Social Science Research 120 (2024) 103013

Contents lists available at ScienceDirect

Social Science Research

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

A new subjective well-being index using anchored best-worst scaling

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ARTICLE INFO

Keywords:
Subjective well-being
Importance weighting
Best-worst scaling
Quality of life

ABSTRACT

Subjective well-being (SWB) describes an individual's life evaluation. Direct elicitation methods for SWB via rating scales do not force individuals to trade-off among life domains, whilst best-worst scaling (BWS) approaches only provide relative measures. This paper instead offers a dual-response BWS task, where respondents nominate areas of most and least importance and satisfaction with respect to 11 SWB domains, whilst also eliciting anchoring points to obtain an absolute measure of domain satisfaction. Combining domain satisfaction and importance produces a robust measure of individual SWB, but statistically unique relative to other life satisfaction measures utilizing single- and multi-item ratings, including global satisfaction and those aggregated over SWB domains, as well as eudemonia. Surveying 2500 Australians reveals anchored-BWS improves discrimination amongst domains in terms of importance and satisfaction, illustrating its value as a diagnostic tool for SWB measurement to focus services, policy, and initiatives in areas to most impact wellbeing. This includes highlighting a major discrepancy between health satisfaction and importance, whilst also reporting that SWB is significantly lower for Indigenous, unemployed, middle-aged, males and lower income groups.

1. Introduction

Subject well-being (SWB) is an important construct for social science researchers to garner insights into quality of life, including cross-sectional comparisons across groups (e.g., Abdel-Khalek, 2012; Kitayama et al., 2000) or over significant periods, such as the COVID-19 pandemic (e.g., Brindal et al., 2021) or after marital disruption (Waite et al., 2009). The importance of SWB is evident in its extensive examination of individual differences in prior literature, such as personality (Costa and McCrea, 1980; Steel et al., 2008), religiosity (Abdel-Khalek, 2012; Myers, 2000), relationship status (Dush and Amato, 2005; Waite et al., 2009), income (McBride, 2001), age, and social support (Siedlecki et al., 2014). Cross-country or cross-cultural comparisons of SWB have also been made whilst controlling for individual differences, such as societal and income inequality (Kelley and Evans, 2017), religious norms (Stavrova et al.,

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https://doi.org/10.1016/j.ssresearch.2024.103013
Received 4 July 2022; Received in revised form 17 March 2024; Accepted 23 March 2024
Available online 5 April 2024

2013) or environmental consumption (Knight and Rosa, 2011). Other research focuses on how SWB is impacted by behaviors, such as digital technology and social media use (Kim and Lee, 2011; Orben and Przybylski, 2019).

SWB measures vary in terms of their reliability and validity (Eid and Diner, 2004; Kahneman and Krueger, 2006; Lyubomirsky and Lepper, 1999; OECD, 2013b). Researchers have explored the components underlying SWB (e.g., Hsieh, 2003), however, debate continues about methods to elicit and assign satisfaction weights across well-being domains (Angelini et al., 2013; Hsieh 2003, 2004; Hsieh and Li, 2019). The present research offers a new measure of SWB with three distinguishing innovations. First, the method involves summation over two constructs, weighting satisfaction across quality of life domains (e.g., health, safety) by importance, inline with multi-attribute measurement theory (e.g., Bettman et al., 1975; Fishbein, 1963; Luce and Tukey, 1964). Second, best-worst scaling (BWS) is introduced to measure domain importance and satisfaction, forcing respondents to trade-off quality of life domains relative to methods where domains are considered separately and potentially rated as equally important. Third, BWS is extended to anchor most and least satisfactory life domains against an absolute measure. Traditional BWS provides only relative measures, allowing two respondents to nominate a domain as most satisfactory, despite it being more satisfactory compared to another (i.e., an absolute outcome). Hence, the proposed anchored-BWS method (ABWS) is an important innovation for SWB measurement, but also other contexts where BWS has been applied (e.g., Beck and Rose, 2016; Lancsar et al., 2013).

The remainder of the paper proceeds as follows. First, prior SWB measurement approaches are reviewed. Second, traditional BWS is introduced, outlining its advantages and limitations. Third, an extension of BWS using a dual-response to measure domain satisfaction and importance and an anchored-BWS approach (ABWS) to measure domain satisfaction in absolute terms are justified and outlined. Fourth, an empirical application demonstrates the insights the proposed method offers for social science researchers. This includes insights about domain satisfaction and importance, as well as differences in SWB across segments relative to single- and multi-item ratings-based approaches life satisfaction measures. The proposed approach addresses concerns about aggregation bias arising using weights varying by domain, but homogenous over individuals (Hutchinson et al., 2000). The paper concludes by discussing the methods' limitations and future applications, highlighting its attractiveness for practice in social science research, including for monitoring policy outcomes and interventions, and comparing SWB across groups.

2. Background literature: measuring subjective well-being

SWB captures an individual's assessment of their subjective state (Diener, 1984, 2006; OECD, 2013b), combining cognitive judgements and affective reactions to life experiences (Diener, 1984). The validity and reliability of SWB measures has been heavily debated, including which well-being domains to assess (e.g., Angelini et al., 2013; Hsieh, 2004; Kahneman and Krueger, 2006; Krueger and Schkade, 2008). In practice, SWB measures focus on 1) global or overall subjective evaluation of life satisfaction; or 2) evaluating the suitable aggregation of satisfaction measures over extraneous life domains, such as satisfaction with work, relationships, or health (Dolan et al., 2008).

In the first case, methods include single-item self-reports of SWB, where respondents rate happiness, life satisfaction, morale or positive affect (e.g., Diener, 1984; Krueger and Schkade, 2008). Whilst attractive for brevity, cognitive ease, and reduced response times, single-item measures have been criticised due to an inability to assess reliability, to average variance due to specific wording of items, reliability over time, and convergence with other measures (Diener, 1984). Alternatively, multi-item reflective measures can be used and combined (e.g., via factor analysis, PCA, averaging) (Diener et al., 1985; Haq and Zia, 2013; Pavot and Diener, 1993) allowing reliability assessment (e.g., Cronbach's Alpha, Composite Reliability). Both measures provide subjective indicators of the unobserved latent construct, personal life satisfaction, but neither utilise extraneously determined life domains (e.g., health; finance); the criterion and integration of domains is idiosyncratic and unobservable (Kafka and Kozma, 2001; Pavot and Diener, 1993).

In the second case, respondents rate satisfaction with life domains, such as health, friendships, and finances (e.g., Eid and Diener 2004; Greenspoon and Saklofske, 2001). Domains for evaluation are a priori determined by researchers, whilst post hoc analysis combine measures to estimate SWB. Social science researchers have compared equal-weighted (averaged) ratings across domains (Hsieh and Li, 2019), against approaches where weightings differ (e.g., Hsieh and Li, 2019). The later are often referred to as value priority or psychological centrality (Hsieh and Kenagy, 2014).

Weighting information is obtainable from various sources. Researchers can normatively determine weights, such as using theory (Hsieh and Kenagy, 2014) or expert opinions (Angelini, 2013). A second approach is data driven, utilizing path coefficients from factor analysis, principal components analysis or regression where domain satisfaction predicts or reflects overall well-being or quality of life (Angelini 2013; Haq and Zia, 2013; Hsieh and Kenagy, 2014; van Praag et al., 2003). Cluster analysis is also used to assign varying domain weights at a latent segment level rather than be identical across individuals (Angelini, 2013). A third approach directly ask respondents to rate or rank domain importance (Hsieh, 2017). Bovkir et al. (2023) compared methods to determine importance weights including data-dependent statistical methods (e.g., Principal Components Analysis; Entropy) and multi-criteria decision analysis techniques (e.g., Analytic Hierarchy Process; Best–Worst). The authors conclude that whilst weight variation is not systematic, concluding that data-dependent methods are potentially weaker, noting BWS methods are easier to apply and calculate relative to methods involving Analytic Hierarchy Process.

Evidence for using importance rather than equal weights, however, is mixed; some researchers indicate the additional variation in life quality or SWB explained using them is negligible (e.g., Bovkir et al., 2023; Wu 2008a, 2008b). Hsieh and Kenagy (2014) question whether the number of formative domains used is comprehensive enough, citing studies using seven domains (Mookherjee, 1992), 33 domains (Ferrans and Powers, 1985), and even 173 domains (Cummins, 1996). Other research highlights how different question stems or reference terms affect domain importance (Hsieh 2003, 2004; Hsieh and Li, 2019) and that importance can differ by age, life stage (e.g., Loewe et al., 2014; Hsieh, 2005, 2008) or culture (Oishi et al., 1999).

Table 1
Life domains used by government or other agencies.

Current study (11)	OECD (10)	BLI (10)	NZGSS (10)	SSF (9)	ONS (9)	CIW (8)	PWI (7)	AUWI (7)
Standard of living	Standard of living	Income and wealth; Housing	Economic standard of living	Material conditions	Personal finance	Living standards	Standard of living	Standard of Living
Health	Health status	Health status	Health	Health	Health (physical and mental)	Healthy populations	Personal health	Health
Achievements in life	Achievement in life	Education and skills	Knowledge and skills	Education	Education and skills	Education	Achieving in life	Achieving in Life
Personal relationships	Personal relationships	Social connections	Social connectedness	Social connections	Our relationships		Personal relationships	Relationships
Safety	Personal safety	Personal security	Safety	Personal insecurity	Where we live		Personal safety	Personal safety
Feeling part of the community	Feeling part of the community					Community vitality	Community connectedness	Community connectedness
Future security	Future security			Economic insecurity	The economy		Future security	Future security
Spirituality/beliefs or religion			Cultural identity			Leisure and culture		
Amount of time you have to do the things that you like doing	Time to do what you like doing	Work and life balance	Leisure and recreation	Personal activities		Time use; Leisure and culture		
Quality of your local environment	Quality of the environment	Environmental quality	The environment	Environmental conditions	The environment	Environment		
Daily job and/or responsibilities	Your job (for the employed)	Jobs and earnings	Paid work		What we do			
		Civic engagement and governance	Civil and political rights	Political voice and governance	Governance	Democratic engagement		

Acronyms and associated source, with number of domains shown in parentheses.
OECD = Subjective Well-Being Domains, Organisation for Economic Co-operation and Development (OECD).
BLI = Your Better Life Index – OECD (BLI).
NSGSS = New Zealand General Social Survey (NZGSS).
SSF = Sen, Stiglitz & Fitoussi (SSF), Commission on the Measurement of Economic Performance and Social Progress.
ONS = Office for National Statistics (ONS).
CIW = Canadian Index of Well-Being (University of Waterloo).
PWI = Personal Wellbeing Index (PWI) (International Wellbeing Group, 2006).
AUWI = Australian Unity Well-Being Index (Australian Unity and Deakin University).

Importance weights elicited from rating scales may also lack discrimination since respondents evaluate well-being domains one-at-a-time. Consequently, respondents may indicate all domains are important or, particularly with small sample sizes, researchers may conclude no significant differences in importance across life domains (Hsieh and Kenagy, 2014. Such concerns parallel work in other settings: Burke et al. (2018a) found consumers rating product features on importance one-at-a-time, produced importance scores with considerable overlap. The authors instead proposed a discrete choice experiment to force trade-off among features to estimate their importance in product choices. Such an approach also avoids issues with collinearity, whereby coefficient importance estimates are biased such that a domain is underweighted if another domain already explains variation in the dependent variable (Angelini, 2013; Black et al., 2018).

Addressing this concern, Hsieh (2013) asked respondents to rate the importance of eight SWB domains on a five-point scale; domains with identical ratings were then ranked to derive a full ranking. Using ranking-based weighting schemes, with various functional forms (e.g., square-ranking), enhanced correlations between single-item global life satisfaction measure and domain satisfactions, relative to using ratings alone. The authors note limitations including using a small convenience sample, telephone interviews, a two-stage evaluation task, and increased complexity with more domains (Louviere and Islam, 2008). Nonetheless, the study warrants encouragement for methods forcing trade-offs among domain importance as proposed in the current research.

3. Methodological approach

The current research addresses the aforementioned concerns by using BWS to quantify which life domains impact SWB with respect to importance and satisfaction, but extended to elicit domain satisfaction in absolute terms. In the following section, traditional BWS, its advantages and applications are reviewed. The process for developing and selecting domains is consistent with other studies, including the searching and screening of existing approaches, expert review, mixed-methods involving qualitative and quantitative phases, piloting for survey feedback, assessment of reliability and comparison to other approaches (Loveridge et al., 2020; Musa et al., 2019).

3.1. Domain selection and questionnaire development

Several research papers explore how to determine which domains to measure SWB or quality of life. Musa et al. (2019) proposed use a Delphi approach where academic rate domains identified via an extensive literature review. The experts then rate the importance of domains that 75 percent of experts rated either a four or five. Domains not gaining unanimous expert consensus in promoting well-being are discarded, with remaining domains forming the ultimate SWB scale. Loveridge et al. (2020), on the other hand, developed a mixed-methods approach they term the Wellbeing Indicator Selection Protocol (WISP). WISP involves six steps beginning with 1) identification of candidate domains through a combination of literature review and qualitative research, 2) questionnaire testing, 3) data exploration that leads to the removal of indicators that add little variation to the SWB construct, 4) the discarding of covarying domains, 5) the removal of statistically redundant indicators, and ending with 6) validation of the scale.

Although the current SWB measure predates publication of the WISP, domain selection followed steps outlined by Loveridge et al. (2020). First, an extensive literature review identified published SWB scales and domains. Domains were culled to minimize overlap (Hsieh and Li, 2009). Sub-domains identified were discarded if their application to a general sample was unclear. This meant "personal relationships" was used rather than the sub-domains "love life", "family" and "friendships" (e.g., Hsieh and Li, 2019), which is irrelevant for some individuals. Finally, domains with low reliability, face validity, convergent validity, and construct validity were excluded.

Next, a series of focus groups occurred in early 2017 to address four key research questions. These were i) how might SWB be measured, including question wording and domain selection; ii) do SWB and domain weights vary across different geographical regions; iii) how does SWB vary over time including in response to events or shocks; and, iv) what broad policy initiatives could influence SWB. Four focus groups were conducted in Sydney (CBD), Parramatta (Western Sydney), Goulburn (regional city, 197 km from Sydney), and Wagga Wagga (remote regional city, 460 km from Sydney). Each group of seven to eight people undertook an unstructured discussion about SWB, including what it is and how it could be measured. The groups confirmed the appropriateness and wording of domains and that each varied by importance and satisfaction.

Based on the above process, 10 domains were identified as suitable for measuring SWB. These mirror those comprehensively reviewed and used by the OECD (OECD, 2013a, 2013b), who include the most number of domains (namely 10), which overlap with other agencies and organisations using fewer domains (e.g., Australian Unity Wellbeing Index). Table 1 compares the domains included in the present research to those used by government and organisations drawing on seminal empirical and theoretical social science research (e.g., Krueger and Schkade, 2008; Diener et al., 2009). Other notable approaches to well-being include those offered by Gallup (e.g., Gallup National Health and Well-Being Index) and the United Nations Sustainable Development Solutions Network report on Global Happiness and Well-being report, focusing on six themes including education, workplace, health, vulnerable populations, and digital well-being. An additional 11th domain, spiritually was added to address the debate about its relevance for SWB research (Abdel-Khalek, 2012; Hsieh, 2003; Stavrova et al., 2013). An a priori expectation from prior research is religiosity varies by importance, providing a suitable example to illustrate the merits of the proposed approach to account for such idiosyncrasies relative to equally weighting life domains.

The focus groups also determined how best to ask SWB questions. Participants undertook a short questionnaire eliciting their preference for ratings tasks or BWS questions. Their answers indicated BWS was preferable. A pilot study of the BWS was then undertaken with 108 respondents using a balanced incomplete block design or BIBD (Bose, 1939) to determine which domains to present

in each task. The particular BIBD employed is a Youden design (see Table 2), and was used for the main empirical study. Each respondent completed 11 BWS tasks, presenting six of the 11 domains from Table 1 each time. Each domain appeared equally and equally co-occurred with each other.

By ensuring each domain appears with equal frequency across tasks eliminates biases from using unequal treatments. Whilst BIBDs ensures equal frequency and co-frequency, a Youden design ensures each domain appears equally at each location (e.g., first and last domain in a set). As per Table 2 – where values correspond to the domain numbers in Table 1 - the first domain (standard of living) appears six times (sets 2, 3, 5, 6, 7, and 11), whilst the second (health) also appears six times (sets 1, 3, 4, 6, 7, and 8). The two domains co-occur three times (sets 3, 6 and 7). Similarly, domains one and three (achievements in life) co-occur three times (sets 2, 5, and 7).

The pilot allowed tests consistent with steps three to six of the WISP method. Domains were tested to see if they produced different weighting scores. Correlation analysis evaluated whether domains measured unique underlying aspects of SWB. A single item rating scale was also used to measure SWB and validate the SWB index. Based on these, the 11 identified domains and BWS approach were retained. Instead of a standard BWS task, several adaptations were made (see Section 3.4), which introduces and critically reviews traditional BWS and its proposed adaptation.

3.2. An overview of best-worst scaling (BWS)

BWS was developed by Louviere and Woodworth (1990) and first published by Finn and Louviere (1992). The task involves respondents nominating two domains as best and worst against a criterion (e.g., importance, satisfaction) rather than separately rate one-at-a-time. Respondents evaluate subsets multiple times. A BWS score is derived, proportionate to the frequency a domain is chosen best and worst against the frequency it appears. Marley and Louviere (2005) provide formal mathematical proofs. The task forces relative comparisons of domains, but is less cognitively cumbersome than other methods, such as assigning percentages or points (Louviere and Islam, 2008).

BWS has been applied in various contexts, but only recently to quality-of-life measurement to determine importance weights, but not satisfaction (Bovkir et al., 2023). Its first application was by Finn and Louviere (1992) to examine food safety concerns. BWS has since been used in health (Lancsar et al., 2013) and in marketing, to evaluate advertising content (Massey et al., 2015) and ethical product choices (Burke et al., 2014). In transport, BWS has been used to understand attitudes to public transport (Beck and Rose, 2016) and barriers to walking in the built environment (Larranaga et al., 2019). In education, BWS was first applied to quantify factors impacting teachers' decisions to leave the profession (Burke et al., 2013), and since used to assess teachers' concerns about educational technology (Burke et al., 2018b), evaluate the importance of pedagogical principles in mobile learning (Burden et al., 2019), explore students' subject choices (Palmer et al., 2017), and understand teachers' preferences for professional development (Burke et al., 2021).

Generally, SWB surveys ask respondents to rate their satisfaction on several domains; however, focusing only on satisfaction may provide incomplete information. Fishbein and Ajzen (1975) noted that attitudes require measuring both satisfaction and importance. For this reason, a dual response BWS mechanism (Beck and Rose, 2016) is adopted: in each BWS task respondents nominate their most and least important life domains and nominate domains they are most and least satisfied (see Fig. 1), enabling a concurrent determination of importance and satisfaction.

3.3. Limitations of traditional best-worst scaling

BWS is appealing as it forces respondents to differentiate objects in relative terms (Louviere and Islam, 2008), but are not evaluated against an absolute threshold. To illustrate, consider a case where traditional BWS determines one hypothetical individual's satisfaction ranking as: {relationships > security > health}. This person might not be very satisfied with any domain, so the ranking including this threshold is: {satisfied > relationships > security > health}. Another individual with the same domain ranking, might be highly satisfied with their relationships, such that: {relationships > satisfied > security > health}. Finally, a third individual with identical domain rankings, but satisfied with all life aspects, has a ranking of: {relationships > security > health > satisfied}.

Table 2
Youden design for SWB Tasks.

Set	Position *I*	Position *II*	Position *III*	Position *IV*	Position *V*	Position *VI*
1	10	7	2	11	8	6
2	8	3	11	1	7	9
3	2	10	1	8	9	4
4	9	2	5	10	11	3
5	1	4	6	3	10	11
6	11	5	7	2	4	1
7	5	1	3	6	2	8
8	6	9	4	7	3	2
9	3	8	10	4	5	7
10	4	11	8	9	6	5
11	7	6	9	5	1	10

Note: Position *I* to Position *VI* refer to the ordered position that domains appear in the BWS task as presented in Fig. 1, with Position *I* and *VI* referring to the first item and last item in a given set, respectively. The numbers within the table represent where to present each domain 1 through 11.

Fig. 1. Exemplar BWS Task for Satisfaction and Importance. NOTE: The vertical and horizontal lines represent equal (average) weighting of importance ($w_i = 0.091$) and satisfaction scores ($S_i = 5.88$), respectively.

Traditional BWS, reliant on only relative satisfaction rankings, cannot distinguish these three individuals; the current research expands BWS to overcome this limitation.

3.4. Anchored best-worst scaling (ABWS) approaches

To the authors' knowledge, only one study (Lattery, 2010) addresses how to obtain absolute measures of domain importance using BWS. Lattery (2010) proposes two methods to "anchor" BWS responses in product evaluations. First, an indirect dual response method sees respondents nominate product feature importance using a scale of "All features are very important", "None of these features are very important" and "Some are very important, some are not". These questions indeterminately anchor some attributes above or below an importance threshold. This indirect approach suits only cases featuring up to four objects at a time (noting the empirical application below uses six domains at a time). A second direct method involves presenting all domains with respondents ticking which are "very important"; this provides information about those objects above (ticked) or below (not ticked) an importance threshold. Osman et al. (2021) uses this approach, asking respondents to compare health domains shown in a BWS task to a binary benchmark (description is better; death is better). Both methods benchmark each object directly or indirectly to a binary importance threshold (i.e., very important; not very important) rather than a more nuanced absolute importance scale (e.g., very important, important, somewhat important).

An alternative to Lattery (2010) follow-up anchored-BWS task (ABWS) is proposed by introducing an extension asking respondents to rate their most and least satisfactory domains. A real-time calculation of individual satisfaction BWS scores for the 11 domains determine which domains are rated. An 11-point scale is used, ranging from zero (not satisfied at all) to 10 (completely satisfied with). The adjusted calculation mechanism is discussed in Section 3.5.

3.5. Calculating overall subjective well-being scores using dual response ABWS

3.5.1. Importance weights

BWS raw importance scores for each individual domain, denoted 'i' (with $i = 1, 2, \ldots, D$), for each respondent, are calculated using methods verified in Marley and Louviere (2004), subtracting the frequency a respondent nominates each domain as most important, MI_i, and least important, LI_i, with the resulting value divided by the frequency each domain is presented to the same respondent across all BWS importance tasks, CI_i. That is, BWS raw importance scores are calculated via:

$$BWSR\_I_i = \frac{(MI_i - LI_i)}{CI_i} \tag{1}$$

To convert importance scores for each domain to importance weights, reflecting the probability that a particular domain i is chosen as most important across all $d = 1$ to D domains, the following is applied, based on Nobel Laureate McFadden's (1973) work on transforming scores into probabilities:

$$w_i = \frac{e^{BWSR\_I_i}}{\sum_{d=1}^{D} e^{BWSR\_I_d}} \tag{2}$$

The use of a logit functional form in Equation (2) is consistent with the dominant practice in the field where discrete choice outcomes are modelled and preferable given that the link function generates a closed form solution relative to other functional forms (e.g., normal probability link function resulting in a probit model) that have no closed form solution and thereby require computationally intensive simulations for estimation (Louviere et al., 2000). As probabilities, the resulting relative BWS-derived importance weights sum to unity, bounded between zero and one. A higher (lower) importance weight, reflects a higher (lower) probability an individual has nominated the domain as a contributor to their overall quality of life.

Table 3
Example of SWB calculations.

Equation used to derive Life Domain *i*	Importance (Weight)						Satisfaction							SWB
	Most (MI_i)	Least (LI_i)	Avail. (CI_i)	BWSR_I$_i$	e^{BWS_Ii}	w_i	Most (MS_i)	Least (LS_i)	Avail (CS_i)	BWSR_S$_i$	BWS_S$_i$	Rating /10	S_i	(w_i)(S_i)
				(1)		(2)				(3)	(4)		(5)	(6)
Standard of living	2	0	6	0.333	1.395	0.112	0	0	6	0.000	0.556	–	6.222	0.698
Health	6	0	6	1.000	2.718	0.219	1	1	6	0.000	0.556	–	6.222	1.361
Achievements in life	0	1	6	−0.167	0.846	0.068	0	0	6	0.000	0.556	–	6.222	0.424
Personal relationships	0	1	6	−0.167	0.846	0.068	0	0	6	0.000	0.556	–	6.222	0.424
Safety	3	0	6	0.500	1.649	0.133	1	3	6	−0.333	0.333	–	5.333	0.707
Feeling part of the community	0	3	6	−0.500	0.607	0.049	1	1	6	0.000	0.556	–	6.222	0.304
Future security	0	0	6	0.000	1.000	0.080	3	1	6	0.333	0.778	–	7.111	0.572
Spirituality/beliefs or religion	0	6	6	−1.000	0.368	0.030	0	0	6	0.000	0.556	–	6.222	0.184
Amount of time you have …	0	0	6	0.000	1.000	0.080	0	5	6	−0.833	0.000	4	4.000	0.322
Quality of your local environment	0	0	6	0.000	1.000	0.080	4	0	6	0.667	1.000	8	8.000	0.644
Daily job and/or responsibilities	0	0	6	0.000	1.000	0.080	1	0	6	0.167	0.667	–	6.667	0.536
Over all 'D' domains:			Min:	−1.000	$\Sigma = 12.43$	$\Sigma = 1.00$			Min:	−0.833	0.000		**SWB:**	**Σ=6.18**
			Max:	1.000					Max:	0.667	1.000			

3.5.2. Satisfaction scores

Again, following Marley and Louviere (2004), raw BWS satisfaction scores for each *i*th domain ($i = 1, 2, \ldots, D$) can be derived, based on comparing the frequency a domain provides most satisfaction, MS_i, and least satisfied, LS_i, adjusted against the frequency a domain is available for evaluation, CS_i. Resulting raw BWS relative satisfaction scores for each domain are derived via:

$$BWSR\_S_i = \frac{(MS_i - LS_i)}{CS_i} \tag{3}$$

Resulting BWS satisfaction scores are bounded between −1 and +1 and assume these two bounds only when an individual nominates a domain as most or least satisfactory on all tasks. Without loss of information, but to aid the transforming BWS satisfaction scores onto an absolute scale of satisfaction and to aid interpretation, Equation (4) allows the raw BWS satisfaction scores to undergo an intermediary step involving a linear transformation (Kiritchenko and Mohammad, 2017; Louviere et al., 2013):

$$BWS_{Si} = \frac{BWSR_{S_i} - \min\left(BWSR_{S_d}\right)}{\max\left(BWSR_{S_d}\right) - \min\left(BWSR_{S_d}\right)} \tag{4}$$

where subscript $d = 1,2, \ldots, D$, refer to the same domains that importance scores have been obtained; max($BWSR\_S_d$) and min ($BWSR\_S_d$) refer to the maximum and minimum unbounded raw BWS satisfaction scores across all 'D' domains, respectively. These transformed scores are bounded between 0 and 1, representing domains nominated as most and least satisfactory, respectively, but perfectly linearly correlated with scores derived in Equation (3) (Louviere et al., 2013).

The resulting scores from Equation (4) do not distinguish individuals who are very satisfied across all domains from individuals who are not very satisfied on any domain. This limitation arises because Equation (4) relies solely on relative inputs from traditional BWS (Lagerkvist, 2013; Lattery, 2010). Most applications to BWS scoring methods terminate at either Equation (3) or 4; any interpretation of BWS scores of this type are based on noting differences in relative terms only, including comparisons across segments, (e.g., health is the most satisfactory domain against all others domains, such as spirituality). The proposed method hereby extends traditional BWS to allow scoring outcomes to also be interpreted in absolute terms (e.g., health is extremely satisfactory rather than marginally satisfactory or unsatisfactory). Further, relative scores can then provide richer insights into making comparisons of domain satisfaction across segments (e.g., older persons are less satisfied with their health than younger persons) even when relative differences do not exist (health is the most important domain in shaping SWB for both younger and older persons).

To make this extension, information from the follow-up rating task is incorporated, as per Equation (5) below. Specifically, after completing all 11 BWS questions, real-time satisfaction scores are computed. Respondents then rate domains providing most and least satisfaction, providing an upper anchor, b_s, and lower anchor, a_s, respectively. Values of BWS_S_i for each domain from Equation (4) are re-adjusted (i.e., anchored) to fall between these two extremes via:

$$S_i = (b_s - a_s)BWS\_S_i + a_s \tag{5}$$

These individual satisfaction scores for each domain can be interpreted on a scale of 0 (no satisfaction) to 10 (complete satisfaction).

3.5.3. Overall subjective well-being scores

The individual BWS-derived importance and BWS-anchored satisfaction scores can be combined via a weighted summation across all D domains, consistent with multi-attribute measurement theory (Bettman et al., 1975; Fishbein, 1963; Luce and Tukey, 1964) and value priority/psychological centrality (Hsieh and Kenagy, 2014) previously incorporated into SWB measures (e.g., Ferrans and

Table 4
Comparison of individuals with varying satisfaction anchors.

	Traditional BWS outcomes		Individual *A*		Individual *B*		Individual *C*	
Life Domain	Importance w_i	Satisfaction BWS_S_i	Si_A	SWB_A (w_i) (S_{iA})	Si_B	SWB_B (w_i) (S_{iB})	Si_C	SWB_C (w_i) (S_{iC})
Standard of living	0.112	0.556	9.112	1.023	1.668	0.187	5.892	0.661
Health	0.219	0.556	9.112	1.993	1.668	0.365	5.892	1.289
Achievements in life	0.068	0.556	9.112	0.620	1.668	0.114	5.892	0.401
Personal relationships	0.068	0.556	9.112	0.620	1.668	0.114	5.892	0.401
Safety	0.133	0.333	8.666	1.150	0.999	0.133	4.331	0.575
Feeling part of the community	0.049	0.556	9.112	0.445	1.668	0.081	5.892	0.288
Future security	0.080	0.778	9.556	0.769	2.334	0.188	7.446	0.599
Spirituality/beliefs or religion	0.030	0.556	9.112	0.270	1.668	0.049	5.892	0.174
Time to do the things you like doing	0.080	0.000[a]	8.000[a]	0.644	0.000[a]	0.000	2.000[a]	0.161
Quality of your local environment	0.080	1.000[b]	10.000[b]	0.805	3.000[b]	0.241	9.000[b]	0.724
Daily job and/or responsibilities	0.080	0.667	9.334	0.751	2.001	0.161	6.669	0.537
			SWB_A	**Σ=9.09**	**SWB_B**	**Σ=1.63**	**SWB_C**	**Σ=5.81**

[a] Anchored-rating of least satisfactory dimension (i.e., a_S) was a '8', '0' and a '2' for individuals A, B and C respectively.
[b] Anchored-rating of most satisfactory dimension (i.e., b_S) was a '10', '3' and a '9' for individuals A, B and C respectively.

Powers, 1985; Hsieh and Li, 2019). Hence, each individual's overall SWB scores is calculated using inputs from Equation (2) (i.e., importance weights) and Equation (5) (anchored satisfaction scores) as:

$$SWB = \sum_{d=1}^{D} w_d S_d \tag{6}$$

The marginal contribution of each domain to SWB is thereby the product of the individual importance of a given domain by its corresponding anchored satisfaction score (i.e., $w_d{}^*S_d$).

To illustrate, the example in Table 3 shows the health domain was nominated most important to a hypothetical individual's quality of life on all six occasions; they are most and least satisfied with their local environment and time to do things, respectively. In the satisfaction rating task, 'time to do things' was rated a '4' out of 10 and their local environment rated an '8'. Applying Equations (3)–(5), satisfaction scores for each domain range between these two extremes. The individual's overall SWB is calculated by weighting the satisfaction derived from each domain by importance; their SWB score is 6.18 out of 10, indicating they have a medial level of well-being.

The justification for transforming satisfaction scores from traditional BWS approach (as per Equation (4)), which inadequately relies on relative measures, to incorporate an absolute satisfaction measure (as per Equation (5)), is demonstrated via a second illustration in Table 4. Specifically, three individuals indicate the same relative importance and relative satisfaction on 11 life domains via the traditional BWS task. The anchoring task indicates individual *A* is satisfied with all life aspects, including rating time to do things – the domain they are least satisfied with – an '8' out of 10. In contrast, individual *B* has a lower satisfaction level for all domains, including their most satisfactory domain (local environment), rating this a '3'. Despite being unable discriminate respondents by the same relative importance each individual places on the 11 domains and satisfaction derived, the anchoring tasks results in different SWB scores determined as 9.09, 1.63, and 5.81 for individuals *A*, *B*, and *C*, respectively. Hence, the dual-response BWS task provides insights about relative importance and satisfaction for domains, whilst rating of the two extremes of satisfaction anchors BWS scores, translates each individual's well-being into absolute terms.

4. Empirical application and results of dual-response anchored BWS to SWB

In addition to outline and demonstrate how to apply the method, an empirical application described below was undertaken to address several research questions (RQ). These include.

RQ1: Do individuals equally weight domains in importance when determining their SWB?
RQ2: How are importance and satisfaction with different life domains aligned or misaligned?
RQ3: Does the proposed ABWS measure of SWB capture variation in life satisfaction that is statistically distinct or consistent with other measures of life satisfaction and SWB?
RQ4: Is the variation in SWB as derived via ABWS able to be explained by a set of independent variables that describe individuals using socio-economic and other profiling characteristics?
RQ5: If RQ4 holds, is the manner in which the set of independent variables predicting variation in SWB identical to the manner in which the same predictors capture variation in other ratings-based measures of life satisfaction and SWB?

After providing background to the empirical research, including a description of the sample used, findings relating to each of the research questions listed are presented below.

4.1. Study overview and sample

An online survey was distributed using an online panel during May2, 019.[1] All respondents were Australian located in New South Wales (93%) or the Australian Capital Territory (7%). A total of 2500 complete responses were available for which individual SWB scores could be derived. Summary statistics are presented in Table 5. The majority of respondents resided in a metropolitan or capital city (47%), working full-time (29%) or part-time (16%), with one in three being retired (33%). The median age was 57 years. The majority were living in a reasonably comfortable financial situation (43%) with a median income of $AUD $78,000 to $91,000 per annum. Most respondents were in a registered marriage (57%), with 72% indicating they had children.

4.2. Importance and satisfaction across life domains

The first research question (RQ1) aimed to assess if individuals place equal importance on the domains used to determine SWB. The justification for addressing this question is exemplified by the debate about the adequacy of equal weighted domain measures in deriving SWB (Angelini et al., 2013; Hsieh, 2004; Hsieh and Li, 2019). Using Equation 1 through 6, SWB was calculated from BWS-derived importance scores of and BWS- anchored satisfaction scores. Of the 2500 responses, 54.6% and 29.1% indicated

[1] Data for other periods have since been collected, but not made available for publication by the collaborating government body. Results and findings from other waves are largely comparable.

Table 5
Sample profile.

Characteristic	Respondent profile	n	%
Gender	Female	1285	51.4
	Male	1210	48.4
	Other	5	0.2
Location	Metro/city	1181	47.2
	Large regional city/town	671	26.8
	Small regional town	471	18.8
	Rural	177	7.1
Indigenous	Non-indigenous	2438	97.5
	Aboriginal	40	1.6
	Aboriginal & Torres Strait Islander	2	0.1
	Other	20	0.8
Marital status	Married (in a registered marriage)	1427	57.1
	Living with someone in a relationship	249	10.0
	In a relationship but not living with them	112	4.5
	Not in a relationship (single)	599	24.0
	Widowed	95	3.8
	Other (don't know; prefer not to answer)	18	0.7
Children	Have children	1789	71.6
	Do not have children	711	28.4
Number of children	1 child	357	14.3
	2 children	809	32.4
	3 children	385	15.4
	4 children	164	6.6
	5 or more children	35	1.4
Work status	Full-time paid work	725	29.0
	Part-time paid work (including casual)	390	15.6
	Self-employed	163	6.5
	Unemployed and looking for paid work	76	3.0
	Student	41	1.6
	Not working (e.g. housemaker)	150	6.0
	Unpaid carer (e.g. for family member)	26	1.0
	Employed, but away from work (e.g. maternity)	8	0.3
	Retired	829	33.2
	Other	77	3.1
	Prefer not to answer	15	0.6
Financial status	Very poor	52	2.1
	Poor	155	6.2
	Just getting along	830	33.2
	Reasonably comfortable	1085	43.4
	Very comfortable	326	13.0
	Prosperous	30	1.2
Income	Median income	$AUD 78 K–91 K p.a.	
Age	Median age	57 years of age	

spirituality and daily job, respectively, were irrelevant to their life; these domains were excluded for these respondents for evaluation and SWB calculations. The importance and satisfaction scores for each domain are shown in Table 6.

Based on raw BWS scores (Equation (1)) and probability weights (Equation (2)) for each individual, the results indicate significant discrimination on importance over domains. In answer to RQ1, domains were unequally weighted by individuals when aggregated over the sample. Specifically, a test of differences in means of the eleven importance weights using MANOVA, rejected the hypothesis that mean probability weights of each domain are equal ($F[10, 2491] = 57141.818$; $\eta^2 = 0.995$; Wilk's $\lambda = 0.005$; Hotelling's Trace = 206.454; $p < 0.0001$).

Post-hoc analysis examining where differences in weights were more pronounced was undertaken. At one extreme, health was most important, on average, relative to other domains ($w_i = 0.134$; S.D. = 0.028) and significantly higher than if individuals had assigned equal importance to domains ($t = 64.127$; $\eta^2 = 0.958$; $p < 0.0001$). Conversely, feeling part of the community was significantly lower in importance compared to other domains, on average ($w_i = 0.077$; S.D. = 0.016), and received significantly less weight compared to outcomes had equal importance of domains occurred ($t = -63.869$; $\eta^2 = 0.956$; $p < 0.001$). The three most important domains were health, relationships and financial security; the three least important domains were feeling part of the community, achievements and job/responsibilities.

Satisfaction scores indicate unequal levels of satisfaction over life domains. Using ABWS scores derived from Equation 3 through 5, on average, individuals derive most satisfaction from spirituality/beliefs or religion ($S_i = 6.60$; SD = 1.93); this is more significant than satisfaction derived from other domains, on average ($t = 13.38$; $p < 0.001$). Future security was least satisfactory ($S_i = 5.21$; SD = 1.98), and significantly less satisfying against the mean satisfaction levels ($t = -15.85$; $p < 0.001$).

From Equation (6), the marginal contribution of each domain to SWB can be derived by multiplying each importance weight by the corresponding anchored satisfaction score (i.e., $w_i{*}S_i$, for each $i = 1{:}D$). Table 6 provides insights into each domains' contribution to

Table 6
Domain importance, satisfaction, and marginal contribution to SWB.

	SWB Importance Weights(w_i)			SWB Satisfaction Scores (S_i)			Marginal Contribution of Domain to SWB(w_i*S_i)			Ranking of Importance, Satisfaction & Marginal Contribution to SWB		
Life Domain	Mean	S.D	t-stat(1)	Mean	S.D	t-stat(2)	Mean	S.D	t-stat (3)	w_i	S_i	w_i*S_i
Health	0.134	0.028	64.127	5.638	2.315	−4.26	0.752	0.358	24.293	[1]	[7]	[2]
Personal relationships	0.114	0.026	30.223	6.553	2.482	14.46	0.766	0.383	24.485	[2]	[2]	[1]
Future security	0.104	0.021	14.959	5.207	1.979	−15.85	0.535	0.227	−9.602	[3]	[11]	[6]
Standard of living	0.103	0.018	14.392	6.137	2.148	7.04	0.628	0.248	9.975	[4]	[3]	[4]
Safety	0.102	0.019	10.454	5.960	1.672	3.76	0.608	0.215	6.744	[5]	[4]	[5]
Spirituality/beliefs or religion	0.093	0.031	−4.851	6.601	1.929	13.38	0.643	0.346	6.293	[6]	[1]	[3]
Time to do the things you like	0.090	0.018	−23.321	5.581	2.124	−5.97	0.500	0.226	−17.429	[7]	[9]	[9]
Quality of local environment	0.088	0.017	−30.097	5.607	1.874	−6.07	0.496	0.207	−20.033	[8]	[8]	[10]
Daily job/responsibilities	0.086	0.017	−29.600	5.907	1.891	1.61	0.515	0.210	−12.821	[9]	[6]	[7]
Achievements in life	0.086	0.018	−34.702	5.956	1.930	3.15	0.513	0.213	−15.531	[10]	[5]	[8]
Feeling part of community	0.077	0.016	−63.869	5.474	1.724	−10.47	0.426	0.184	−41.321	[11]	[10]	[11]
Average over all domains	**0.098**	**0.021**	-	**5.835**	**2.006**	-	**0.580**	**0.256**	-			

Note: t-statistic refers to tests of (1) equal importance weighting of domains: (2) equal satisfaction across domains domains; and, (3) equal marginal contribution from each domain. Specifically, the t-statistic indicates a.
(1) test of mean importance weight of each domain (w_i) against equal importance weighting.
(2) test of mean satisfaction of each domain (Si) against mean satisfaction over all domains.
(3) test of each mean marginal contribution of each domain (i.e., wi*Si) against mean marginal contribution over all SWB domains.
All mean differences significant at 0.05 level.
Ranking indicates domain with most [1] to least [11] importance with respect to importance (w_i), satisfaction (S_i), and marginal contribution (ie., w_i*S_i) to SWB.

SWB via importance and satisfaction. Notably, SWB was driven by higher importance ($w_i = 0.114$) and satisfaction ($S_i = 6.553$) with personal relationships, with a marginal contribution to SWB of 0.766 (w_i*$S_i = 0.114$*6.553), which is more significant relative to other domains, on average ($t = 24.485$; $p < 0.001$). Conversely, SWB was significantly less impacted by the combined importance ($w_i = 0.077$) and satisfaction ($S_i = 5.474$) of feeling part of the community resulting in a significantly lower contribution to SWB than other domains, on average (w_i*$S_i = 0.077$*5.474; $t = -41.32$; $p < 0.001$).

The second research question (RQ2) explored in the empirical analysis examines the strategic policy insights offered in considering any (mis)alignment between life domain importance and satisfaction. That is, we provide a practical method to highlight domains in

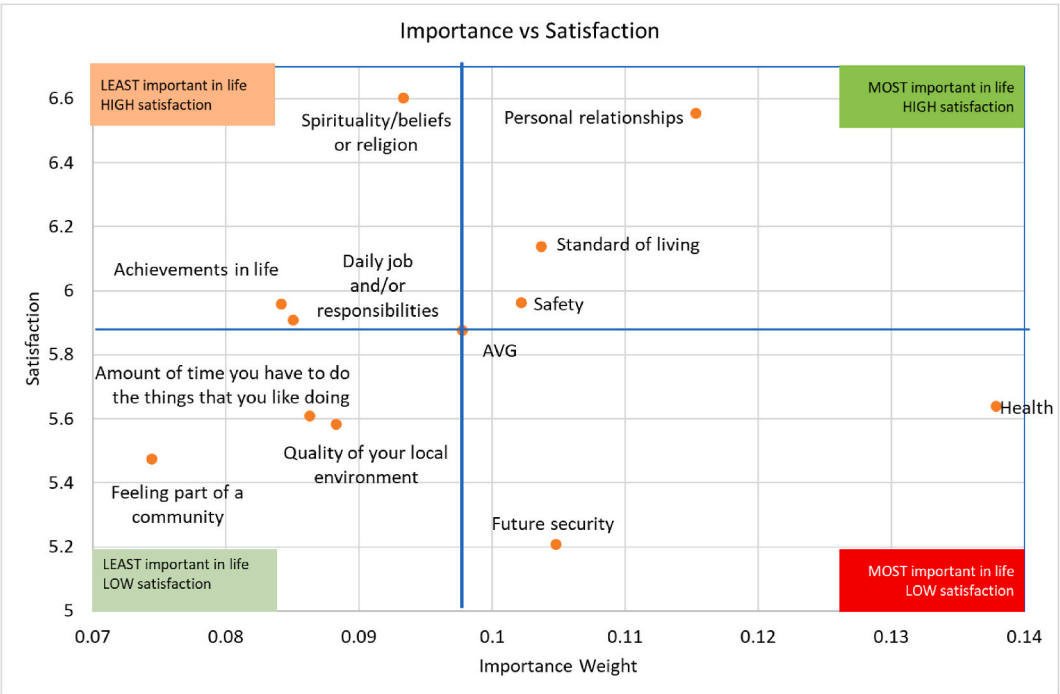


Fig. 2. Importance vs Satisfaction of Contributing Areas of SWB.

which satisfaction may be high (low) relative to their low (high) importance, and thereby misaligned. Areas of misalignment (alignment) may indicate where greater (fewer) resources for policy outcomes to improve subject well-being are required. The evaluation of alignment bears resemblance to other literature in marketing management in which performance on various product dimensions are evaluated against their importance of such dimensions to consumers (Prajogo et al., 2011). In such literature, this strategic tool is commonly referred to as an 'importance-performance matrix analysis' (IMPA) and thereby presented as a useful practical analytical method to determine priorities for product improvement (Slack et al., 1994). Specifically, in the marketing literature, the value of IMPA is commonly used to highlight areas in which a company may be perceived in delivering poor performance on attributes that may be highly important to individuals (i.e., misaligned), thereby indicating areas of strategic value to address such perceptions such as via marketing communications or new product development (Wu et al., 2010).

In the present context, the evaluation of alignment between importance and satisfaction, is to highlight the value of our approach for policy makers to draw greater attention to those domains that citizens are less satisfied with despite being more important dimensions in determining their subjective well-being. As policy makers have limited resources to address all dimensions of well-being, such analysis indicates where greater inroads to improving SWB can be achieved relative to expending resources on domains where improving them will have less impact on overall SWB. A similar approach has been offered in prior literature examining SWB outcomes (e.g., Cheng et al., 2023).

Thereby, to illustrate how problematic areas of subjective well-being performance and importance can be highlighted, the mean importance (w_i) and satisfaction for each life domain (S_i) appear in Fig. 2, providing a visualization of the results in Table 6. The figure demonstrates significant deviations of BWS-derived importance weights from equal importance (indicated by the vertical line), confirming conclusions from RQ1. It also shows substantial variations in satisfaction scores across life domains compared to equal satisfaction (indicated by the horizontal line). Each quadrant indicates where estimates of relative satisfaction and importance either deviate or align. Notably, personal relationships emerge as highly important and satisfying. Conversely, health is most important, but provides less satisfaction. Life domains in the top-left quadrant depict higher satisfaction, but assigned less importance in well-being. Policy makers in this context, therefore, would benefit in improving SWB by addressing ways to improve the satisfaction of individuals with their perceived health relative to allocating more resources to feeling part of a community. As such, this visualization demonstrates the insights that may be generated for academics and policy makers in other contexts where the method is applied.

4.3. SWB relationship with other life measures

Once each of the marginal contributions in terms of the satisfaction derived from each domain weighted by importance are summated following Equation (6), an overall SWB score can be determined for each individual. Average overall SWB was estimated to be 5.835 (S.D. = 2.006), which can be interpreted against the minimum SWB score (zero) and maximum (ten) score. The estimate is significantly higher than the mid-point SWB score of five ($t = 33.09$; $p < 0.001$), implying individuals, on average, are more positive than negative in the SWB they derive from their satisfaction across the 11 life domains weighted by importance.

The third research question evaluates if ABWS-BWS captures variation in life satisfaction that is statistically distinct from other measures of life satisfaction and SWB (RQ3). The intention was to understand whether the proposed SWB measure was identical to indicators of well-being used in prior literature – thereby sharing the same underlying covariance with other indicators – or was unique

Table 7
Ratings-based measures of personal situation.

	Measure	Mean	S.D.
GLS	**Global life satisfaction (single-item rating)**	**6.89**	**2.08**
	How satisfied are you with life overall (0 = No satisfaction; 10 = Completely satisfied)		
EUD (single)	**Eudemonia overall (single-item rating)**	**7.35**	**1.96**
	To what extent do you feel things in your life are worthwhile (0 = Not at all worthwhile; 10 = Completely worthwhile)		
EUD (multi)	**Eudemonia (multi-item rating) (AVE=.733; CR=.916; CA=.854)**	**6.31**	**1.86**
	Indicate your level of agreement (0 = Disagree; 10 = Agree completely)		
	In general, I feel very positive about myself (Factor loading, $\lambda = 0.909$)	6.78	2.37
	I'm always optimistic about my future (0.89)	6.42	2.42
	I am free to decide for myself how to live my life (0.739)	7.34	2.27
	Most days I get a sense of accomplishment from what I do (0.877)	6.47	2.35
	When things go wrong in my life it generally takes me a long time to get back to normal (−)	4.35	2.78
SWB (ratings)	**Satisfaction on 11 SWB domains (multi-item rating)**	**6.76**	**1.48**
	How satisfied are you with life with respect to … (0 = No satisfaction; 10 = Completely satisfied)		
	Spirituality/beliefs or religion	7.72	2.06
	Personal relationships	7.40	1.81
	Future security	7.15	2.63
	Standard of living	6.90	1.97
	Safety	6.89	2.33
	Spirituality/beliefs or religion	6.88	2.23
	Time to do the things you like	6.81	2.14
	Quality of local environment	6.58	2.41
	Daily job/responsibilities	6.37	2.46
	Achievements in life	6.16	2.27
	Feeling part of community	6.03	2.46

in terms describing variation in wellbeing. Factor analysis and associated reliability measures, thereby, are appropriate (Eid and Diner, 2004; Guttman, 1945; Kahneman and Krueger, 2006; Krueger and Schkade, 2008; Lyubomirsky and Lepper, 1999) to assess if ABWS-SWB is internally consistent in its variation with existing SWB rating-based measures. Our approach, thereby, improves on methods that establish whether measures are significantly correlated or not (see, Hsieh et al., 2019), but instead evaluates the extent to which these correlations are consistent with determining if ABWS-SWB produces a reliable measure of the same underlying latent construct captured by other established reflective measures of life satisfaction.

If SWB measured using ABWS is found to be perfectly consistent and, thereby a reliable measure of the same underlying construct offered by other SWB and life measures, the new insights for academics and policy makers garnered by our approach would be marginal. Instead, as demonstrated below, an ABWS-SWB offers something statistically unique and thereby captures life satisfaction outcomes that are distinct from previous measures. As such, a follow-up set of results is considered below as to why such distinctions arise, drawing attention to the skewed nature of ratings-based approaches, whereby a greater number of respondents indicate near complete or complete life satisfaction, particularly in cases where single-item measures are used.

Several measures were included for the evaluation of ABWS in its internal consistency with outcomes garnered by using established approaches to life satisfaction (see Table 7). This included Global Life Satisfaction (GLS), measured via an 11-point single-item rating scale (0 = no satisfaction, 10 = complete satisfaction). Additionally, respondents rated satisfaction with life domains on the same scale and used to derive SWB by averaging ratings. Two eudemonia measures included: respondents rated the extent they feel the things they do in their life are worthwhile on a 11-point scale (0 = “not at all worthwhile”, 10 = “completely worthwhile”); respondents also completed a multi-item reflective measure, rating future positivity, optimism, and other aspects on a 11-point scale (0 = disagree completely; 10 = agree completely). The statements and factor loadings are presented in Table 7, with all but one of the five items reliable and valid measures of overall eudemonia (see Table 7).

Examining the results relating to RQ3, Table 8a reports the bi-variate correlations between measures. SWB-ABWS is significantly correlated with all ratings-based measures; the highest shared variation occurred with SWB derived from the average multi-item rating of satisfaction on the same 11-domains used in the ABWS approach ($r = 0.553$; $p < 0.001$). The variation in SWB-SWB and single-item measures of eudemonia indicate the lowest linear association ($r = 0.412$; $p < 0.001$).

Second, a multi-variate approach assessed the reliability of the same life-satisfaction measures. Table 8b shows the rating-based measures are internally consistent and reliable measures of the same underlying construct (Guttman, 1945) yielding a Cronbach’s Alpha of 0.885; removing any one measure decreases reliability (Cronbach, 1951). When assessing common variance explained by including the four-ratings based measures, Cronbach’s Alpha is $\alpha = 0.876$; when using equal-weighted satisfaction or using anchored SWB scores from BWS, Cronbach’s Alpha increases to $\alpha = 0.885$. Thus, equal-weighted and weighted ABWS-SWB are not statistically reliable measures of the same common variance explained by rating approaches to life satisfaction.

Third, a similar conclusion is reached using exploratory factor analysis (EFA). Variation over the four ratings-based measures considered are reflective of a single latent construct only, with each a reliable and valid measure. All four factor loadings are greater than the benchmark of 0.707 and associated average variation extracted was 0.851, above 0.50 for convergent validity (Fornell and Larcker, 1981). When including ABWS-SWB, EFA identifies one common factor only (based on eigen values being greater than one), but ABWS-SWB is not a valid nor reliable measure of this latent factor (factor loading of 0.564). Similarly, including equally weighted BWS satisfaction scores, EFA similarly identifies one common factor only with a factor loading of 0.538. Hence, when both measures are used, they explain less than 50% of the common variance (Hair et al., 2009). Identical conclusions are reached when using alternative extraction methods and estimation approaches, including principal components analysis, whilst any consideration of rotation (e.g., oblique) is not applicable as only a single factor is identifiable (Hendrickson and White, 1964).

Hence, whilst equally weighted SWB and ABWS-SWB provide measures of life satisfaction that are correlated with measures of overall life satisfaction, eudemonia, and SWB over the same 11 domains, both are not reliable or valid representations of these ratings-based measures. In other words, and addressing RQ3, SWB measured using ABWS provides an overlapping, but unique perspective of life satisfaction obtained via ratings-based approaches.

To grasp the conclusion regarding RQ3, focusing on whether ABWS measures something distinct in terms of life satisfaction compared to other measures, Fig. 3 presents the distribution of each life satisfaction measure. Ratings-based measures show a higher mean and variation in scores than SWB derived from ABWS. With single-item measures, a higher proportion of individuals gave the maximum score (10) indicating complete satisfaction with their life. This is noted in 5.6% and 13.4% of the sample for the GLS and eudemonia measures, respectively. Multi-item measures, like the average satisfaction rating over the 11 life domains (SWBR), have a lower proportion of ratings at the extreme levels. However, ABWS-derived SWB scores are notably lower on average, with a larger

Table 8a
Correlation of SWB-AWB with other life-satisfaction measures.

Measure	Description of measure	GLS	EUDS	EUDM	SWBR	SWB_EBWS
GLS	Global Satisfaction (single-item)					
EUD_S	Eudemonia (single-item)	0.713				
EUD_M	Eudemonia (multi-item)	0.760	0.730			
SWB_R	SWB ratings (multi-item)	0.756	0.656	0.725		
SWB_EBWS	SWB BWS satisfaction (equal weighted importance)	0.458	0.400	0.445	0530	
SWB_ABWS	SWB Anchored-Best Worst Scaling	0.487	0.412	0.465	0.553	0.990

* All bi-variate correlations significant at $p < 0.001$ level.

Table 8b
Reliability and Validity of SWB-AWB with other life-satisfaction measures.

		Ratings-Based Approaches			Ratings + EBWS Approach			Ratings + ABWS Approach		
Measure	Description of measure	C.A.	λ	R^2	C.A.	λ	R^2	C.A.	λ	R^2
GLS	Global Satisfaction (single-item)	0.834	0.884	0.781	0.823	0.882	0.778	0.827	0.883	0.780
EUD_S	Eudemonia (single-item)	0.855	0.812	0.659	0.839	0.807	0.651	0.845	0.806	0.650
EUD_M	Eudemonia (multi-item)	0.869	0.872	0.760	0.844	0.868	0.753	0.849	0.867	0.752
SWB_R	SWB ratings (multi-item)	0.845	0.836	0.699	0.823	0.846	0.716	0.828	0.847	0.717
SWB_EBWS	SWB Equal Best Worst Scaling	–	–	–	0.885	0.538#	0.289#	–	–	–
SWB_ABWS	SWB Anchored-Best Worst Scaling	–	–	–	–	–	–	0.885^	0.564#	0.318#
	When above measures included:	**0.885**	**AVE=.851**		**0.872**	**AVE=.637**		**0.876**	**AVE=.793**	

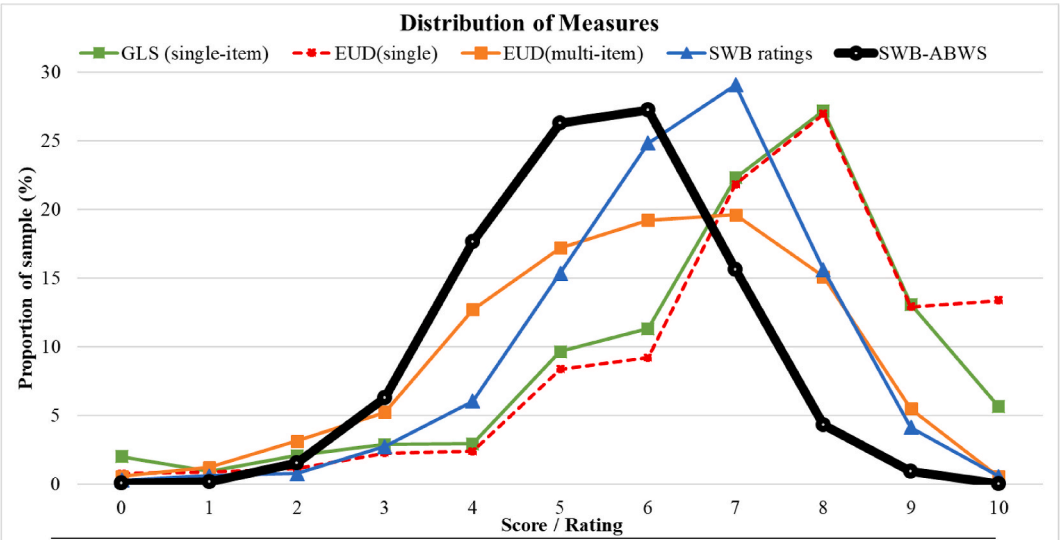
C.A. = Value of Cronbach's Alpha when item deleted.
λ = Factor loading; R^2=Represents communality of measure/variation extracted by measure (i.e., = 1- R^2).
^ Indicates measure should be deleted on basis of reliability when compared against Cronbach's Alpha retaining all items.
# Indicates measure should be deleted on basis of factor loading below benchmark of .707 (i.e., communality/variance explained <50%).

proportion of the sample reporting scores closer to zero satisfaction than complete satisfaction (i.e., a 10). Specifically, ABWS reveals a substantial proportion of the sample with scores indicating very low satisfaction compared to the other measures. For instance, scores of SWB less than 5 using a single-item measure (GLS), average ratings over the 11 domains, and ABWS are observed for 10.8%, 10.5%, and 25.8% of the sample, respectively. In summary, ratings-based SWB measures are positively skewed to indicate higher levels of life satisfaction relative to employing an ABWS approach, thereby providing insights to the conclusions for RQ3.

4.4. Individual differences in SWB

A fourth research question addressed by the empirical application quantifies whether variation in SWB derived via ABWS is explained by a set of independent variables describing individuals using socio-economic indicators and other profiling characteristics (RQ4). This research question considers whether inadequate conclusions are reached when assuming individuals are homogenous in life satisfaction (Hutchinson et al., 2000). The heterogeneity identified offers areas for policy interventions to address areas where SWB is unsatisfactory (e.g., McBride, 2001), such as for those in remote areas or Indigenous (Western and Tomaszewski, 2016). Hence, one hypothesis of interest is to validate whether individuals with higher (lower) levels of life satisfaction derived from an ABWS approach to measuring subjective well-being have higher (lower) life satisfaction or eudemonia as derived from using single- or multi-item ratings-based measures.

The choice of measures was guided by prior literature examining differences in SWB across various segmentation variables, but also



Measure:	Mean	S.D.	Median	Focus of measure	Scale (0 / 10)
GLS (single-item)	6.89	2.08	7	Overall life satisfaction	No satisfication / Completely satisfied
EUD(single)	7.35	1.96	8	Extent feel things do in your life worthwhile	Not at all worthwhile /Completely worthwhile
EUD(multi-item)	6.31	1.86	6.5	Future positivivity, optimism, etc.	Disagree / Agree completely
SWB ratings	6.76	1.48	6.91	Satisfaction on 11 well-being domains	No satisfication / Completely satisfied
SWB-ABWS	5.88	1.34	5.92	BWS Weighting of ABWS Satisfaction on 11 domains	No satisfication / Completely satisfied

Fig. 3. Distribution of measures (ratings-based approaches and ABWS approach).

the preferences for comparisons of interest to the supporting government body for which the researchers partnered with. In that regard, the chosen measures overlap with the prior literature of SWB differences across groups defined by various indicators including: age (Hsieh, 2005; Siedlecki et al., 2014), relationship status (Dush and Amato, 2005; Waite et al., 2009), income (McBride, 2001; Stutzer, 2004), indigenous identity (Western and Tomaszewski, 2016), geographic location (Gilbert et al., 2016; Mookherjee, 1992; Requena, 2015), employment status (Mousteri et al., 2018), and gender (Kim and Moen, 2002). A linear regression model of ABWS-SWB as the dependent variable and a set of independent variables profiling individuals (e.g., sociodemographic) was estimated to identify differences in SWB across various segments. Coefficient estimates are presented in Table 9 whilst Table 10 presents a profile of those with differing SWB emerging from these estimates.

The results reveal that variation in ABWS-SWB is best predicted by variation in financial circumstances. Individuals with very comfortable or prosperous financial security report significantly higher SWB compared to those with poor financial security ($\beta = 0.333$; S.E. = 0.019). Similar conclusions are drawn based on income. The impact of linear and quadratic effect of age indicates younger and older individuals have significantly higher SWB compared to those of a medial age. Retirees also have significantly higher SWB compared to others, particularly the unemployed looking for work. SWB is lower among unmarried persons in a relationship with children relative to those in relationships without children. SWB was significantly lower among indigenous Australians, whilst those living in rural or small regional towns have significantly lower SWB relative to their city counterparts.

A fifth research question, RQ5, considers whether the same set of independent variables predicting variation in ABWS-SWB matches how the same predictors (e.g., age, gender) capture variation in other measures of life satisfaction and SWB as reported in prior literature (e.g., Alesina et al., 2004; Kapteyn et al., 2015). Hence, estimates from four regressions were evaluated against the estimates pertaining to RQ4. The dependent variables used were the same four measures of SWB derived from single and multi-item rating-scales introduced in addressing RQ3; the same independent variables used to evaluate RQ4 were included.

As noted in Table 9, estimates from each model with single- or multi-item ratings-based measures of SWB or life satisfaction are highly correlated with models using ABWS-SWB scores. Individuals with significantly higher (lower) SWB derived from ABWS are similar – but not statistically identical in all cases – to those with significantly higher (lower) SWB or eudemonia ratings. The highest overlap with ABWS-SWB estimates is from using average domain satisfaction ratings ($r = 0.961$). There are several exceptions: Using

Table 9
Model results describing individual differences in life-satisfaction measures.

	SWB-ABWS		GLS (single item)		EUD (single-item)		EUD (multi-item)		SWB ratings	
Individual Measure	Est. β	S.E.	Est. β	S.E.	Est. β	S.E.	Est. β	S.E.	Est. β	S.E.
Female	0.046	0.020*	0.041	0.020*	0.100	0.020***†	0.047	0.020*	0.053	0.020**
Age (Standardized)	0.159	0.021***	0.221	0.021***†	0.184	0.021***	0.224	0.021***†	0.292	0.021***†
Age (Quadratic; Standardized)	0.106	0.022***	0.098	0.021***	0.074	0.022***	0.066	0.021**	0.105	0.021***
Female x Age	0.047	0.021*	−0.037	0.021†	−0.006	0.021†	0.002	0.018†	−0.003	0.019†
Metro/city	0.020	0.020	0.004	0.020	−0.008	0.021	0.016	0.020	−0.018	0.020
Large regional city/town	0.048	0.020*	0.059	0.020**	0.049	0.020*	0.029	0.020	0.011	0.020
Small regional town	−0.012	0.021	0.030	0.021†	0.018	0.021	0.035	0.020†	0.048	0.021*†
Rural location	−0.056	0.021**	−0.093	0.020***	−0.059	0.019**	−0.080	0.020***	−0.041	0.017*
Aboriginal/Torres Strait Islander	−0.107	0.020***	−0.081	0.020***	−0.035	0.020†	−0.076	0.020***	−0.124	0.020***
Married (in a registered marriage)	0.119	0.027***	0.200	0.026***†	0.127	0.026***	0.126	0.026***	0.196	0.026***†
Living with someone in a relationship	0.012	0.023	0.041	0.022	−0.045	0.022*†	−0.034	0.022†	0.012	0.022
In a relationship not living with them	0.002	0.023	0.013	0.024	0.011	0.023	0.020	0.024	0.003	0.024
Not in a relationship (single)	−0.105	0.023***	−0.108	0.022***	−0.123	0.023***	−0.092	0.023***	−0.121	0.022***
Have children	0.039	0.031	0.077	0.030*	0.097	0.030**	0.074	0.030*	0.091	0.030**
Number of children (standardized)	0.044	0.020*	0.051	0.019**	0.025	0.019	0.037	0.020	0.061	0.019**
Have children x Married	0.001	0.032	−0.022	0.031	−0.019	0.031	−0.045	0.030	−0.026	0.030
Have children x Living in relationship	−0.056	0.022*	−0.086	0.022***	−0.057	0.022*	−0.064	0.022**	−0.083	0.022***
Have children x In relationship	−0.022	0.024	−0.042	0.023	−0.009	0.023	−0.029	0.023	−0.027	0.023
Have children x Single	−0.017	0.025	0.025	0.024	0.063	0.024**†	0.061	0.024*†	0.002	0.023
Full-time paid work	0.057	0.022*	0.118	0.022***†	0.068	0.022**	0.111	0.022***†	0.043	0.021*
Part-time or casual paid work	−0.007	0.024	0.086	0.022***†	0.101	0.022***†	0.054	0.022*†	0.053	0.022*†
Self-employed	0.046	0.025	0.060	0.024*	0.080	0.024**	0.103	0.024***†	0.083	0.024***
Unemployed, looking for work	−0.063	0.029*	−0.157	0.028***†	−0.161	0.028***†	−0.118	0.028***	−0.109	0.028***
Not working (housemaker; carer)	0.002	0.021	0.004	0.022	0.032	0.024	−0.027	0.024	−0.014	0.023
Retired	0.160	0.022***	0.254	0.022***†	0.156	0.022***†	0.226	0.022***†	0.278	0.021***†
Income (Standardized)	0.097	0.025***	0.193	0.024***†	0.162	0.025***†	0.146	0.025***	0.156	0.025***†
Income (Std. Squared)	−0.035	0.025	−0.077	0.024**	−0.105	0.025***	−0.080	0.025**	−0.093	0.025***†
Financial status (Prosperity)	0.333	0.019***	0.494	0.017***†	0.341	0.019***	0.430	0.018***†	0.488	0.017***†
Correlation with estimates BWS-ABWS			0.949		0.893		0.941		0.961	

*/**/*** parameter estimate significant at 0.05/.01/.001 level; † parameter estimates significantly different from ABWS-SWB derived estimate ($p < 0.05$).

Table 10
Profile of lower and higher SWB.

Covariate	Lower SWB	Higher SWB
Gender	Male	Female
Age	Aged 40–50 years	Aged 20–30 years or 65+ years
Location	Rural location	Large regional city/town
Indigenous	Aboriginal/Torres Strait Islander	Non-indigenous
Relationship status	Not in a relationship (single)	Married (in a registered marriage)
Number of children	Less children	More children
Relationship x Children	Living in a relationship with children	Living in a relationship without children
Employment	Unemployed and looking for paid work	Full-time or Retired
Income	Lower income	Higher income
Financial prosperity	Poor/just getting along	Very comfortable/More prosperous

ABWS-SWB, a significant interaction effect between age and gender ($\beta = 0.047$; $p < 0.05$) indicates SWB is higher among older persons, but more so among older females. This effect is not significant in models using ratings, including those over the 11 domains ($\beta = -0.003$; $p = 0.878$). Conversely, the finding that retirees have higher levels of SWB is more pronounced using ratings-based ($\beta = 0.278$; $p < 0.001$) than ABWS measures ($\beta = 0.160$; $p < 0.001$).

4.5. Summary of findings

The results affirm that ABWS-derived SWB effectively discerns between domains in terms of individual importance for determining SWB. The extension to traditional BWS, achieved by anchoring satisfaction scores, facilitates obtaining both relative and absolute measures of domain satisfaction, enabling discrimination between individuals beyond relative measures. The findings from each research question can be summarized as follows: First, individuals do not uniformly weigh domains in deriving overall SWB based on their importance (RQ1). Second, significant differences exist in the alignment of domains perceived as more or less important to SWB compared to the levels of satisfaction they provide (RQ2). Third, SWB derived from ABWS captures life satisfaction variation similar to, but statistically distinct, from other measures of life satisfaction (RQ3). ABWS scores are less positively skewed towards complete or near-complete life satisfaction compared to other ratings-based measures. Fourth, variation in SWB via ABWS can be explained by several independent variables describing individuals, including socio-economic and other profiling characteristics (RQ4). Fifth, the set of independent variables predicting SWB variation is statistically identical to some predictors capturing variation in other ratings-based measures of life satisfaction and SWB, but not all (RQ5). While these differences have implications, they lead to similar general conclusions about segments where SWB is significantly higher or lower. In the following section, each finding is discussed in detail, along with an evaluation of its implications and relationship to prior literature.

5. Discussion

The current research offers a new approach to SWB by examining the using BWS to examine the trade-offs individuals make regarding life domains on importance and satisfaction; an anchoring task determines the range of satisfaction occurring for each individual. This allows discrimination between those who experience high and low levels of satisfaction in their lives and/or a small or larger range in satisfaction across life domains.

The results debunk the assumption of equal weighting to life domains based on importance (RQ1). Instead, statistically significantly weight is attributed to health, relationships, and security to determine life satisfaction. Health's significance aligns with prior findings (e.g., Diener et al., 1999; Kapteyn et al., 2015). Conversely, life achievements and community inclusiveness were less important. The lower importance of life achievement contradicts Yiengprugsawan et al. (2009) who find it to be the strongest determinants of well-being alongside spirituality, living standards, and security. Comparing importance of and satisfaction with life domains indicates health holds greater importance than other domains for SWB, yet heath satisfaction fall below ideal. Conversely, people are highly satisfied with personal relationships and it is a significant driver of SWB.

The results show that ABWS-derived SWB correlates with other life satisfaction measures, but it is distinct in capturing something unique, as determined by an analysis of common variance (RQ3). Firstly, the ABWS measure indicates that, on average, individuals have a lower level of life satisfaction compared to ratings-based approaches to well-being and eudemonia. Ratings-based approaches tend to inflate the number of individuals reporting complete life satisfaction, especially when using single-item measures. Conversely, ABWS reveals more individuals categorizing themselves as unsatisfied with their lives compared to ratings-based approaches. However, all ratings-based approaches consistently reflect the same underlying latent construct, whereas ABWS is an unreliable measure of this construct (RQ3). Lastly, the profile and predictors of variation in subjective well-being using various individual measures (e.g., age, residing in a rural area) are similar, though not identical (RQ5). Overall, the ABWS approach, by compelling individuals to prioritize and weigh trade-offs in life domain importance and satisfaction, offers distinct insights into the drivers, outcomes, and resulting profile of SWB compared to ratings-based approaches.

The current model identifies segments where SWB significantly varies using ABWS scaling (RQ4) and offers some different predictions compared to rating-based SWB measures (RQ5). Given the diverging conclusions from RQ4 and RQ5, it is crucial to assess whether ABWS aligns with prior literature regarding the association of profiling characteristics with differing levels of life satisfaction.

Indeed, the ABWS-derived model generally aligns with prior literature regarding predicting life satisfaction among segments, as detailed in the subsequent discussion.

Using ABWS, higher SWB is predicted among females as per prior literature (e.g., Alesina et al., 2004; Kapteyn et al., 2015). Increased income and financial security were also associated with higher SWB, in line with Kapteyn et al. (2015). However, a significant positive but diminishing effect of income reported by Dolan et al. (2008) was not observed. SWB was higher among individuals with a partner, especially those in registered marriages with children, aligning with earlier works (e.g., Dolan et al., 2008; Blanchflower and Oswald, 2000). Older individuals (aged 65 or more) and retirees, as well as younger individuals (below 30), were predicted to have higher SWB (Kim and Moen, 2002). Consistent with other studies, a U-shaped relationship between age and SWB was observed (e.g., Dolan et al., 2008; Blanchflower and Oswald, 2004; Kapteyn et al., 2015). Additionally, the research affirmed findings that SWB tends to be lower among males, those not in a relationship, individuals with lower incomes, and those with less financial security.

Residential location was a notable SWB determinant, with individuals in rural areas exhibiting significantly lower SWB compared to their urban counterparts. While prior literature presents mixed findings, this study's results contrast with some earlier work, such as Gilbert et al. (2016), who reported higher SWB among those living in rural Scotland. Likewise, Requena (2015) found that, in richer countries, rural residents tend to have higher SWB than urban residents, with the situation reversed in less developed countries. This indicates the importance of conducting replications in various countries to explore the relationship between urbanization and SWB further.

A noteworthy segment includes those identifying as Indigenous (Aboriginal; Torres Strait Islanders), exhibiting significantly lower SWB. Data on life expectancy estimates a 9.7 to 17-year gap between Aboriginal and non-Indigenous Australians (Shepherd et al., 2012), reflecting health inequality and social disadvantage (Kinglsey et al., 2013). Western and Tomaszewski (2016) found well-being is lower among Australian Aboriginals and Torres Strait Islanders, linked to subjective life satisfaction. Thus, this study underscores the persistent issue of comparatively poorer quality of life among Indigenous Australians.

6. Future research and conclusions

Future research could enhance insights by broadening the range of individual measures, such as considering differences in SWB for individuals with disabilities, as noted in Lucas (2007) and Kapetyn et al. (2015). Disability is a significant factor affecting satisfactory experiences, impacting access to transport (Darcy and Burke, 2018) and education (Kearney et al., 2022). Exploring the stability of SWB, including its components of satisfaction and importance over time, is another avenue. While importance is expected to remain relatively stable for individuals, satisfaction levels may fluctuate based on micro and macro factors. Macro factors, like the impact of the COVID-19 pandemic, have constrained personal relationships, financial security, and standards of living, particularly for older individuals (Li and Mutchler, 2020). Likewise, the ability to attend religious services during this time may have negatively affected satisfaction with spirituality (Das et al., 2022). Additionally, research by Waite et al. (2009) indicates variations in well-being following periods of marital disruption, such as divorce or separation.

There are opportunities to develop the SWB approach to evaluate alternative anchoring tasks. The current approach only elicited anchors for the most and least satisfactory domains. The satisfaction attributed to other domains was based on these. Another option, therefore, is to consider inferring satisfaction using additional point estimates, such as eliciting domains with medial satisfaction. Further, BWS anchoring method offers opportunities for prior research utilizing traditional BWS. For instance, Burke et al. (2014) used traditional BWS to examine why consumers choose or reject ethical products, considering factors like impact on others or perceived quality. However, different individuals may reject ethical products for various reasons, and their relative rankings might not align with their true importance. ABWS instead allows researchers to differentiate individuals in terms of an absolute measure relative to an informative benchmark.

Using SWB BWS-anchoring offers significant opportunities to enhance the assessment of actions, interventions, and initiatives aimed at improving well-being for specific segments. This extends to evaluating government policies, particularly in the context of fiscal recovery from the COVID-19 pandemic, on their impact on life domains and overall well-being. Assessing SWB outcomes for targeted segments, especially those with lower incomes, would also be highly valuable. Further, ABWS-SWB can be adapted to predict outcomes of proposed policies or interventions to improve well-being: future applications could ask respondents about the impact policy introductions will have on their life (e.g., which area do you anticipate will be most improved by this policy) and to compare outcomes across segments (e.g., rural areas; indigenous) before committing resources. The reported findings that life domains are unequally weighted by importance nor experienced with homogenous satisfaction indicates that accounting for idiosyncratic differences using the proposed method is important for social science researchers.

Funding sources

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Statement and declarations

The authors have no relevant financial or non-financial interests to disclose.

CRediT authorship contribution statement

Paul F. Burke: Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Software, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing. **John M. Rose:** Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Software, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing. **Simon Fifer:** Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Software, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing. **Daniel Masters:** Conceptualization, Data curation, Funding acquisition, Investigation, Methodology, Project administration, Resources, Visualization, Writing – original draft. **Stefan Kuegler:** Conceptualization, Data curation, Funding acquisition, Investigation, Methodology, Project administration, Resources, Supervision, Writing – original draft. **Ariana Cabrera:** Data curation, Formal analysis, Investigation, Methodology, Project administration, Visualization.

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