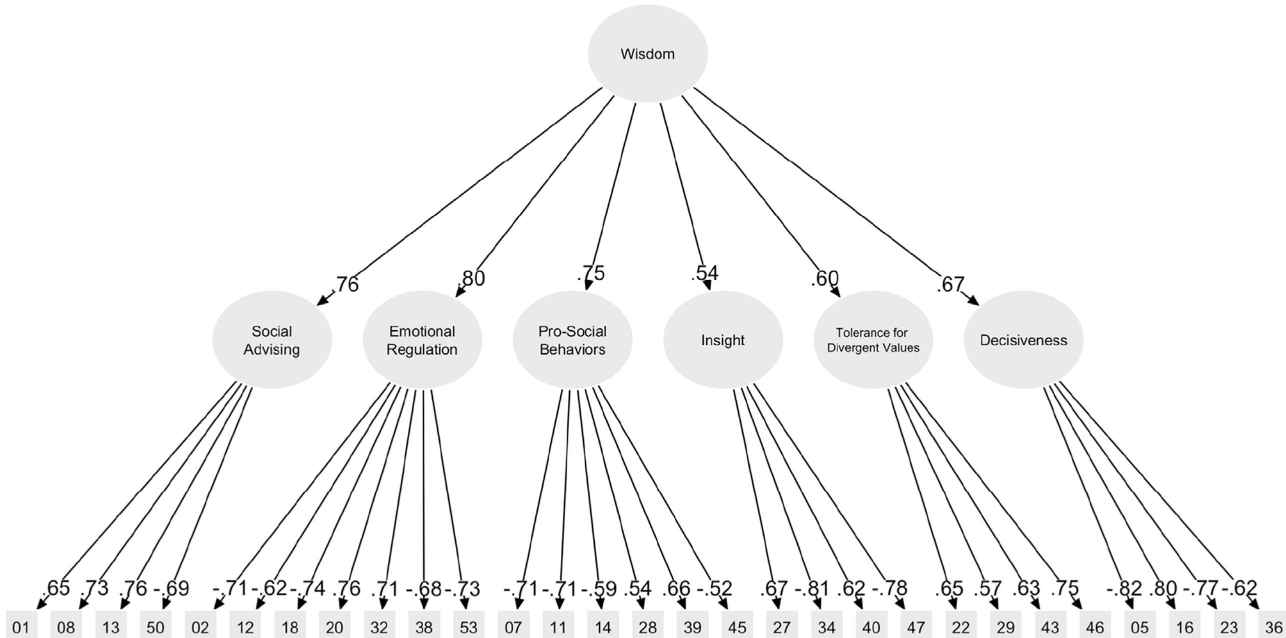

Fig. 1. Model and parameter estimates for a confirmatory factor analysis of the final item set for the San Diego Wisdom Scale. Ovals represent latent variables and squares represent observed variables. Standardized loadings are reported in the figure.

scale, averaging these to create a composite ranking for each item, and then selecting the top four items for each domain. Four items per factor (total 24) were chosen because it was felt that this number would achieve a good balance between reliability and speed. Table 1 shows the final item set. The higher-order measurement model provided acceptable fit ($\chi^2(246) = 657.03$, $p < 0.001$, CFI = 0.94, TLI = 0.93, RMSEA = 0.06). Fig. 1 shows parameter estimates for this final model.

Reliability: The 24-item SD-WISE produced a ω_H value of 0.80, a ω value of 0.93, and a α value of 0.72. In comparison, ω_H, ω, and α values were 0.74, 0.82, and 0.66, respectively, for the 12-item 3D-WS (3D-WS-12), and 0.82, 0.96, and 0.79, respectively, for the 40-item SAWS. Thus, the SD-WISE compared favorably to both the 3D-WS-12 and SAWS, especially given its length, and the results suggest the SD-WISE provides reliable estimates of the trait.

Convergent and Discriminant Validity: Table 2 shows convergent and divergent correlations for the SD-WISE. SD-WISE scores were strongly correlated with both 3D-WS-12 and SAWS scores. Moreover, SD-WISE scores demonstrated a stronger correlation with the BIDR-16 SDE scale when compared to the BIDR-16 IM scale, which supports the scale's discriminant validity (Taylor et al., 2011).

Correlations with Demographic Variables and Measures of Mental Health and General Well-being: SD-WISE scores demonstrated a small negative correlation with age but were only weakly correlated with gender and education (Table 3). As hypothesized, SD-WISE scores were negatively correlated with cognitive failures, anxiety, and depression scores, but positively correlated with mental health, self-ratings of successful aging, mastery, resilience, happiness, and satisfaction with life scores. However, the magnitude of many of these associations were small—especially correlations with ratings of depression, anxiety, and successful aging—suggesting that the SD-WISE is not just a global measure of mental state, especially mood.

3.3. Dimensionality of all SD-WISE, 3D-WS-12, and SAWS subscales

The parallel analysis indicated that the subscales of the SD-WISE, 3D-WS-12, and SAWS measure four common factors (Supplemental Fig. 3). Therefore, we next conducted an exploratory factor analysis with a bifactor rotation specifying five factors: one general factor and four specific factors (Table 4). Nearly all subscales across instruments demonstrated moderate to large loadings onto the general factor (GFA). The subscales also generally demonstrated moderate to large secondary loadings onto one of the specific factors (SFA).

4. Discussion

We developed a new measure of wisdom, the SD-WISE, based on six content domains of wisdom commonly cited in the literature (Bangen et al., 2013) and also identified through a Delphi consensus survey of international experts in wisdom research (Jeste et al., 2010) as well as a mixed-methods study of the concept of wisdom in the an ancient religious document from India (Jeste and Vahia, 2008). These domains form the basis of a putative neurocircuitry model of wisdom (Meeks and Jeste, 2009). Results suggest that the new scale successfully measures five of the six targeted domains. The sixth, general knowledge of life and social decision making, was only partially recovered, and is instead labeled social advising. As hypothesized, the lower-order factors all indicated a

Table 2
Correlations among San Diego Wisdom Scale (SD-WISE), 12-item Three-Dimensional Wisdom Scale (3D-WS-12), Self-Assessment Wisdom Scale (SAWS), and Balanced Inventory of Desirable Responding Short form (BIDR-16) scores.

	3D-WS-12	SAWS	BIDR-16 SDE	BIDR-16 IM
SD-WISE	0.45 [0.38, 0.52]	0.47 [0.40, 0.54]	0.34 [0.26, 0.41]	0.20 [0.11, 0.28]
3D-WS-12		0.44 [0.36, 0.50]	0.50 [0.44, 0.57]	0.28 [0.20, 0.26]
SAWS			0.17 [0.09, 0.26]	0.07 [−0.01, 0.016]
BIDR-16 SDE				0.35 [0.28, 0.43]

Note: 95% confidence intervals are shown in brackets below each correlation.

Table 3
San Diego Wisdom Scale (SD-WISE) total score correlations with demographic variables and measures of mental health and general well-being.

Scale	SD-WISE Total Score
Age	−0.15 [−0.23, −0.06]
Gender (Female)	0.06 [−0.03, 0.15]
Education	−0.01 [−0.10, 0.08]
Cognitive Failures Questionnaire	−0.13 [−0.23, −0.04]
Brief Symptom Inventory Anxiety Scale	−0.06 [−0.17, 0.01]
Patient Health Questionnaire Depression Module	−0.08 [−0.17, 0.01]
SF-36 Mental Component Score	0.05 [−0.04, 0.14]
Self-Rating of Successful Aging	0.03 [−0.06, 0.12]
Personal Mastery Scale	0.23 [0.14, 0.31]
Connor-Davidson Resilience Scale (10-item)	0.33 [0.24 0.40]
CES-D Happiness Scale Total	0.13 [0.04, 0.21]
Satisfaction with Life Scale	0.14 [0.05, 0.23]

Note: Confidence intervals are reported in brackets.

single higher-order factor, which is designed to reflect individual differences in wisdom. Moreover, SD-WISE scores demonstrated good reliability and validity as indicated by their convergent and discriminant associations. SD-WISE scores also had a small negative correlation with age. Although aging is popularly associated with wisdom, empirical data on the relationship have been equivocal (Thomas et al., 2017). The relationship was examined in cross-sectional data, and thus may be tied to cohort effects. Finally, our results suggest that the 3D-WS-12, SAWS, and SD-WISE all measure a shared construct, even though they collectively comprise 15 subscales that measure at least a dozen distinct domains.

4.1. Limitations

Cross-cultural differences should be considered when comparing measures of wisdom across individuals and groups (Kross and Grossmann, 2012). Our study participants comprised a higher proportion of Caucasians and individuals with a higher education compared to census data (Jeste et al., 2013). Also, survey responders were less racially diverse than non-responders. Both concerns could limit the generalizability of our findings. Additional studies are needed to validate the model in new populations. Studies are also needed to further assess the convergent and discriminant validity of scores, given that the SAWS, 3D-WS-12, and BIDR were used both to select items and to validate the instrument. The SD-WISE and other measures of wisdom employed in the present study were all based on self-report. Self-report measures have obvious pragmatic benefits, and SD-WISE scores have shown early value through their correlations with measures of well-being. Nonetheless, self-reports are vulnerable to social desirability and other response biases, and thus should be supplemented with objective measures when possible (Smith and Baltes, 1990). We should point out, however, that SD-WISE scores demonstrated only a small correlation with scores from a scale designed to assess impression management—one's conscious attempts to favorably influence others' views of one's image—supporting the discriminant validity of SD-WISE scores. Finally, we did not collect additional personality data or measures of emotional intelligence, which may overlap with the construct of wisdom (Zacher et al., 2013). Associations with other personality traits warrants attention in future research.

4.2. Future directions

There are several potentially valuable lines of research.

1. The reliability and validity of SD-WISE should be evaluated across different socio-cultural, racial/ethnic, and national samples. There are also newly emerging options for validating measures of a construct. For example, one may use ecological momentary assessments (Shiffman, 2007) or measurement burst design (Sliwinski, 2008) to further test validity of SD-WISE.
2. Wisdom may be studied from a life course perspective to identify possible critical periods for wisdom development. Advances in genetics/genomics and connectivity analyses in functional neuroimaging as well as neurophysiology may help clarify the interplay between biological and environmental factors in the lifetime course of wisdom. It may be argued that wisdom is simply another word for prefrontal executive and cognitive control processes. While there is clearly some overlap, we disagree that the constructs are equivalent because, among other considerations, the definition of wisdom includes a compassionate/altruistic component, and the proposed neurobiological model of wisdom involves the amygdala, which are

Table 4
Bifactor-rotated factor loadings for an exploratory factor analysis conducted on subscales from the San Diego Wisdom Scale (SD-WISE), 12-item Three-Dimensional Wisdom Scale (3D-WS-12), and Self-Assessment Wisdom Scale (SAWS).

Scale	Subscale	Items	GFA	SFA1	SFA2	SFA3	SFA4
SD-WISE	Social Advising	4	0.52	0.06	0.28	−0.08	0.00
SD-WISE	Emotional Regulation	4	0.41	0.07	0.52	−0.02	0.05
SD-WISE	Pro-Social Behaviors	4	0.34	0.02	0.50	−0.08	0.05
SD-WISE	Insight	4	0.47	−0.08	0.26	−0.07	−0.36
SD-WISE	Tolerance	4	0.56	0.06	0.10	0.49	−0.04
SD-WISE	Decisiveness	4	0.22	−0.02	0.57	0.04	−0.10
3D-WS-12	Cognitive	3	0.32	0.49	−0.03	0.20	−0.20
3D-WS-12	Reflective	3	0.44	0.74	0.02	−0.08	0.06
3D-WS-12	Affective	3	0.34	0.42	0.02	0.16	0.01
SAWS	Experience	8	0.55	−0.29	−0.08	0.13	0.14
SAWS	Emotional Regulation	8	0.75	0.11	0.02	−0.14	0.22
SAWS	Reminiscence/Reflection	8	0.62	−0.26	−0.22	−0.09	−0.04
SAWS	Humor	8	0.65	−0.04	0.02	−0.01	0.35
SAWS	Openness	8	0.69	−0.08	−0.14	0.52	0.05

Note: GFA = bifactor-rotated general factor; SFA1 − SFA4 = bifactor-rotated specific factors 1 through 4.

not an integral part of the construct of executive functioning or its circuitry, respectively. Combined behavioral and brain imaging studies might be useful for determining the extent to which the development of wisdom overlaps with the development of prefrontal executive and cognitive control processes and circuitry.

3. The possible enhancement of wisdom and its specific components, using SD-WISE, with aging-related cumulative life experience warrants longitudinal prospective investigations. Studies have shown that, compared to youth, older people have higher levels of emotional regulation and positivity (Read and Carstensen, 2012; Roecke et al., 2009), social reasoning (Grossmann et al., 2010), experience-based decision making (Worthy et al., 2011), and dealing with uncertainty (Blanchard-Fields, 2007).
4. It has been proposed that Hemispheric Asymmetry Reduction of OLD age (HAROLD) (Cabeza, 2002) and Posterior-Anterior Shift with Aging (PASA) (Dennis and Cabeza, 2008) enable improved functioning of the brain, especially anterior regions, in later life. Similarly, greater fMRI activation of the amygdala while viewing positive than negative pictures in older age may underlie greater emotional regulation and positivity in older adults (Mather et al., 2004). These hypotheses can be empirically tested using SD-WISE along with neurophysiological and neuroimaging measures.
5. Research, employing SD-WISE, in neuropsychiatric disorders affecting wisdom or traumatic injuries that affect the implicated neurobiological substrates of wisdom, would help inform the neurobiology of wisdom as well as clinical applications of the concept.
6. While wisdom may be uniquely human, certain intermediate phenotypes could be studied in appropriate animal species. A study of well-being across the lifespan in zoos and research laboratories involved animals' caretakers completing scales of well-being of apes (Weiss et al., 2012). A similar study of components of wisdom in large animals could be conducted using SD-WISE, with the caretakers completing the scale for their subjects.
7. Development and testing of interventions (psychosocial, biological, or technological) to enhance components of wisdom such as compassion would be valuable. Examples of the types of individuals who might benefit from such interventions include those with autism spectrum disorder (in which there is a cognitive deficit in understanding others' state of the mind) and antisocial personality disorder (which is associated with a lack of compassion). Similarly, whether wisdom moderates the outcomes of other interventions (e.g., psychotherapy in people with personality disorders) would be useful to evaluate, with the help of SD-WISE.

5. Conclusion

Wisdom is a complex personality trait with several content domains. The SD-WISE is unique in focusing on commonly cited domains, drawing inspiration from both modern western scientific and ancient eastern religious conceptualizations of wisdom, and defining wisdom in a manner that lends itself well to putative neurobiological models. The SD-WISE may be a useful instrument that could play a role in future studies on wisdom.

Acknowledgement section

Declaration of interest

None to declare.

Funding/support

Research reported in this publication was supported, in part, by NIMH R01 MH094151-05, R01 MH099987-04, and K23 MH102420, a VA Clinical Science Research & Development Award (Career Development Award-2 1IK2CX000938 to KJB), and the Stein Institute for Research on Aging.

Role of funder/sponsor

The funding organizations had no role in the design and conduct of the study; collection, management, analysis, and interpretation of the data; and preparation, review, or approval of the manuscript; and decision to submit the manuscript for publication.

Conflict of interest

Authors have no conflict of interest to report.

Appendix A. Supplementary data

Supplementary data related to this article can be found at https://doi.org/10.1016/j.jpsychires.2017.09.005.

References

Ardelt, M., 1997. Wisdom and life satisfaction in old age. J. Gerontol. B-Psychol 52 (1), P15–P27.
Ardelt, M., 2000. Antecedents and effects of wisdom in old age - a longitudinal perspective on aging well. Res. Aging 22 (4), 360–394.
Ardelt, M., 2003. Empirical assessment of a three-dimensional wisdom scale. Res. Aging 25 (3), 275–324.
Ardelt, M., Jeste, D.V., 2016. Wisdom and hard times: the ameliorating effect of wisdom on the negative association between adverse life events and well-being. Journals Gerontol. Ser. B Psychol. (Advance online publication).
Baltes, P.B., Smith, J., Staudinger, U.M., 1992. Wisdom and successful aging. In: Sonderegger, T. (Ed.), Psychology and Aging. University of Nebraska Press, Lincoln, pp. 123–167.
Bangen, K.J., Meeks, T.W., Jeste, D.V., 2013. Defining and assessing wisdom: a review of the literature. Am. J. Geriat Psychiat 21 (12), 1254–1266.
Bergsma, A., Ardelt, M., 2012. Self-reported wisdom and happiness: an empirical investigation. J. Happiness Stud. 13 (3), 481–499.
Birren, J.E., Svensson, C.M., 2005. Wisdom in history. In: Sternberg, R.J., Jordan, J. (Eds.), A Handbook of Wisdom: Psychological Perspectives. Cambridge University Press, New York, NY, pp. 3–28.
Blanchard-Fields, F., 2007. Everyday problem solving and emotion: an adult developmental perspective. Curr. Dir. Psychol. Sci. 16, 26–31.
Blazer, D.G., Kinghorn, W.A., 2015. Positive Social Psychiatry, Positive Psychiatry: A Clinical Handbook, pp. 71–87.
Broadbent, D.E., Cooper, P.F., Fitzgerald, P., Parkes, K.R., 1982. The Cognitive Failures Questionnaire (CFQ) and its correlates. Brit J. Clin. Psychol. 21 (Feb), 1–16.
Brown, T.A., 2006. Confirmatory Factor Analysis for Applied Researchers, 2 ed. The Guilford Press, New York, NY.
Cabeza, R., 2002. Hemispheric asymmetry reduction in older adults: the HAROLD model. Psychol. Aging 17 (1), 85–100.
Campbell-Sills, L., Stein, M.B., 2007. Psychometric analysis and refinement of the Connor-Davidson Resilience Scale (CD-RISC): validation of a 10-item measure of resilience. J. Trauma. Stress 20 (6), 1019–1028.
Cato, M.A., Delis, D.C., Abildskov, T.J., Bigler, E., 2004. Assessing the elusive cognitive deficits associated with ventromedial prefrontal damage: a case of a modern-day Phineas Gage. J. Int. Neuropsychol. Soc. 10 (3), 453–465.
Clayton, V.P., Birren, J.E., 1980. The development of wisdom across the life-span: a reexamination of an ancient topic. In: Baltes, P.B., Brim, O.G. (Eds.), Life-span Development and Behavior. Academic Press, New York, pp. 103–135.
Cloninger, C.R., 2012. Healthy personality development and well-being. World Psychiatry 11 (2), 103–104.
Dennis, N.A., Cabeza, R., 2008. Neuroimaging of healthy cognitive aging. In: Salthouse, T.A., Craik, F.E.M. (Eds.), Handbook of Aging and Cognition, third ed., pp. 1–54.
Derogatis, L.R., 1993. In: BSI, Brief Symptom Inventory: Administration, Scoring, and Procedures Manual, fourth ed. National Computer Systems, Minneapolis, MN.
Diener, E., Emmons, R.A., Larsen, R.J., Griffin, S., 1985. The Satisfaction with Life Scale. J. Personal. Assess. 49 (1), 71–75.
Erikson, E.H., 1959. Identity and the Life Cycle. International University Press, New York.
Etezadi, S., Pushkar, D., 2013. Why are wise people happier? An explanatory model of wisdom and emotional well-being in older adults. J. Happiness Stud. 14 (3),

929–950.
Ferrari, M., Kahn, A., Benayon, M., Nero, J., 2011. Phronesis, Sophia, and Hochma: developing wisdom in Islam and Judaism. Res. Hum. Dev. 8 (2), 128–148.
Fowler, J.H., Christakis, N.A., 2008. Dynamic spread of happiness in a large social network: longitudinal analysis over 20 years in the Framingham Heart Study. Brit Med. J. 337.
Gluck, J., Konig, S., Naschenweng, K., Redzanowski, U., Dorner, L., Strasser, I., Wiedermann, W., 2013. How to measure wisdom: conten reliability, and validity of five measures. Front. Psychol. 4.
Grossmann, I., Na, J., Vamum, M.E., Park, D.C., Kitayama, S., Nisbett, R.E., 2010. Reasoning about social conflicts improves into old age. Proc. Natl. Acad. Sci. U. S. A. 107, 7246–7250.
Harlow, L.H., 2014. The Essence of Multivariate Thinking: Basic Themes and Methods, second ed. Routledge, New York, NY.
Hart, C.M., Ritchie, T.D., Hepper, E.G., Gebauer, J.E., 2015. The Balanced Inventory of Desirable Responding Short form (BIDR-16). Sage Open 5 (4).
Haynes, S.N., Smith, G., Hunsley, J.D., 2011. Scientific Foundations of Clinical Assessment. Routledge, New York.
Horn, J.L., 1965. A rationale and test for the number of factors in factor-analysis. Psychometrika 30 (2), 179–185.
Hu, L.T., Bentler, P.M., 1999. Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. Struct. Equ. Model. A Multidiscip. J. 6 (1), 1–55.
Jeste, D.V., Ardelt, M., Blazer, D., Kraemer, H.C., Vaillant, G., Meeks, T.W., 2010. Expert consensus on characteristics of wisdom: a Delphi method study. Gerontologist 50 (5), 668–680.
Jeste, D.V., Savla, G.N., Thompson, W.K., Vahia, I.V., Glorioso, D.K., Martin, A.S., Palmer, B.W., Rock, D., Golshan, S., Kraemer, H.C., Depp, C.A., 2013. Association between older age and more successful aging: critical role of resilience and depression. Am. J. Psychiat 170 (2), 188–196.
Jeste, D.V., Vahia, I.V., 2008. Comparison of the conceptualization of wisdom in ancient indian literature with modern views: focus on the Bhagavad Gita. Psychiatry 71 (3), 197–209.
Kroenke, K., Spitzer, R.L., Williams, J.B.W., 2001. The PHQ-9-Validity of a brief depression severity measure. J. Gen. Intern Med. 16 (9), 606–613.
Kross, E., Grossmann, I., 2012. Boosting wisdom: distance from the self enhances wise reasoning, attitudes, and behavior. J. Exp. Psychol. Gen. 141 (1), 43–48.
Le, T.N., 2011. Life satisfaction, openness value, self-transcendence, and wisdom. J. Happiness Stud. 12 (2), 171–182.
Mather, M., Canli, T., English, T., Whitfield, S., Wais, P., Ochsner, K., Gabrieli, J.D.E., Carstensen, L.L., 2004. Amygdala responses to emotionally valenced stimuli in older and younger adults. Psychol. Sci. 15, 259–263.
McDonald, R.P., 1999. Test Theory: A Unified Treatment. Lawrence Erlbaum Associates Publishers, Mahwah, NJ.
McKeon, R., 1941. Nichomachean Ethics, the Basic Works of Aristotle. Random House, New York, pp. 935–1112.
Meeks, T.W., Jeste, D.V., 2009. Neurobiology of wisdom a literature overview. Arch. General Psychiatry 66 (4), 355–365.
Miller, B.L., Seeley, W.W., Mychack, P., Rosen, H.J., Mena, I., Boone, K., 2001. Neuroanatomy of the self: evidence from patients with frontotemporal dementia. Neurology 57 (5), 817–821.
Mulaik, S.A., 2010. Foundations of Factor Analysis, second ed. CRC Press, Boca Raton, FL.
Nusbaum, H., 2016. Turning Points: Finding Experiential Forks in the Path to Wisdom and Virtues. Self, Motivation & Virtue Project's e-Newsletter, Norman, OK.
Pearlin, L.I., Schooler, C., 1979. Some extensions of the structure of Coping. J. Health Soc. Behav. 20 (2), 202–205.
Read, A.E., Carstensen, L.L., 2012. The theory behind the age-related positivity effect. Front. Psychol. 3, 1–9.
Reise, S.P., 2012. The rediscovery of bifactor measurement models. Multivar. Behav. Res. 47 (5), 667–696.
Reise, S.P., Moore, T.M., Haviland, M.G., 2010. Bifactor models and rotations: exploring the extent to which multidimensional data yield univocal scale scores. J. Pers. Assess. 92 (6), 544–559.
Revelle, W., 2011. psych: procedures for personality and psychological research. http://personality-project.org/r/psych.manual.pdf.
Roecke, C., Li, S.C., Smith, J., 2009. Intraindividual variability in positive and negative affect over 45 days: do older adults fluctuate less than younger adults? Psychol. Aging 24, 863–878.
Roharikova, R., Spajdel, M., Cvikova, V., Jagla, F., 2013. Tracing the relationship between wisdom and health. Act. Nerv. Super. Rediviva 55, 95–102.
Rosseel, Y., 2012. lavaan: an R package for structural equation modeling. J. Stat. Softw. 48 (2), 1–36.
Shiffman, S., 2007. Designing protocols for ecological momentary assessment. In: Stone, A.A., Shiffman, S., Atienza, A., Nebeling, L. (Eds.), The Science of Real-time Data Capture: Self-reports in Health Research. Oxford University Press, New York, NY, pp. 27–53.
Sliwinski, M.J., 2008. Measurement-burst designs for social health research. Soc. Personal. Psychol. Compass 2 (1), 245–261.
Smith, J., Baltes, P.B., 1990. Wisdom-related knowledge - age cohort differences in response to life-planning problems. Dev. Psychol. 26 (3), 494–505.
Staudinger, U.M., Glück, J., 2011. Psychological wisdom research: Commonalities and differences in a growing field. Annu. Rev. Psychol. 62, 215–241.
Sternberg, R.J., 1990. Wisdom and its relations to intelligence and creativity. In: Sternberg, R.J. (Ed.), Wisdom: its Nature, Origins, and Development. Cambridge University Press, Cambridge, pp. 142–159.
Taylor, M., Bates, G., Webster, J.D., 2011. Comparing the psychometric properties of two measures of wisdom: predicting forgiveness and psychological well-being with the Self-Assessed Wisdom Scale (SAWS) and the Three-Dimensional Wisdom Scale (3D-WS). Exp. Aging Res. 37 (2), 129–141.
Thomas, M.L., Bangen, K.J., Ardelt, M., Jeste, D.V., 2017. Development of a 12-item abbreviated Three-Dimensional Wisdom Scale (3D-WS-12): item selection and psychometric properties. Assessment 24 (1), 71–82.
Thomas, M.L., Kaufmann, C.N., Palmer, B.W., Depp, C.A., Martin, A.S., Glorioso, D.K., Thompson, W.K., Jeste, D.V., 2016. Paradoxical trend for improvement in mental health with aging: a community-based study of 1,546 adults aged 21-100 years. J. Clin. Psychiatry 77 (8). E1019-+.
Vaillant, G.E., Mukamal, K., 2001. Successful aging. Am. J. Psychiatry 158 (6), 839–847.
Ware, J.E., Sherbourne, C.D., 1992. The mos 36-item Short-Form Health Survey (SF-36) .1. Conceptual-framework and item selection. Med. Care 30 (6), 473–483.
Webster, J.D., 2003. An exploratory analysis of a Self-Assessed Wisdom Scale. J. Adult Dev. 10 (1), 13–22.
Webster, J.D., 2007. Measuring the character strength of wisdom. Int. J. Aging Hum. Dev. 65 (2), 163–183.
Webster, J.D., Westerhof, G.J., Bohlmeijer, E.T., 2014. Wisdom and mental health across the lifespan. J. Gerontol. B-Psychol 69 (2), 209–218.
Weiss, A., King, J.E., Inoue-Myrayama, M., Matsuzawa, T., Oswald, A.J., 2012. Evidence for a midlife crisis in great apes consistent with the U-shape in human well-being. Proc. Natl. Acad. Sci. 109 (49), 19949–19952.
Worthy, D.A., Gorlick, M.A., Pacheco, J.L., Schnyer, D.M., Maddox, W.T., 2011. With age comes wisdom: decision making in younger and older adults. Psychol. Sci. 22 (11), 1375–1380.
Zacher, H., McKenna, B., Rooney, D., 2013. Effects of self-reported wisdom on happiness: not much more than emotional intelligence? J. Happiness Stud. 14 (6), 1697–1716.