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Neural Correlates of Well-Being in Young Adults

Kayla H. Green[1], Suzanne van de Groep[1, 2], Renske van der Cruijsen[3], Esther A. H. Warnert[4], and Eveline A. Crone[1]

[1] Erasmus School of Social and Behavioural Sciences, Erasmus University Rotterdam
[2] Department of Psychology, Education and Child Studies, Erasmus University Rotterdam
[3] Behavioral Science Institute, Radboud University Nijmegen
[4] Department of Radiology and Nuclear Medicine, Erasmus Medical Center, University Medical Center Rotterdam

Subjective experiences of well-being are multifaceted in nature, but the behavioral and neural correlates of subdomains of well-being are not yet well understood. Prior neuroimaging studies have primarily focused on single aspects of well-being (e.g., happiness). In the present study, we differentiated between five domains of well-being based on prior research (Green, van de Groep, et al., 2023): (a) family relationships; (b) dealing with stress; (c) self-confidence; (d) having impact, purpose, and meaning; and (e) feeling loved, appreciated, and respected. Young adults (age range = 20–25 years; $n = 34$) completed a self-evaluation functional magnetic resonance imaging task addressing the applicability of the items to the self on a scale of 1 to 4, followed by whether this item addressed a desire for change on a scale of 1 to 4. Behavioral ratings showed that young adults were least positive about dealing with stress and reported the highest degree of desired change for this domain. Higher positivity ratings in all five domains of current well-being were negatively associated with burnout symptoms. More burnout symptoms were associated with higher desire for future changes in the impact, confidence, and loved conditions. More depressive symptoms were associated with higher desire for future changes in all domains, except for confidence. Neural results showed increased activity in the precuneus for items addressing "positive family relations" and the dorsolateral prefrontal cortex for items addressing "dealing with stress," relative to the other domains, which did not result in distinct neural patterns. Together, these findings highlight the importance of assessing various components of well-being, which show distinct behavioral and neural patterns.

Keywords: well-being, young adulthood, functional magnetic resonance imaging, neuroimaging, mental health

Supplemental materials: https://doi.org/10.1037/emo0001526.supp

There is a growing interest in understanding what makes young people feel happy and satisfied about themselves and their lives, also referred to as well-being (Bautista et al., 2023; Diener, 1984; Rice & Steele, 2004). Although there is still a large inconsistency on how to define and assess well-being, scholars agree on its multidimensional nature (Bautista et al., 2023; Ben-Arieh et al., 2014; Diener et al., 2009; Ross et al., 2020). Well-being is an overarching construct with multiple facets, including life satisfaction, happiness, quality of life, and mental health (Diener et al., 2009; Dodge et al., 2012; Ryan & Deci, 2001). However, most studies tend to examine single aspects of well-being (e.g., happiness), instead of its full multidimensionality (Bautista et al., 2023). To understand how we can improve and stimulate positive well-being, it is important to unravel the mechanisms underlying the various components of well-being. Therefore, the present study aimed to identify the behavioral and neural correlates of subjective evaluation of well-being across multiple domains.

Neuroimaging methods such as functional magnetic resonance imaging (fMRI) provide us with the opportunity to get a more detailed perspective on and understanding of underlying processes of well-being (Finn et al., 2023). Most studies examining the neural processes underlying well-being, happiness, and life satisfaction have related resting-state fMRI to single dimensions of well-being (de Vries et al., 2023; King, 2019). For example, self-report ratings on well-being were associated with functional connectivity between

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Kayla H. Green https://orcid.org/0000-0001-6962-4047
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Correspondence concerning this article should be addressed to Kayla H. Green, Erasmus School of Social and Behavioural Sciences, Erasmus University Rotterdam, Burgemeester Oudlaan 50, 3062 PA Rotterdam, the Netherlands. Email: green@essb.eur.nl

the default mode network (including the ventral medial prefrontal cortex [mPFC] and precuneus) and the salience network (i.e., anterior cingulate cortex [ACC], ventral striatum, anterior insula) and with increased connectivity between the posterior cingulate cortex and the anterior insula (Q. Li et al., 2021). Furthermore, happiness was associated with stronger connectivity between the precuneus and the amygdala (Sato et al., 2019). These findings fit with a larger resting-state fMRI literature showing that well-being is associated with connectivity with the dorsolateral PFC (dlPFC; Luo et al., 2014), orbitofrontal cortex, ACC (Kong et al., 2016; Luo et al., 2014; Matsunaga et al., 2016), posterior cingulate cortex (Kong et al., 2015; Luo et al., 2016), precuneus (Q. Li et al., 2021; Sato et al., 2019), superior temporal gyrus (Goldbeck et al., 2019), amygdala (Sato et al., 2019), and hippocampus (Luo et al., 2014).

To gain more specificity of these regions' roles, insights can also be acquired with the use of task-based fMRI. In a recent study, Cosme et al. (2023) developed a task-based fMRI paradigm to examine the neural correlations of well-being. Participants evaluated themselves in terms of well-being (e.g., satisfaction with life), which was contrasted with a condition in which participants judged the malleability of these well-being-related items (i.e., are these constructs changeable?). Their findings showed that evaluating items related to well-being, relative to the control (i.e., changeable) condition, was associated with neural activation in cortical midline structures like the ACC and ventromedial PFC (vmPFC), middle temporal gyrus, and subcortical regions including the hippocampus and ventral striatum. These results are consistent with prior research showing that evaluating self-traits involves the mPFC, the temporoparietal junction, ACC, and posterior cingulate cortex (Denny et al., 2012; Ochsner et al., 2005; Pfeifer & Peake, 2012), which are also involved in reflected self-appraisals (Jankowski et al., 2014; Pfeifer et al., 2009; van der Cruijsen et al., 2017). Despite these important insights, few studies examined the specificity of subcomponents of well-being in young adults, despite recent research showing that well-being is dissociable in subdomains (Bautista et al., 2023; Ross et al., 2020). Building on this work, we recently developed a novel multidimensional well-being measure, in collaboration with youth panels, that fits with the challenges that young people face in contemporary times. This well-being assessment distinguished five domains: (a) family relationships; (b) dealing with stress; (c) self-confidence; (d) having impact, purpose, and meaning; and (e) feeling loved, appreciated, and respected (Green, van de Groep, et al., 2023). Possibly, the wide network of neural activity that was associated with well-being in prior research can be specified further by understanding the mechanisms underlying the multidimensionality of well-being when distinguishing between domains.

The central aim of the present fMRI study was to investigate the neural underpinnings of self-evaluation of multiple domains of well-being in young adults. Participants performed an adapted well-being task in the scanner, based on the studies by Cosme et al. (2023) and Green, van de Groep, et al. (2023), in which they rated their well-being across the five previously identified and validated domains: (a) family relationships; (b) dealing with stress; (c) self-confidence; (d) having impact, purpose, and meaning, and (e) feeling loved, appreciated, and respected. In addition to providing self-ratings (Cosme et al., 2023), we asked participants on each trial their desire for future changes for this item for their well-being. We expected that higher order cognitive control regions, specifically the lateral prefrontal cortex, would be associated with activation in domains in which participants had the highest desire for change, based on prior studies showing that this region has an important role in the cognitive reappraisal of emotions (Morawetz & Basten, 2024).

Given the rising prevalence of mental health challenges, such as internalizing symptoms in adolescence (Collishaw, 2015; Kieling et al., 2011), growing burnout due to stress since the COVID-19 pandemic (Jagodics & Szabó, 2023; May et al., 2020), and increasing uncertainty about the future (Fuligni & Galván, 2022; Schweizer et al., 2023), we aimed to explore how these factors relate to behavioral ratings during the fMRI task. Specifically, we examined associations with depressive symptoms, burnout, and feelings of uncertainty (Green, van de Groep, et al., 2023) to better understand how these psychological experiences influence adolescents' well-being evaluations (Collishaw, 2015; Fuligni & Galván, 2022; Green, van de Groep, et al., 2023; Jagodics & Szabó, 2023; Kieling et al., 2011; May et al., 2020; Schweizer et al., 2023). Based on the previous studies, we hypothesized that evaluating overall well-being would yield neural activation in regions involved in self-referential processing, including the mPFC and precuneus (Cosme et al., 2023; Jankowski et al., 2014; King, 2019; van der Cruijsen et al., 2018). We explored whether these regions were differentially activated for the five domains, with a specific focus on the role of the lateral prefrontal cortex for domains in which participants had the highest desire for change (Morawetz & Basten, 2024). Finally, we expected that self-report ratings of well-being would be negatively associated with depressive symptoms, burnout symptoms, and feelings of uncertainty about the future and a higher desire for change (Green, van de Groep, et al., 2023).

Method

Participants

We reinvited participants from the longitudinal Braintime project (Braams et al., 2015; Peters et al., 2016). We contacted participants with valid contact information (n = 105; all were younger than 18 years at the initial onset of the longitudinal project in 2011). A total of 46 participants visited the lab and filled in an online survey. One participant was excluded due to claustrophobic feelings; therefore, eventually, 45 participants were scanned. After fMRI preprocessing, we excluded an additional 11 participants; six participants were excluded due to technical issues with the scanner, three participants were excluded due to errors with the task, and two participants were excluded due to excessive head movements (>3 mm at any point during the scan). This resulted in a final sample of 34 participants (age range between 20 and 29 years, $M_{\text{age}} = 25.20$, $SD_{\text{age}} = 2.86$; see Table 1 for detailed sample characteristics).

All participants were Dutch speaking and had normal or corrected-to-normal vision. Participants were screened for MRI contraindications (including possible pregnancy, heart arrhythmia, metal implants, head injury, epileptic insults, claustrophobia, and tinnitus). Based on the criteria of population sampling, we did not exclude diagnoses of intellectual disability and neurological or psychiatric disorders (Bornstein et al., 2013). Informed consent was obtained from all participants. Participants received a monetary reward of €50 for completing the lab visit. The present study was approved by the Medical Ethics Committee of Erasmus Medical Center (NL81454.078.22).

Table 1
Detailed Sample Characteristics

Variable	*N* (percentage of the sample)
Gender	
Female	21 (61.8)
Male	9 (26.47)
Nonbinary or otherwise specified	0 (0)
Ethnicity	
Dutch	28 (82.35)
Non-Dutch	0 (0)
Multiple ethnicities, including Dutch	3 (8.82)
Multiple ethnicities, all non-Dutch	0 (0)
Education ongoing	11 (32.4)
Vocational education	0 (0)
College education	3 (8.8)
Academic education	7 (20.6)
Combination of tracks	1 (2.9)
Education completed	19 (55.9)
High school or less	0 (0)
Vocational education	4 (11.8)
College education	3 (8.9)
Academic education	12 (35.3)
Occupation	
Full time	13 (38.2)
Part time	8 (23.5)
Multiple jobs	4 (11.8)
None	5 (14.7)
Income (euros; yearly)	
<10,000	11 (32.4)
10,000–20,000	4 (11.8)
20,000–30,000	3 (8.8)
30,000–40,000	7 (20.6)
40,000–50,000	0 (0)
50,000–100,000	5 (14.7)
>100,000	0 (0)
Current living situation	
With partner	9 (26.5)
Alone	6 (17.6)
With roommates	8 (23.5)
With parent(s)	7 (20.6)
Current psychiatric disorder	
Yes	10 (29.4)
Maybe	3 (8.8)
No	17 (50.0)
Current somatic disorder	
Yes	4 (11.8)
Maybe	0 (0)
No	26 (76.5)

Note. Four participants did not fill in the survey on sociodemographic questions, resulting in $n = 30$ data, and thus percentages do not add up to 100. Most frequently reported psychiatric disorders were attention-deficit/hyperactivity disorder and depression. Somatic disorders included endometriosis, migraine, asthma, and Hashimoto's disease.

Task Description

Participants performed a novel self-referential well-being fMRI task in which they were instructed to evaluate their well-being over the past month on 46 trials. The task design was based on the self-concept task developed by van der Cruijsen et al. (2018) and the self-evaluation task by Cosme et al. (2023). Participants were presented with sentences from the validated and youth-codesigned Multidimensional Well-being in Youth Scale (MWYS; Green, van de Groep, et al., 2023) and were asked to rate their well-being on a scale from 1 (*not at all*) to 4 (*completely*) by pressing buttons on a box using the four fingers (from index finger and forward) of their right hand. The MWYS has a total of 46 items, which cover five domains: (a) family relationships (six trials); (b) dealing with stress (10 trials); (c) self-confidence (seven trials); (d) having impact, purpose, and meaning (11 trials); and (e) feeling loved, appreciated, and respected (12 trials). From here on we will refer to these domains as *family*, *stress*, *confidence*, *impact*, and *loved*. We also included an adapted version of the change condition, which was previously used as a control task in Cosme et al. (2023), as a second experimental condition of the task. Here, participants were asked to rate to what extent they would want to see changes in their future well-being directly following the assessment of their well-being ratings. In contrast to Cosme et al. (2023), this future change condition was not used as control task, but as a second dimension of the paradigm, given the time dependency between trials. Thus, the design differed from previous research in that we did not include an active control condition given the debates about the feasibility and applicability of control conditions in self-rating paradigms (Crone et al., 2022). Instead, we examined differences between domains within the task.

Prior to the start of task, participants could choose whether the task was tailored toward work or school, such that items related to situations in their daily lives (e.g., "school/work causes too much stress"). Each trial started with a black screen with a jittered duration between 0 and 4,400 ms, followed by a black screen with a white fixation cross for 400 ms (see Figure 1). Subsequently, an instruction screen with the sentence "do you have the feeling that" was shown for 2,500 ms. After this instruction, the well-being stimulus appeared (e.g., "accept yourself for who you are?") for the duration of 4,600 ms. Within this time frame, participants were required to respond using the button box. Responses were highlighted in yellow to signal to the participants that their response was registered. If participants failed to respond within the 4,600 ms time frame, a "too late!" screen was shown for 1,000 ms and the trial ended. This occurred in 4.7% of the trials. For in-time responses, the trial continued with a second black screen with a jittered duration between 0 and 1,000 ms. Then, a second stimulus appeared, which was the following sentence: "would you want this to be different in the future?" with a duration of 4,600 ms. This second stimulus allowed participants to indicate to what extent they desired changes in this specific aspect of their well-being. Again, a "too late!" screen appeared if participants failed to respond within 4,600 ms. This occurred in 2.2% of the trials. The task was developed in the software E-Prime (Version 3). OptSeq was used for jittered intervals.

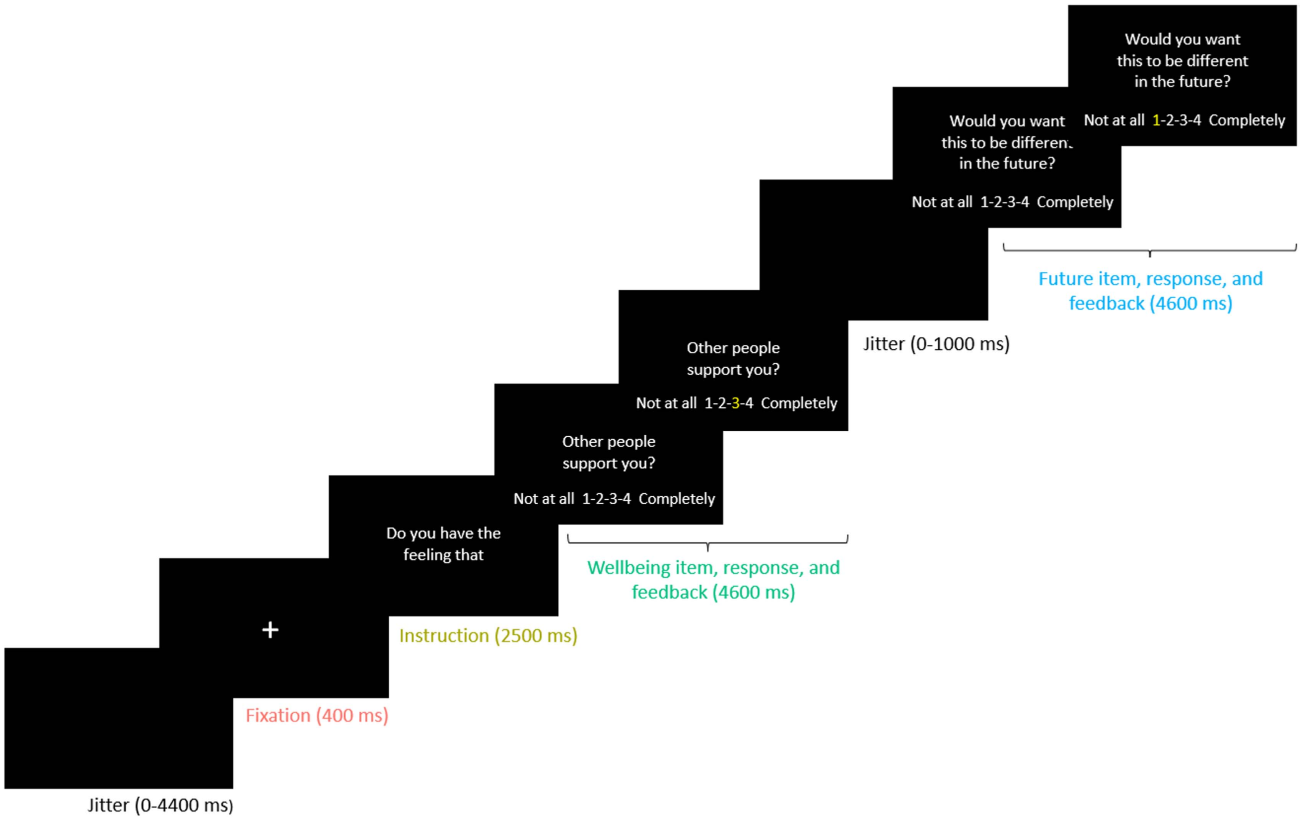
All items are presented in the Supplemental S1. Items with negative valence were recoded to compute mean scores of positivity, such that a higher score indicates greater well-being in a particular domain.

Self-Reported Survey Measures

Perceived Importance of Well-Being Items

Directly after scanning, participants were asked to rate the degree of (personal) importance of each MWYS item in the fMRI task. Responses were given on a scale of 1 (*not important at all*) to 4 (*very much important*). A total mean score per domain was computed,

Figure 1
Example of a Trial in the Well-Being Block



Note. Each trial started with a black screen with a jitter duration between 0 and 4,400 ms, which was then followed by a black screen with a white fixation cross for 400 ms. Subsequently, participants viewed the instruction screen (2,500 ms) containing the sentence: "do you have the feeling that." Then, the well-being stimulus (e.g., "other people support you") was shown for 4,600 ms. Within this time frame, participants were asked to respond, using a button box, on a scale of 1 (*not at all*) to 4 (*completely*) and saw a feedback screen highlighting their response in yellow. If participants failed to respond within 4,600 ms, a "too late!" feedback screen was shown for 1,000 ms. After the well-being stimulus, a second black screen with a jittered duration between 0 and 1,000 ms appeared. This was followed by a second stimulus screen with the sentence "would you want this to be different in the future?" again for the duration of 4,600 ms. Similarly, to the well-being stimulus, participants were asked to respond within the 4,600 ms time frame. Modeled events are highlighted in distinct colors; we created separate modeled events for each well-being and future well-being domain (i.e., stress, family, self-confidence, impact, and loved). See the online article for the color version of this figure.

with a higher score indicating a higher importance of including that domain as an aspect of well-being.

Depressive Symptoms

To assess depressive symptoms, the Beck Depression Inventory–II was administered (Beck et al., 1988). The Beck Depression Inventory–II is a frequently used questionnaire in clinical and research settings. It comprises 21 items in which individuals must indicate the severity of depressive symptoms over a 2-week period. Responses are given on a scale of 0 to 3, with higher scores indicating greater severity. Internal consistency was good (Cronbach's $\alpha = .81$). The questionnaire was administered after participants completed the MRI scan. A total sum score was computed, with a higher score reflecting greater severity of depressive symptoms. All participants received information on how to (anonymously) contact various mental health care organizations if they felt like they needed support or advice.

Burnout

We used the Dutch version of the Maslach Burnout Inventory, named Utrechtse Burnout Schaal–Algemene versie, to assess burnout symptoms (Schaufeli & van Dierendonck, 1993). The Utrechtse Burnout Schaal–Algemene versie was administered after participants completed the MRI scan. It is a 15-item questionnaire that focuses on burnout symptoms related to exhaustion, dissonance, and competence. Participants were asked to respond on a 7-point Likert scale ranging from 0 (*never*) to 6 (*daily*). Internal consistency was good (Cronbach's $\alpha = .89$). The competence items were reversed scored, so a total mean score could be calculated with a higher score indicating greater severity of burnout symptoms.

Future Uncertainty

We also assessed general feelings of distress, worry, and uncertainty about the future, using a six-item questionnaire (Green, Becht, et al., 2023). Examples are the following: "my future feels uncertain," "I am afraid that I am making the wrong choices," "I am concerned about my future." Items were rated on a 5-point Likert scale ranging from 1 (*does not describe me at all*) to 5 (*describes me very well*). The questionnaire was filled out prior to the MRI lab visit in an online survey approximately 1 week before their MRI appointment. A mean score was computed (Cronbach's α = .79), with a higher score indicating higher feelings of an uncertain future.

MRI Data Acquisition

MRI scans were acquired on a 3T scanner (Premier, General Electric Healthcare, Chicago, Illinois, United States) with a 48-channel whole-head coil. Functional scans were acquired in two runs with a T2*-weighted echo planar imaging (repetition time = 2,200 ms, echo time = 30 ms, flip angle = 80, sequential acquisition, 42 slices of 2.90 mm, field of view = 220 mm). Before the start of each functional run, three dummy scans were acquired. A 3D T1-weighted anatomical image was collected for anatomical reference (TI = 450 ms, echo time = in phase, flip angle = 12, slice thickness = 0.8 mm, field of view = 240 mm). Participants could see the screen on which the sentences were presented via a mirror attached to the head coil.

Data Analysis

Behavioral Analyses

First, we tested whether all domains were viewed as equally important for well-being. Next, behavioral analyses were performed using repeated measures analyses of variance (ANOVAs) for positivity ratings on the MWYS task across domains and for desired future change ratings between domains. In case Mauchly' test indicated that the assumption of sphericity was violated, we reported the Greenhouse–Geisser corrected test ($\varepsilon < .75$) or Huynh–Feldt corrected test ($\varepsilon > .75$). Last, we tested the associations between the current and desired future change positivity ratings and burnout and depression symptoms and feelings of uncertainty about the future.

MRI Preprocessing and First-Level Analyses

All data were analyzed using Statistical Parametric Mapping 12 (Wellcome Centre for Human Neuroimaging, London, United Kingdom). Functional scans were preprocessed using realignment, slice-timing corrections, spatial normalization (to T1 templates using an algorithm resampling volumes of 3-mm cubic voxels), and spatial smoothing with a 6-mm full width at half maximum isotropic Gaussian kernel. Templates were based on Montreal Neurological Institute-305 stereotaxic space. All functional scans were corrected for head motion using six parameters (x, y, z translations and rotations), which were included as regressors in the generalized linear model.

First-level individual analyses were performed using a general linear model in Statistical Parametric Mapping 12. The fMRI time series were modeled as a series of zero-duration events convolved with the hemodynamic response function. Previous studies have modeled trials both as zero-duration events and with reaction time as regressor and showed great overlap between the two models (Nohlen et al., 2014). We modeled three moments in the design: instruction, well-being items, and future change in well-being items. Specifically, modeled events were "Instruction," "Family," "Stress," "Confidence," "Impact," "Loved," "Impact-Future," "Family-Future," "Stress-Future," "Confidence-Future," and "Loved-Future" (see Figure 1 for trial example). Trials on which participants failed to respond were modeled as events of no interest. The modeled events were used as regressors in a general linear model along with a basic set of cosine functions that high-pass filtered the data.

Second-Level Analyses and Regions of Interest

To test well-being domain specificity, two whole-brain full-factorial ANOVAs were performed with domain as a within-subject factor (five levels: family, stress, confidence, impact, and loved) for self-evaluation of current well-being and future-change of well-being. Although flexible factorial models can also be used, we chose the full-factorial model for consistency with previous studies (van de Groep et al., 2020; van der Cruijsen et al., 2017) and because the full factorial may be more efficient when the number of conditions is relatively small, as is the case in the present study (Candemir, 2024).

In case of main effects, whole-brain follow-up analyses were conducted to test for activity in a single domain compared with all other domains. Therefore, we compared the activity of each domain in relation with all other domains (e.g., family > stress, confidence, impact, loved). For visualization purposes, we performed regions of interest (ROIs) analyses for ROIs derived from the full-factorial ANOVA (main effect domain; see Table 2) using the Marsbar toolbox in Statistical Parametric Mapping 12. ROIs were contrasted with fixation baseline. We applied family-wise-error-cluster correction of $p < .05$ at an initial uncorrected voxel-wise threshold of $p < .001$ to test for main effects and for follow-up analyses.

In the Supplemental Material, we also present each event relative to fixation using whole-brain t tests (see Supplemental S3). Specifically, the *instruction* > *fixation* contrast revealed which network was

Table 2
Brain Regions Activated Across Domains of Well-Being (Full-Factorial Whole Brain)

Area	MNI coordinate x, y, z	Statistic F	Cluster
Main effect domain (FWEc = 136)			
L precuneus	0, −58, 30	11.30	293
L inferior frontal tri (i.e., dlPFC)	−58, 18, 16	6.66	136
Family > impact, stress, confidence, loved (FWEc = 219)			
L precuneus	0, −58, 28	5.26	392
L middle temporal	−60, −4, −18	5.28	219
Stress > impact, family, confidence, loved (FWEc = 347, $p < .001$)			
L middle frontal (i.e., dlPFC)	−48, 42, 18	4.58	347
L insula	−40, 16, 6	4.48	367

Note. Names were based on the automatic anatomical labeling (aal) toolbox in Statistical Parametric Mapping 12. For functional regions discussed throughout the article, both the aal label and functional label (between brackets) are displayed. All regions for the main effect survived FWE-cluster correction at $p < .001$, the follow-up effects survived false discovery rate-cluster correction. MNI = Montreal Neurological Institute; FWEc = family-wise error correction; L = left; dlPFC = dorsolateral prefrontal cortex; FWE = family-wise error.

engaged when participants prepared for the well-being questions relative to a fixation baseline condition. The *well-being > fixation* contrast examined which regions were active while answering the well-being trials relative to a fixation baseline condition. The same analysis was performed for *desired future changes in well-being > fixation*.

Transparency and Openness

The present study was not preregistered due to its explorative nature. For the sample size, we aimed for a minimum of $n = 30$, which is relatively small, especially in combination with the number of trials (Szucs & Ioannidis, 2020) but should be enough to ensure power to detect general condition effects (Desmond & Glover, 2002). We subsequently used Bayesian statistics to determine the robustness of the effects based on Klapwijk et al.'s (2025) study. These results are described in Supplemental S2 and confirm that the sample size is sufficient for detecting general condition effects. The software SPSS was used for data analyses (Hayes, 2012). The materials, the pseudonymized behavioral and ROI data, which were analyzed in the present study, are available upon reasonable request from the authors, in the Data Repository of Erasmus University Rotterdam. The computer code will be publicly available without request. All contrasts are publicly available on NeuroVault at https://neurovault.org/collections/SWTIIMQR/.

Results

Behavioral Results

First, we investigated how important items within a domain were perceived to be for a positive well-being (either to have or not to have). These data were assessed in a questionnaire directly after scanning. Higher scores indicate greater importance for well-being. We found no main effect of domain in the perceived importance of items for having a positive well-being, $F(2.91, 96.03) = 1.13$, $p = .342$, $\eta^2 = .03$, Greenhouse–Geisser, ($\varepsilon = .73$). Thus, participants rated a similar degree of importance across the five domains.

To test within-subject differences in how positive individuals rated their well-being, we performed a repeated measures ANOVA with the five domains (family, stress, confidence, impact, and loved). There was a main effect of domain, $F(3.37, 111.23) = 10.52$, $p < .001$, $\eta^2 = .24$, Huynh–Feldt corrected, $\varepsilon = .84$ (see Figure 2A). Pairwise comparisons with Bonferroni correction showed that participants evaluated their well-being lower for the stress domain ($M = 2.53$, $SD = 0.50$) compared with the domains of confidence, $M = 2.91$, $SD = 0.51$, $p < .001$, $b = -.38$, $t(1, 33) = -5.64$, 95% CI [−.58, −.18]; impact, $M = 2.89$, $SD = 0.52$, $p = .002$, $b = -.35$, $t(1, 33) = -4.16$, 95% CI [−.61, −.10]; and loved, $M = 3.00$, $SD = 0.53$, $p < .001$, $b = -.47$, $t(1, 33) = -5.67$, 95% CI [−.71, −.22]. They also evaluated their well-being lower for family ($M = 2.74$, $SD = 0.73$) compared with loved, $p = .016$, $b = -.26$, $t(1, 33) = -3.42$, 95% CI [−.49, −.03]. Family did not differ significantly from the other three conditions.

Next, we examined within-subject differences in the degree to which participants would like to see future changes in their well-being across the five domains. There was a main effect of domain, $F(4, 132) = 9.58$, $p < .001$, $\eta^2 = .23$ (see Figure 2B). Using pairwise comparisons with Bonferroni correction, we found that participants had a greater desire for future changes in the domain of stress ($M = 2.62$, $SD = 0.63$) compared with all four other domains, family $M = 1.98$, $SD = 0.70$, $b = .64$, $t(1, 33) = 6.15$, 95% CI [.33, .95]; confidence $M = 2.17$, $SD = 0.75$, $b = .45$, $t(1, 33) = 3.24$, 95% CI [.03, .87]; impact $M = 2.16$, $SD = 0.75$, $b = .46$, $t(1, 33) = 4.46$, 95% CI [.15, .78]; and loved $M = 1.98$, $SD = 0.59$, $b = .64$, $t(1, 33) = 5.86$, 95% CI [.31, .97], respectively, $p < .001$, $p = .029$, $p < .001$, and $p < .001$. The mean score on well-being positivity ratings and the mean score on the desire for future changes in well-being were negatively correlated, $r = -.60$, $p < .001$. Thus, participants with lower well-being had a higher desire for future changes in their well-being across domains.

Finally, we show in Table 3 the associations between all the behavioral measures and their associations with depression, burnout, and uncertainty about the future. We found negative associations between all well-being domains and burnout ratings and positive associations with desire for change in the confidence, impact, and loved domains and feelings of burnout. In addition, we found positive associations with a desire for change in the stress, family, impact, and loved domains and depressive symptoms.

Whole-Brain and ROI Results

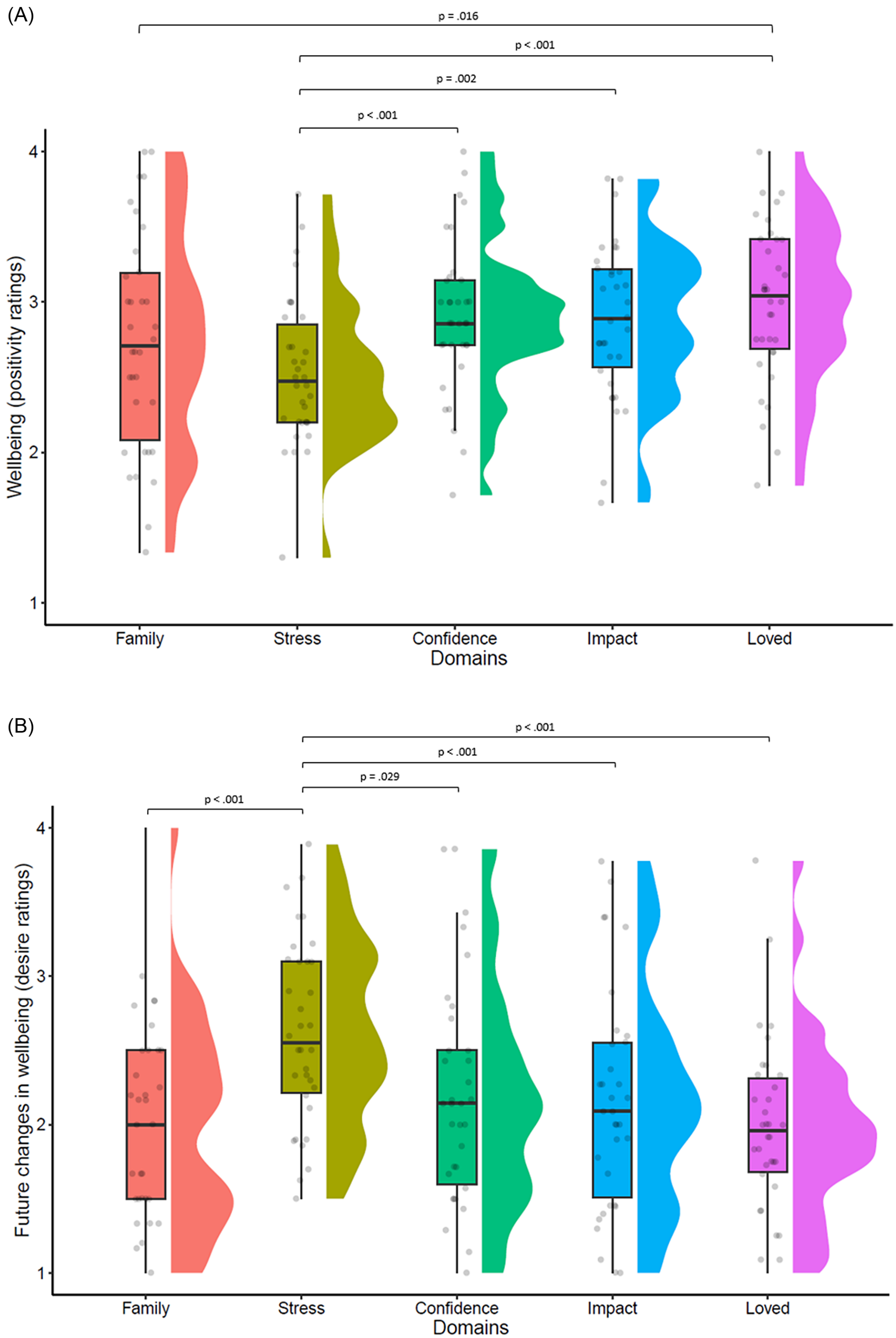
To test whether domains showed differences in neural activity, we conducted a full-factorial whole-brain ANOVA at the onset of the well-being condition. We found a main effect of domain with significant activation in the precuneus and the left dlPFC (see Table 3, Figure 3A, 3B). To further inspect the differences in activity within these regions across the five domains, we used two follow-up approaches: (a) whole-brain domain-specific activations by contrasting each domain against the other domains and (b) ROIs.

We examined whole-brain domain-specific activations by contrasting each domain against the other domains. The contrast *family > other* and *stress > other* resulted in significant effects. For the family domain, we found activation in the precuneus (Figure 3C). For the stress domain, we found activation in the left lateral prefrontal cortex (Figure 3D). We found no specific activation for the confidence, impact, or loved domains. The same analyses for changes in future well-being condition did not result in significant activity between domains.

Next, we derived the two ROIs from the full-factorial ANOVA (see coordinates in Table 2). First, we observed domain specificity for the family condition in the precuneus, as we found higher activity in the precuneus compared with the impact ($p = .034$), stress ($p < .001$), and confidence ($p = .003$) conditions (see Figure 4A). Next, we observed domain specificity for the stress condition in the dlPFC. We found higher activity for the stress conditions compared with the impact ($p < .001$) and confidence ($p = .003$) conditions (see Figure 4B).

We also performed t tests to examine effects of task condition. mPFC activation did not differ significantly for overall current well-being trials compared with fixation; however, mPFC activation was observed when thinking about future changes in well-being relative to fixation (see Supplemental S3 for further details). Last, we also tested brain-behavior associations per ROI. No significant associations were found (see Supplemental S4).

Figure 2
Positivity Ratings for Current and Future Well-Being



Note. Graph A: main effect of domain on positivity ratings of well-being. Self-report ratings were higher in the impact, confidence, and loved condition compared with stress. Higher ratings were also reported in the loved condition compared with family. Graph B: Lower graph: main effect of domain on the desire for future changes in well-being. Higher ratings for future changes in the stress condition were reported compared with the impact, family, confidence, and loved conditions. See the online article for the color version of this figure.

Table 3

Correlations Between Well-Being Measures and Depressive Symptoms, Burnout Symptoms, and Feelings of Future Uncertainty

Measure	1	2	3	4	5	6	7	8	9	10	11	12	13
Current well-being													
1. Impact	—												
2. Stress	**.52**	—											
3. Family	**.67**	**.61**	—										
4. Confidence	**.82**	**.70**	**.67**	—									
5. Loved	**.71**	**.56**	**.80**	**.71**	—								
Future changes in well-being													
6. Future impact	**−.59**	−.39	−.25	**−.48**	−.26	—							
7. Future stress	−.28	**−.53**	−.40	−.31	−.19	**.62**	—						
8. Future family	−.19	−.31	−.42	−.23	−.07	.42	**.58**	—					
9. Future confidence	**−.52**	−.37	−.39	**−.62**	−.38	**.54**	.32	.31	—				
10. Future loved	**−.51**	**−.55**	**−.54**	**−.59**	**−.51**	**.60**	.46	.40	**.69**	—			
Other constructs													
11. BDI-II	**−.48**	−.46	−.45	−.40	−.32	**.57**	**.65**	**.48**	.35	**.49**	—		
12. UBOS	**−.70**	**−.60**	**−.50**	**−.77**	**−.52**	**.62**	.44	.33	**.52**	**.60**	**.58**	—	
13. FUS	−.46	−.35	−.29	−.48	−.29	.33	.25	.24	.37	.40	**.63**	**.78**	—

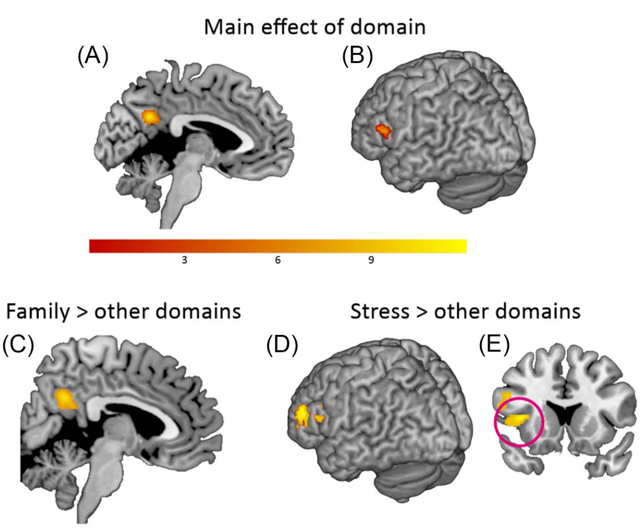
Note. The "future" variables highlight the extent to which a future change within a particular well-being domain is desired. Values presented in bold represent Bonferroni corrected (https://www.quantitativeskills.com/sisa/index.htm) significant associations ($p < .004$). BDI-II = Beck Depression Inventory–II; UBOS = Utrechtse Burnout Schaal; FUS = Future Uncertainty Scale.

Discussion

The central aim of the present study was to examine behavioral and neural patterns for well-being in general and across separable domains (Green, van de Groep, et al., 2023). The study resulted in three specific findings. First, behavioral findings showed that young adults were least positive about dealing with stress compared with other domains of well-being and that this was also the domain in which they would like to see future changes in their well-being. These ratings were associated with more activity in the left dlPFC relative to the other domains. Second, the positive family relations condition was selectively associated with increased activity in the precuneus. Third, individual differences in burnout were associated with current well-being and desired changes in future well-being in the domains of impact, loved, and confidence. Depression was primarily associated with changes in future well-being in the domains of impact, loved, stress, and family, but not current well-being. The discussion is organized along the lines of these three findings.

Figure 3

Main Effect of Domain in the Whole-Brain Full-Factorial Analysis of Variance for Well-Being Conditions

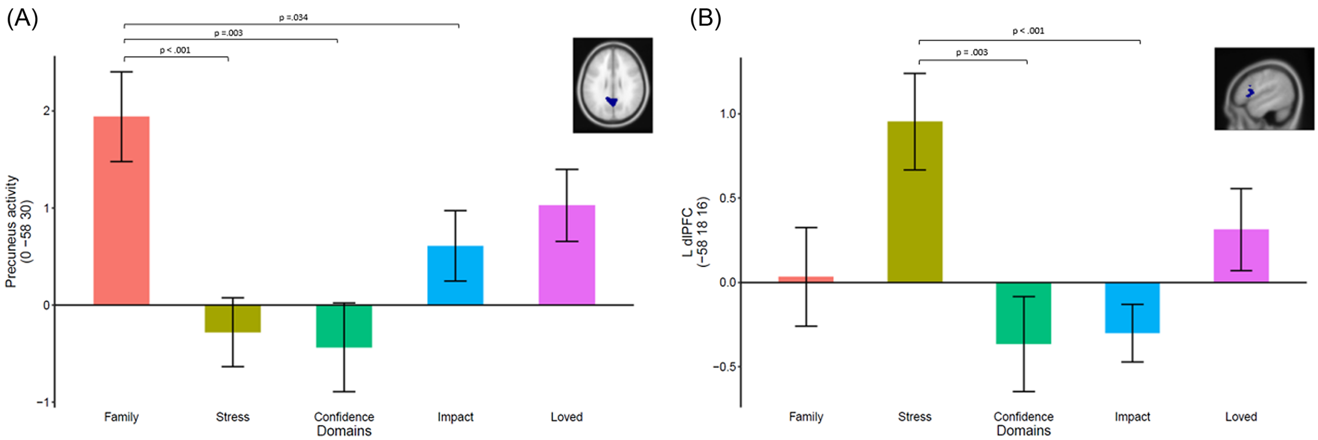


Note. Specific activation in the precuneus (A) and dlPFC (B). All regions survived family-wise-error-cluster correction with an initial threshold at $p < .001$. Follow-up effects for specific conditions relative to all other conditions; with activity in the activity in the precuneus (C) for the family condition and in the dlPFC (D) and insula (E) for the stress condition and survived false discovery rate-cluster correction with an initial threshold at $p < .001$. dlPFC = dorsolateral prefrontal cortex. See the online article for the color version of this figure.

Domain-Specific Neural Actions for Well-Being

The primary aim of this study was to unravel whether there was neural specificity for subdomains of well-being, which would further pinpoint the wide range of activities that were observed in prior fMRI resting state (King, 2019) and task-based well-being studies (Cosme et al., 2023). Consistent with this hypothesis when testing for domain-related activity during well-being assessments, we observed activity in the precuneus for family condition. This result is in line with prior studies by Cosme et al. (2023) and Jo et al. (2019) who reported precuneus activity during self-evaluation of well-being in the context of social relationships and others. Indeed, the precuneus has been observed to be involved in various social processes, as, for example, in prosocial behavior (i.e., behavior intended to benefit others) toward close and distant others (Crone et al., 2022; van de Groep et al., 2020, 2022). With regard to well-being, prior studies found mixed results (i.e., both negative and positive relations) for associations between precuneus activity/connectivity and well-being (de Vries et al., 2023). Possibly, part of this inconsistency was that single aspects or general measurements of well-being were included, whereas this study suggests that this

Figure 4
ROI Analyses: Precuneus and L dlPFC



Note. Panel A shows that precuneus was higher for the family trials compared with the impact, stress, and confidence trials. Panel B illustrates that left dlPFC activation was higher for the stress trials compared with the impact and confidence trials. Results are displayed with a primary voxel-wise threshold of $p < .001$ (uncorrected) and family-wise-error-cluster correction of $p < .05$. dlPFC = dorsolateral prefrontal cortex; ROI = regions of interest; L = left. See the online article for the color version of this figure.

region may be specifically engaged for well-being related to family. Prior studies have shown that the precuneus plays an important role in autobiographical and episodic memories (Svoboda et al., 2006; Torres-Morales & Cansino, 2024). Possibly, well-being in relation to family members results in stronger reliance on these autobiographical memories in relation to family or in one's reflected self in relation to close others (Pfeifer & Peake, 2012).

We also found that the left dlPFC is engaged in evaluating well-being within the domain of dealing with stress (and happiness) relative to the other domains. Previous work showed activation in more ventral regions of the PFC (e.g., vmPFC) in the context of self-development (Pfeifer & Peake, 2012), self-judgments (Denny et al., 2012), and when evaluating traits (Barendse et al., 2020; van Buuren et al., 2022; van der Cruijsen et al., 2018) and well-being (Cosme et al., 2023; King, 2019), especially in the context of valence and affective processes. Involvement of more lateral prefrontal cortex has previously been associated with cognitive control processes (Crone & Dahl, 2012), possibly suggesting that thinking about stress-related items requires some level of cognitive reappraisal. Indeed, this condition was also associated with the greatest desire for change. Extensive work on the function of the dlPFC has shown its involvement in emotion regulation and reappraisal in both healthy (Dobbelaar et al., 2023; Golkar et al., 2012; Kerestes et al., 2014) and clinical samples (Dolcos et al., 2011; Nejati et al., 2022). Compared with the other domains in the MWYS, the stress domain (including positive and negative affect) reflects hedonic well-being the most. As we only found dlPFC activity for the stress domain, possibly the dlPFC is more involved in the evaluation of hedonic aspects of well-being (which comprises affect, mood, happiness, etc.), which may have stronger relations with cognitive reappraisal, compared with the judgment of eudemonic well-being (i.e., having purpose and meaning in life). This assumption is in line with prior studies on hedonic well-being, which too reported dlPFC engagement. For example, in recent resting-state studies, associations between subjective happiness and dlPFC connectivity (Katsumi et al., 2021) as well as between happiness and dlPFC were found (Kerestes et al., 2014; Luo et al., 2014). Taken together, the present study implies that evaluating affective components of well-being involves cognitive control regions in the brain.

Domain-General Aspects of Well-Being

In the present study, we found no evidence for the involvement of the vmPFC for specific domains of well-being, but vmPFC activity was observed at the moment of the instruction as well as the desire for change conditions. These findings suggest that vmPFC has a domain-general role in evaluating well-being, already at the onset of the instruction screen. Evaluating well-being trials specifically, in contrast to fixation, was found to yield precuneus activity. In the current task, participants were asked to reflect upon their well-being over the past month, which requires the engagement of memory retrieval. This may explain the precuneus activity similar to what was observed for the family condition, as previous studies have reported that the precuneus is associated with episodic and autobiographical memory (Dörfel et al., 2009), particularly in the context of self-referential processing (Sajonz et al., 2010; Saxe et al., 2006). Several studies have found associations between the default mode network (including the precuneus) and well-being (Jo et al., 2019; R. Li et al., 2020; Shi et al., 2018). Activation in the precuneus may thus also reflect the involvement of spontaneous thought and mind wandering when evaluating your well-being (Cavanna & Trimble, 2006; Fox et al., 2015; Utevsky et al., 2014).

Individual Differences in Burnout Relates to Well-Being Beyond the Self

As expected, the results showed a negative association between well-being positivity ratings and the degree to which changes in future well-being are desired. In other words, individuals who evaluated their well-being less positively were more likely to seek future changes in their well-being. We also demonstrated that young adults were least positive about well-being items related to dealing with stress compared with other domains of well-being (Green, van de Groep, et al., 2023). Likewise, they reported a wish for future changes in their well-being more strongly for this domain compared with the other domains, and this stress change desire was significantly associated with depression, but not burnout symptoms.

When testing for relations with other individual differences variables that are associated with well-being in daily life, we observed that, in general, lower positivity ratings for the impact condition of current well-being were associated with more depressive symptoms and that lower positivity ratings in all domains of current well-being were associated with more burnout symptoms (Cárdenas et al., 2022; Green, van de Groep, et al., 2023; Rehman et al., 2020). Moreover, individuals who seek a higher degree of future changes in specifically the impact, confidence, and loved condition reported higher levels of burnout symptoms (strengths of the associations differed across the domains). A similar pattern was found for depressive symptoms, for all domains except confidence. These findings may on the one hand suggest that people dealing with internalizing symptoms are unsatisfied with their situation and seek changes or on the other hand that desiring change in these domains of well-being leads to more feelings of burnout and depression (Rickwood et al., 2007). Future studies should unravel these temporal relations in longitudinal designs and developmental samples. The domain specificity is important because all domains were indicated to be equally important aspects of well-being, therefore suggesting that the relation with burnout symptoms is specific for conditions wherein participants may perceive the possibility of self-improvement (impact, confidence).

Limitations and Future Directions

The present study builds upon prior work on the neural substrates of well-being (Cosme et al., 2023; Jo et al., 2019) and had several limitations that should be addressed in future research. First, the relatively small sample size of 34 individuals is sufficient for unraveling general task effects but limits the possibility to find brain-behavior associations (Szucs & Ioannidis, 2020). Second, the number of trials for each condition was relatively limited (ranging from 6 to 12 trials per condition). Future research would benefit from increasing the number of trials to perform trial-level analyses (e.g., differences in neural activity based on the ratings per trial; Gotts et al., 2024). It should be noted that the scales were carefully assessed in prior research in cocreation with adolescents and young adults and that the subdomains were validated in prior research (Green, van de Groep, et al., 2023). Moreover, this was a slow event-related design, which typically needs fewer trials given that slow designs provide a better estimation of the trial time course (Gotts et al., 2024). Third, the fMRI task could potentially benefit from an adaptation by adding an appropriate cognitive demanding control condition, although there is no consensus in the literature yet on what an appropriate control condition encompasses. Likewise, a change in trial design (i.e., similar time dependence for current well-being items and future change items) could enable researchers to adequately compare neural correlates of current well-being with desire for change in future well-being. In addition, youth can be actively involved in reshaping the future condition, so that it aligns with their perspectives (Powers & Tiffany, 2006). In sum, larger sample sizes are needed to further investigate the complexity of multifaceted constructs like well-being, including longitudinal designs to examine temporal relations with burnout and depression. An important direction for future research is to include more diverse samples to improve the generalizability of findings and samples with neurodivergent individuals to explore how well-being is processed among individuals with psychopathology. Despite these limitations, the current findings contribute to our existing knowledge on the behavioral and neural correlates of multiple domains of well-being using more specific task components and relations with future change desire.

Conclusion

The present study aimed to examine domain-specific neural activation related to evaluating well-being across multiple domains. Overall, young adults were least positive about their well-being in the domain of dealing with stress and expressed the highest desire for future change in this domain. These findings align with the literature and findings on the neural correlates of well-being, which has often been inconsistent and heterogeneous (de Vries et al., 2023; King, 2019). This variability may stem from differences in the aspects of well-being addressed and the variety in well-being measures used across studies. Our findings emphasize the multidimensional nature of well-being, by providing evidence for distinct neural activation during self-evaluation of multiple well-being domains. Specifically, we observed social brain network engagement in the precuneus in well-being trials related to family relationships and activation in the left dlPFC for well-being trials related to dealing with stress. This suggests that the dlPFC may be particularly involved in hedonic well-being and cognitive reappraisal processes. Together, these findings confirm the complexity and multifaceted nature of well-being and highlight the importance of research and its full multidimensionality.

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