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Fluency generating emotion words correlates with verbal measures but not emotion regulation, alexithymia, or depressive symptoms

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Abstract

How do you feel? To answer this question, one must first think of potential emotion words before choosing the best fit. However, we have little insight into how the ability to rapidly bring to mind emotion words—emotion fluency—relates to emotion functioning or general verbal abilities. In this study, we measured emotion fluency by counting how many emotion words participants could generate in 60s. Participants (*N* = 151 in 2011-2012) also completed a behavioral measure of verbal fluency (i.e., how many words starting with “P” or “J” participants could produce in 60s), a cognitive reappraisal emotion regulation task, and emotion functioning questionnaires. In pre-registered analyses, we found that participants produced more negative emotion words than positive words, and more positive words than neutral words in the emotion fluency task. As hypothesized, emotion fluency was positively related to verbal fluency, but contrary to hypotheses, emotion fluency was not related to self-reported or task-based emotion functioning (e.g., alexithymia, depression, and emotion regulation ability). As such, in community samples, emotion fluency may reflect general cognitive abilities rather than processes crucial to emotional well-being. While emotion fluency as measured here does not track indices of well-being, future research is needed to investigate potential contexts in which verbal fluency for emotion words may be key to emotion regulation.

Keywords: Emotion regulation, emotion fluency, verbal fluency, alexithymia, depression

Introduction

Emotion regulation—the set of strategies people use to change or modify their emotions (Gross, 1998, 2015)—is key to mental well-being, and emotion dysregulation is considered a transdiagnostic risk factor for psychopathology (Aldao et al., 2016; Fernandez et al., 2016). Effective emotion regulation encompasses a broad range of emotion-related skills and competencies that aid in monitoring and modifying one's emotions (Gross, 1999; Hoemann et al., 2021; Thompson, 1994). Researchers have investigated many of these components, but one relevant skill that has received little attention is "emotion fluency," or the ability to rapidly bring to mind emotion words. Thinking of potential emotions is likely a first step in identifying one's emotions, which prior research has associated with positive outcomes (Honkalampi et al., 2000; Kashdan et al., 2015; Nook et al., 2021; Starr et al., 2017; Weissman et al., 2020). Here, we conduct preregistered tests of how emotion fluency relates to verbal fluency and several indices of *emotion functioning*, such as emotion regulation, alexithymia, and symptoms of depression.

Although little work has examined emotion fluency, substantial research has examined "verbal fluency" (i.e., the ability to rapidly bring to mind words; Benton et al., 1994; Fossati et al., 2003; Henry & Crawford, 2005; Regard et al., 1982). Verbal fluency tasks require a person to quickly (e.g., 60s) produce as many words as they can that belong to a category (e.g., animal) or begin with a letter (e.g., "P"). Verbal fluency tasks test a person's working vocabulary by challenging them to express the words that they can quickly access (Schrauf & Sanchez, 2004). These tasks are thought to assess specific executive functioning abilities, including word retrieval and processing speed, and are widely used in neuropsychological testing to evaluate cognitive functioning (Henry et al., 2004; Henry & Crawford, 2004; Jurado & Rosselli, 2007; Metternich et al., 2014; Shao et al., 2014). In the current study, we adapted these verbal fluency measures to assess how many *emotion* words people can generate in 60s. By altering one aspect of the task (i.e., asking participants to generate emotion words) while retaining other aspects (e.g., a short time limit; Badre & Wagner, 2002; Michalko et al., 2022), we maintain consistency with prior verbal fluency measures. Conceptually, maintaining a short time limit also allows us to measure the psychological process that occurs when people must name their emotions in daily life with relative speed, such as when in conversations with others.

Theoretically, this measure of verbal fluency for emotion words, or “emotion fluency,” may be a basic emotional skill that scaffolds other emotional capacities. Prominent theoretical models of emotion posit that people use emotion concepts to categorize bodily sensations into discrete emotional experiences, and emotion words are thought to be symbols that organize and bring to mind these underlying emotion concepts (Barrett, 2017; Barrett et al., 2007; Lindquist, Satpute, et al., 2015; Nook et al., 2015; Satpute et al., 2016). By these accounts, emotion words facilitate cohesion across the diverse experiences that constitute a concept (e.g., public speaking, walking home after dark, and witnessing violence all can be understood and labeled as instances of “fear”). Empirical studies show that either priming or satiating emotion words influences how affective signals from one’s body and others’ emotional expressions are interpreted and categorized (Gendron et al., 2012; Hoemann & Barrett, 2019; Lindquist et al., 2006; Lindquist, MacCormack, et al., 2015; Lindquist & Barrett, 2008; Nook et al., 2015). Thus, given that words bring to mind underlying concepts, and concepts are central to constructing emotions, we posited that the fluency with which a person can generate emotion words may assess the rapidity with which they can summon and apply emotion concepts to parse their emotional experiences. If so, measures of “emotion fluency” could assess this foundational emotional skill.

In particular, the ability to generate emotion words more fluently could be important to the ability to specifically identify one's emotions (i.e., emotion differentiation; Barrett et al., 2001; Kashdan et al., 2015). Previous research has found that increased emotion differentiation is associated with adaptive emotion regulation (Kalokerinos et al., 2019; Kashdan et al., 2010; Pond et al., 2012; Smidt & Suvak, 2015). Emotion differentiation, especially for negative emotion words, is also thought to buffer from stress-related psychopathology and behavioral dysregulation (Erbas et al., 2014; Nook, 2021; Nook et al., 2021; O'Toole et al., 2020; Seah et al., 2022; Starr et al., 2017, 2020). Furthermore, people who experience alexithymia, or difficulty identifying and describing one's emotions, have reduced competency with accessing and remembering emotion words (Luminet et al., 2004, 2006; Vermeulen & Luminet, 2009; Wotschack & Klann-Delius, 2013). Alexithymia is also related to psychopathology and emotion regulation deficits (Honkalampi et al., 2000; Swart et al., 2009; Zeitlin & McNally, 1993). In another line of inquiry, studies of "affect labeling" demonstrate that pairing aversive stimuli with affective labels (e.g., "angry," "crying," "gross") reduces distress (Lieberman et al., 2011; Torre & Lieberman, 2018). As such, increased emotion fluency may facilitate emotion functioning and regulation through rapid access to emotion concepts.

However, again at the theoretical level, it is important to note that emotion words are abstract verbal symbols that are not *equal to* one's underlying emotion concepts (Barrett, 2004). An individual can connect several concepts to the same emotion word (e.g., colexification; Jackson et al., 2019). Across individuals, people have different conceptual knowledge about the same emotion words (Nook, Stavish, et al., 2020). Some people have precisely differentiated concepts connected to different emotion words (i.e., anger and sadness occur in specific and unique instances), while others have less differentiation in how they connect emotion concepts and words (i.e., anger and sadness can be seen as highly overlapping; Barrett et al., 2001). An important aim of affective science is to elucidate the relationships between emotion words, concepts, and experiences (Adolphs, 2017; Hoemann et al., 2019), and existing research suggests that there is not a strict one-to-one mapping between emotion concepts and emotion words (Barrett, 2004; Barrett et al., 2001; Jackson et al., 2019; Nook, Stavish, et al., 2020). Although the fluency with which one brings to mind emotion words *may* assess one's ability to rapidly deploy emotion concepts to construct and regulate one's emotions, this is not necessarily the case. Thus, we sought to test relations between emotion fluency and several indices of emotion functioning in this study.

We are aware of only two previous studies that have examined emotion fluency's relations with emotion functioning. The first study established that emotion fluency correlates with other verbal fluency measures (i.e., the number of emotion words produced by participants in 60s is positively correlated with the number of animal words and words that begin with "F", "A", and "S" they produced in 60s; Abeare et al., 2017). In contrast to our hypotheses, this study found that emotion fluency was *positively* related to psychopathology (i.e., scores drawn from the Depression Anxiety and Stress Scales (DASS)-42 and State/Trait Inventory for Cognitive and Somatic Anxiety; Lovibond & Lovibond, 1995; Ree et al., 2008) and that trait anxiety was positively correlated with the number of "unhappy" and "calm" words produced (i.e., valence-specific emotion fluency). A second study also found that emotion fluency correlated with other verbal fluency measures (i.e., the number of clothing words, girls' names, and words that start with "B", "H", and "R" that could be produced in 60s; Camodeca et al., 2021). However, emotion fluency was not significantly correlated with psychopathology (i.e., DASS-21 scores; Henry & Crawford, 2005) in this study.

Overall, prior research provides preliminary evidence that emotion fluency correlates with other verbal fluency tests. However, findings connecting emotion fluency to psychopathology have been inconsistent. Prior research did not test how emotion fluency relates to other measures of emotion functioning, such as emotion regulation or self-reported abilities to identify one's own emotions (e.g., emotional awareness and alexithymia; Sifneos, 1973). Additionally, the specific emotion words a person produces in this task may reveal aspects of their emotional experience. In particular, the valence of emotion words produced may be a specific indicator of emotion functioning, as we expect that individuals will rapidly bring to mind emotion concepts that they commonly use in their thinking (Boyd & Pennebaker, 2017; Tausczik & Pennebaker, 2010). Having rapid access to negative emotion words may indicate that a person frequently experiences negative emotions, and recent work indeed supports this notion (Vine et al., 2020). Little research has examined the tendency to produce negative emotion words in this task (or "negative fluency bias"). Here, we address these gaps.

Overall, this project aims to advance understanding of emotion fluency by charting its psychometric properties, relations with self-reported measures of emotion functioning, and relations with behavioral measures of emotion regulation. We preregistered analyses on a previously collected dataset ($N = 151$) that includes a battery of self-report questionnaires, a cognitive reappraisal emotion regulation paradigm, and tests of verbal and emotion fluency (https://osf.io/2bvk7). We hypothesized that (1) emotion fluency would positively correlate with verbal fluency, (2) increased emotion fluency would be associated with better emotion functioning and emotion regulation given that the ability to easily generate emotion words may scaffold other adaptive emotion processes, and (3) negative fluency bias would relate to worse emotion functioning and emotion regulation because negative emotion concepts may be easily brought to mind by people who frequently experience negative affect.

Methods

Participants

The current analyses include data from two studies conducted in 2011-2012 that were previously reported on in Nook et al. (2021). Power analyses were conducted prior to data collection to determine the sample size for each study (see Nook et al., 2021 for further details). Given that the emotion fluency task is identical in both studies, we combined the samples for most analyses, yielding a total usable sample of 151 participants (age range = 18–35 years old, *M* = 20.9 years, *SD* = 3.4 years; 68.2% female, 2 participants did not disclose gender; 10.6% Hispanic; 12.6% African American, 27.8% Asian, 36.4% Caucasian, 2% Middle Eastern, 2% Native American, 7.3% Other, 2 participants did not disclose race/ethnicity). We conducted analyses to ensure that the two samples did not differ on questionnaire and demographic details to justify treating the two studies as one sample (see **Supplemental Materials**). Some individuals only completed a subset of the study tasks. These individuals were excluded from analyses of missing dependent variables and retained for other analyses (see **Table 1** for list of sample per analysis). All participants were fluent in English and received $12/hr for their time. All study procedures for both studies were approved by the Columbia University IRB.

Procedure

In both studies, participants first completed a battery of self-report questionnaires, followed by an emotion regulation paradigm, and finally, tests of emotion fluency and verbal fluency. Methods and materials were similar across the two studies.

Self-Report Questionnaires

Participants completed the Levels of Emotional Awareness Scale (LEAS; Lane et al., 1990), the Toronto Alexithymia Scale (TAS; Bagby et al., 1994), and the Beck Depression Inventory (BDI; A. T. Beck et al., 1961, 1996). We used slightly modified versions of the TAS and BDI to remove mentions of specific emotion words (full details regarding these questionnaires are provided in the **Supplemental Materials**). The LEAS was only collected in Study 1. The BDI-II was administered in Study 1 and the BDI-I was administered in Study 2. To account for this difference, we included study as a covariate for analyses including the BDI. All questionnaires showed adequate reliability (Cronbach's αs = 0.66 – 0.85).

Emotion Regulation Paradigm

This study adapted a commonly used cognitive reappraisal task to examine how naming one's emotions impacts cognitive emotion regulation (Buhle et al., 2014; Nook et al., 2017; Nook, Vidal Bustamante, et al., 2020; Ochsner et al., 2002). There were slight differences in administration of the emotion regulation paradigm across the two studies, but in both studies participants (i) viewed negative images drawn from the International Affective Picture Set (IAPS; Lang et al., 2008), (ii) engaged with each image according to instructions (e.g., passively view or actively reinterpret the meaning of the image), and (iii) reported their positive and negative affect. We give a brief overview of each study's paradigm below, and we refer the reader to Nook et al. (2021) for further details.

The paradigm in Study 1 involved two phases. During the baseline phase, participants passively observed 24 negative images and reported their positive and negative affect on two seven-point scales (1 = *not at all*, 7 = *extremely*). This phase allowed for comparisons between participants' baseline emotional responses and their emotional responses after naming and/or regulating their emotions. In the experimental phase, participants viewed the 24 negative images for a second time, and they were randomly assigned to one of four between-subjects conditions: *Look, Name, Regulate,* and *Name and Regulate*. In the *Look* condition, participants passively observed the images, as they did during the baseline phase. In the *Name* condition, participants said aloud the dominant emotion they felt while the image was on the screen. In the *Regulate* condition, participants regulated their emotional response by employing cognitive reappraisal (i.e., by silently creating a story or context that made the image less aversive). In the *Name and Regulate* condition, participants completed the instructions for the *Name* condition followed by the instructions for the *Regulate* condition. Experimenters verified participants' comprehension of and compliance with task directions during a set of practice trials before each phase. Each image was displayed for 12s, during which the participants responded according to their assigned condition. Then, the participants reported their levels of positive and negative affect using the same seven-point scales.

Study 2 employed a mixed between- and within-subjects design. Each participant completed two runs of 40 trials (total 80 trials) with a short break in between the runs. For half of the participants, the emotion regulation strategy they were instructed to use was cognitive reappraisal ($N = 29$) and the other half regulated using mindful acceptance ($N = 31$). Image presentation was divided into two 6s-windows. In the first 6s-window, participants were instructed to *Look* or to *Name*. In the second 6s-window, participants were instructed to *Look* or to *Regulate*. This resulted in four conditions, 20 trials each, where across the two 6s-windows participants would: *Look-Look* (which corresponds to the *Look* condition in Study 1)*, Name-Look* (which corresponds to the *Name* condition in Study 1)*, Look-Regulate* (which corresponds to the *Regulate* condition in Study 1)*, Name-Regulate* (which corresponds to the *Name and*

Regulate condition in Study 1). After implementing the instructions in response to the images, participants reported their positive and negative affect using the same procedure as in Study 1. Trial order was randomized across participants, with the number of each trial type equal across the two runs. Unlike Study 1, there was no initial passive viewing of the images (i.e., no baseline phase). Because of the subtle differences in the procedures of Study 1 and Study 2, we conducted tests to justify combining the two studies for analyses. Specifically, we tested whether performance on the emotion fluency task differed by task and emotion regulation strategy conditions and found no differences (see **Supplemental Materials**).

Emotion Fluency and Verbal Fluency Tests

At the end of the study, participants completed tests of emotion fluency and verbal fluency. Participants were given a piece of paper and instructed to write down as many words as they could in 60s for a cue. The first cue was emotion words (i.e., "Please write down as many emotion words as you can think of in 60s"), from which we calculated the participant's emotion fluency. The second cue was to write as many words as they could think of that start with the letter "P" in 60s. Third and finally, they wrote words that start with "J." These comprise "easy" and "difficult" measures of verbal fluency, respectively. By keeping the time limits short and consistent, differences in performance across the tasks can be attributed to differences in their fluency for generating *emotion* words rather than their overall processing speed or executive functioning, which are assessed in all three tasks.

Transparency and Openness

The preregistration can be accessed on: https://osf.io/2bvk7. All study materials and data can be accessed on: https://osf.io/mr3uj/.

Data Processing

Our preregistered analyses investigated how emotion fluency relates to verbal fluency and several measures of emotion functioning. Emotion fluency was calculated as the total count of emotion words that the participant generated in the emotion fluency test. We similarly computed easy verbal fluency by counting the number of “P” words produced, and difficult verbal fluency by counting the number of “J” words produced. The emotion words were coded by valence (i.e., into positive, negative, or neutral) at the time of data collection using colloquial norms informed by the emotion science literature. The emotion fluency tests were given on paper, and the sums of words participants produced (both overall and by valence) were digitized and retained. Thus, we also calculated counts of positive, negative, and neutral emotion fluency, but unfortunately cannot calculate other fluency metrics that depend on the words’ order nor provide the original coding scheme. Finally, we calculated participants’ negative fluency bias, or the proportion of negative emotion words generated [Negative Fluency Bias = Negative emotion fluency / Total emotion fluency]. As such, negative fluency bias is a measure of the participant’s tendency to bring to mind negative emotion words controlling for how many emotion words they produced in general (see the **Supplemental Materials** for analyses showing that counts and proportions of emotion fluency by valence yield similar results).

We extracted two measures of emotion naming from the emotion regulation paradigm: naming interference and naming reaction time. Naming interference captures the degree to which naming one’s emotions interferes with emotion regulation. To calculate naming interference, we first combined participants’ positive and negative affect ratings into one unpleasant affect rating for each trial [Unpleasant Affect for each trial = (Negative Affect + (8 − Positive Affect)) / 2]. The unpleasant affect ratings were averaged within each condition, such that each participant had one mean unpleasant affect rating for the *Regulate* condition and another for the *Name and Regulate* condition. Naming interference was operationalized as the difference between the two condition's unpleasant affect ratings [Naming Interference = *Name and Regulate* Mean Unpleasant Affect – *Regulate* Mean Unpleasant Affect]. Higher scores reflect greater interference, with higher unpleasant ratings in the *Name and Regulate* condition than in the *Regulate* condition. Because this calculation requires a within-subject design, this measure was only computed for Study 2. Naming reaction time was measured as the interval between when the negative image was displayed on the screen and when the participant named their emotion in seconds. We calculated a mean reaction time for each participant who provided naming data (i.e., for the 40 participants in the *Name* and *Name and Regulate* conditions in Study 1 and for all participants averaging across the two conditions in Study 2).

Analytic Approach

All statistical analyses were conducted using RStudio Version 1.3.1093. Following our preregistered analysis plan, we first produced descriptive statistics of the emotion fluency task (e.g., means and standard deviations of overall emotion fluency, emotion fluency for each valence, and negative fluency bias). We compared emotion fluency across valences (i.e., positive, negative, and neutral emotion fluency) using a one-way within-subjects ANOVA with Greenhouse-Geisser correction. We investigated three research questions, using the Benjamini-Hochberg procedure to reduce the false discovery rate (Benjamini & Hochberg, 1995).

We first investigated whether emotion fluency shows convergent validity with verbal fluency using Pearson's correlations. To assess whether emotion fluency and positive/negative emotion fluency were more strongly associated with easy or difficult verbal fluency, "P" and "J" respectively, we compared the correlations using Steiger's method implemented in the *cocor* package (Diedenhofen & Musch, 2015; Steiger, 1980). We hypothesized significant positive relationships between emotion fluency and both types of verbal fluency. Further, we hypothesized that participants may have greater ease producing negative emotion words than positive emotion words, because (1) there are more negative than positive emotion words in the English language (Averill, 1975; Jackson et al., 2021), and (2) the emotion regulation task may have primed negative emotion words or induced a negative mood. As such, we hypothesized that negative emotion fluency would have a stronger positive relationship with easy verbal fluency than it would with difficult verbal fluency, while positive emotion fluency would have a stronger positive relationship with difficult verbal fluency than easy verbal fluency.

Second, we asked whether emotion fluency or negative fluency bias demonstrates convergent validity with relevant self-reported emotion functioning measures (i.e., emotional awareness, alexithymia and depression symptoms) using Pearson's correlations. We used linear regressions when investigating associations with depression symptoms in order to include study as a covariate in all depression analyses. For emotion fluency, we hypothesized a positive relationship with LEAS scores and a negative relationship with both TAS and BDI scores. For negative fluency bias, we hypothesized the opposite relationships: a negative association with LEAS scores and positive with TAS and BDI scores.

Third, we asked whether emotion fluency or negative fluency bias tracks the ability to name and regulate one's emotions when confronted with aversive stimuli, using Pearson's correlations. Because emotion naming, like emotion fluency, requires the retrieval of emotion words, we hypothesized that emotion fluency would be negatively correlated with both the time it takes to name one's emotions in the emotion regulation task and naming interference (i.e., the extent to which naming interferes with regulation). We also hypothesized that negative fluency bias would be positively associated with naming reaction time and naming interference.

Results

Following our preregistered analysis plan, we generated descriptive statistics of emotion fluency responses (**Table 1**). Participants produced an average of 12.1 and 13.1 emotion words in Study 1 and Study 2 respectively. These means are similar to the number of emotion words produced in previous work (*Ms* = 11.6, 11.8; Abeare et al., 2017; Camodeca et al., 2021). We observed a main effect of valence in the number of emotion words produced, $F(1.42, 213.04) = 571.54$, $p < 0.001$, $\eta^2_G = .73$ (**Fig. 1**). Negative words were most frequent ($M = 8.49$, $SD = 2.64$), occurring significantly more than positive words ($M = 3.76$, $SD = 2.07$; $t(150) = 15.7$, *adjusted-p* < 0.001, 95% CI [4.13, 5.32], Cohen's $d_z = 1.28$), and neutral words ($M = .32$, $SD = 1.44$; $t(150) = 33.1$, *adjusted-p* < 0.001, 95% CI [7.68, 8.66], Cohen's $d_z = 2.70$). Participants also generated significantly more positive than neutral words, $t(150) = 21.6$, *adjusted-p* < 0.001, 95% CI [3.13, 3.76], Cohen's $d_z = 1.76$.

Relations Between Emotion Fluency and Verbal Fluency

Consistent with hypotheses, emotion fluency was positively associated with both easy verbal fluency (**Fig. 2**), $r(149) = 0.54$, *adjusted-p* < 0.001, 95% CI [.42, .65], and difficult verbal fluency, $r(149) = 0.30$, *adjusted-p* < 0.001, 95% CI [.15, .44]. Positive emotion fluency correlated positively with easy verbal fluency, $r(149) = 0.33$, *adjusted-p* < 0.001, 95% CI [.18, .47], but not difficult verbal fluency, $r(149) = 0.15$, *adjusted-p* = 0.07, 95% CI [-.01, .30]. Negative emotion fluency correlated positively with both easy verbal fluency, $r(149) = 0.39$, *adjusted-p* < 0.001, 95% CI [.24, .52], and difficult verbal fluency, $r(149) = 0.24$, *adjusted-p* = 0.003, 95% CI [.08, .39]. Contrary to hypotheses, all kinds of emotion fluency had a stronger positive relationship to easy verbal fluency than difficult verbal fluency, Steiger test $zs > 1.99$, $adjusted\text{-}ps < 0.05$.

Relations Between Emotion Fluency, Self-Reported Emotion Functioning, and Task-Based Emotion Regulation

We did not find support for the hypothesized relationship between emotion fluency and emotion functioning. Emotion fluency was not related to any self-reported or task-based measures of emotion functioning, $adjusted\text{-}ps > .05$. Negative fluency bias also did not relate to any measures of emotion functioning, $adjusted\text{-}ps > 0.05$. Negative fluency bias was positively related to emotional awareness before adjustment to reduce the false discovery rate, $r(76) = 0.24$, $p = 0.03$, but did not survive correction for multiple comparisons. At the request of reviewers, we conducted non-preregistered exploratory analyses testing whether emotion fluency and negative fluency bias correlated with two measures of task-based emotion regulation (i.e., mean affect levels and regulatory success). These also returned null results (see **Supplemental Materials**).

Exploratory Analyses: Controlling for Verbal Fluency

We conducted non-preregistered exploratory analyses examining whether emotion fluency and negative fluency bias relate to emotion functioning measures when controlling for verbal fluency. So that easy verbal fluency could be included as a covariate, correlations were converted to linear regression models. When controlling for verbal fluency, emotion fluency and negative fluency bias did not relate to any measures of emotion functioning after adjustment to reduce the false discovery rate ($adjusted\text{-}ps > 0.05$). As in the primary analyses, negative fluency bias was positively related to emotional awareness scores ($\beta = 0.24$, $p = 0.03$), but the relationship did not survive adjustment. Verbal fluency was not associated with any emotion functioning measures ($ps > 0.26$).

Discussion

The current preregistered study asked whether the ability to rapidly generate emotion words—emotion fluency—relates to verbal fluency and emotion functioning. We also asked whether the tendency to produce negative emotion words—negative fluency bias—relates to emotion functioning. As hypothesized, we found that emotion fluency was positively associated with verbal fluency. However, contrary to our hypotheses, neither emotion fluency nor negative fluency bias correlated with either self-reported emotion functioning or task-based measures of emotion regulation ability. Together, these results show that emotion fluency as measured here reflects cognitive abilities important to other kinds of verbal fluency but is not a direct measure of emotion functioning or well-being.

The current study replicates previous research that emotion fluency positively relates to verbal fluency (Abeare et al., 2017; Camodeca et al., 2021), providing additional evidence that emotion fluency may be a test of cognitive ability and executive functioning similar to other kinds of verbal fluency. We extend this prior research by demonstrating that emotion fluency, as well as positive and negative emotion fluency, have stronger positive relationships to an easier measure of verbal fluency (i.e., “P” words produced) than a more difficult measure (i.e., “J” words produced). The stronger association with easy verbal fluency may suggest that these two tasks are of similar difficulty. However, an important distinction between the emotion fluency and verbal fluency tasks is that emotion fluency tests a person’s ability to bring to mind words from a category, while the “P” and “J” tests their ability to bring to mind words that start with a certain letter. Previous work has shown that the two kinds of verbal fluency, category and letter, may draw upon some overlapping and some distinct cognitive abilities (Henry et al., 2004), and studies of emotion fluency have demonstrated that emotion fluency positively correlates with measures of both category and letter verbal fluency (Abeare et al., 2017; Camodeca et al., 2021).

We observed that participants produced the most negative emotion words, followed by positive, and then neutral emotion words in this task. Participants also tended to produce more negative emotion words than words of other valences, regardless of the number of emotion words they produced ($M_{negative\ fluency\ bias} = .67$). The proportion of negative emotion words found in this study is comparable to the overall proportion of negative emotion words in the English language (Averill, 1975; Jackson et al., 2021). We also note that participants completed the emotion fluency task after the emotion regulation task. Because the emotion regulation task only contained negative images, it likely induced negative mood and primed negative emotion concepts (Challis & Krane, 1988; Forgas, 1995; Tambini et al., 2017). Although the current study cannot assess negative fluency bias nor its associations with emotion functioning in the absence of priming effects, previous studies that use free listing to elicit emotion words without a negative mood induction find similar results: Participants produce more negative emotion words than positive and neutral emotion words (Schrauf & Sanchez, 2004; Zammuner, 2010). Greater facility generating negative than positive emotion words may reflect the notion that negative emotion words motivate emotion regulation by signaling that action is needed to change how one feels (Barrett et al., 2001; Liu et al., 2020).

Contrary to hypotheses, emotion fluency and negative fluency bias had null relations with emotion functioning. Previous work yielded mixed results regarding the association between emotion fluency and psychopathology, with one study identifying a positive association and the other finding a null relation (Abeare et al., 2017; Camodeca et al., 2021). The current study thus adds additional evidence that emotion fluency is not related to these outcome measures. We also advance understanding of emotion fluency by demonstrating that both emotion fluency and negative fluency bias have null relations with emotion functioning measures beyond psychopathology, such as alexithymia and task-based measures of cognitive reappraisal abilities. Motivated by research demonstrating that language is important for emotion functioning (Barrett, 2017; Barrett et al., 2007; Lindquist, Satpute, et al., 2015; Nook et al., 2015; Satpute et al., 2016; Torre & Lieberman, 2018), we sought to test the notion that *one way* in which language could relate to emotion functioning is for the rapid generation of emotion words to facilitate rapid application of differentiated emotion concepts to construct and regulate one's emotions. As such, one interpretation of the null relations is that emotion fluency is not a foundational emotional ability that fosters other helpful skills like emotion regulation. If so, individual differences in emotion functioning are not related to how quickly one can generate emotion words. However, other possible explanations of this relation exist, prompting further investigation.

One potential explanation of the null relations is that fluency for emotion words may be important *only* when assessed when labeling and regulating emotions aroused by personally meaningful events in one's daily life. It is possible that the current study's emotion fluency task is too decontextualized to tap into the processes used when labeling the emotions immediately provoked with an affective experience. The key may be that a list of relevant emotion words must be generated *within the context* of one's emotional experience. Indeed, theoretical approaches to emotion differentiation and emotion regulation stress the importance of flexible adaptation to a person's context for their emotional well-being (Aldao, 2013; Barrett, 2006, 2017; Kashdan et al., 2015). Some measures of emotion functioning require participants to consider the context of an emotional experience when producing emotion words, such as when the LEAS asks participants to describe how they would feel in each emotional scenario (Lane et al., 1990), and some emotion differentiation measures ask participants to describe their emotional experiences and code these open-ended descriptions for affective states (Ottenstein & Lischetzke, 2020; Williams & Uliaszek, 2022). These approaches not only assess emotion word production, but specifically how these emotion words are used to make sense of emotional experiences in context. By contrast, the current study's emotion fluency task asked participants to produce emotion words in the absence of the context provided by actual affective experience. As such, the process(es) used to freely list emotion words may not align with the process(es) that occurs when a person attempts to identify or regulate their emotions *in vivo*. Asking participants to produce emotion words that are relevant for their current experience may evidence stronger associations to emotion functioning (e.g., Li et al., 2020; Ottenstein & Lischetzke, 2020; Williams & Uliaszek, 2022). Alternatively, instructing participants to produce more specific emotion words may also align the task more closely with the underlying emotional process(es) we aim to capture. For example, the task could ask participants to produce positive emotion words and negative emotion words in separate questions. Such an approach may also provide insight into the prior literature showing that negative emotion differentiation is more consistently related to well-being than positive emotion differentiation (Erbas et al., 2014; Seah et al., 2022).

Another potential explanation is that fluency generating emotion words is not the same process as rapidly applying emotion concepts to parse one's emotions. A person's conceptual structure contains information beyond emotion words, such as how closely concepts are related or how they are differentiated from other concepts. This conceptual structure for emotions may indeed be relevant for emotion functioning but still operate separately from the ability to rapidly produce emotion words (Barrett, 2004; Barrett et al., 2001; Nook, 2021; Nook et al., 2021; Starr et al., 2017, 2020). As such, merely counting the number of emotion words and proportion of negative emotion words may be weak measures to draw from the emotion fluency task. Indeed, category verbal fluency is theorized to represent aspects of a person's conceptual structure (Goñi et al., 2011; Kenett et al., 2013). For example, if "dog" and "cat" are semantically related in a person's conceptual structure, they will likely emerge close to each other in a task such as this. As such, more granular analyses of the emotion words, such as the order of the words or clustering of emotion concepts (e.g., through network analysis) may reveal more information about how a person conceptualizes emotions (Gruenewald & Lockhead, 1980; Li et al., 2021; Toivonen et al., 2012; Troyer et al., 1997; Wartmann et al., 2015). These conceptual measures may demonstrate stronger relations with emotion functioning, such as one's tendency to differentiate emotion concepts. Although one of our reasons for expecting emotion fluency to relate to emotion functioning is that it might facilitate emotion differentiation, we did not directly assess that relation, which future work could test. Further, the specific words produced may provide insight into a person's emotional well-being (e.g., producing emotion words related to psychopathology, such as "depressed", "worthless", or "hopeless"). Unfortunately, the way data were recorded for this study (i.e., number of positive, negative, and neutral words produced) does not allow for such analyses. Future research pursuing these questions could yield additional insight into emotion representation using this task.

Additional open questions about emotion fluency should be addressed by future research. It is unknown how the time constraint traditionally imposed in verbal fluency tasks impacts both scores on the emotion fluency task and its overall construct validity. The 60s time constraint may have diminished participants' performance or inhibited deep semantic processing of the emotion words (Maule & Edland, 1997; Winkielman et al., 2018). A systematic manipulation of the task duration (e.g., 1 minute vs. 5 minutes, as has been called for in verbal fluency tasks; Michalko et al., 2022) could clarify how time pressure impacts performance and how well scores track other variables of interest. That said, we would conceptualize allowing participants to fully list all known emotion words without a time limit as a separate construct (potentially “emotion vocabulary”; see L. Beck et al., 2011). Additionally, this study examined the relationship between emotion fluency and explicit emotion regulation (i.e., intentionally attempting to change one’s emotions using reappraisal or acceptance; Braunstein et al., 2017). However, emotion fluency may be a relevant skill for implicit emotion regulation (i.e., changing one’s emotions without conscious desire and/or without exerting effortful control; see work on affect labeling Torre & Lieberman, 2018). The work on affect labeling suggests that spontaneously bringing emotion words to mind may reduce negative affect. Relatedly, prominent theories of emotion call into question the distinction between emotion generation and emotion regulation (Gross & Barrett, 2011). Future research should investigate whether the ability to rapidly generate emotion words is related to implicit emotion regulation.

Future research should also address a few key limitations. First, research should rule out possible carryover effects in the current design. Specifically, the emotion regulation task could have induced a negative mood, and the questionnaires completed prior to the emotion fluency task could have influenced results. We did not use a task to wash-out these possible persisting emotional influences on emotion word generation, although we do find similar average emotion word counts compared to those previously reported (Abeare et al., 2017; Camodeca et al., 2021). Second, future research should use standardized norms to code the valence of the emotion words. In this study, the emotion words were coded using colloquial norms as determined by the authors, but more formal and open source coding dictionaries would improve reproducibility of this task. Third, because our pre-registered data analysis plan used correlations to test the associations between emotion fluency and emotion functioning, we cannot be certain of causal relations. Future work could experimentally manipulate variables. For example, researchers could manipulate mental health status by testing emotion fluency before and after psychotherapy.

Constraints on Generality

The findings of the current study may not generalize to all populations due to limitations of the sample. The participants were predominantly young adults who identify as female. Although the recruited sample is racially diverse, we did not collect information about their socioeconomic status, so it is unknown whether the sample includes people from a diverse range of socioeconomic statuses. Further, the community sample may not have a wide variability of outcomes on emotion functioning measures (e.g., depression symptoms). Future studies should seek to expand these findings to a broader range of ages, socioeconomic statuses, and gender identities, as well as to a clinical sample with greater variability in emotion functioning.

To conclude, our study replicated previous research that emotion fluency positively relates to verbal fluency and extended this prior work by demonstrating that emotion fluency had null relations with emotion functioning. These results suggest that the ability to rapidly bring to mind emotion words may draw upon similar cognitive processes to verbal fluency rather than emotion functioning. Nonetheless, we continue to believe that the free listing of emotion words will be a useful tool to aid with new discoveries about emotions. Pursuing novel analyses of the emotion words produced or using more naturalistic task designs in which participants must rapidly generate emotion words in response to actual affective experiences may uncover new methods for capturing a participant’s emotion fluency when it matters most.

TABLES

Table 1. Descriptive statistics for the variables within each study.

	Study 1 N = 80			Study 2 N = 71		
	Mean	SD	N	Mean	SD	N
Emotion fluency	12.1	3.3	80	13.1	3.0	71
Negative fluency bias	0.6	0.2	80	0.7	0.1	71
Easy verbal fluency	15.3	4.1	80	16.5	3.6	71
Difficult verbal fluency	10.0	3.6	80	10.9	3.2	71
Emotional awareness	29.5	3.7	78			
Difficulty identifying feelings	11.0	3.8	80	10.8	4.2	71
Difficulty describing feelings	12.7	4.5	80	12.5	4.5	71
Depression symptoms	8.9	5.5	80	7.1	5.8	71
Naming interference				0.3	0.4	60
Naming reaction time	4.0	1.0	40	3.4	0.5	60

FIGURES

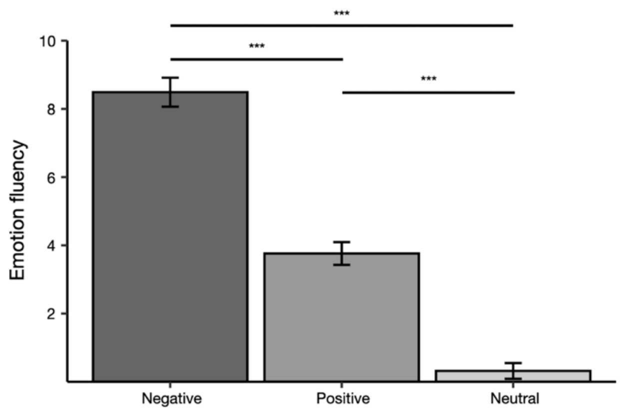

Figure 1. Emotion fluency by valence. Bars illustrate the mean number of emotion words produced, split by valence. Negative emotion words were generated more often than positive emotion words, which were generated more often than neutral words. Error bars represent 95% confidence intervals adjusted for within-subject comparisons (Morey, 2008). ***$p < 0.001$.

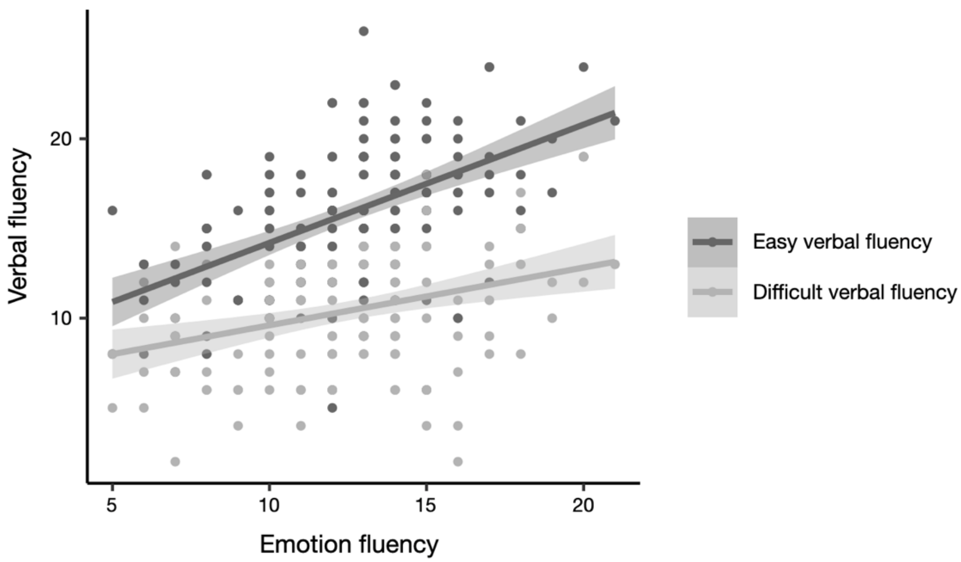

Figure 2. Associations between emotion fluency (i.e., how many emotion words participants could generate in 60s) and phonemic verbal fluency measures (i.e., how many words they could generate in 60s that started with "p" [easy verbal fluency] and "j" [difficult verbal fluency]). Shaded regions represent 95% confidence intervals.

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Supplemental Materials

For

Fluency generating emotion words correlates with verbal measures but not emotion regulation, alexithymia, or depressive symptoms

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Table of Contents

I. Analyses to Clarify Study Differences

In the primary analyses, we treated the two samples from Study 1 and Study 2 as one group. However, there were differences in the study procedures across the two studies. For example, in Study 1 some participants "looked" at the negative images, while others "named" the primary emotion they felt in response to the image. This naming may have provided the opportunity for a subset of participants to practice generating emotion words, which could influence the results of the emotion fluency task. Because of these subtle yet potentially important differences, we conducted analyses to ensure that the two studies could be treated as one sample.

Conditions of the Cognitive Emotion Regulation Task

The condition of the cognitive emotion regulation task (i.e., *Look, Name, Regulate, Name/Regulate*) was manipulated between-subjects in Study 1. This means that some participants passively viewed the image, some named their primary emotion, some regulated their emotional response, and some named their primary emotion then regulated their emotional response. These conditions may have provided different levels of practice generating emotion words and may have unequal cognitive efforts (e.g., regulating emotions may take more cognitive effort than looking at the images; Ortner et al., 2016; Sheppes & Meiran, 2008). As such, we sought to ensure that the between-subjects condition did not impact performance on the emotion fluency task. Using a one-way ANOVA, we found no differences in emotion fluency between the conditions, $F(3, 76) = 0.82$, $p = .49$. Similarly, we found no differences in negative fluency bias between the conditions, $F(3, 76) = 0.83$, $p = .48$. The null results suggest that the study conditions did not significantly impact performance on the emotion fluency task.

Additionally, emotion regulation strategy (i.e., Reappraise $N = 38$, Accept $N = 33$) was manipulated between-subjects in Study 2. These strategies may introduce unequal cognitive effort. Previous work indicates that reappraisal depletes more cognitive resources than acceptance (Keng et al., 2013). We sought to determine whether the emotion regulation strategy that participants used in the emotion regulation task impacted their performance on the emotion fluency task. Using an independent samples t-test, we found no differences in emotion fluency between regulation strategies in Study 2, $t(69) = 1.08$, $p = .28$. Similarly, we found no differences in negative fluency bias by strategy, $t(69) = .08$, $p = .93$. This indicates that even though reappraisal and acceptance may introduce unequal cognitive effort, this does not affect performance on the emotion fluency task.

Demographics and Questionnaires

To ensure the participants of the two samples did not systematically differ, we tested whether there were significant differences in the demographic composition and questionnaire scores between the samples. Overall, we did not find evidence for systematic differences between the two samples (*ps* > .05), suggesting that we can treat them as one group. See **Supplemental Tables 1**, **2**, and **3** for the results of all tests of these variables. BDI scores were significantly different before correction for multiple comparisons ($t(149) = 1.98$, $p < .05$), but this difference did not survive adjustment (*adjusted-p* > .05). The different versions of the BDI administered in the two studies may explain this potential difference, and we conducted analyses to ensure that the different BDI versions did not impact the primary results.

II. Self-Report Questionnaires

Levels of Emotional Awareness Scale (LEAS). The LEAS (Lane et al., 1990) is a measure of emotional awareness (i.e., how complexly people identify their own and others' emotions). Participants completed the LEAS Form A by writing responses to the questions "How would you feel?" and "How would the other person feel?" in response to 10 different vignettes (e.g., "Your boss tells you that your work has been unacceptable and needs to be improved"). Following standardized procedures, responses were scored based on complexity, with higher scores indicative of higher emotional awareness. For example, participants score one point for providing a physiological cue (e.g., "I'd feel tired"), and four points for providing two emotion words demonstrating greater emotion differentiation than either word alone (e.g., "I'd feel rejected and guilty"). We used the "total" scores for analyses. The LEAS was only collected in Study 1 and demonstrated adequate internal consistency (Cronbach's $\alpha = 0.66$).

Toronto Alexithymia Scale (TAS). The TAS (Bagby et al., 1994) is a measure of alexithymia (i.e., difficulty identifying and describing one's emotions). Participants respond to 20 items on five-point Likert scales (1 = *Disagree strongly*, 5 = *Agree strongly*). The TAS yields three subscales: Difficulty Identifying Feelings (DIF), Difficulty Describing Feelings (DDF), and Externally-Oriented Thinking (EOT). The version administered here was modified so that questions including specific emotion names (e.g., sad, angry) were removed. Participants completed 5 items from each of the DIF and DDF subscales (total 10 items). These items' scores were summed for the DIF and DDF subscale scores. The DIF and DDF subscales showed strong internal consistency in the current study (Cronbach's $\alpha = 0.77$ and 0.8, respectively).

Beck Depression Inventory (BDI). The BDI (Beck et al., 1961, 1996) is a measure of depression symptoms. Scores are calculated by summing the severity of each symptom reported on four-point Likert scales, with higher scores indicative of more severe depression symptoms. The two studies administered different versions of the BDI. Study 1 administered the BDI-II (Beck et al., 1996), while Study 2 administered the BDI-I (Beck et al., 1961). Furthermore, the versions used in both studies were modified to exclude the questions about sadness, hopelessness, libido, and suicidal ideation to avoid priming participants with specific emotion names. To account for these differences, we included study as a covariate for analyses including the BDI. The versions used in each study demonstrated robust internal consistency (Cronbach's $\alpha = 0.79$ and 0.85 for Study 1 and Study 2 respectively). See the next section (III. Beck Depression Inventory (BDI) Versions) for analyses demonstrating that the BDI version did not influence results.

III. Beck Depression Inventory (BDI) Versions.

The two studies administered different versions of the BDI. Study 1 administered the Beck Depression Inventory-II (BDI-II; Beck et al., 1996), while Study 2 administered the Beck Depression Inventory-I (BDI-I; Beck et al., 1961). Practically, this means that the version used in Study 1 included questions about agitation, worthlessness, concentration difficulty, and loss of energy, while Study 2 did not. The version used in Study 2 included questions about weight loss, weight gain, body image change, somatic preoccupation, and work difficulty, while Study 1 did not. The version used in Study 1 collapsed two questions about sleep pattern change from the version used in Study 2 into one question. Furthermore, the versions used in both studies were modified to exclude the questions about sadness, hopelessness, and suicidal ideation to avoid priming participants with specific emotion names. The version used in Study 1 also excluded the question about libido. Thus, the BDI-II used in Study 1 included 17 questions, while the BDI-I collected in Study 2 included 20 questions.

To further probe the differences in BDI administration across the two studies, we compared each BDI version's correlations with the two alexithymia subscale scores using the Fisher r-to-z method (Cohen et al., 2003). The positive relationship between depression symptoms and alexithymia is well-characterized (Hendryx et al., 1991; Honkalampi et al., 2000). As such, if the correlations between alexithymia scores and the BDI scores were similar across the two studies, this would provide supporting evidence that the BDI versions are measuring the same construct in the two studies. We also rescored the questionnaires to only include the 10 questions shared across both versions and re-ran the linear regression models with these scores.

The positive correlations between depression symptoms and alexithymia did not differ across the two studies (*ps* > .05). This may provide supporting evidence that the versions measured the same construct. Re-scoring to only include the 10 shared questions yielded similar results to the primary analyses, such that emotion fluency and negative fluency bias were not related to depression symptoms. However, study was no longer a significant predictor (*ps* > .05). These results may indicate that the differences in BDI scores across the studies were primarily due to question differences rather than sample differences.

IV. Comparisons of the Counts and Proportions of Emotion Fluency by Valence

To address the concern that negative fluency bias (i.e., the proportion of negative words each participant produced) might conflate the number of items generated with the valence of those items, we conducted additional analyses. First, we found that the patterns for the count and proportion of emotion words by valence are very similar, which can be seen in **Supplemental Figure 1**. Second, given the very low number of neutral words produced, the proportion of positive and negative words are essentially perfectly correlated (r = -.95, p < .001). This means that negative fluency bias captures individual differences in a participants' overall use of valenced words. Third, we conducted analyses examining the relationships between the emotion functioning measures reported in the main text and (i) the number of negative emotion words, (ii) the number of positive emotion words, and (iii) the number of neutral words. We found the same pattern of results for all dependent variables (i.e., null relations between the numbers of positive/neutral/negative emotion words and emotion functioning). Consequently, these results indicate that analyzing the proportion of negative valence words, rather than both the proportion and count, is sufficient.

V. Relations Between Emotion Fluency and Affect Levels, Regulatory Success

The emotion regulation task provided two additional indices of emotion functioning: mean affect levels and regulatory success. Psychological well-being is associated with both mean affect levels (i.e., the overall endorsement of negative emotion; Dejonckheere et al., 2019; Watson et al., 1988) and regulatory success (i.e., how strongly one can reduce negative emotions while regulating; Balzarotti et al., 2016; Gross & Muñoz, 1995; Hu et al., 2014). Given the body of work suggesting that language is critical for emotion functioning reviewed in the main text, we hypothesized that fluency for emotion words would relate to these indices and conducted non-preregistered exploratory analyses to test these hypotheses. We calculated mean affect levels separately for positive affect and negative affect across all trials in the emotion regulation task. Regulatory success was operationalized as the difference between unpleasant affect levels in the *Regulate* and the *Look* conditions [Regulatory Success = *Regulate* Mean Unpleasant Affect – *Look* Mean Unpleasant Affect]. Next, we correlated emotion fluency and negative fluency bias separately with each measure (i.e., mean positive affect, mean negative affect, and regulatory success). We found null results for all correlations ($ps > .05$). Because these tests were not preregistered and had null relations, we cautiously interpret the findings as additional support to the conclusion of the preregistered primary analyses, that emotion fluency is not related to emotion functioning in a community sample.

TABLES

Supplemental Table 1. T-test results for comparing variable means in Study 1 and Study 2.

Variable	$M_{Study\ 1}$	$M_{Study\ 2}$	**DF**	***t***	***adjusted- p***
Age	20.91	20.96	148	-0.08	.94
Easy verbal fluency	15.34	16.52	149	-1.88	.18
Difficult verbal fluency	10.03	10.89	149	-1.54	.25
Difficulty identifying feelings	10.98	10.85	149	0.20	.94
Difficulty describing feelings	12.65	12.46	149	0.25	.94
Depression symptoms	8.89	7.06	149	1.98	.18

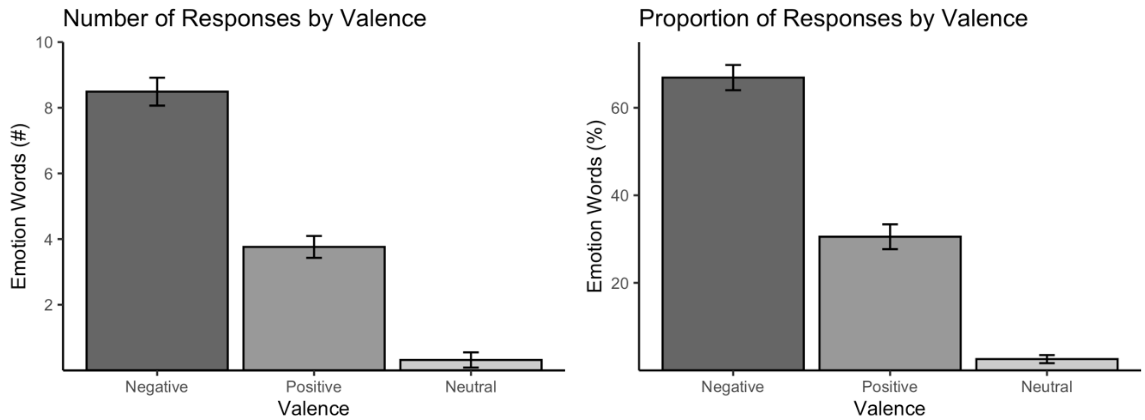
Supplemental Table 2. Pearson's chi-squared test with Yates' continuity correction for comparing the distribution of gender in Study 1 and Study 2 samples.

	Male	**Female**	**DF**	X^2	***p***
Study 1	24 (30.4%)	55 (69.6%)			
Study 2	22 (31.4%)	48 (68.6%)	1	< .001	1

Supplemental Table 3. Fisher's exact test for comparing the distribution of race in Study 1 and Study 2 samples.

	Hispanic	**African American**	**Asian**	**Caucasian**	**Middle Eastern**	**Native American**	**Other**	***p***
Study 1	8 (10.1%)	8 (10.1%)	25 (31.6%)	28 (35.4%)	0 (0%)	3 (3.8%)	7 (8.9%)	
Study 2	8 (11.4%)	11 (15.7%)	17 (24.3%)	27 (38.6%)	3 (4.3%)	0 (0%)	4 (5.7%)	.33

FIGURES



Supplemental Figure 1. The patterns of number and proportion of emotion words by valence. Bars illustrate the mean number or proportion of emotion words produced, split by valence. Error bars represent 95% confidence intervals adjusted for within-subject comparisons (Morey, 2008).

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