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EVALUATION OF INDONESIAN VERSION OF THE EMOTION WORD FLUENCY TEST

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Abstract

A cognitive assessment is not complete without an inspection of a client's emotional status. The Emotion Word Fluency Test (EWFT) is a newly developed instrument for Indonesia. It provides similar assessment to other semantic word fluency tasks, linguistic and memory skills, and also a client's current emotional standing and previously experienced emotions. Our study aims to present the newly-developed EWFT and its scoring system, and the psychometric properties of the test including its test-retest reliability and construct validity, as well as the reliability of the scoring system. Healthy participants with no history of brain-related diseases (n = 98), varying in age and education, were recruited; an additional group (n = 30) was included in the test-retest reliability study. The construct validity was evaluated with a phonemic verbal fluency test (pVFT). The EWFT was correlated (.51-.56) with the pVFT, and the three subscales of the pVFT correlated highly (.75-.80), indicating that the EWFT and pVFT share a common construct, but are also different. The scoring system showed excellent reliability (.86 for the number of correct generated words), and the test-retest reliability for the number of correct words was moderate (.54). Participants produced more negative than positive emotion words, $t(29) = 6.33$, $p < .05$. The correlation between the number of positive and negative emotion words was zero. Age affected the performance in both EWFT, $F(3, 80) = 3.10$, $p < .05$; and pVFT $F(3, 80) = 2.47$, $p < .05$; as was internationally reported. The EWFT scoring system is concluded reliable and the test has moderate reliability.

Keywords: emotion; word fluency test; neuropsychology; interaction emotion-cognition; validity

INTRODUCTION

Emotions are multifaceted complex responses, regarding how they are expressed, elicited, and modulated. Nowadays, the function of emotions in neuropsychological assessments is getting some attention, while previously the emphasis was laid on cognitive functions, perhaps because they are better conceptualized, measurable, and often related to neuroanatomically identifiable systems (McDonald, 2017; Zald & Anderotti, 2010; Borod & Madigan, 2000). However, a complete neuropsychological assessment requires not only descriptive information about a client's cognitive status but also regarding his emotional standing (Lezak et al., 2012).

In case how emotions are evaluated, a series of scales are available, including and especially the tests that have been adapted to Bahasa Indonesia, such as the Four Dimensions Mood Scale (FDMS) – 55 (Adinugroho, 2018), or scales specifically aiming at anxiety like DASS (Depression Anxiety Stress Scales (Hakim & Aristawati, 2023) or the Emotional Recall Task (Masitah, 2018). All these scales are self-reports and depend on the client's ability to evaluate by introspecting his emotional status and it is no surprise that there have been quite some discussions regarding the reliability of the measurement of emotions based on self-reports (Harmon-Jones et al., 2016). Other emotion scales mainly measure traits, while neuropsychological assessment is aimed at revealing basic processes behind a client's current cognitive and affective functioning (state). Therefore, self-report measures of emotions are not sufficient for an objective

assessment of neuroaffective functioning and more objective measurements, e.g., on how emotion-laden words are cognitively processed might be a putative way to assess neuroaffective functioning (Abeare et al., 2017), similar to how other aspects of cognitive functioning are assessed.

Abeare et al. (2017) and Camodeca et al. (2021) proposed a newly developed neuroaffective function test, analogous to existing word fluency tests, which measures the type and number of generated emotion words, the Emotion Word Fluency Task (EWFT). In EWFT, respondents are asked to name as many words related to emotions as possible in one minute and to avoid repetitions and incorrect responses. The EWFT is a new variant of the widely used word fluency tests, measuring verbal ability including lexical knowledge and lexical retrieval ability, as well as aspects of executive functions such as initiation, shifting, and cognitive flexibility, self-monitoring, inhibition of non-categorical words, and working memory (Ghanavati et al., 2019; Shao et al., 2014). The emotion words that are generated are dependent on the same linguistic and recall skills but are also dependent on current and previous experienced emotions (Chainay, et al., 2023).

Another often-used verbal fluency test is the phonemic Verbal Fluency Test (pVFT). Recently, Pesau and van Luijtelaar (2021) adapted this test for Indonesia and preliminary normative scores for the Javanese population were recently published (Wahyuningrum et al., 2022). The pVFT is significantly correlated with activation in the left inferior frontal gyrus, i.e., Broca's area, left medial frontal gyrus, insula, anterior cingulate cortex, and parts of the parietal cortex (Cipolotti et al., 2021; Ghanavati et al., 2019; Baciu et al., 2016). Clinically, this test is used to examine phonological processes in speech production (Biesbroek et al., 2021). Functional impairments of phonemic verbal fluency were found in patients with brain tumors (Zienius et al., 2022), in stroke patients with left frontal lesions (Schmidt et al., 2019), and in people with schizophrenia (Quan et al., 2015). Considering that the EWFT is a word fluency task it can be assumed that some regions, e.g., Broca's area, involved in the production of words, are shared with the pVFT. We will use the latter test to tap the construct validity of the EWFT.

In contrast to pVFT, fMRI studies during the EWFT have not been done, but there is however evidence that processing emotion-laden words involves different brain regions compared to neutral words (Šimić et al., 2021; Nakamura et al., 2020; Rolls, 2019). Emotional words activate the left frontal pole and temporal cortex connected with the limbic system including the amygdala, cingulate gyrus, and hippocampus next to the common activation of brain regions involved in the production of neutral words. Therefore, differences between the PVFT and EWFT can be readily anticipated.

The processing of emotions can be explained by several theories, among others by the circumplex model of affect, which posits that emotions can be plotted along two main axes: valence and arousal. The arousal dimension relates to the intensity of emotion, high or low, the valence dimension regards the ordering of the emotions according to whether and how much they produce positive and negative emotions (Imbir et al., 2022; Russel, 2003). This study focuses on the valence of the words produced by participants and in particular on the difference between positive and negative words. Previous imaging studies have shown differences between positive and negative emotion words, such as an Event Related Potentials (ERP) study showing in a word fluency task that the generation of positive words elicited greater activation in the frontal regions and the cingulate cortex, while negative words activated the parietal and temporal areas (Gawda et al., 2017). Neuroimaging studies also contributed to differential brain activation of positive and negative emotions. They have shown that the activity in the amygdala, an important area of emotion processing associated with negative affect, is positively correlated with depressive symptoms. A similar relation holds for the

anterior region of the right hemisphere. The left prefrontal cortex (PFC), bilateral orbiofrontal cortex (OFC) dorsal medial, PFC-amygdala connectivity via subgenual anterior cingulate cortex (ACC) is associated with positive affect (Alexander et al., 2021; Scharnowski et al., 2020). A final difference between positive and negative emotions is that the left hemisphere is more dominant in processing positive emotions such as joy and happiness, while the right hemisphere is more activated in negative emotions such as anger, fear, sadness, and disgust (Mouri et al., 2023). In all, there are theoretical reasons and results of imaging studies to make a difference between positive and negative emotion words.

This analysis of the validity of the EWFT as an instrument for exploring the interaction between cognition, language, and emotion (Wauters & Marquardt, 2018) is done here by a correlation analysis between the EWFT and pVFT and by an analysis and comparison of the two tests regarding the role of the demographic factors age and education. It is commonly noticed that the pVFT scores are sensitive for education (Ilkmen & Büyükişcan, 2022; Baufeldt, 2020; Hazin et al., 2016; Nogueira et al., 2016), to a lesser extent for age effects (Esteves et al., 2015; Cavaco et al., 2013; Steiner et al., 2008), and, mostly, without significant effects for sex (Ilkmen & Büyükişcan, 2022; Kavé & Knafo-Noam, 2015). The age effect manifests itself through a general increase in pVFT performance throughout childhood and adolescence, accompanied by a decline in late adulthood (Cavaco et al., 2013), the education effect through better performance in participants with a longer formal education (Baufeldt, 2020; Cavaco et al., 2013). Here it will be further scrutinized whether the adapted pVFT and the newly introduced EWFT show the same sensitivities for the demographic factors as were reported in the international literature for the pVFT. If there is an agreement between the role of the demographic factors on how they influence the scores of the two tests, then this will contribute to the validity of the tests. Reliability testing is also needed to show whether the Indonesian version of the EWFT is sufficiently reliable to be used as an emotion-cognition measurement tool.

METHOD

Participants

Participants in this study met the criteria that they have not experienced any neurological or psychiatric disorders (such as traumatic brain injury, cerebrovascular disease, epilepsy, Parkinson's, depression, anxiety, schizophrenia, etc.) based on a medical history questionnaire, not having a record of being an alcoholic and (illegal) drug user, nor having abnormal hearing and vision. The assessment was done in Bahasa Indonesia and all participants reported conversational fluency in Bahasa Indonesia. An overview of the included participants in the $n = 98$ sample is given in Table 1.

Table 1.
Demographics of the Participants

	M (*SD*)	Range	%
Age	41.20 (15.5)	16 – 30	30.6%
		31 – 40	17.3%
		41 – 50	20.3%
		51 – 60+	31.6%
Edu (years)	12.47 (2.5)	0 – 6	3.1%
		7 – 12	73.5%
		13 – 20	23.5%

Note. $n = 98$.

In order to establish the test-retest reliability of the EWFT, 30 additional participants were included (12 men and 18 women) in the age range of 16 - 60 years old ($M = 36.4$, $SD = 15.3$) with education ranging from 9 - 18 years ($M = 14.0$, $SD = 2.3$).

Measurement

All participants consented for their data to be used for research purposes. After giving the informed consent, the participants completed first the pVFT and next the EWFT. For the test-retest reliability study of the EWFT, we

used a two-week interval for a second EWFT session.

The phonemic Verbal Fluency Test (pVFT)

Participants were asked to mention as many words as possible within one minute that started with the letter F, A, and S (Lorentzen et al., 2021; Yi et al., 2020). The letters S, K and T were chosen as Hendrawan and Hatta (2010) found that these letters are in the top five rankings based on the frequency of words starting with these letters in Indonesian dictionaries. This finding was also supported by Pesau and van Luijtelaar (2021). The test was administered in Bahasa Indonesia, the country's official language used in media, education, and in business.

The Emotion Word Fluency Test (EWFT)

All spoken words from the participants were meticulously recorded. The metrics employed in both tests encompassed the number of correct spoken words, the number of incorrect words, and instances of word repetition, with duplicates being counted only once. Responses in both tests were deemed correct if the spoken word matched an entry in the Indonesian dictionary; if regional or dialectal words were used, their meanings were verified through inquiries. This verification process took place after the completion of the tests, with recourse to local language experts in cases of uncertainty. Regarding the EWFT, judgments were rendered on whether a word denoted an emotional or subjective state or expressed a feeling. Words such as verbs, adjectives, or nouns that clearly conveyed or were associated with emotion—such as 'to smile', 'smiling', 'a smile', 'happy', or 'happiness'—were considered correct. However, if these words were used together, they were counted as a single instance. Emotion words were categorized into positive or negative emotions through inter-rater assessments. Table 2 provides an overview of the emotion words approved by the panel, distinguishing between positive and negative emotions.

Data analyses

Several analyses were carried out to answer the research objectives. First, the construct validity of EWFT as a verbal fluency test was measured by conducting a bivariate correlation Pearson product moment test between EWFT (the number of correct words, the number of negative and positive emotion words, and the number of error words) and the scores of the pVFT; that is the scores of the three subscales and the total number of correct and error words.

The purpose of the second and third analysis was to examine the inter-rater and test-retest reliability of the newly developed scoring system of the EWFT. Five raters, students and graduates of psychology faculty fluently in Bahasa Indonesia and with an interest in emotion research, trained in cognitive assessment, and the first author scored the EWFT independently to assess the inter-rater reliability and the intra-class correlation coefficient (ICC) (Koo & Li, 2015). Pearson product-moment correlations were calculated between the obtained EWFT scores at the initial test session and those obtained two weeks later.

Paired samples *t*-tests were conducted to test the difference between the number of negative and positive emotion words for both the $n = 98$ and $n = 30$ studies. This is regarded as an analysis for the fourth purpose of our study. This fourth analysis used Pearson's correlations (*r*) and shared variances (*r2*) to explore the effects of demographic characteristics (i.e., sex, age, and education) on the test performances. Multiple stepwise regression with the demographic factors as predictors for the test scores and a MANOVA with the demographic variables as factors were conducted to establish whether the tests, as most cognitive tests, were sensitive to age and level of formal education. This was done for the number of correct words, the number of repetitions, and errors of the pVFT and EWFT, and the number of positive and negative emotion words of the EWFT.

RESULT AND DISCUSSION

The study used several analyses for the Indonesian adapted version of the EWFT. The test is new and was not previously used in Indonesia. Before analyzing the test's validity and reliability, the words generated by the participants were scored as correct, false, or as a repetition. For the pVFT, the word is scored as correct if the word has a correct initial letter (S, K, and T), and EWFT is scored correct if the word represents an emotional state or feeling or a verb or adjective that clearly describes an emotion, as is internationally done (Abeare et al., 2017).

Analysis 1: The Validity of Emotion Word Fluency

The scoring of the words is then followed by the first analysis that was carried out to rigorously test the validity of the EWFT as a reliable tool for measuring emotion-cognition by testing its correlation with another widely-used verbal fluency test, that is the pVFT. Pearson's correlations were computed between the numbers of correct words of the EWFT and the three subscales of the pVFT (S, K, T), and its total score (pVFT Total), that is the sum of the three subscales (pVFTOT). The outcomes are presented in Table 2.

Table 2.
Product-Moment Correlation between pVFT and EWFT

Variable	*M* (*SD*)	pVFT (S)	pVFT (K)	pVFT (T)	pVFT Total	EWFT	PEW	NEW
pVFT (S)	10.9 (4.8)		.75**	.76**	.91**	.52**	.27**	.45**
pVFT (K)	11.8 (4.7)			.80**	.92**	.52**	.18	.51**
pVFT (T)	10.4 (5.2)				.93**	.51**	.19	.48**
pVFT Total	33.1 (13.5)					.56**	.23*	.52**
EWFT	6.9 (3.2)						.58**	.81**
PEW	2.4 (1.9)							-.02
NEW	4.5 (2.6)							

Note. n = 98. PEW = Positive Emotion Words, NEW = Negative Emotion Words.
**p < .05. **p < .01*

The number of words produced on the three subscales of the pVFT were highly correlated with each other (between .75 and .80, all highly significant). These correlation coefficients were higher than the correlation between the EWFT and the three pVFT subscale scores and pVFT total score, here the coefficients ranged from .51 - .56, much lower but still significant. Interestingly, the correlation between the number of negative emotion words and the number of correct words of the three pVFT subscales was between .45 and .52 (all significant). In contrast, the number of positive emotion words correlated much lower with the scores of the pVFT subscales (between .18 and .27 and were not or barely significant). The results showed a high intercorrelation between the pVFT subscales, where the EWFT also showed a significant correlation with the pVFT, but the correlation coefficients were lower, and this was due to the positive emotion words. The total number of repetition errors made in the two fluency tests was significantly correlated at .23, also suggesting that the same mistakes made in the two-word fluency tests, repetition errors, are only to a limited extent correlated.

The significant correlation between the two fluency tests can be explained by the fact that they share the word production aspect of the fluency tasks, most likely involving Broca's area and other regions in word production, such as parts of the brain that regulate language functions, retrieval, and working memory. A recent study indeed showed that the emotional and non-emotional word

fluency tests were similar in activation of the bilateral frontopolar, dorsolateral, and ventrolateral prefrontal cortex, and there was no significant difference in frontal cortical activation between the two test versions of verbal fluency (Yeung, 2022). On the other hand, the correlation was only about .50, suggesting that there are also differences between the two fluency tasks. Affective fluency involves not only the prefrontal cortex, but also cooperates with the hippocampus formation, thalamic nuclei, and especially the amygdala in activating memory traces (Palomero-Gallagher & Amunts, 2021; Zhang et al., 2019). The limbic cortical regions interconnected with the limbic system at large might have become uniquely activated for the generation and production of as many as possible emotion words (Palomero-Gallagher & Amunts, 2021; Zhang et al., 2019;), also involves prefrontal cortex, especially the left limbic prefrontal cortex, medial prefrontal cortex (MPFC), and anterior cingulate cortex or ACC (Dixon et al., 2017; Herbert et al., 2011).

Besides that, a previous study (Wauters & Marquardt, 2018) showed a weak correlation between EWFT and pVFT, showing that the performance of EWFT was influenced by other than language abilities, namely the retrieval of emotion words and the processing of (experienced) emotions, while phonemic verbal fluency was significantly correlated with differences in language proficiency ratings. In addition, the correlation of the number of errors with the number of words generated was moderate and significant for the pVFT, and negative and non-significant for the EWFT, indicating that the EWFT measures a different aspect of word fluency from the pVFT.

The emotional response generated in this case in the form of a verbal response (words) can be associated with daily experiences or events previously related to these emotions (Chainay, et al., 2023). To retrieve both positive and negative emotional events, participants used autographic memory which involved self-reflection, emotion, episodic memory, visual imagery, executive functions, and semantic processes (Razumnikova & Khoroshaviseva, 2020). Thus, other parts of the brain are also involved in autobiographical activation as used in the EWFT, including hippocampal-cortical networks in the lateral and anterior temporal cortex, lateral orbitofrontal and anterior prefrontal cortex, and hippocampus (Sheldon et al., 2019; Mizuno-Matsumoto et al., 2013).

The correlation between the number of positive and negative emotion words was close to zero, already suggesting that the number of negative words represents something different than the number of positive emotion words. Finally, a significant high positive correlation (.467) was found between the pVFT's total score and the number of pVFT errors, in contrast, only low negative non-significant correlations were found between the number of correct positive and negative EWFT and the number of EWFT errors. The correlation analyses showed a rather different pattern of correlations for the number of positive and negative emotion words. First, the number of positive emotion words was not correlated at all with the number of negative emotion words. Second, the number of negative words correlated much higher with the number of words in the pVFT than the number of positive emotion words. Third, the correlation of the number of errors with the number of words generated was moderate and significant for the pVFT, and negative and non-significant for the EWFT.

Analysis 2: The adaptation of the scoring in Bahasa Indonesia of the EWFT and the reliability of the scoring

Table A1 (at the Appendix) gives an overview of the approved words generated by 128 subjects (*n = 98* and *n = 30)* in Bahasa Indonesia when asked to generate words reflecting an emotional or subjective state or representing a feeling, either a verb, adjective or noun that describes or relates either a positive or negative emotion. The emotional words produced by the respondents and mentioned in Table A1 are based on the

predetermined scoring provisions. After all the resulting emotional words were recorded, each research assistant and researcher determined whether the words were correct, not correct, or were a repetition. The correct word response was then identified as a positive or negative emotion word. The results show that negative emotion words (e.g., sad, hate, down, hopeless, etc.) are produced more frequently than positive emotion words (e.g., happy, smile, flattered, etc.).

The words were scored individually by each of the raters whether it was an emotion word and whether it had a positive or negative valence and then the results of the scoring were compared and discussed together to select reasons in cases that some words were ambiguous regarding whether they could be scored as correct or not. An example is "silence and shouting", the word was scored as an error because it could not be associated with the expression of certain emotions, and because there might be other reasons why people keep silent followed by shouting. Some words also were scored correctly if the word is used to express the emotion that is being felt based on the subject's local culture or place of life, taking into account the respondent's background, such as the words *"Setan"* (devil); "*Tolol*" (foolish, dumb); "*Kurang ajar"* (insolent); *"Awas ko"* (To threaten, or to feel threatened); *"Gila"* (crazy, insane); *"Sinting"* (wacky, screwy). These are some examples of harsh words where Rachmat (2017) found that the pronunciation of harsh words was used to express angry feelings, particularly in Makassar (Sulawesi) where the current study was conducted.

After that, the research assistants and researchers conducted a comprehensive rating to measure the reliability of the scoring system, which was carried out through inter-rater reliability. The inter-rater reliability of the EWFT, reflecting the variation between two or more raters who scored the same subjects independently, is expressed by the ICC. The results averaged for the five raters are presented in Table 3.

Table 3.
Inter-rater Reliability Expressed by ICC Values

	Total words	Incorrect	Repetition	Correct words	Positive emotion words	Negative emotion words
First Assessment	.999	.896	.874	.864	.866	.863
Second Assessment	1.0	.965	.875	.818	.953	.804

The scoring system, newly developed for Bahasa Indonesia, was evaluated based on data from 128 subjects, helping us accurately classify each generated word as a correct positive, correct negative, non-emotion word (error), or a repetition error. The ICC for each dependent variable in both data collections (test-retest) showed coefficients between .8 and .9, indicating good reliability, and greater than .9 (Koo & Li, 2015) indicating excellent reliability (for the scoring of the words generated by the subjects). It showed good internal consistency between the panel and the principal investigator.

Analysis 3: Test-Retest Reliability of the EWFT and the Effect of Practice

This procedure yielded the test-retest reliability for the EWFT and showed a significant positive correlation of the total number of words (.41, $p < .05$); the number of incorrect words (.76, $p < .01$); the number of repetitions (.47, $p < .01$); the number of correct words (.54, $p < .01$); the number of negative emotion words (.51, $p < .01$); and was not significant for the number of positive emotion words (.32, $p > .05$). A significant practice effect was noted for the two times that

the EWFT was assessed, as revealed by the total number of words, $t(29) = 3.05$, $p < 0.1$) and the number of incorrect words, $t(29) = 3.22$, $p < .01$). It was indeed obvious that at the second time more words were generated, although the number of errors also increased significantly. Other variables, such as the number of correct, positive, and negative emotion words, as well as the number of repetitions, did not show any practice effects; the results are clearly depicted in Figure 1 and in Table 4.

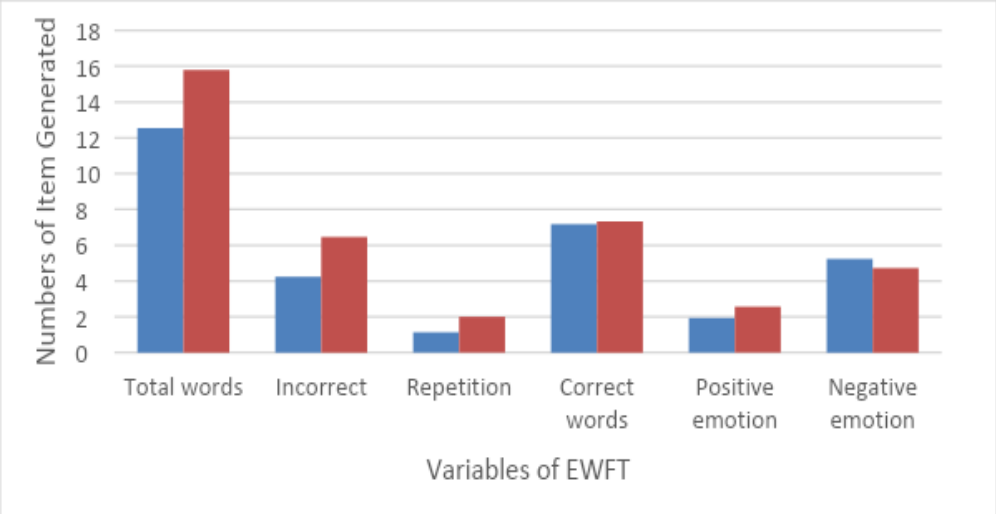

Figure 1. Mean Numbers of Items Generated in the Test (blue)-Retest (red) of EWFT

Table 4.
Descriptive and Inferential Test Results of Difference between First and Second EWFT Assessment

Variables	*M*(*SD*)	95% CI of Difference		*t*(29)	*p*	*r*	*p*
		Lower	Upper				
Total Words	-3.27(5.86)	-5.46	-1.08	-3.05	.005	.41*	.024
Incorrect	-2.23(3.80)	-3.65	-.81	-3.22	.003	.76**	.000
Repetition	-.87(2.43)	-1.78	.04	-1.95	.061	.47**	.008
Correct Words	-.17(3.82)	-1.60	1.26	-.24	.813	.54**	.002
Positive emotion words	-.63(2.34)	-1.51	.24	-1.48	.149	.32	.081
Negative emotion words	.50(2.68)	-.50	1.50	1.02	.317	.51**	.004

Note. Significances are two-tailed.
*$p < .05$. **$p < .01$.

The test-retest reliability with an interval of 2 weeks, as based on an $n = 30$ sample, was not extremely high, while a repetition effect for the number of correct, positive and negative words was not present. These results are more or less the same as Abeare' s (2017) who first developed EWFT, in that there were no practice effects for a one-week interval. It can be concluded that the EWFT in this study is moderately reliable, and the developed scoring system has good to excellent reliability.

Analysis 4: Positive and Negative Emotion Words

This study also found more negative than positive emotion words and this effect was

obtained in both samples and in the n = 30 sample two times. Paired samples *t*-tests were conducted to examine the difference between the number of negative and positive emotion words for both the *n* = 98 and *n* = 30 participants. The results of the first study (*n = 98)* showed that subjects mentioned more negative than positive emotion words, *M* = 2.1, *SD* = 3.3, *t*(29) = 6.33, *p* < .05). A similar effect of the two times administration of the test-retest in the *n* = 30 study (the results are presented in Table 5) again, revealed evidence that the subjects generated more negative than positive emotion words.

Table 5.
Descriptive and Inferential Statistics of The Difference Between The First and Second Assessment of The EWFT Regarding the Difference Between the Number of Positive and Negative Emotion Words

Test-Retest	*M*(*SD*)	95% CI of Difference		*t*(29)	*p*	*r*	*p*
		Lower	Upper				
Positive - Negative emotion words part 1 (test)	-3.3(2.6)	-4.27	-2.33	-6.95	.000	.47**	.009
Positive - Negative emotion words part 2 (retest)	-2.2(2.5)	-3.09	-1.24	-4.79	.000	.42*	.020

Note. *n* = 30. Significances are two-tailed.
*p < .05. **p < .01.

The difference is rather large, two to threefold. One of the simple reasons might be that Bahasa Indonesia has more negative than positive emotion words (Shaver et al., 2002). Another putative non-excluding explanation might be that negatively-valence emotions are more important than positive-valence emotions: known is, that negative emotional stimuli provoke a stronger behavioral response than positive stimuli, even when arousal (i.e., intensity or degree of activation of each system) is held constant (Fehring et al., 2019). The prevalence of negative emotions might witness a larger survival value for negative emotional stimuli and emotions and this effect is known in the literature as the negativity bias and has been explained in evolutionary terms (Cacioppo et al., 1999). Besides that, the participants generated more negative emotion words than positive words, it was noticed that the number of positive and negative emotion words were not correlated (*r* = -.02, see Table 2), suggesting that they represent different and unrelated underlying constructs. At firsthand, this result seems somehow surprising considering that the scores for the number of positive and negative emotion words were generated in a single word fluency task. On the other hand, the search in the lexicon for negative and positive emotion words requires admission to and retrieval from distinct brain regions. It is also that the right hemisphere is more dominant in processing negative emotions (Hartikainen, 2021), while the left hemisphere is associated with positive emotions (Wyczesany et al., 2018). Moreover, parametric mapping of the negative valenced stimuli showed activity in brain areas such as the dorsolateral prefrontal cortex, anterior midcingulate cortex, frontal pole, and inferior parietal cortex; whereas positive valenced stimuli involve the substantia nigra, ventral striatum (or nucleus accumbens), and right caudate nucleus (Colibazzi et al., 2010). In addition, processing positive stimuli such as the word happy is associated with increased brain dopamine levels whereas negative stimuli are associated with an increase in serotonin levels (Kuchinke & Lux, 2012; Mueller & Kuchinke, 2016). On the other hand, the absolute number of positive emotion words

generated by the subjects is rather low and this may hamper its interpretation. The correlation between EWFT and pVFT, and in particular the number of negative emotion words was moderate, and this validates the EWFT as a word fluency task, but with some unique properties.

Analysis 5: Demographic Factors

The last analysis was conducted to test whether demographic factors age, sex, and formal years of education affected test results. The ANOVAs were employed to explore whether the two fluency tests are sensitive to the same or to different demographic factors. The three-way ANOVA for age, levels of education, and sex as "between-subjects factors" showed only a significant age effect, $F(3, 80) = 3.10$, $p < .05$; $eta^2 = .10$, for the number of negative words in the EWFT and a significant age effect for the total number correct words of the pVFT, $F(3, 80) = 2.47$, $p < .05$; $eta^2 = .09$. *Post-hoc tests* showed that the oldest group (in fact the two oldest groups in case of the EWFT) scored less words on the EWFT and the pVFT compared to the two youngest groups. There was no main effect of sex on any of the variables of both tests. However, there were significant education x sex, $F(1, 80) = 6.62$, $p < .05$; e$ta^2 = .08$, and age x sex an interaction effect, $F(1, 80) = 5.46$, $p < .01$; $eta^2 = .17$, for the number of positive words only, none of the other variables showed significant or interaction effects. Post-hoc tests following the education x sex effect showed that only the highest educated woman produced more positive words than the equally educated man ($p < .05$). The post-hoc tests for the age x sex interaction showed that only women > 40 years produced more positive emotion words than men of the same age ($p < .05$). Finally, a main effect of education was found for the number or errors in the EWFT, $F(2, 80) = 3.15$, $p < .05$; $eta^2 = .07$) with more errors being made in the 13-20 versus the 7-12 year educated groups.

The stepwise multiple regression analyses confirmed the role of the demographics factor of age as was obtained with the three-way ANOVA since only significant regression models could be obtained for age as a predictor for two variables: the total number of negative words of the EWFT and the total number of correct words of the pVFT. For both variables, only age predicted the scores significantly, $F(1, 96) = 18.07$, $p < .001$, and $F(1, 96) = 18.28$, $p < .001$, respectively. The least-square prediction equations are: Predicted number of negative words = 7.23 + (-.067 x age) and Predicted number of correct words = 47.46 + (-.348 x age). The negative coefficients in the regression's formula indicate that the higher the age of the subject, the lower the test score for each of these variables, as can be seen in Figure 2.

An effect of age was not found in the number of positive emotion words. The regression analyses also confirmed the lack of effect of sex on all and education on six of the seven variables, the seventh one, the number of errors in the EWFT showed a small effect size in the ANOVA. It might be that an ANOVA is more sensitive in explaining variance than a regression analysis.

We found that age predicted significant performance measures of the EWFT. Also, others noticed that the ability to produce emotion is related to the brain aging process where research showed that increased age was significantly associated with reduced accuracy and increased latency, in processing emotions of anger, disgust, fear, sadness, and surprise (Gray et al., 2024). Interestingly, the age-dependent effect was shared between the pVFT and the number of negative emotion words of the EWFT, not for the number of positive emotion words, once more demonstrating that the number of positive and negative emotion words are differently sensitive for the aging process. and represent a different aspect of the cognitive-emotion interaction. Once more, it can be safely assumed that different brain regions are involved in the retrieval and production of positive and negative emotion words. We found that education affected only the number

of errors of EWFT, then sex did not affect the test result. The results obtained have similarities with previous studies where sex does not show an effect, while the age factor does not show an effect different from our result. A previous study showed a significant education effect (Demenescu et al., 2014); differences in sample characteristics or composition might contribute to the differences.

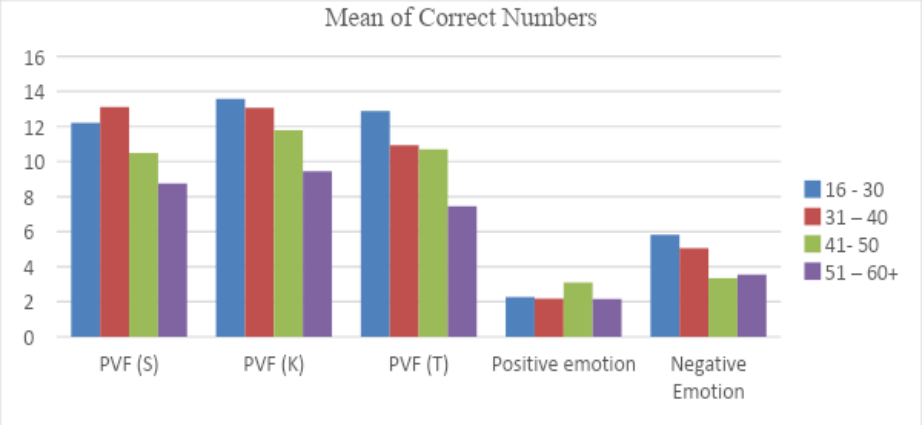

Figure 2. Mean Scores of The Three Subscales of The pVFT and The Two Subscales Of The EVFT for Four Age Groups

Table 6.
Descriptive Results of EWFT and pVFT Based on Sex, Age, and Education Groups

Demographic Aspects	*n*	%	Total Correct of pVFT (S, K, T)		Correct of EWFT	
			Mean	*SD*	*Mean*	*SD*
Sex						
Male	30	30.6	32.97	15.40	6.37	3.35
Female	68	69.4	33.18	12.70	7.07	3.13
Age						
16 – 30	30	30.6	38.63	13.23	8.10	3.64
31 – 40	17	17.3	37.12	13.28	7.24	2.46
41- 50	20	20.4	33.00	12.11	6.45	3.58
51– 60+	31	31.6	25.65	11.67	5.71	2.40
Length of Education						
0 – 6	3	3.1	8.33	6.51	5.33	3.79
7 – 12	72	73.5	2.14	13.35	6.92	3.11
13 – 20	23	23.5	6.78	14.30	6.87	3.48

Other factors that may affect the results with regards to interindividual performance differences in verbal fluency are the participants lexicon and good lexical access, as well as the ability to store and update relevant information in working memory (Shao et al., 2014). Individual differences in emotional processing and memory strategies contribute also to the effects of emotion word retrieval (Mueller & Kuchinka, 2016), as well as the ability to self-reflect on previous emotional experiences.

CONCLUSIONS

The EWFT has good validity as a word fluency test, measuring a different aspect of word fluency than the pVFT. The scoring system of the EWFT is very reliable, the test-retest reliability is moderate, and this deserves

attention. Similar to other fluency tests, the EWFT is sensitive to formal years of education effect. Age-related effects were found only for the number of negative emotion words. Interestingly, there are clear differences between what is measured by the number of positive and negative emotion words, and this also warrants further research. Considering that not all Indonesian people speak Bahasa Indonesia daily at home or in public and that Indonesian culture shows a large diversity (Ananta et al., 2015), the effects of spoken language(s) and ethnic groups need to be explored in the future for Indonesia new test. Next, the sample size is not very large, and a replication study might be imperative.

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APPENDIX

Table A1.

Correct Scored Words of the Emotion Word Fluency Test (EWFT) Generated as Judged Correct by Our Panel

Emotion word in Bahasa Indonesia (English Translation)					
Bahasa Indonesia	English	*Bahasa Indonesia*	English	*Bahasa Indonesia*	English
Senang	Happy	*Sukaria*	Delight	*Histeris*	Feeling hysterically upset
Kasih	Love, be attached	*Hati*	Heart	*Dongkol*	Resentment, acrimony; feeling irked, vexed
Bahagia	Happy, blissful	*Perasaan*	Feeling	*Manyun*	Expression of disappointed
Cinta	Love	*Jatuh cinta*	Fall in love: being in love	*Dengki*	Envy, spite
Suka	Like	*Riang, ceria*	Cheerful	*Jengkel*	Vexation, annoyance, irritation
Sayang	Love, affection	*Nyaman*	Comfortable	*Dendam*	Vengeance, bearing a grudge, animosity, rancor
Iba	Compassionate	*Damai*	Peaceful	*Kalut*	Confusion, disturbance, inner chaos
Gembira, bergembira	Happy, glad	*Sebal*	Resentment, vexation	Benci	Hatred, extreme dislike, animosity
Senyum, tersenyum	Smile	*Tersanjung*	Flattered	*Menyesal*	Feel sorry for
Kasihan	Pity, compassionate	*Sumringah*	Ecstatic, elated	*Terpuruk*	Devastated
Ketawa, tertawa	Laugh	*Sedih*	Sadness, distress, sorrow, misery	*Kacau*	Distracted, screwed up
Lucu	Funny	*Sakit hati*	Pain, hurt, displeasure, bitterness	*Bimbang*	Worry, hesitation, vacillation, indecision

Table A1. (continued)

Terharu, haru	Touched	*Marah*	Wrath, anger, ire, fury	*Gelisah*	Nervousness, restlessness, uneasiness, worry, concern
Semangat, bersemangat	Enthusiasm, excited	*Frustrasi*	Fblocked, frustration	*Tersinggung*	Feeling offended, bitter
Harapan, berharap	Hope	*Cemas*	Worry; feeling disturbed, anxious	*Kehilangan*	Feeling lost
Simpati	Sympathy	*Takut*	Fear, apprehension, dread	*Terkejut*	Startled, surprised
Empati	Empathy	*Galau*	Confusion, upset	*Deg-degan*	Nervous, jumpy
lapang dada	Relieved	*Emosi*	Negative emotion, feeling seized by emotion	*Merajuk*	Be sulky
Sukacita, sukaria	Joy, delight	*Iri hati, iri*	Envious resentment	*Putus asa*	Hopelessness, being dispirited, disconsolation
Kasmaran	In love	*Cemburu*	Jealousy, envy, dissatisfaction	*Rindu*	Yearning, homesickness
tenang, ketenangan	Calm	*Pedih*	Mortification, grief, pain (literally: stinging, smarting heart)	*Muak*	Loathing, revulsion, repugnance
Bangga	Feeling rightfully, proud of	*Susah*	Troubled, doleful	*Termehek-mehek*	Sob, sniffle
Bergelora	Impassioned	*Pilu*	Sadness, heartache, compassion	*Tersedu-sedu*	Sob, sniffle
Girang	Delighted	*Menangis, nangis*	Cry, weep, same as above.	*Bosan*	Boredom; feeling tired of, sick of
Tulus	Honesty, openness, sincerity	*Kesal*	Feeling peeved, fed up, piqued, cross	*Gila*	Crazy, insane, mad
Berbunga-bunga	Blossomed	*Kecewa*	Disappointed,	*Sinting*	Wacky, screwy

Table A1. (continued)

Malu	Shame, disgrace, mortification	*Menjijikkan, jijik*	Disgust, Abhorrent,	*Sepi, kesepian*	Lonely
Gundah	Anxiety, restlessness	*Murka*	Anger, fury, feeling incensed	*Terpukul*	Devastated
Kaget	Surprised, frightened	Sengsara	Deprived, be miserable	*Bodoh*	Foolish, stupid, dumb
Setan	Satan, devil, demon	*Ngeri*	Terrible, fearful	*Terkhianati*	Betrayed
Tolol	Foolish, stupid, dumb	*Merinding*	Goose-flesh	*Tersakiti*	Hurt
Patah hati	Feeling discouraged, heartbroken	*Malu-malu*	Red-faced, shy	*Curiga*	Suspicion, distrust
Kurang ajar	Insolent, impertinent, brash	*Geram*	Being infuriated, enraged (growling)	*Cemberut*	Grim, sullen
Awas'ko'	To threaten, or to feel threatened	*duka*	Grief, sorrow, misery	*Gemas*	Annoyance, irritation