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Fluency Generating Emotion Words Correlates With Verbal Measures But Not Emotion Regulation, Alexithymia, or Depressive Symptoms

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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 60 s. 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 60 s), a cognitive reappraisal emotion regulation task, and emotion functioning questionnaires. In preregistered 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

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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., 60 s) 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 & Crawford, 2004; Henry et al., 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 could generate in 60 s. 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

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We included the data and analysis code in the repository https://osf.io/mr3uj/

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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 & Barrett, 2008; Lindquist et al., 2006; Lindquist, MacCormack, et al., 2015; 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 & Coifman, 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.

At the theoretical level, however, 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 60 s is positively correlated with the number of animal words and words that begin with "F," "A," and "S" they produced in 60 s; 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 60 s; Camodeca et al., 2021). However, emotion fluency was not significantly correlated with psychopathology (i.e., DASS-21 scores; Henry & Crawford, 2005) in this study.

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; Hegefeld et al., 2022). We hypothesized that (a) emotion fluency would positively correlate with verbal fluency, (b) 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 (c) 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.

Method

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 before 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, two 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, two 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 online 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 a list of samples 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 online 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 = .66– .85).

Table 1
Descriptive Statistics for the Variables Within Each Study

Variable	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	.6	.2	80	.7	.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

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 the administration of the emotion regulation paradigm across the two studies, but in both studies participants (a) viewed negative images drawn from the International Affective Picture Set (IAPS; Lang et al., 2008), (b) engaged with each image according to instructions (e.g., passively view or actively reinterpret the meaning of the image), and (c) 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 7-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 12 s, 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 6 s-windows. In the first 6 s-window, participants were instructed to *Look* or to *Name*. In the second 6 s-window, participants were instructed to *Look* or to *Regulate*. This resulted in four conditions, 20 trials each, where across the two 6 s-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 online 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 60 s for a cue. The first cue was emotion words (i.e., "Please write down as many emotion words as you can think of in 60 s"), 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 60 s. 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 at https://osf.io/2bvk7. All study materials and data can be accessed at https://osf.io/mr3uj/ (Hegefeld et al., 2022).

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 online 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 (a) there are more negative than positive emotion words in the English language (Averill, 1975; Jackson et al., 2021), and (b) 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

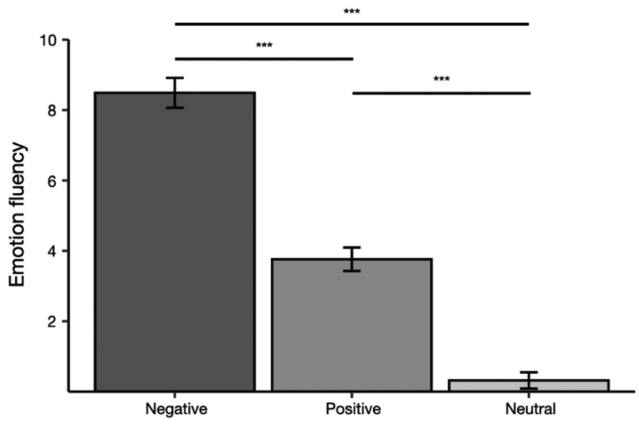
emotion functioning measures (i.e., emotional awareness, alexithymia, and depression symptoms) using Pearson's correlations. We used linear regressions when investigating associations with depression symptoms to include the study as a covariate in all depression analyses. For emotion fluency, we hypothesized 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, $p < .001$, $\eta_G^2 = .73$ (Figure 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* < .001, 95% CI [4.13, 5.32], Cohen's $d_z = 1.28$), and neutral words ($M = 0.32$, $SD = 1.44$; $t(150]) = 33.1$, *adjusted-p* < .001, [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* < .001, [3.13, 3.76], Cohen's $d_z = 1.76$.

Figure 1
Emotion Fluency by Valence



Note. 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).
***$p < .001$.

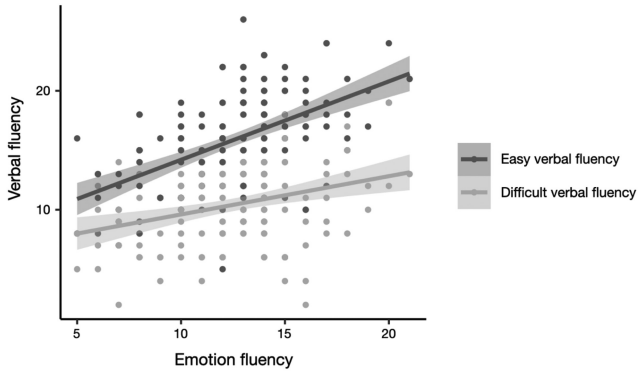
Relations Between Emotion Fluency and Verbal Fluency

Consistent with hypotheses, emotion fluency was positively associated with both easy verbal fluency (Figure 2), $r(149) = .54$, *adjusted-p* < .001, 95% CI [.42, .65], and difficult verbal fluency, $r(149) = .30$, *adjusted-p* < .001, [.15, .44]. Positive emotion fluency correlated positively with easy verbal fluency, $r(149) = .33$, *adjusted-p* < .001, [.18, .47], but not difficult verbal fluency, $r(149) = .15$, *adjusted-p* = .07, [−.01, .30]. Negative emotion fluency correlated positively with both easy verbal fluency, $r(149) = .39$, *adjusted-p* < .001, [.24, .52], and difficult verbal fluency, $r(149) = .24$, *adjusted-p* = .003, [.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-p*s < .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-p*s > .05. Negative fluency bias also did not relate to any measures of emotion functioning, *adjusted-p*s > .05. Negative fluency bias was positively related to emotional awareness before adjustment to reduce the false discovery rate, $r(76) = .24$, $p = .03$, 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 online supplemental materials).

Figure 2
Associations Between Emotion Fluency and Verbal Fluency



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

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-p*s $> .05$). As in the primary analyses, negative fluency bias was positively related to emotional awareness scores ($\beta = 0.24$, $p = .03$), but the relationship did not survive adjustment. Verbal fluency was not associated with any emotion functioning measures ($ps > .26$).

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 ($M_{\text{negative fluency bias}} = .67$). 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). 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 the 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 & Coifman, 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 60 s 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 min vs. 5 min, 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., 2012). 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 before 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 the reproducibility of this task. Third, because our preregistered 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 the 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.

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