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A case for emojis, more or less: An analysis of word and emoji expressivity in text messaging for high and low alexithymia levels

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ABSTRACT

The impact of alexithymia on verbal and non-verbal expressivity was investigated in one of the most prevalent mediums for present-day human interacting, smartphone text messaging. The variety of words and emojis used to express negative, neutral and positive feelings was compared between people with higher and lower levels of alexithymia measured by the Perth Alexithymia Questionnaire, controlling for covariates anxiety and depression. Verbal expressivity was not impacted by higher levels of alexithymia, for total scores nor by subscale. Non-verbal expressivity for high-level alexithymia showed differences in variety of emoji on two subscales: compared to low-level alexithymia, higher scores on difficulty describing negative feelings used greater variety of emojis when describing negative feelings, while higher scores on externally oriented thinking used less variety of emojis when describing positive feelings. This may be related to greater and lesser interoceptive ability. Further research is warranted. Findings support facet-level over total scores analyses in informing more nuanced understandings of the impacts of alexithymia in interpersonal communication. They suggest that text messaging may attenuate the impacts of the verbal deficits associated with higher-level alexithymia and that emoji use may be more sensitive to specific alexithymic difficulties in particular valence contexts.

1. Introduction

People's ability to express emotions to convey how they are feeling is embedded within verbal and non-verbal communication. This emotional expression comes easier to some than to others (Hoemann et al., 2022) and is important for human wellbeing (Berry & Pennebaker, 1993), with finer-grained emotional expression linked to better emotion regulation and social and emotional functioning (Barrett, 2017; Barrett et al., 2001; Kalokerinos et al., 2019). With the ubiquity of computer-mediated communication, digital equivalents of verbal and non-verbal aspects of emotion expression in face-to-face interactions have evolved. In smartphone text messaging - which is an increasingly prevalent form of interpersonal communication in work and social interactions across all aspects of daily life (Silver et al., 2019; Statista, 2022; Strugar, 2022) - typed words provide an explicit verbal means of emotional expression, while emojis provide the non-verbal cues that influence understanding of emotions in face-to-face interactions (Burgoon et al., 2016; Danesi, 2017; W. Li et al., 2018; Riordan & Trichtinger, 2017) and are functionally similar to face-to-face non-verbal expressions (Erle et al., 2022; Li & Yang, 2018). Emojis are digital graphic icons representing faces, objects, symbols and actions and are commonly used to convey sentiment (Ai et al., 2017; Miller et al., 2017) that can augment the meaning, interpretation, affect and connectiveness of text messages (Hu et al., 2017; Rodrigues et al., 2017; Tantawi & Rosson, 2019; Völkel et al., 2019). However, for some people, recognising and expressing their emotions can be difficult, whether face-to-face or online, and this can have detrimental effects on their wellbeing (Gvirts & Dery, 2021; Vanheule et al., 2011). How these difficulties – which are characteristic of alexithymia – impact emotional expressivity via one of today's most predominant modes of interpersonal communication is therefore a salient topic for research. The present study explored whether people scoring high on alexithymia (HA) found it easier to express how they felt using words or emojis in smartphone messages (hereon, "text messages") compared to low alexithymia scorers (LA).

The authors are aware of no other studies to date examining how verbal expressivity in text messages differs for varying levels of alexithymia, and only one (Wei, 2021) that investigates emojis as a measure of non-verbal expressivity in HA. There are also surprisingly few quantitative emoji studies, and those use experimenter-generated stimuli - whether text messages or emoji sets (e.g. Jaeger et al., 2019; Phan et al.,

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2019; Wei, 2021) - which may limit the dynamic and expressive nature of this ubiquitous form of non-verbal digital communication.

1.1. *Alexithymia – the construct*

Alexithymia is a multidimensional construct defined by 3 facets - difficulty identifying feelings (DIF), difficulty describing feelings (DDF) and externally oriented thinking (EOT; Sifneos, 1994; Taylor et al., 1997, 2016; Taylor & Bagby, 2004) - and affects both verbal and non-verbal communication in face-to-face and digital contexts (Lane et al., 1996; Trevisan et al., 2016; Wei, 2021). Existing on a continuum in 10–19% of the general population (Lyvers et al., 2020; Mason et al., 2005), the condition is considered both a stable personality trait and state (de Haan et al., 2014; Nicolò et al., 2011) most helpfully understood as a psychological disposition of thought, feeling and processing (da Silva et al., 2017). The difficulties experienced in alexithymia have implications for interpersonal misunderstandings and self-expression and can have deleterious impacts on wellbeing and social connectedness (Gvirts & Dery, 2021; Izard et al., 2011; Vaiouli & Panayiotou, 2021; Vanheule et al., 2011). While alexithymia is recognised as a risk factor for a range of diagnoses including anxiety and depression (Fietz et al., 2018; Honkalampi et al., 2018; Sagar et al., 2021), this is likely related to the behaviours associated with alexithymia rather than the condition itself (Lumley, 2004) and it is generally regarded as a comorbid condition rather than a feature of anxiety or depression (Taylor, 2000). In the present research, measures of depression and anxiety were included as covariates to control for effects of these frequent comorbidities.

1.2. *Reduced verbal and non-verbal expressivity in alexithymia*

Problems verbalising emotions is central to the concept of alexithymia, and studies examining its relationship with language confirm a pattern of deficits in frequency, variety, complexity and self-reference of emotion vocabulary and expression for HA compared to LA (Jelinek et al., 2010; Lamberty & Holt, 1995; Lee et al., 2022; Luminet et al., 2004, 2021; Meganck et al., 2009; Roedema & Simons, 1999; Wotschack & Klann-Delius, 2013). Non-verbal expression has also been shown to be diminished in alexithymia in both face-to-face and digital contexts. HA show reduced facial expressivity of emotions (Keating & Cook, 2020; Trevisan et al., 2016; Wagner & Lee, 2008) and are less likely than LA to add non-verbal cues such as emoji (Wei, 2021), which are shown to enhance interpersonal understanding in digital communication.

The deficits, verbal and non-verbal, might be understood more accurately not as lack but difference. Verbal deficits may be related to language use in emotional contexts rather than lack of language itself (Luminet et al., 2004). Similarly, the absence of facial emotion expression in HA may support the possibility that reduced interoceptive ability plays a role in the observed behaviours rather than indicating lack of bodily responses to emotion (Trevisan et al., 2016). Differences in interoception – the perception and recognition of internal bodily sensations – have been associated with alexithymia (Brewer et al., 2016; Jakobson & Rigby, 2021; Murphy et al., 2017, 2018; Pearson & Jakobson, 2018; Shah et al., 2016), which is popularly theorised as a three-dimensional construct measured in terms of objectively tested interoceptive accuracy (e.g. comparing estimated to scientifically measured internal bodily sensations such as heartbeats), subjective self-reports of interoceptive sensibility (e.g. using questionnaires to measure self-perceived tendencies to focus on inner bodily signals), and the correspondence between the two as a metacognitive measure of interoceptive awareness (Gaggero et al., 2021). While a recent meta-analysis (Trevisan et al., 2019) suggests the strength of the association between interoception and alexithymia depends on the methods (objective or self-report) and measure (accuracy or sensibility) of interoception, both increased and reduced interoceptive abilities have been found to predict alexithymia in different clinical and non-clinical populations (Aaron et al., 2020; Scarpazza et al., 2022). It may be that such processes make distinct contributions or may interact with verbal processes in alexithymia, and these may influence the non-verbal responses. Alternatively, the contact hypothesis proposes negative facial expressions are suppressed in HA as a defence against conflict and negative affect in interpersonal interactions (Taylor et al., 1991).

Overall, the evidence of reduced verbal and non-verbal expressivity for HA would predict reduced variety of both words and emojis in text messaging (see Hypothesis 1 (H_1) below). However, there may be more complexity involved related to the different facets of alexithymia and whether the emotional content of the message is positive or negative in valence.

1.3. *Relevance of valence*

Valence is an important factor in assessing emotional constructs (Becerra et al., 2019; van der Velde et al., 2013) and HA is associated with negative bias in experiencing emotions (Barchetta et al., 2021; Edwards et al., 2020; Taylor & Bagby, 2013) and reduced valence appraisals, especially in negative contexts (Bayot et al., 2014; Larwood et al., 2021). The literature on verbal and non-verbal responding for HA suggests reduced expression for negative emotions (Aaron et al., 2018; Larwood et al., 2021; Luminet et al., 2000; Trevisan et al., 2016), while for positive emotions, verbal responses alone are likely to be reduced (Páez et al., 1999; Rasting et al., 2005; Trevisan et al., 2016; Tull et al., 2005; Wagner & Lee, 2008).

The present study collected single-word or -emoji text messages conveying participants' feelings, and their self-rated valence (negative; neutral; positive) for those descriptions throughout the course of a day, over four separate days. Since a range of positive and negative expressions could reasonably be expected as part of everyday human experience, and given the impact of valence in alexithymia, it was considered important to include this factor as an independent variable.

Notably, for the present research interest, the only other study currently known to the authors to have investigated the influence of alexithymia on emoji use (Wei, 2021) did not find a difference between HA and LA in the pattern of emoji use for negative and positive messages as previous research on facial expressions might have predicted. However, given Wei used total alexithymia scores rather than valence-sensitive subscales, the present study based its prediction on non-verbal facet-level analyses (Aaron et al., 2018; Luminet et al., 2004; Trevisan et al., 2016), predicting less variety for HA in words and emojis expressing negative feelings, but no difference between HA and LA in using emojis to express positive feelings (see Hypothesis 2 (H_2)).

1.4. *Importance of facet-level analysis*

This last consideration highlights the evidence base supporting valence-specific analyses of alexithymia at facet level. These reveal more intricate relationships concealed by total scores, and differences between alexithymia facets when appraising the valence of emotional stimuli (Luminet et al., 2021; Preece et al., 2017). In particular, reduced emotional responding to negative emotional stimuli for HA has primarily found to be driven by DDF and EOT (Aaron et al., 2018; Luminet et al., 2000, 2004).

The Perth Alexithymia Questionnaire (PAQ; Preece et al., 2018a) was considered the most appropriate assessment measure for current research purposes since it allows valence-sensitive assessment at facet level - distinguishing between negative (N-DIF; N-DDF) and positive (P-DIF; P-DDF) emotions for DIF and DDF, while EOT is a non-valence-specific general factor (G-EOT). Founded on an attention-appraisal model of alexithymia conceptualised within Gross's (2015) valuation systems framework, DIF and DDF in PAQ are concerned with appraising, and EOT with attending to, emotions. Preece et al.'s (2018b) reconceptualization of EOT to reflect difficulties attending to internal feelings rather than excessive focus on external events (Nemiah & Sifneos, 1970, 1976) seemed especially relevant to the current study.

Given the relative recency of PAQ development, the authors are aware of no other relevant research currently employing this new measure for assessing alexithymia. The Toronto Alexithymia Scale (TAS-20; Bagby et al., 1994) is currently the most widely used (Veirman et al., 2021) and employed by most studies referenced in this paper. Therefore, most references to alexithymia facets in this Introduction refer to the TAS-20's more generalised DIF, DDF and EOT, which do not have the valence specificity of the PAQ subscales used in the current analyses.

Distinguishing between valence at the facet level within a digital context leads to the prediction that there will be reduced word and emoji variety for HA compared to LA in negative responses, especially on the corresponding PAQ subscales difficulty describing negative feelings (N-DDF) and general externally oriented thinking (G-EOT; see Hypothesis 3 (H_3)).

1.5. The current study

The present study sought to expand research by exploring verbal and non-verbal expressivity in self-described feelings conveyed via text messages, for high and low levels of alexithymia. It is the first quantitative study known to the authors to compare real-world word and emoji use in this context, and contributes to the evidence base employing the newer, valence-sensitive PAQ. Variety of words and emojis, relative to their frequency, was used as a measure of expressivity in a novel development on the more common frequency counts. The upper and lower quartiles of scores were considered more useful than clinical cut-offs in representing the dimensional nature of alexithymia in this non-clinical sample. In analysing participant- rather than researcher-generated messages, current findings have arguably greater ecological validity and may be more generalisable to the real-world impact of alexithymia on expressivity in text messages.

Variability in emoji appearance across different operating platforms was not considered problematic for the present research, since the salient measure was the variety for each participant rather than what emoji were in themselves. Moreover, any subjectivity or potential for misinterpretation relating to perceived valence of a chosen word or emoji was countered by the participant giving their own valence rating for the description they chose.

Based on existing evidence for the impact of alexithymia on verbal and non-verbal expressivity, it was hypothesised that:

- H_1: variety of words and emojis would be less for HA than for LA on total scores (ALEXI)
- H_2: variety of negative and positive word responses, and variety of negative emoji responses, would be less for HA than for LA on ALEXI
- H_3: variety would be less for HA than for LA on difficulty describing negative feelings (N-DDF) and general externally oriented thinking (G-EOT), especially for negative responses

2. Methods

2.1. Participants

Before commencing, full ethical approval was sought and granted from the School of Psychology Research Ethics Committee at the University of East London. Participants were an opportunity sample comprising students at the University of East London and the researchers' wider work and social network within the UK. Links to the survey were distributed in emails via online student forums and email distribution lists and required participants be aged 18 or over, English-speaking, and using smartphones as a means of communication in their daily life. Entry into a draw for a £25 Amazon voucher was offered as an incentive to participate. No other payment was offered. An *a priori* G*Power analysis (Faul et al., 2007) determined that, based on a Cohen's F of 0.4 (large effect size) and a power of 0.8 in line with Cohen's (1992) guidelines, a total sample size of 64 would be needed for a within-subjects three-way, 2 × 3 × 2 ANCOVA. Only data from the 72 participants who completed both parts of the study was analysed. Respondents ranged from 21 to 79 years of age, of whom 71% identified as female (n = 51), 26% male (n = 19), 3% non-binary (n = 2). Of these, 19 were categorised in the high alexithymia group (14 female, M age = 35.79, SD = 14.23; 5 male, M age = 30.20, SD = 6.72) and 20 in the low alexithymia group (15 female, M age = 34.67, SD = 6.68; 5 male, M age = 35.60, SD = 7.86) for total PAQ scores.

2.2. Design

The study used a 3-factor (IV 1: response-type (emojis; words); IV 2: valence rating participants assigned to their response (negative; neutral; positive); IV 3: level of alexithymia (low; high) corresponding to the lower (LQ) or upper (UQ) quartile of scores), within-participants quasi-experimental design. Continuous scores for anxiety and depression were included as covariates to control for effects due to comorbid symptoms. The dependent variable (DV: variety of emojis and words in messaged descriptions of mood) was calculated according to Shannon's Diversity Index (Shannon, 1948).

2.3. Measures

Perth Alexithymia Questionnaire (PAQ; Preece et al., 2018b) is a 24-item self-report scale designed to assess the alexithymia construct and its components, *difficulty identifying feelings* (DIF), *difficulty describing feelings* (DDF) and *externally oriented thinking* (EOT). It allows 5 subscales to be derived that take the valence of emotional responses into consideration: *negative-difficulty identifying feelings* (N-DIF; e.g. "When I'm feeling bad, I get confused about what emotion it is."); *positive-difficulty identifying feelings* (P-DIF; e.g. "When I'm feeling good, I'm puzzled by those feelings."); *negative-difficulty describing feelings* (N-DDF; e.g. "When I'm feeling bad, I can't talk about those feelings in much depth or detail."); *positive-difficulty describing feelings* (P-DDF; e.g. "When I'm feeling good, if I try to describe how I'm feeling I don't know what to say."); Perth Alexithymia Questionnaire (G-EOT; e.g. "It's strange for me to think about my emotions."). Participants selected how much they agreed or disagreed each statement is true of them on a 7-point Likert-type scale (1 = strongly agree; 7 = strongly disagree). Higher scores indicate higher levels of alexithymia.

Beck Depression Inventory-II (BDI-II; Beck et al., 1996) is a 21-item self-report measure for assessing depression severity for adolescents and adults in clinical and non-clinical populations. For each item (e.g. "sadness"), the participant selected which of several statements best described how they had felt over the previous 2 weeks. Responses were scored on a 4-point Likert-type scale (0 = no depression; 3 = severe depression) with higher scores indicating more severe depression.

Beck Anxiety Inventory (BAI; Beck et al., 1993) is a 21-item self-report for assessing symptoms of anxiety distinct from depression in clinical and non-clinical populations. Participants indicated how much they had been bothered by each of 21 common symptoms of anxiety during the past month on a 4-point Likert-type scale (0 = "not at all"; 3 = "severely – it bothered me a lot"). Higher scores indicate more severe anxiety symptoms.

2.4. Procedure

Part 1 – An email invitation included a link to an online survey hosted on Qualtrics (https://qualtrics.com). Demographics (age, gender) were collected followed by the 3 scales, presented randomly across participants to control for order effects, which provided data for IV 3 (alexithymia scores) and the two covariates (depression and anxiety scores). Further details (phone number, preferred contact days, messaging method (WhatsApp; text message) and time-zone if outside the UK to adjust messaging times) were requested to proceed to Part 2.

Part 2 – 5 pairs of messages at 5 evenly spaced time-points throughout the day were sent on participants' 2 chosen days, for 2 concurrent weeks. Message 1 asked to describe in 1 word/emoji how they were feeling at that moment; message 2 asked how they would rate their response on a 7-point Likert-type scale (−3 = "feeling negative"; 0 = "neutral", +3 = "feeling positive"). No restrictions were specified for type of words or emoji to use, to elicit participants' most natural response and allow for individual differences in interpretation of emoji meaning. Valence rating was requested following the description, to minimise the influence of valence considerations on mood description. Type of response requested (word; emoji) was counterbalanced so that 5 emoji and 5 word responses were collected for the same day across the 2 weeks. In total, 10 emojis and 10 words, along with associated valence rating, were collected for each participant.

2.5. Data analysis

Data from both parts of the study was collated and cleaned in Microsoft Excel (v16.60). The upper and lower quartiles for the total PAQ scores (ALEXI) as well as for each subscale (N-DIF; P-DIF; N-DDF; P-DDF; G-EOT) were calculated, and data coded according to where scores fell: corresponding to low alexithymia (LA, lower quartile), high alexithymia (HA, upper quartile) for ALEXI and each subscale. Group sizes were approximately equal, or considered close enough, in all cases.

The variety of responses relative to their frequency, for each response-type (emojis; words) in each of three valence categories (negative; neutral; positive), was calculated using the Shannon Diversity Index[1] (Shannon, 1948), conventionally used in ecology to estimate the diversity of a species within a community:

$$\text{Shannon Index (H)} = -\sum_{i=1}^{u} p_i \ln p_i$$

This gave a variety score of words and emojis for each valence level, and a total variety score, for each participant.

Data was transferred to IBM SPSS Statistics (v27) for analysis. All scales and subscales satisfied the criteria for internal consistency (Cronbach, 1951) and assumptions for ANCOVA were met.

Six 2 × 3 × 2 ANCOVAs were conducted with alexithymia scores categorised at 2 levels (HA; LA) for ALEXI and for each subscale (N-DIF; P-DIF; N-DDF; P-DDF; G-EOT). ANCOVAs were run using an α level of .05. For the 5 subscale analyses, a Bonferroni adjustment was used to correct for the multiple separate analysis, adjusting the α level to 0.01 for the 5 tests. The more stringent Greenhouse-Geisser adjustment was used to reduce chances of making a Type I error.

3. Results

Descriptive statistics (Table 1) indicated greater variety of both emoji and words when expressing positive affect, whether accounting for PAQ or not.

A preliminary analysis explored whether response-type or valence had an impact on variety overall, regardless of PAQ level. A 2 × 3 ANCOVA for response-type (emojis; words) × valence (negative; neutral; positive), and controlled for BAI and BDI-II as covariates, indicated that the main effects of response-type ($F(1, 69) = 4.25, p = .04, \eta_p^2 = 0.06$) and valence ($F(1.77, 121.95) = 74.57, p < .001, \eta_p^2 = 0.52$) on variety were significant, but there was no significant interaction between the two ($F(1.70, 117.51) = 1.15, p = .32, \eta_p^2 = 0.02$). Pairwise comparisons indicated significantly greater variety for words ($M = 0.31$, $SD = 0.18$, $p < .001$) than emoji ($M = 0.29$, $SD = 0.16$). For valence, mean variety for positive responses ($M = 0.53$, $SD = 0.20$) was significantly higher than for negative ($M = 0.22$, $SD = 0.17$, $p < .001$) or neutral responses ($M = 0.15$, $SD = 0.14$, $p < .001$), and variety for neutral responses was significantly less than for negative or positive responses ($p < .05$).

3.1. How does the measure of overall alexithymia influence variety of verbal and non-verbal expressivity in text messages?

A 2 (response-type: emojis; words) × 3 (valence: negative; neutral; positive) × 2 (ALEXI: HA; LA) ANCOVA was used to explore the variety of words and emojis for ALEXI.

The non-significant main effect of response-type ($F(1, 35) = 3.29, p = .08, \eta_p^2 = 0.09$) indicated no significant difference in variety of words and emoji across both levels of alexithymia. There was also no significant interaction between response-type and ALEXI ($F(1, 35) = 0.39, p = .54, \eta_p^2 = 0.01$), indicating the variety of words and emoji did not differ significantly between HA and LA for total PAQ scores. H_1, which predicted greater variety of emojis than words for HA overall, was therefore not supported.

3.2. How does response valence impact the influence of overall alexithymia on verbal and non-verbal expressivity?

The same ANCOVA was used to examine the impact on variety of words and emoji for negative, positive and neutral responses. The main effect for valence was significant ($F(1.83, 63.87) = 56.61, p < .001, \eta_p^2 = 0.62$), but there was not a significant interaction with ALEXI ($F(1.83, 63.87) = 0.47, p = .61, \eta_p^2 = 0.01$). There was also no interaction between response-type, valence and ALEXI ($F(1.88, 65.65) = 1.86, p = .17, \eta_p^2 = 0.05$). Therefore, when considering total PAQ scores, there was no significant difference between HA or LA on variety of words or emoji when expressing positive, negative and neutral feelings. Thus, H_2, that there would be less variety for negative and positive responses for HA, was not supported.

3.3. How does emotional expressivity in text messages differ between alexithymia facets for different response-type and valence?

Five 2 (response-type: emojis; words) × 3 (valence: negative; neutral; positive) × 2 (PAQ subscale score: HA; LA) ANCOVAs explored the effect on variety of words and emojis expressing negative, positive and neutral emotions for each PAQ subscale. Two of the five subscale analyses – N-DDF and G-EOT – showed significant effects.

The three-way ANCOVA for response-type × valence × N-DDF revealed significant main effects for response-type ($F(1, 38) = 4.17, p = .048, \eta_p^2 = 0.10$) and valence ($F(1.76, 66.70) = 51.54, p < .001, \eta_p^2 = 0.58$), indicating significantly greater variety of words ($M = 0.31$, $SD = 0.16$) than emoji ($M = 0.29$, $SD = 0.14$), and greatest variety for positive ($M = 0.54$, $SD = 0.18$) and least variety for neutral responses ($M = 0.15$, $SD = 0.13$). After adjusting for the 5 tests using the Bonferroni correction, the interaction between response-type, valence and the PAQ subscale N-DDF then failed the significance level of $p < .01$, ($F(1.89, 71.77) = 4.42, p = .017, \eta_p^2 = 0.10$). However, given the proximity to the adjusted α level, post hoc analysis was conducted to explore the marginally significant relationship.

Simple main effects revealed significantly greater variety of negative emoji than negative words for HA than LA, (Fig. 1; $F(1, 38) = 5.29, p = .03$). This three-way interaction indicated that when there was more difficulty describing negative feelings, emoji were used with greater variety in negative descriptions for HA than they were for LA.

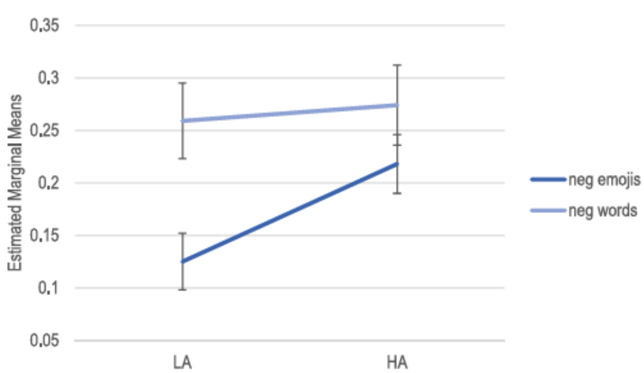
The three-way ANCOVA for response-type × valence × G-EOT revealed a significant main effect for valence ($F(1.77, 60.10) = 34.79, p < .001, \eta_p^2 = 0.51$), but not for response-type ($F(1,34) = 1.62, p = .21, \eta_p^2$

[1] p is the proportion ($\frac{n}{N}$) of emoji/words for each unique emoji/word response (n) divided by the total number of emoji/words for that participant (N). ln is the natural log, Σ is the sum of the calculations for each set of responses for each valence level of each participant, and u is the number of unique responses.

Table 1
Mean and standard deviation of variety scores for No PAQ, and high and low scores for ALEXI, and subscales.

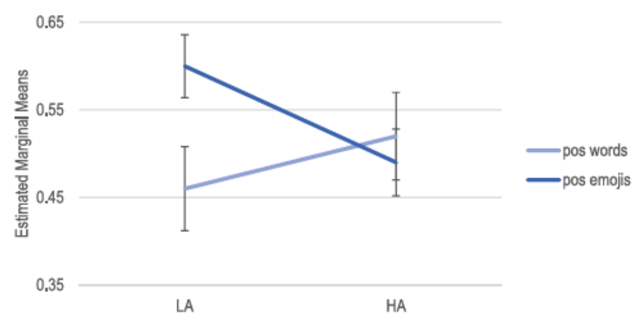
Response-Type	Valence	Level	NO PAQ (N = 72)		ALEXI (n = 39)		N-DIF (n = 43)		P-DIF (n = 41)		N-DDF (n = 42)		P-DDF (n = 51)		G-EOT (n = 38)	
			M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
emoji	**neg**	**LA**			.13	.13	.14	.13	.19	.15	.11	.11	.14	.12	.13	.14
		HA			.20	.15	.23	.15	.15	.14	.24	.13	.18	.15	.19	.14
		Total	.17	.14	.16	.14	.19	.15	.17	.14	.17	.14	.16	.13	.16	.14
	neut	**LA**			.17	.11	.16	.11	.12	.08	.15	.11	.14	.11	.13	.11
		HA			.19	.14	.19	.16	.20	.17	.21	.15	.17	.13	.18	.15
		Total	.16	.13	.18	.12	.17	.14	.16	.14	.17	.13	.15	.12	.15	.13
	pos	**LA**			.56	.14	.58	.16	.55	.13	.59	.15	.59	.15	.60	.17
		HA			.50	.20	.48	.19	.53	.21	.47	.18	.55	.21	.50	.18
		Total	.53	.20	.53	.17	.53	.18	.54	.18	.53	.17	.57	.17	.55	.18
words	**neg**	**LA**			.26	.18	.24	.17	.25	.17	.25	.18	.26	.15	.36	.27
		HA			.25	.17	.36	.21	.29	.19	.29	.16	.28	.20	.26	.16
		Total	.27	.20	.25	.17	.30	.20	.27	.18	.27	.17	.27	.17	.31	.22
	neut	**LA**			.17	.13	.18	.13	.10	.12	.14	.12	.12	.13	.12	.12
		HA			.13	.14	.14	.15	.16	.14	.11	.13	.12	.12	.12	.14
		Total	.13	.14	.15	.14	.16	.14	.13	.14	.13	.13	.12	.13	.12	.13
	pos	**LA**			.50	.22	.50	.23	.56	.19	.54	.22	.54	.20	.46	.26
		HA			.55	.17	.45	.18	.48	.21	.56	.16	.54	.20	.52	.18
		Total	.52	.21	.53	.20	.47	.20	.52	.20	.55	.19	.54	.19	.49	.22

Note: ALEXI = total PAQ scores; N-DIF = Difficulty Identifying Negative Feelings; P-DIF = Difficulty Identifying Positive Feelings; N-DDF = Difficulty Describing Negative Feelings; P-DDF = Difficulty Describing Positive Feelings; G-EOT = General Externally Oriented Thinking.



Note: *n* = 42

Fig. 1. Estimated Marginal Means and Standard Errors for Response-Type and Negative Valence with High and Low N-DDF Scores
Note: n = 42.



Note: *n* = 38

Fig. 2. Estimated Marginal Means and Standard Errors for Response-Type and Positive Valence with High and Low G-EOT scores
Note: *n* = 38.

= 0.05). Variety was greatest for positive responses ($M = 0.52$, $SD = 0.19$), and least for neutral ($M = 0.14$, $SD = 0.13$). Adjusting for the 5 tests using the Bonferroni correction to reduce Type I errors, the interaction between response-type, valence and G-EOT failed to meet the significance level of $p < .01$, ($F(1.63, 55.42) = 4.56, p = .021, \eta_p^2 = 0.12$). Nevertheless, since there was a greater effect here than for all other subscales except N-DDF, the simple effects of response-type and valence for high and low scores on G-EOT were further investigated using post hoc pairwise comparisons. These showed significantly less variety of positive emoji for HA than LA, (Fig. 2; $F(1, 34) = 4.48$, $p = .04$). So, when there was a difficulty focussing on internal feelings, there was significantly less emoji variety for positive descriptions than when it was easier to attend to internal events.

H_3 predicted differences in the effects on variety between facets – specifically those for N-DDF and G-EOT. This was partially supported, with interactions that were notably closer to significant for N-DDF and G-EOT than for any other subscales.

3.4. Summary

For all PAQ analyses, the main effect of valence was significant in every case ($p < .001$), indicating that variety was greatest when describing positive affect, regardless of alexithymia level, overall or by subscale. There were no other significant main effects or interactions for ALEXI, nor the other subscales (N-DIF, P-DIF, P-DDF).

For the sample overall, when not factoring in PAQ levels, words and positive responses showed greatest variety, but there was no statistically significant relationship between the two, when controlling for anxiety and depression. When considering total PAQ scores, there was no significant difference between HA and LA on variety of words or emoji when expressing positive, negative and neutral feelings and the general pattern for valence remained, with greater variety for positive responses for both HA and LA. However, when considering effects by subscale rather than total scores, the pattern of variety between emojis and words differed between HA and LA on N-DDF and G-EOT, which approached significant effects after adjusting for multiple tests using the Bonferroni correction. The three-way interaction on N-DDF indicated that where describing negative feelings was more difficult, emoji were used with greater variety in negative responses than when this difficulty was low. On G-EOT, where focussing on internal feelings was more difficult, emoji were used with less variety in positive responses than when there was little difficulty focussing on internal feelings. Therefore, while verbal expressivity was not affected for HA, non-verbal expressivity was both greater and less than LA on specific facets.

4. Discussion

4.1. Summary

The present study examined how verbal and non-verbal expressivity in smartphone text messaging is affected in people with alexithymia. Variety of words and emojis used in self-described feelings was used as a measure of expressivity and compared for three valence categories (negative; neutral; positive) for high- and low-level alexithymia. Separate analyses were run for total scores and subscales. Analysis of ALEXI showed no significant difference between HA and LA in verbal and non-verbal expressivity of positive, negative and neutral feelings. Subscale analyses revealed a more intricate pattern of differences between HA and LA for non-verbal expressivity – with high scores on N-DDF and G-EOT approaching significantly greater and less variety of emojis respectively. These differences in emoji use for HA may reflect increased and reduced interoceptive awareness when there are greater difficulties describing and focussing on internal feelings. Together, these findings indicate that the verbal deficits often associated with alexithymia did not impact expressivity in the present study, but that there was both non-verbal over- and under-responding - which contributes to previous evidence of a relationship between non-verbal expressivity and differing interoceptive abilities in alexithymia. This highlights the importance of facet-level analysis, as recommended in previous research (Aaron et al., 2020; Jakobson & Rigby, 2021; Luminet et al., 2021), in revealing the influence of the different difficulties in alexithymia.

4.2. Total scores analyses

H_1 and H_2 were based on prior evidence of reduced verbal (Jelinek et al., 2010; Luminet et al., 2021; Wotschack & Klann-Delius, 2013) and non-verbal (Trevisan et al., 2016; Wagner & Lee, 2008) expressivity for HA, especially in negative contexts (Aaron et al., 2018; Larwood et al., 2021; Luminet et al., 2000; Trevisan et al., 2016; Wagner & Lee, 2008). Neither H_1 nor H_2 were supported. Contrary to expectations, variety of words and emojis was no less for HA than LA and did not differ significantly when describing negative, neutral and positive feelings, for ALEXI. The expectation that there would be no reduction for HA in variety of positive emoji expressions was supported. The lack of difference between HA and LA on ALEXI might be explained by a difference in the level of emotional content, which was not assessed in the present study. This aligns with the conclusion Luminet et al. (2004) drew from their findings that while HA had equivalent emotional vocabulary as LA, they used it less in emotional contexts. Thus, the verbal deficits associated with HA may not actually be a lack of emotional vocabulary, but an inhibition in conveying emotion related to fewer self-referential words and lower introspection. If the verbal responses for HA in the present study contained fewer emotion and self-reference words than LA, this could account for the unexpected lack of difference between the two and would be an avenue for future research (see Limitations and Future Directions below). Moreover, the effect of HA in terms of impaired verbal ability may have been reduced by the requirement for only one-word responses. That there was greater variety of both words and emoji in positive responses, and no reduction for HA compared to LA, could imply that positive expressions in general admit greater variety, just as, inversely, negative affect, as manifested in depression for example, is shown to limit emotional responding, regardless of alexithymia level (Balsters et al., 2012; Ellgring, 2007; Girard et al., 2014). Further research is needed to support this interpretation.

Present findings may indicate that in general, text messaging could be a helpful form of interpersonal communication for people with alexithymia, whose problems recognising and expressing feelings can impede their social interactions and connectedness. This may be due to the more concise, less elaborative nature of text messages, the greater time that can be taken to respond or the remove from more direct face-to-face interaction. Alternatively, it may show that total scores can obscure important differences in effects specific to particular alexithymia facets, as next discussed.

4.3. Facet-level analyses

Evidence of reduced negative emotional responding for HA compared to LA on DDF and EOT (Aaron et al., 2018; Luminet et al., 2000, 2004), underpinned H_3, which was partially supported insofar as both and only these subscales approached significant effects. Results diverged from expectations in the dissociative direction of the effect - with negative feelings showing increased rather than reduced variety - and in applying only to emojis. The findings have implications for both verbal and non-verbal factors. The lack of difference on verbal expressivity between HA and LA may indicate that verbal deficits are not so involved in expressions via text message, supporting the previously discussed proposal that text messaging may be a useful means of communication for HA. The divergences found in non-verbal factors are also potentially explicable and revealing. The innovative nature of the current research afforded no prior grounds for predicting the dissociation at such a degree of specificity - HA on N-DDF using greater variety of emoji than LA to describe negative feelings; HA on G-EOT using less variety of emoji than LA to describe positive feelings. Although the connection between facial expression, interoception and emoji use in alexithymia is discernible in the literature, this is only the second study known to date to explore emoji use as an extension of non-verbal expressivity in alexithymia. Given the marginal significance, further research is needed to substantiate the following interpretations. Nonetheless, drawing on previous work some interesting new conclusions and potential developments for understanding alexithymia can here be proposed.

Facial emojis function similarly to real life facial expressions (Gantiva et al., 2020; Li & Yang, 2018; Riordan & Trichtinger, 2017), and non-face emojis function similarly in conveying affect (Riordan & Trichtinger, 2017; Sugiyama, 2015). Emoji use in text messages have therefore been interpreted as digitally functional equivalents of face-to-face expressions (Wei, 2021). If this translation from real-life expressions to emoji use holds, current findings conflict with previous research that found reduced facial expression for negative but not positive emotions (Rasting et al., 2005; Trevisan et al., 2016) and thereby contradicts the conflict hypothesis (Taylor et al., 1991) which theorises that reduced facial expressions of negative emotions in HA are an avoidance mechanism to evade negative feelings and conflict in interactions.

A further implication for the cognitive processes contributing to HA in the current sample connects to the literature suggesting the effects for non-verbal expressions on certain subscales under particular valence conditions could indicate differences in interoception (Pearson & Jakobson, 2018; Scarpazza et al., 2022; Trevisan et al., 2016). If, as the literature suggests, expression in terms of emoji variety can be understood as a digital relative of real-life, non-verbal expressivity such as body gestures or facial expressions (Erle et al., 2022; Li & Yang, 2018), then the differences between HA and LA in emoji variety on certain PAQ subscales may reflect differences in recognising internal bodily sensations. For example, a study found a quadratic relationship between interoceptive accuracy and HA, such that HA is associated with both reduced and heightened interoceptive accuracy, especially for DIF and DDF (Aaron et al., 2020). Another recent study found HA associated with higher interoceptive accuracy, interoceptive sensibility and lower interoceptive awareness, and proposed the dissociation of interoceptive accuracy and awareness may contribute to the psycho-physiological processes underlying alexithymia (Scarpazza et al., 2022). While further research in the area is due, these dissociations seem consistent with the present study, where HA shows both increased and reduced variety of emoji compared to LA.

Moreover, present findings add some specificity to the way in which these effects apply. Increased variety of emojis for HA on N-DDF suggests greater interoceptive ability with negative feelings when there is greater difficulty describing negative feelings, while the reduced variety of emoji for HA compared to LA on G-EOT suggests less interoceptive ability for positive feelings when there is greater difficulty focussing on internal feelings. This is partially consistent with findings connecting higher DDF scores to greater interoceptive ability (Jakobson & Pearson, 2021; Longarzo et al., 2015; Pearson & Jakobson, 2018), and also supports the extrapolation from real-life facial expressivity to the non-verbal expressivity via emojis suggested in the Introduction. Although no significant differences were found between HA and LA on difficulty identifying negative or positive feelings (N-DIF/P-DIF) in the present analyses, this may align with Pearson and Jakobson's conclusion (Jakobson & Pearson, 2021; Pearson & Jakobson, 2018) that higher DIF can accurately interpret non-verbal cues but need more time to do so. The real-life text messaging context of the present study allowed that time, and therefore may have ameliorated the differences between HA and LA on the DIF subscales. The marginally significant effect for G-EOT also accords with the finding that higher EOT is connected to lower interoceptive accuracy (Jakobson & Rigby, 2021). This is coherent given the facet measures difficulty focussing on internal states. Notably, other studies found weaker or little relationship between EOT and interoception (Gaggero et al., 2021; Zamariola et al., 2018), however this could be attributed either to issues with internal consistency on EOT reported in the studies, or differences in what EOT was measuring. These studies use the TAS-20 EOT subscale which measures excessive outward focus and more concrete thinking, whereas the PAQ version reconceptualised by Preece et al. (2017) and used in the present study, measures difficulty focussing on internal states.

It is possible that the dissociation in current findings reflects differing relationships between the different interoceptive components – accuracy, sensibility, awareness - and alexithymia facets. Future research might fruitfully explore how components of the interoceptive construct are involved by taking measures for interoception (see Limitations and Future Directions below).

4.4. *Limitations and future directions*

First, the study does not permit causal inferences. Second, given the limited sample size and number of data points, interpretations are tentative. Future research would benefit from a larger sample, and more message responses for each participant, and might usefully control for age and gender as factors considering evidence for age and gender differences in both alexithymia level (Levant et al., 2009; Nam et al., 2020) and emoji use (Herring & Dainas, 2020; Koch et al., 2022). Third, while both face and non-face emojis are used to convey affect (Riordan & Trichtinger, 2017), future relevant analysis might compare frequency and/or variety of face to non-face emoji responses in relation to valence reported. Fourth, raw data indicated valence on a finer-grained 7-point scale that could admit further analysis assessing intensity, which has been shown to be relevant to alexithymia (Fantini-Hauwel et al., 2015; Wagner & Lee, 2008). It may be that high scores on N-DIF showed less intensity of negative emotions, veering towards neutral, as demonstrated for HA (Larwood et al., 2021; Wagner & Lee, 2008). This may have contributed to the lack of significant difference on N-DIF in the present study. Fifth, variety being the measure of expressivity, no restrictions were imposed on words describing feelings. Future research might consider a more in-depth analysis of the emotionality or expressiveness of responses beyond variety. Sixth, the potential for connecting non-verbal expressivity, emoji use and interoceptive differences in alexithymia may benefit from research that includes measures of interoception. Finally, the present data set was considered within a Western context and defined by the English language. However, there are differences in the way languages convey emotion (Jackson et al., 2019) and in emoji use across cultures (Barbieri et al., 2016). Moreover, alexithymia is shaped by differences in language and culture (Ryder et al., 2018). Therefore, despite the ubiquity of emoji and text messaging globally, the current study may have a cultural and linguistic specificity that is not found in differing linguistic and cultural contexts, which could be an interesting avenue for future research.

5. Conclusions

Findings suggest a nuanced understanding of how alexithymia impacts expressivity in verbal and non-verbal text messages requires facet-level, valence-specific analyses which was possible using PAQ subscales. These revealed a dissociation in the effects of HA on emoji use, showing greater expressivity than LA for negative feelings where describing negative feelings is a particular difficulty, and reduced expressivity for positive feelings when focussing on internal states is a greater difficulty. Emojis may therefore be especially sensitive to specific difficulties in alexithymia, and in negative contexts may be a more helpful means of emotional expression for some HA. If the interoceptive differences associated with non-verbal expressivity in alexithymia transfer to emoji use in text messages, then the differential between HA and LA may be related to differences in people's ability to recognise their somatic experiences in HA, with greater and lesser interoceptive ability for negative and positive feelings respectively. While this innovative proposal requires further support, emoji use as a measure of non-verbal expressivity expands existing understandings of alexithymia and could inform future research within computer-mediated communication and emotion regulation. Word expressivity was not impacted by higher levels of alexithymia, for total scores nor by subscale, implying HA found it no less easy to express their feelings using words than LA. Overall, these findings contrast with previous literature in suggesting there may not be a generalised pattern of deficits in verbal and non-verbal expressivity for HA, which has implications for the study and conceptualization of alexithymia. Present results may signal an advantage in text messaging for HA, where the more concise verbal style and pre-defined emoji sets, alongside the extra time a message might allow to process an emotional response, could offset some of the communication difficulties HA experience in face-to-face interactions. This could have important repercussions for their social interactions and connectedness, given the predominance of smartphone communication and the ubiquity of emojis today.

Credit author statement

Harri Allan: Conceptualization, Methodology, Investigation, Formal analysis, Visualization, Writing - Original Draft, Writing - Reviewing & Editing Mary-Jane Budd: Conceptualization, Methodology, Writing - Reviewing & Editing, Supervision.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.chb.2023.107845.

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