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Relationship between contentment and working memory capacity: experimental and naturalistic evidence

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Abstract

Contentment is a positive emotion characterized by perceived goal attainment, a sense of having or being enough, and a focus on the present. Research on this new construct is thin, and no studies have examined its cognitive properties, particularly whether it facilitates or impairs controlled cognitive processes. We hypothesize that contentment positively predicts working memory. We found support for this hypothesis in two experimental studies (Studies 1 and 2) which showed that induced contentment improved working memory in the operation span task, and in one non-experimental study (Study 3) which showed that measured contentment positively correlated with working memory on the backward digit span task. In addition, induced amusement (Study 1) and hope (Study 2) did not affect working memory, and measured happiness did not correlate with working memory (Study 3), supporting the uniqueness of contentment as a predictor of greater working memory. We discuss the implications that the combined characteristics of contentment, including perceptions of goal attainment and being low in arousal and approach, and its associations with relevant constructs of negative affectivity and mindfulness, could enable it to be uniquely predictive of better working memory.

Keywords Contentment · Working memory · Positive emotions · Executive functions

Introduction

Contentment involves satisfaction with one's situation, a sense of completeness, and orientation to the present moment (Berenbaum et al., 2019; Cordaro et al., 2016). It is theorized to be fundamental to a fulfilling life (Cordaro et al., 2016), and has been found to be closely tied to well-being and health (Gaskins, 1999; Ryff et al., 2004). However, research has not delved into basic cognitive processes underlying contentment, even as many of these cognitive processes could engender the important outcomes associated with contentment such as well-being. In particular, no research has examined how contentment is linked to working memory, a key cognitive function critical to numerous cognitive processes, such as planning and problem solving (Diamond, 2013), and predictive of life outcomes including well-being and health (Pe et al., 2013). In three studies, we test the hypothesis that contentment uniquely predicts greater working memory.

Positive affect and cognitive processes

There have been mixed findings on how positive affect is linked to various effortful cognitive processes. Enriching effects of positive affect have been found on processes such as cognitive set switching (Dreisbach & Goschke, 2004), attentional capacity (Derryberry, 1993), and decision making (Isen, 2001). These processes require greater cognitive flexibility, since they involve high attentional control to process multiple contents, which requires stronger working memory (Diamond, 2013). These findings suggest, albeit indirectly, that positive affect might enable better working memory. Conversely, there is also evidence linking positive affect to poorer effortful cognitive performance. For instance, positive affect can encourage reliance on non-systematic problem-solving approaches and mental shortcuts (Park & Banaji, 2000). Other studies found that positive affective states can lead to impairments in cognitive inhibition (Katzir et al., 2010) and planning abilities (Phillips et al., 2002).

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However, these studies did not examine working memory specifically. More direct evidence concerning working memory comes from Yang et al. (2013), who found that positive affect improved working memory using the operation span task. Similarly, Storbeck and Maswood (2016) found that positive affect enhanced spatial and verbal working memory. In addition, these studies showed that the improvement in working memory was not due to increased motivation to engage in the cognitive tasks, but reflected facilitation in controlled processing (Yang et al., 2013; Storbeck & Maswood, 2016). On the other hand, other studies instead found that positive affect led to reduced working memory performance. Martin and Kerns (2011) found that positive mood reduced working memory storage capacity, and Allen et al. (2014) reported that positive affect impaired verbal working memory, making it unclear whether positive emotions have faciliatory, inhibitory, or any effect on working memory.

In addition, the conclusiveness of existing evidence is further limited by the fact that most studies only examined global positive affect. Research has shown that discrete positive emotions can have distinct cognitive effects (e.g., Griskevicius et al., 2010; Katzir et al., 2010), which implies that a potential reason for the mixed evidence is that prior studies did not differentiate positive emotions, so they were never able to demonstrate consistent evidence that only certain positive emotions could enhance working memory. Therefore, this suggests that a key direction towards resolving inconsistencies in existing research is to examine discrete rather than global emotions. Specifically, we argue that contentment could be uniquely facilitative of working memory.

Contentment and working memory

Fredrickson (1998) proposes that contentment is associated with savoring of current moments and acceptance of current circumstances. Cordaro et al. (2016) propose that contentment entails a perception of completeness, peaceful acceptance of current circumstances, and the sense of having or being enough, preventing one from dwelling over the past and obsessing about the future. Berenbaum et al. (2019) posit that contentment is experienced either through fulfilment of one's goals or acceptance of one's current status, both of which lead to reduced goal approach. Drawing from these complementary accounts of contentment, we propose that contentment is associated with the perception that goals or expectations are met and no longer require pursuit, a sense of having or being enough, and a greater orientation to the present moment. Furthermore, contentment is low in approach motivation (Fredrickson, 1998) and arousal (Kreibig, 2010).

Several lines of research suggest a specific link between contentment and working memory. First, there is theoretical ground to posit that perceptions of goal attainment could be associated with enhanced cognitive functions. Specifically, when goals are fulfilled, thoughts and concerns about achieving them tend to be deactivated, enabling a person to be less occupied with these goals (e.g., Sparrow & Wegner, 2006), which should free cognitive resources for other tasks. Consistently, Masicampo and Baumeister (2011) found that activation of an unfulfilled goal led to impairments in executive functions, including impulse control, logical reasoning, and fluid intelligence, all of which rely on working memory. In contrast, when participants returned to fulfil their goal, the impairments on executive functions were eliminated. The researchers further showed that the impairments of executive functions were attributable to intrusive thoughts arising from the unfulfilled goals. Other indirect evidence also demonstrates that goal failure results in increased rumination, higher cognitive load, and poorer cognitive functions (e.g., Martin & Tesser, 2006). Contentment, being associated with goal fulfilment (e.g., Berenbaum et al., 2019), may thus possibly be associated with reduced goal preoccupation and greater cognitive resources relevant for enhanced working memory.

Second, positive emotions low in approach motivation appear to enable resource-dependent cognitive processes. For instance, Wang et al. (2013) found that low approach positive affect improved response inhibition and task switching, while high approach positive affect impaired task switching. Avery et al. (2013) found that participants performing a task without a goal exhibited improved working memory. Furthermore, in Yang's et al. (2013) study described above, low-approach positive affect was posited by the authors to be responsible for enhancing working memory. Hence, prior work implies the theoretical perspective that contentment, being a low-approach positive affect (Berenbaum et al., 2019), may have beneficial effects for cognitive processes.

Third, there is evidence indicating that low arousal positive emotions are beneficial to cognitive functions. Griskevicius et al. (2010) found that generally low arousal positive emotions (e.g., awe and nurturant love) enabled effortful, resource-dependent processing, whereas high arousal positive emotions (e.g., amusement) impaired it. In addition, Fedorikhin and Patrick (2010) demonstrated that high positive arousal, induced through viewing arousing clips or images, reduced resistance to temptation through the depletion of required cognitive resources. Galentino et al. (2017) also found that high positive arousal increased risk-taking and posited that it could be due to the reduction of cognitive resources needed for thoughtful elaboration of the choices. Hence, the findings suggest that positive arousal may impair effortful cognitive processes. Conversely, these studies found that low positive arousal increased resistance to temptation, in-depth reasoning, and consideration of long-term benefits (Fedorikhin & Patrick, 2010; Galentino et al., 2017). Evidence from these studies thus provide further theoretical support for the argument that contentment, being a low-arousal positive affect, could enhance effortful cognitive processes.

Fourth, the associations between contentment and certain relevant constructs including negative affectivity and mindfulness provide further indirect indication of a link between contentment and improved cognitive functions. Contentment is strongly related to reduced anxiety and depressive symptoms. For instance, in a factor analysis of emotion items, a *content* positive affect factor that is associated with feelings of contentment and safeness emerged from a three-factor solutions (Gilbert et al., 2008). Most notably, this was the factor with the strongest association with reduced anxiety and stress, depression, and self-criticism, all of which have been found in several studies to be linked to poorer executive functions (e.g., Shields et al., 2016; Watkins & Brown, 2002). Lending further support, Eckland et al. (2021) found that lower levels of contentment were associated with higher depression and suicidality. In addition, contentment is closely associated with mindfulness. Mindfulness directs focus to the present moment and enables acceptance of oneself and one's circumstances (Chiesa et al., 2011), both of which are key components of contentment (Cordaro et al., 2016). Of relevance is that mindfulness has been linked to a wide range of improved cognitive functions, including enhanced working memory capacity, sustained attention, and problem-solving capabilities (Chiesa et al., 2011). Thus, to the extent that contentment is associated with lower levels of depression, anxiety, and stress, and higher levels of mindfulness, it may also be associated with stronger cognitive processing capacity including stronger working memory.

Together, these considerations suggest an apparent pattern. Contentment is uniquely associated with a network of variables, including lower concerns with goal achievement, approach motivation, arousal intensity, negative affectivity, and higher mindfulness, that have been found in several independent lines of research to be associated with more efficient resource-dependent cognitive capabilities. Given that these cognitive capabilities, such as deliberate processing and attentional control, are dependent on working memory (Conway et al., 2005), we hypothesize that contentment should uniquely predict stronger working memory.

The current study

We report three studies that test this hypothesis. Studies 1 and 2 induced contentment and tested its effect on working memory relative to an induced neutral state and another positive emotion. In Study 1, contentment was tested against amusement. Amusement is an emotional response to benign violation of expectations, low seriousness, and the experience of being entertained (McGraw & Warren, 2010; Wyer & Collins, 1992). It is a high arousal positive emotion (e.g., Kreibig, 2010) and provides a suitable comparison against contentment which is low in arousal. Study 2 tested contentment against hope. Hope is associated with an enhanced motivation to achieve a personally important unattained goal (Snyder et al., 1991). It is high in approach motivation and hence provides a contrast to contentment which is low in approach. Based on our reasoning outlined above, we predicted that contentment should strengthen working memory relative not only to the neutral condition (Studies 1 and 2), but also amusement (Study 1) and hope (Study 2). These contrasts would allow tests of whether contentment is unique from other discrete positive emotions in enhancing working memory.

In both Studies 1 and 2, working memory was measured using the operation span task, which is a valid and reliable measure of working memory performance (Conway et al., 2005). We adapted the task specifically from Yang et al. (2013). In addition, both experiments were conducted online, due in part to the lack of resources to recruit large samples in our institution. While lacking the experimental control afforded in in-lab studies, Studies 1 and 2 could validate whether the hypothesized process between contentment and working memory could occur in naturalistic settings.

Study 3 is a non-experimental study that examined the relationship between reported contentment and working memory in comparison to reported happiness, a positive emotion high in both arousal and approach (Fredrickson, 1998; Kreibig, 2010). It uses a large-scale dataset from the Midlife in the United States (MIDUS) survey project. Participants indicated how contented and joyful they felt, and their working memory was measured using the backward digits span task. Study 3 enabled a conceptual replication test of Studies 1 and 2 and a test of whether measured happiness would also predict higher working memory.

Study 1

Method

Participants

450 Amazon Mechanical Turk (MTurk) users from USA and Canada participated for US$0.75. They were randomly assigned to the three emotion conditions. After dropping participants (to be explained), *N* per condition (147 males, 223 females; $M_{age} = 43.56$, SD = 12.40) were as follows: contentment ($N = 122$), amusement ($N = 117$), and neutral condition ($N = 131$). While it was difficult to generate an effect size estimate for power analysis given the novelty of the study, we had the following considerations. First, we did not expect a large or medium effect because the uncontrolled setting inherent in online studies should increase data noise. Second, we did not expect the effect size to be too small either because we took steps to strengthen the manipulation (to be explained). These led to the expectation that the effect size might be between small and medium. Assuming $\eta^2 = .010$ is small and $\eta^2 = .058$ is medium for a one-way between-participant study with three conditions (according to convention and

G-power), $\eta^2 = .030$ seemed a reasonable estimate. Assuming power of .80, and alpha at .05, $N = 318$ (~106 per condition) would be the approximate minimum sample size. However, thirdly, we expected some participants to be dropped for reasons including failure to follow instructions and technical failures, which are common in online studies, but we could not anticipate exactly how many. Fourth, we were also mindful that our effect size estimate might be too liberal, and a larger minimum sample size might be required. Hence, we aimed to recruit about 150 participants per condition (i.e., about 50% above estimate for each condition), choosing to err on the side of caution. A total of 370 participants were eventually included for analyses.

Procedure

All studies are approved by the ethics committees of our university. Participants logged onto a webpage programmed on Qualtrics. They first read a statement urging them to complete the study in one sitting using a computer alone and undisturbed, which are conditions similar to an isolated lab setting. The experiment began with two practice trials of the operation span task, followed by emotion manipulation, before proceeding to six actual trials (see Appendix 1 Fig. 3 for experiment flow).

Each practice trial consisted of three strings presented one by one. Each string comprised a mathematical operation (e.g., "4 × 2–5 = 2") with the answer options ("True or False") on one screen and a to-be-remembered word (e.g., "CABINET") on the next screen (see stimuli in Appendix 2 Tables 3 and 4). We instructed participants to solve the mathematical problem as quickly and accurately as possible by selecting "True" or "False" and silently read the word. At the end of each trial, participants recalled and entered the three words shown previously in the three strings, in any order of presentation. All the words were neutral in valence to ensure no interference on the induced emotions (Kensinger & Corkin, 2003).

After the practice trials, participants proceeded to their respective emotion induction. In the contentment condition, we instructed participants to describe an area of their life that they were feeling contented about. They were told that it could involve anything including their career, studies, family, and so on. We described contentment as follows, in line with current conceptualizations: "*Contentment is a positive and pleasant emotion. However, it differs from happiness and joy, as these emotions make you feel excited and aroused. In contrast, contentment gives you a sense of fundamentally having and being enough, without feeling disappointment or resentful. One can either feel contented from achieving something or one can feel contented from not achieving as one feels that one has enough.*" We instructed participants in the amusement condition to describe something that amused them right now, which could be a joke, an event, and so on. The instruction in the neutral condition was: "*This study examines cognitive processes related to cognitive sequences and we would like to understand how you will carry out a routine activity. Thus, we would like you to describe, step-by-step, how you will do your laundry, starting from a basket of dirty clothes to them fully cleaned and dried.*" We provided participants in all conditions relevant question prompts to assist their recall (e.g., "*What is it that made you feel contented?*") and encouraged them to describe with more details.

Next, participants completed six actual trials of the operation span task, which were in the same format as the practice rounds except that there were four to six strings in each trial – two trials contained four strings, two trials contained five strings, and two trials contained six strings. We divided the six trials into three blocks with one additional emotion induction positioned between two consecutive blocks. Order of the trials was randomized. As emotions dissipate with time and a challenging cognitive task can weaken them faster, we included additional emotion inductions as 'boosters' to sustain the induced emotion (e.g., Oh & Tong, 2021). In the first emotion booster, participants in all conditions summarized in two or three sentences what they previously wrote. In the second emotion booster, we instructed participants in the contentment and amusement conditions to imagine that they could write a feature story about their experience and provide a title for their story. Contentment participants further indicated which area in their life they felt contented about, rated how important this area was to them on a 1 to 10 scale, and described in one short sentence their feelings of contentment. Amusement participants further indicated what they felt funny about, rated how funny it was to them on a 1 to 10 scale, and described in one short sentence their feelings of amusement. We instructed participants in the neutral condition to imagine that they could submit their description to a daily lifestyle magazine and to give a title for their imagined publication using only neutral and factual terms. These responses are not relevant to our subsequent analyses and served only to prompt participants to immerse themselves in their respective feelings.

After the final trial of the operation span task, participants completed manipulation check measures, an attention check item, and demographic measures. The manipulation check measures were administered after the operation span task, as placing them prior to the dependent variable measures can affect participants' response to the dependent measures (e.g., Hauser et al., 2018). Furthermore, there were two additional rounds of emotion induction within the actual trials of the operation span task. However, the downsides of positioning the manipulation check measures after the dependent measures are that participants' emotion might have diminished substantially by that stage and their emotion could have been affected by their responses in the dependent measures (e.g., Hauser et al., 2018). Therefore, to address these downsides, we also employed an implicit manipulation check method that tests for

the presence of the induced emotions in participants' recalled descriptions (see Tong et al., 2016), which will be described below. All materials and data are uploaded in https://osf.io/c6t5d/?view_only=9c1e88e20d8e4b47b4290113a8002022.

Materials

Reported emotions For the purpose of manipulation checks, participants rated the following items (which began with "*I am …*") on a seven-point scale ranging from 1 (*strongly disagree*) to 7 (*strongly agree*) concerning how they felt during the emotion recall task: *content*, *satisfied*, and *fulfilled*, which were averaged to give reported contentment ($\alpha = .95$), *amused*, *entertained*, and *playful*, which were averaged to give reported amusement ($\alpha = .93$). Other items were included to mask the purpose of the study.

Attention check Amid the manipulation check measures, a prompt appeared instructing participants to "*please select strongly disagree*" (i.e., option 6) out of a seven-point scale that ranged from 1 (*strongly disagree*) to 7 (*strongly agree*).

Data preparation and processing

Twenty-one participants failed attention checks (i.e., who did not select option 6); 12 participants ignored emotion induction instructions and provided unsolicited descriptions; five participants were identified by Qualtrics as bots. In addition, we observed from the duration data recorded by Qualtrics that a few participants took an unrealistically long time (e.g., >90 min). Given the absence of a standard cut-off on acceptable duration and the lack of precedence for the current study, we identified the extreme duration outliers (i.e., multiplier = 3 was entered in inter-quartile outlier-detection procedure) separately within each condition and dropped participants whose time spent on the study exceeded the outlier. Outliers were detected within individual conditions because the different experimental manipulations might affect the variation in scores. To allow for individual variability and to retain as many participants as possible, we excluded only the most extreme outliers. Three participants were dropped for exceeding their condition-specific duration outliers, at 48 min 52 sec (contentment), 45 min 15 sec (amusement), and 47 min 20 sec (neutral).

The operation span task requires attention to both the mathematics operation and word stimuli, but some participants might strategize by focusing only on the words and eventually obtain high scores for the task. This would not reflect the capacity of their working memory in processing multiple tasks. Hence, as recommended by Turner and Engle (1989), participants who did not solve 80% or more of the mathematics problems across the six actual trials were dropped ($N = 39$). In all, 80 participants were dropped. Studies conducted on MTurk that examined cognitive functioning reported similar exclusion rates (e.g., Young et al., 2018).

Following past studies (Conway et al., 2005), we computed two indices of working memory for subsequent analyses. The first index is known as partial-credit loading (PCL) scoring, which represents the total number of words correctly recalled summed across all trials ($\alpha = .86$). Hence, PCL are raw indicators of working memory unadjusted for number of strings per trial. The second index is partial-credit unit (PCU) scoring, which is scored by computing the proportion of words correctly recalled in each trial (e.g., proportion = 0.8 if four words were correctly recalled in a trial with five strings) and then summing the proportions across the six trials ($\alpha = .87$). Therefore, PCU measures working memory performance adjusted for the volume of information required for processing in each trial. We further searched for within-condition extreme outliers in these two indices and dropped only one score each in PCL and in PCU.

As noted, there were concerns whether the manipulation check items could sufficiently capture the induced emotions as they were placed after the dependent measures. To supplement these items, we utilized an implicit manipulation check method that tests for the presence of the induced emotions in participants' recalled descriptions (see Tong et al., 2016). Specifically, we coded the written descriptions for attributes (based on the literature as reviewed earlier) associated with contentment and amusement. If participants in the contentment condition were primed with contentment concepts, their descriptions should contain more contentment attributes than those in the amusement condition. If participants in the amusement condition were primed with amusement concepts, their descriptions should contain more amusement attributes than those in the contentment conditions. Attributes for contentment include: 1) perception of goal achievement; 2) a sense of having or being enough; and 3) focus on the present moment (Berenbaum et al., 2019; Cordaro et al., 2016a; Fredrickson, 1998). Attributes for amusement include: 1) benign violations of expectations; 2) low seriousness; and 3) being entertained (McGraw & Warren, 2010; Wyer & Collins, 1992). Two coders were instructed and coded every description on each attribute, assigning a value of '1' if the attribute was present and '0' if it was absent in the description (see Appendix 3 Table 5 for details). We do not expect descriptions in the neutral condition (where participants provided factual details about doing laundry) to contain any contentment or amusement attributes whatsoever, but for completeness we also coded these neutral descriptions. We analyzed differences between the contentment and amusement conditions only. Agreement was high between the two coders across all the attributes, $\kappa > .94$, $p < .001$. Scores for each attribute were first averaged across the two coders and then summed within each respective emotion to give *contentment attributes* and *amusement attributes*.

Results

Manipulation checks

A one-way ANOVA conducted on reported contentment revealed a significant difference between the conditions, $F(2, 367) = 16.41$, $p < .001$, $\eta^2 = .08$. Contrast analysis supported predictions that reported contentment was higher in the contentment condition ($M = 5.28$, $SD = 1.55$) than the amusement ($M = 5.15$, $SD = 1.47$) and neutral conditions ($M = 4.38$, $SD = 1.57$), $t(367) = 3.49$, $p = .001$. Another ANOVA conducted on reported amusement found a significant effect of emotion, $F(2, 367) = 30.35$, $p < .001$, $\eta^2 = .14$. Contrast analysis supported the prediction that reported amusement was higher in the amusement condition ($M = 4.80$, $SD = 1.49$) than the contentment ($M = 3.70$, $SD = 1.60$) and neutral conditions ($M = 3.32$, $SD = 1.67$), $t(367) = 7.60$, $p < .001$.

Next, we analyzed the coded attribute scores. Neither type of attributes was found in the neutral condition ($M = .00$, $SD = .00$). We also found no amusement attributes in the contentment condition and no contentment attributes in the amusement conditions ($M = .00$, $SD = .00$ for both). The absence of particular attributes in certain conditions is likely due to the nature of the description required (e.g., it is highly improbable to detect indicators of contentment in a joke or a laundry account). However, the ensuing lack of variance might render any further analysis untenable. The coding indeed indicated presence of contentment attributes in the contentment condition ($M = .99$, $SD = .03$) and presence of amusement attributes in the amusement condition ($M = .97$, $SD = .09$).

Main analyses

A one-way ANOVA indicated a significant effect of emotion on PCL, $F(2, 366) = 6.43$, $p = .002$, $\eta^2 = .03$.[1] Following our prediction, follow-up contrast analysis found that working memory was higher in the contentment condition ($M = 26.61$, $SD = 3.67$) relative to both amusement ($M = 24.76$, $SD = 5.19$) and neutral conditions ($M = 24.66$, $SD = 5.30$), $t(366) = 3.58$, $p < .001$[2] (Fig. 1a). The same analyses conducted on PCU found similar results. A one-way ANOVA revealed a significant difference in the PCU scores between the conditions, $F(2, 366) = 6.25$, $p = .002$, $\eta^2 = .03$. Contrast analysis showed that working memory capacity as indexed by PCU was higher in the contentment condition ($M = 5.34$, $SD = .72$) than the amusement ($M = 4.98$, $SD = 1.03$) and neutral conditions ($M = 4.97$, $SD = 1.05$), $t(366) = 3.53$, $p < .001$ (Fig. 1b).

Study 2

Study 1 provides the first evidence that contentment positively predicts working memory. Induced contentment was found to lead to stronger working memory performance relative to an induced neutral state and amusement. Study 2 aimed to replicate the effect and at the same time tested whether the same effect can be found with another positive emotion, hope. We hypothesized that contentment should increase working memory relative to neutral and hope. This study is pre-registered in https://aspredicted.org/blind.php?x=zj8gy7.

Method

Participants

A total of 682 participants from USA recruited using MTurk participated for US$1.40 and were randomly assigned to the three emotion conditions. After participant exclusion (to be explained), final N was 513 (243 males, 257 females, 13 others; $M_{age} = 37.70$, $SD = 10.34$): contentment ($N = 163$), hope ($N = 167$), and neutral ($N = 183$). As in Study 1, we originally planned to recruit about 450 participants based on similar considerations. Also, the effect sizes from the results of Study 1 implied that total N of 285 could be the approximate minimum sample size required. Hence, 450 was deemed a reasonably conservative estimate to proceed with. However, preliminary analysis conducted right after 450 participants were recruited revealed that more participants had to be dropped due to more stringent exclusion criteria via the data quality checks applied in this study (to be explained below). Concerned that power would be compromised and not knowing how many more participants would need to be excluded, we collected more participants set to about 50% of the original 450, resulting in the 682 participants.

Procedure

The procedure in this study, including instructions (see Appendix 1 Fig. 3 for experiment flow and Appendix 2 Tables 3 and 4 for stimuli in the operation span task), were largely similar to Study 1, with the following exceptions. First, instead of amusement, hope was induced. Second, the emotion recall instructions for both contentment and

[1] The df for main analyses is one less than that for manipulation checks because the working memory scores for one participant were found to be extreme outliers and dropped, whereas the manipulation check scores for the same participant were within range and hence analyzed.

[2] Contrast analysis is used because predictions were made concerning the effect of contentment on working memory. As additional demonstration of the reliability of these results, post-hoc tests showed that contentment differed significantly from amusement (PCL, $p = .003$; PCU, $p = .003$) and neutral (PCL, $p = .001$; PCU, $p = .002$) on working memory in Study 1. In Study 2, post-hoc tests also revealed that contentment differed significantly from hope (PCL, $p = .022$; PCU, $p = .022$) and neutral (PCL, $p = .028$; PCU, $p = .032$) on working memory.

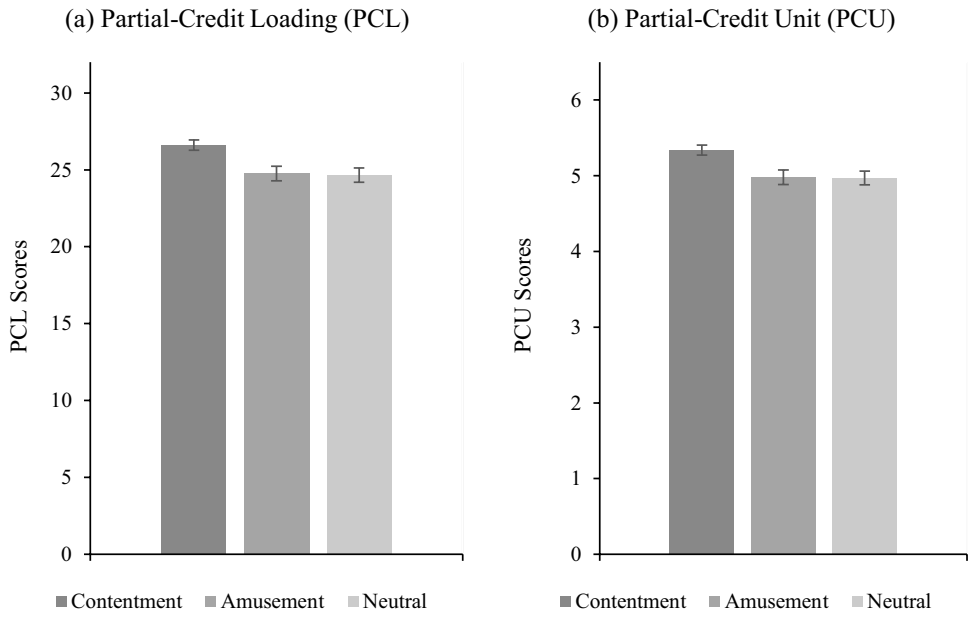

Fig. 1 The mean PCL and PCU scores between conditions for Study 1. Error bars represent ±1 SE of the mean

hope asked for personal experiences. In Study 1, there is a potential limitation in that the contentment recall asked for personal experiences whereas the amusement recall allowed for various types of accounts including fictional or non-personal contents (e.g., jokes, funny comics), potentially making descriptions generated from the two types of recall not highly comparable. In Study 2, we address the lack of comparability by inducing two emotions that involved personal experiences. Participants in the hope condition were told to write about a current goal that they were feeling hopeful about, which they wanted to achieve. They were told that the goal could be about anything including their studies, relationships, and so on. They received the following description of hope: "*Hope is a state where you are looking towards reaching a desired goal. The goal is not yet achieved, and you may or may not know how to achieve it, but you harbor this hope that sometime in the future, the goal will be fulfilled. Similar to optimism, it involves the belief that one will be able to experience a good outcome in the future.*" Like the contentment and neutral conditions, they were guided by question prompts (e.g., "*Why you are hopeful that you can achieve it?*") and encouraged to describe in one or two paragraphs. Third, for generalizability, participants in the neutral condition were asked to describe their dishwashing (rather than laundry) routine. Fourth, after completing the first emotion induction, participants also answered two items on self-control that were not relevant for the current purpose.[3] Fifth, we made minor changes to the second emotion booster to make it more concise. Those in the contentment (hope) condition were asked to explain in one or two sentences what it meant to be contented (have hope) and those in the neutral condition wrote the last two steps of their dishwashing routine.

At the end of the study, participants completed the manipulate check measures, an attention check item, and several items designed for data quality check purposes (see below), which asked them where and how they completed the study. All materials and data are uploaded in https://osf.io/c6t5d/?view_only=9c1e88e20d8e4b47b4290113a8002022.

Materials

Reported emotions For manipulation check purposes, participants rated their current feelings on several items on the same seven-point scale from Study 1. Unlike Study 1, we provided a concise definition of each emotion due to concerns that some participants might interpret some items in idiosyncratic ways. The items for reported contentment (*content*, *satisfied*, and *fulfilled*; $\alpha = .96$) were preceded by a definition that contentment meant "feeling satisfied and at ease because you have enough and your needs are met". The items for reported hope (*optimistic, hopeful*; $\alpha = .93$) were headed by a statement that hope referred to "looking to the future and knowing that a goal may be attained". The definitions are consistent with those given in the recall task. Similar to Study 1, other items were included to mask the purpose of the study.

Attention check The same attention check item from Study 1 was used.

[3] The two items were "I feel that I am in control of my thoughts at this present moment" and "I feel that I can focus my thoughts on whatever I am doing right now", rated on a seven- point scale ranging from 1 (*strongly disagree*) to 7 (*strongly agree*). There was no effect of emotion on the average of these items ($\alpha = .85$), $F(2, 506) = 1.30$, $p = .27$, $\eta^2 = .01$.

Data preparation and processing

Using the same procedures as Study 1, we found that 71 participants failed to solve at least 80% of the mathematics problems; 20 participants failed the attention check; and one participant did not recall the instructed emotion. In addition, 22 participants completed the study with a duration exceeding their respective condition-specific extreme outliers (outlier duration for the contentment, hope, and neutral conditions were 50 min 14 sec, 49 min 44 sec, and 48 min 51 sec respectively). These participants were dropped. Mean duration after exclusion was 18 min 27 sec ($SD = 6$ min 19 sec).

In addition, we took further measures to obtain higher quality data (see Oh & Tong, 2021). Online studies can have several limitations including reduced control over participants' environment, which can influence whether they complete the study diligently and produce reliable data. A laboratory setting where participants complete a study in a conducive room, alone, uninterrupted, properly positioned, and on suitable devices, would allow better experimental control and more reliable data. Therefore, we administered data quality check items aimed at assessing whether participants completed the study in contexts that approximate laboratory settings. Participants were asked at the end of the study to indicate whether they completed the study in their room or in a public venue (e.g., a café); whether they were alone or with someone; whether they were interrupted (e.g., someone called them on the phone); whether they communicated with someone; whether they were seated down, standing up, or in another position; and whether they completed the study on a PC, tablet, or smartphone. The last item was relevant because small devices could hinder responses to the operation span task.[4] Participants who indicated that they were not in their room ($N = 5$); were interrupted ($N = 11$); were with someone ($N = 27$); had communicated with someone ($N = 7$); were not seated down ($N = 19$); were not using a PC ($N = 22$) while doing the study were excluded. In total, data from 169 participants were excluded from analysis, with some participants failing multiple exclusion criteria.

As in Study 1, we computed and analyzed two indices of working memory: PCL ($\alpha = .77$) and PCU ($\alpha = .77$). In addition, similar to Study 1, two coders coded the recalled descriptions to supplement the self-reported manipulation check items (see Appendix 3 Table 5 for details). Attributes for contentment remained the same. Attributes for hope included 1) an unfulfilled goal; 2) a goal of personal value; and 3) motivation to work towards the goal (Snyder et al., 1991). Again, a value of '1' was assigned if the attribute was present in the description and '0' if it was absent. There was a high agreement between the two coders for all six attributes, $\kappa > .94$, $p < .001$. Scores for each attribute were first averaged across the two coders and then summed within the respective emotion to give *contentment attributes* and *hope attributes*.

Results

Manipulation checks

Repeating the same analyses in Study 1, we found significant differences between the experimental conditions on reported contentment, $F(2, 510) = 16.75$, $p < .001$, $\eta^2 = .06$. Contrast analyses revealed support for the hypothesis that reported contentment should be highest in the contentment condition ($M = 5.94$, $SD = 1.06$) relative to the hope ($M = 5.21$, $SD = 1.56$) and neutral conditions ($M = 5.14$, $SD = 1.53$), $t(450) = 5.76$, $p = .001$. The conditions differed significantly on reported hope, $F(2, 510) = 9.90$, $p < .001$, $\eta^2 = .04$. However, contrast analysis did not indicate that reported hope was strongest in the hope condition ($M = 5.76$, $SD = 1.24$) than the contentment ($M = 5.97$, $SD = 1.01$) and neutral conditions ($M = 5.37$, $SD = 1.50$), $t(510) = 0.79$, $p = .43$.

With regard to the coded attributes, there were no contentment and hope attributes in the neutral descriptions as expected ($M = .00$, $SD = .00$). However, in contrast to Study 1, more attributes were found in the non-intended emotion condition (e.g., some hope attributes were found in the contentment condition) which enabled analyses to be conducted. Given the lack of attributes in the neutral condition, we tested for differences only between the contentment and hope conditions. First, paired-sampled *t*-tests indicated more contentment attributes ($M = .96$, $SD = .11$) than hope attributes ($M = .02$, $SD = .13$) in the contentment condition, $t(162) = 67.12$, $p < .001$, Cohen's $d = 5.26$, 95% CI [4.66, 5.85], and more hope attributes ($M = 1.00$, $SD = .00$) than contentment attributes ($M = .002$, $SD = .03$) in the hope condition, $t(164) = 494.00$, $p < .001$, Cohen's $d = 38.46$, 95% CI [34.29, 42.62]. Further, independent-samples *t*-tests revealed more contentment attributes in the contentment condition than the hope condition, $t(326) = 105.78$, $p < .001$, Cohen's $d = 11.68$, 95% CI [10.73, 12.57], and more hope attributes in the hope condition than the contentment condition, $t(326) = 97.35$, $p < .001$, Cohen's $d = 8.52$, 95% CI [7.82, 9.19].

In sum, evidence from both reported emotions and emotion attributes suggests that contentment was induced to a greater extent in the contentment condition as compared to the other two conditions. Reported hope was not strongest in

[4] These exclusion items were not included in the pre-registration because they were conceptualized only after we pre-registered the study. We reanalyzed the data without excluding participants based on these exclusion items. A-priori contrast analyses found marginally significant trends consistent with the hypotheses that the contentment condition should produce higher PCL, $t(559) = 1.73$, $p = .084$, and PCU scores, $t(559) = 1.71$, $p = .088$, relative to the neutral and hope conditions. The duration criterion was also decided after the pre-registration when inspection of Studies 1 and 2 data revealed that some participants took unacceptably long to complete the studies. A-priori contrast analyses without the duration criterion found significant differences in which the contentment condition generated higher PCL, $t(535) = 2.24$, $p = .025$, and PCU, $t(533) = 2.40$, $p = .017$, than the other conditions.

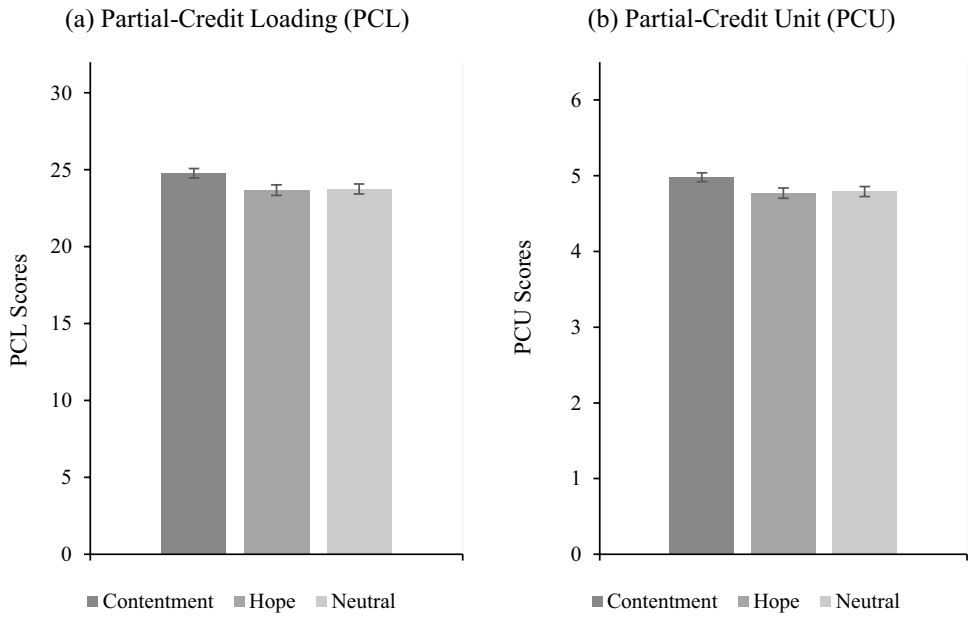

Fig. 2 The mean PCL and PCU scores between conditions for Study 2. Error bars represent ±1 SE of the mean

the hope conditions. As noted, manipulation checks placed after the dependent measure may be less able to detect the induced emotion which may have diminished at this stage (e.g., Hauser et al., 2018). Importantly, the implicit method of assessing participants' written descriptions showed that participants wrote according to their induction instructions, suggesting that thoughts associated with the emotion intended in their respective condition were activated.

Main analyses

A one-way ANOVA revealed significant difference between conditions on PCL, $F(2, 510) = 3.35$, $p = .036$, $\eta^2 = .01$. Planned contrast analysis supported the prediction that contentment condition ($M = 24.77$, $SD = 3.91$) led to the highest PCL score relative to the neutral ($M = 23.75$, $SD = 4.52$) and hope conditions ($M = 23.68$, $SD = 4.43$), $t(510) = 2.59$, $p = .010$ [2] (Fig. 2a). Similarly, a one-way ANOVA indicated a significant effect of emotion on PCU, $F(2, 510) = 3.28$, $p = .039$, $\eta^2 = .01$. Planned contrast analysis showed that working memory capacity as indexed by PCU was higher in the contentment condition ($M = 4.98$, $SD = .75$) than the neutral ($M = 4.79$, $SD = .89$) and hope conditions ($M = 4.77$, $SD = .88$), $t(510) = 2.56$, $p = .011$ (Fig. 2b).

Study 3

In two studies, we found replicable evidence that contentment can enhance working memory, while amusement and hope do not affect it, supporting the proposition that contentment is a unique positive emotion linked to stronger working memory. Study 3 aimed to conceptually replicate the key finding by measuring contentment as a self-reported item and using a different working memory task – the backward digit span task. By utilizing a large-scale public-sample dataset, Study 3 also provides naturalistic evidence that is more ecologically valid, complementing the experimental evidence provided by Studies 1 and 2. Study 3 also seeks to test whether contentment positively predicted working memory independently of happiness, which is a positive emotion high in arousal and approach (Fredrickson, 1998; Kreibig, 2010).

Method

Participants and procedure

Participants comprises of 1011 adults (557 females) who participated in the second phase of the MIDUS project (http://www.icpsr.umich.edu). They were a subset of a nationally representative random-digit-dial sample of 4244 non-institutionalized, English-speaking American residents from the first phase (MIDUS I). They were between 34 to 84 years old ($M = 55.42$, $SD = 11.76$) during the second phase (MIDUS II), which occurred between 2004 to 2006. There were two sub-phases in MIDUS II. In the first sub-phase, they completed by telephone a set of executive function tasks that included the digit-backward task to measure working memory. In the second sub-phase between 0 to 5 years later, participants completed several measures including items for contentment and happiness. In both sub-phases, they completed numerous other measures that are not relevant for our study and can be found in the link provided.

Table 1 Descriptive statistics and correlations (Study 3)

	M	*SD*	*1*	*2*	3	4
1. Contentment	3.25	.83				
2. Happiness	3.35	.77	.73**			
3. Working memory	5.02	1.39	.07*	0.04	0.05	0.06

*, $p < .05$; **, $p < .01$

Measures

Contentment and happiness In the second sub-phase of MIDUS II, they rated the extent to which they generally felt contented ('I am content') on a 4-point scale (1 = *almost never*, 4 = *almost always*). In addition, they rated items on happiness ('I feel happy') on the same scale.

Working memory Participants completed a battery of tasks from the Brief Test of Adult Cognition by Telephone (Lachman et al., 2014). Working memory was measured by the backward digits span task that was part of this test battery. During the task, participants were given an increasingly longer series of digits, ranging from two to eight digits, and they were required to repeat the numbers in the reverse order. The experimenter read aloud each set of digits in list intonation, at a rate of one per second, beginning with a set size of two digits. The score is the largest number of digits that was correctly reproduced. The backward digits span task is considered one of most widely used task in the assessment of working memory in neuropsychological research (e.g., Richardson, 2007).

Results

Descriptive statistics and zero-order correlations are presented in Table 1. As shown, reported contentment correlated positively with working memory, $r(1009) = .074$, $p = .019$. Happiness did not correlate with working memory – despite the large sample size. As expected, contentment correlated positively with happiness. We next examined whether contentment would continue to predict working memory if happiness was controlled for. As large-scale surveys with general-public samples are typically highly heterogeneous due to substantial individual differences among participants, we also controlled for gender (male and females coded as 0 and 1 respectively) and age, which are key demographic variables related to executive functions (Maitland et al., 2000).

Hence, we conducted a regression analysis predicting working memory from contentment (Step 1), happiness (Step 2), and age and gender (Step 3). As shown in Table 2, reported contentment remained predictive of higher working memory at every step controlling for happiness and then age and gender.

General discussion

It was hypothesized that contentment should be positively associated with working memory. The results of three studies are consistent with this hypothesis. In Studies 1 and 2, induced contentment improved performance in the operation span task relative to an induced neutral state. In Study 3, measured contentment was positively related to performance on the backward digits span task. Hence, there was direct replication (Studies 1 and 2) and conceptual replication support (Studies 1 to 3) for the hypothesis that contentment and working memory are positively associated, across different operationalizations of contentment and measurements of working memory. In addition, demonstrating the uniqueness of contentment in predicting greater working memory, induced contentment improved working memory relative to induced amusement (Study 1) and hope (Study 2), and reported contentment independently and positively predicted working memory beyond happiness (Study 3).

Studies 1 and 2, in using a similar operation span task, extends Yang et al.'s (2013) study. The authors found that general positive affect enhanced working memory and interpreted their findings to be limited to only low approach positive emotions. In studies 2 and 3, we found the first evidence to support their propositions. Contentment, a low approach positive emotion, uniquely predicted enhanced working memory, whereas other positive emotions high in approach such as hope (Study 2) and happiness (Study 3) did not. Extending beyond Yang et al.'s (2013) findings, we also found that not all approach positive states predicted greater working memory. In Study 1, both contentment and amusement are low in approach, but only the former improved working memory. Contentment is low in positive arousal, while amusement is high in positive arousal. Therefore, this significantly builds on Yang's et al. (2013) findings, indicating that positive emotions low in arousal and approach are more likely to be predictive of greater working memory.

Overall, the current studies testify to the importance of studying discrete emotions to understanding the nuanced, differentiated relationships between affect and cognition. Prior studies have mainly examined global positive emotions and found that they either facilitated or impaired cognitive functions. This conundrum could be clarified by having greater precision in the conceptualization of the positive emotional antecedents and employing methods that induced specific kinds of positive emotions. We found that contentment, and not amusement, hope or

Table 2 Hierarchical regression analysis predicting working memory from contentment and happiness (Study 3)

	B	*SE*	*β*	*p*	95% CI (lower bound)	95% CI (upper bound)
Step 1						
Contentment	0.12	0.05	0.07	0.019	0.02	0.23
Step 2						
Contentment	0.17	0.08	0.10	0.032	0.01	0.32
Happiness	−0.06	0.08	−0.03	0.453	−0.23	0.10
Step 3						
Contentment	0.19	0.08	0.11	0.012	0.04	0.34
Happiness	−0.04	0.08	−0.02	0.619	−0.20	0.12
Age	−0.02	0.00	−0.16	0.000	−0.03	−0.01
Gender	0.06	0.09	0.02	0.493	−0.11	0.23

happiness, predicted greater working memory. This is consistent with several separate lines of research, none of which examined the link between contentment and working memory, but together suggest indirectly that there could be such a relationship. Prior studies suggest that goal attainment should lead to better cognitive functions (e.g., Masicampo & Baumeister, 2011). Researchers have also found evidence suggesting that low approach positive emotions and low arousal positive emotions could enhance cognitive functions (e.g., Griskevicius et al., 2010; Wang et al., 2013). In addition, contentment is related to reduced anxiety and depressive symptoms (e.g., Gilbert et al., 2008) and higher mindfulness (Cordaro et al., 2016), which have been found to be associated with enhanced cognitive functions (e.g., Shields et al., 2016). Together, the findings in the current research supplement past research to provide the first empirical support that contentment is uniquely associated with higher working memory.

The current study has four potential limitations. First, contentment may not be the only positive emotion to be positively predictive of working memory and it is possible that other positive emotions low in arousal and approach could have the same effect. However, the current study is the first critical step towards demonstrating that discrete positive emotions may be uniquely linked to greater working memory. To our knowledge, no other studies have examined this. In addition, it may be difficult to identify and conceptualize another discrete positive emotion that also involves perceptions of goal attainment, low arousal, and low approach, which are the three key characteristics of contentment and which have been linked to enhanced cognitive functions in previous works.

Second, future studies should employ more impactful methods to induce contentment and other emotions. In Studies 1 and 2, it is possible that the induced positive emotions, despite the booster manipulations, might have diminished substantially by the end of the working memory task, which if true would produce a reduced effect. The manipulation checks placed at the end of the dependent measures might not be able to capture the emotions if they were substantially diminished (e.g., Hauser et al., 2018). Further studies can consider using other manipulation methods, such as having participants watch a video or read a related story (Siedlecka & Denson, 2019). However, alternative methods such as these can induce a plethora of emotions other than the intended one. Future studies may also enhance the evocativeness of the current method by using audiotaped personal recall instructions, where participants are guided and paced to visualize an incident in their lives where they felt the specific positive emotion, before writing it down. This method should have greater specificity in inducing specific emotions and could potentially also be more impactful if the guiding instructions could focus participants' attention on the intended emotion.

Third, we found the facilitation of contentment on two working memory tasks – the operation span task and backward digit span task, suggesting the generalizability of the effect. However, future studies can examine other working memory paradigms, such as the N-back task. Future studies can even examine other forms of cognitive functions such as task-switching and inhibitory control.

Finally, our samples are mainly from the United States. Future studies can investigate whether the association between contentment and working memory can be found in other cultures, especially in Eastern cultures where contentment may be more common in daily life (Cordaro et al., 2016).

We hope to conclude by proposing a broader implication on the current findings. Contentment has long featured prominently in many philosophical and spiritual traditions as an optimal human experience and fundamental to well-being (Cordaro et al., 2016). Contentment is also intricately linked to interventions (Chiesa et al., 2011; Cordaro et al., 2016) that strive to cultivate contentment in everyday life to engender its positive consequences on well-being. Our research aims to contribute towards understanding the significance of contentment further by providing the first evidence of its cognitive properties. Stronger working memory has been linked to many positive aspects in daily functioning such as learning and health (e.g., Diamond, 2013; Pe et al., 2013). Hence, a positive feedback loop could arguably exist in which initial feelings of contentment could improve

controlled cognitive processes, which could aid in daily functioning, translating eventually to better well-being and further experience of contentment. Further, the findings in Studies 1 and 2 that contentment can be induced suggest the possibility that intervention to cultivate contentment could be developed with the broader goal of harnessing its positive effects. In sum, future research could establish whether the facilitative relationship that contentment has with working memory could indeed play a role in the positive effects that contentment has on well-being and daily functions.

Appendix 1

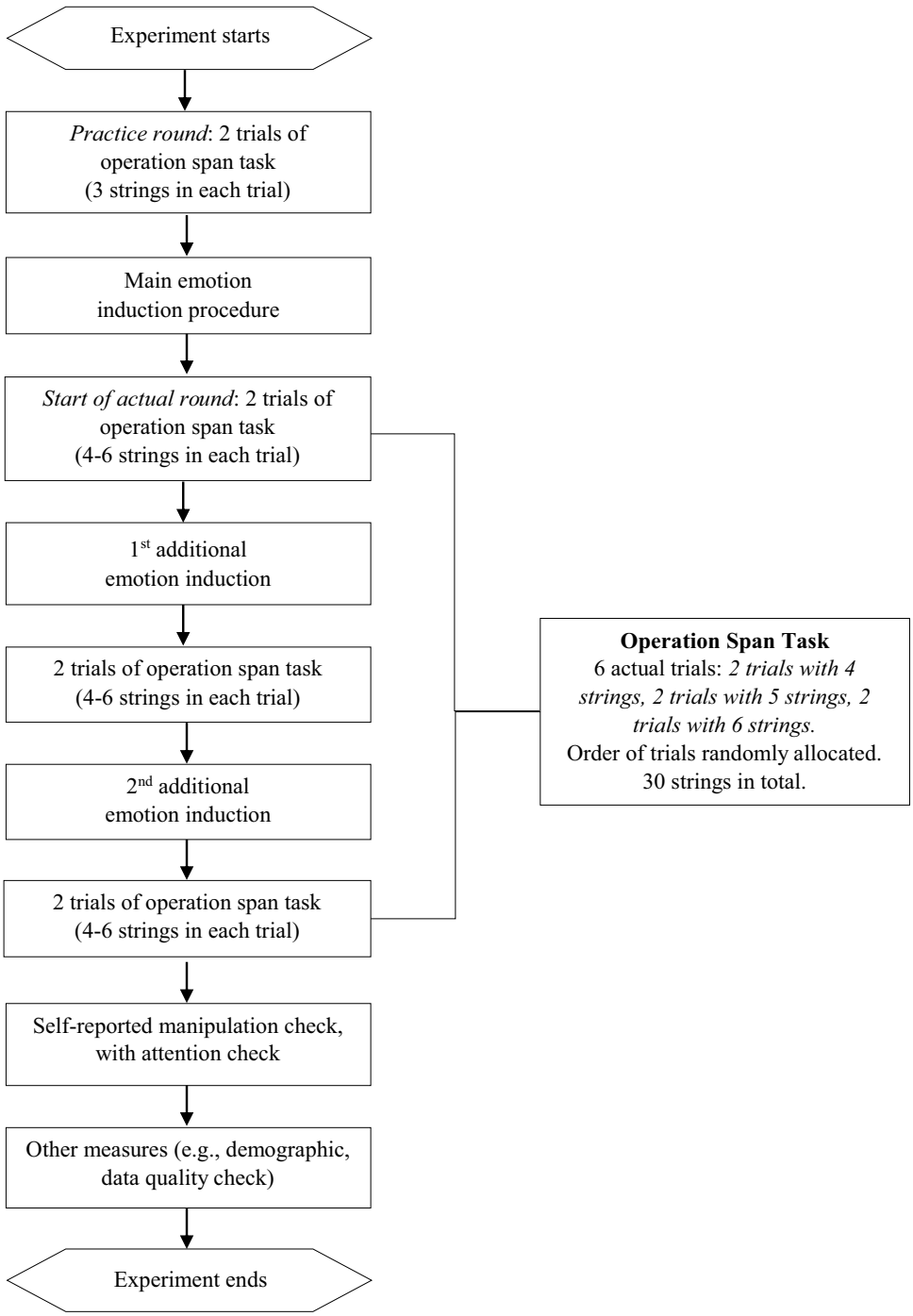

Fig. 3 Experiment flow of Studies 1 and 2

Appendix 2

Table 3 Mathematical operations and word stimuli in Study 1

		Operation	Answer	Word stimuli
Size 3 (practice)	trial	4/2 + 4 = 6	T	context
		4/2 + 7 = 9	T	jelly
		6/2 + 5 = 7	F	fabric
	trial	2 × 1 + 3 = 4	F	whistle
		2 × 3 + 2 = 8	T	trunk
		3 × 3–5 = 3	F	statue
Size 4	trial	4 × 2–5 = 2	F	cabinet
		4 × 2–4 = 4	T	runner
		8/2 + 3 = 5	F	coast
		9/3 + 3 = 6	T	poster
	trial	6/3 + 5 = 7	T	kettle
		3 × 3–7 = 1	F	village
		4/2 + 2 = 4	T	solemn
		2 × 4–1 = 6	F	clock
Size 5	trial	2 × 2 + 3 = 7	T	journal
		2 × 3 + 1 = 7	T	plant
		4/2 + 5 = 8	F	hammer
		3 × 3–4 = 5	T	rain
		2 × 4–7 = 2	F	limber
	trial	8/2 + 2 = 6	T	lantern
		8/2 + 4 = 6	F	habit
		6/3 + 2 = 5	F	dirt
		2 × 1 + 4 = 6	T	coarse
		6/2–2 = 2	F	ankle
Size 6	trial	2 × 4 + 1 = 9	T	patient
		6/2 + 6 = 9	T	sphere
		2 × 4–3 = 7	F	rock
		8/2–2 = 4	F	stove
		8/2–1 = 3	T	modest
		2 × 2 + 4 = 7	F	street
	trial	9/3 + 4 = 6	F	history
		9/3–1 = 2	T	cellar
		4 × 2–6 = 2	T	black
		4/2 + 3 = 6	F	unit
		6/3 + 4 = 7	F	window
		8/2–2 = 2	T	finger

Table 4 Mathematical operations and word stimuli in Study 2

		Math problem	Answer	Word stimuli
Size 3 (practice)	trial	4/2 + 4 = 6	T	context
		4/2 + 7 = 9	T	jelly
		6/2 + 5 = 7	F	fabric
	trial	2 × 1 + 3 = 4	F	whistle
		2 × 3 + 2 = 8	T	trunk
		3 × 3–5 = 3	F	statue
Size 4	trial	4 × 2–5 = 2	F	cabinet
		4 × 2–4 = 4	T	runner
		8/2 + 3 = 5	F	coast
		9/3 + 3 = 6	T	poster
	trial	6/3 + 5 = 7	T	kettle
		3 × 3–7 = 1	F	village
		4/2 + 2 = 4	T	tower
		2 × 4–1 = 6	F	clock
Size 5	trial	2 × 2 + 3 = 7	T	journal
		2 × 3 + 1 = 7	T	plant
		4/2 + 5 = 8	F	hammer
		3 × 3–4 = 5	T	rain
		2 × 4–7 = 2	F	limber
	trial	8/2 + 2 = 6	T	lantern
		8/2 + 4 = 6	F	habit
		6/3 + 2 = 5	F	dirt
		2 × 1 + 4 = 6	T	coarse
		6/2–2 = 2	F	ankle
Size 6	trial	2 × 4 + 1 = 9	T	radiator
		6/2 + 6 = 9	T	sphere
		2 × 4–3 = 7	F	rock
		8/2–2 = 4	F	stove
		8/2–1 = 3	T	modest
		2 × 2 + 4 = 7	F	street
	trial	9/3 + 4 = 6	F	history
		9/3–1 = 2	T	cellar
		4 × 2–6 = 2	T	black
		4/2 + 3 = 6	F	unit
		6/3 + 4 = 7	F	window
		8/2–2 = 2	T	finger

Order of the trials was randomized

Appendix 3

Table 5 Summary of instructions for the coding of recalled descriptions

Attribute	Instruction
Contentment (Studies 1 and 2)	
Goal attainment (achievement of a goal and reduced goal pursuit)	Assign '1' if participant thinks that they have achieved a goal and/or that they find it no longer necessary to pursue the goal further.
A sense of having or being enough	Assign '1' if participant thinks that there is nothing more that they need in certain aspects of their life or in being who they are.
Orientation to the present moment	Assign '1' if person is focused on the present situation, instead of thinking about the past or future.
Amusement (Study 1)	
Benign violations of expectations	Assign '1' if the description involves something unexpected or a breach of norm (e.g., social norm, linguistic norm) but in a ways that is non-threatening.
Diminished seriousness	Assign '1' if the participant takes the described situation in a lighthearted, non-serious manner.
Being entertained	Assign '1' if person seems entertained in the described situation
Hope (Study 2)	
Unfulfilled goal	Assign '1' if participant describes a goal that he/she wants to achieve but has not yet achieved it.
Goal has personal value	Assign '1' if the unfulfilled goal described is personally meaningful or important.
Motivation to work towards goal	Assign '1' if participant demonstrates a desire to work towards the goal or describes plans to achieve it.

For each attribute, a score of "0" was assigned if the person did not demonstrate the attribute

Supplementary Information The online version contains supplementary material available at https://doi.org/10.1007/s12144-022-03714-7.

Data availability All materials and datasets generated during and/or analyzed during the current study are available in the OSF repository, https://osf.io/c6t5d/?view_only=9c1e88e20d8e4b47b4290113a8002022.

Declarations

Ethics approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and with the 1964 Declaration of Helsinki and its later amendments or comparable ethical standards. The studies are approved by the Departmental Ethics Review Committee (DERC) of our university.

Informed consent Informed consent was obtained from all individual participants included in the studies to participate in the studies and for their data to be used for publication.

Conflict of interest We declare that we have no financial and personal relationships with other people or organizations that could inappropriately influence this work.

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