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Affect labeling and other aspects of emotional experiences in relation to alexithymia following standardized emotion inductions

Rachel V. Aaron^a, Matthew A. Snodgrass^c, Scott D. Blain^c, and Sohee Park^b

^aDepartment of Anesthesiology and Pain Medicine, University of Washington and Center for Child Health, Behavior, and Development, Seattle Children's Research Institute; Seattle, WA, USA

^bVanderbilt University Department of Psychology, Nashville, TN, USA

^cUniversity of Minnesota Twin Cities, Department of Psychology, Minneapolis, MN, USA

Abstract

Alexithymia is associated with increased risk for mental and physical health disorders but available assessments rely exclusively on self-report. The major aim of the current study was to develop and implement a performance-based task designed to characterize and quantify the relationship between one's description of emotional experience and self-reported alexithymia. Specifically, we examined performance-based measures of affect labeling of one's own emotions, emotional granularity and dialecticism.

Healthy participants (N=108) completed the Toronto Alexithymia Scale–20 Item Questionnaire. Participants viewed a series of film clips standardized to elicit discrete emotional states. After each clip, they indicated the emotion they experienced “the most” and rated a list of non-primary emotions, which formed indices of emotional granularity and dialecticism.

Alexithymia was associated with increased tendency to report experiencing “no emotion” following evocative film clips, reduced negative emotional granularity and dialecticism of experienced emotions. TAS-20 subscales were each associated with a unique set of emotional correlates.

In a healthy population, alexithymia is associated with reduced awareness of emotional states, and reduced dialecticism and granularity of negative (but not positive) emotions. Our performance-based assessment enriches understanding of the mechanisms underlying alexithymia by underscoring the central importance of emotion awareness, negative emotional granularity and dialecticism.

Correspondence concerning this article should be directed to Rachel Aaron at aaronrv@u.washington.edu (206-884-1142). This work was performed at Vanderbilt University in partial fulfillment of a Doctor of Philosophy Degree in Clinical Psychology awarded to Rachel V. Aaron.

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1. Introduction

Alexithymia refers to difficulties labeling, describing, and introspecting about one's own emotional experience. It is thought to reflect a general deficit in affect processing (Lane et al., 1997) and altered awareness of internal bodily sensations (Brewer et al., 2016). It is continuously distributed in the population, multidimensional, and transdiagnostic (Keefer et al., 2017). Heightened levels of alexithymia are found in myriad clinical populations (Leweke et al., 2011; Lumley et al., 2008; Westwood et al., 2017). Although alexithymia was once thought of as a stable personality trait, recent research shows that absolute levels fluctuate overtime (Cameron et al., 2014), particularly with changing levels of symptoms of psychopathology (e.g., depression; (Marchesi et al., 2008; Saarijärvi et al., 2006)). Accordingly, alexithymia represents a malleable construct responsive to intervention. In clinical populations, growing evidence suggests levels of alexithymia decrease in response to general psychological intervention (see Cameron et al., 2014 for review) and interventions targeting increases in emotional awareness directly (Burger et al., 2016) in diverse populations.

The Toronto Alexithymia Scale (TAS-20) is the most common assessment of alexithymia, and is comprised of three distinct subscales: difficulty identifying feelings, difficulty describing feelings, and a preference for externally-oriented thinking (Bagby et al., 1994). Alexithymia may be associated with reduced ability to label internal affective states, hindering successful regulation of negative emotions. Gross's extended process model of emotion regulation states identification of one's emotional state precedes intentional steps towards regulating emotions (Gross, 2015). Affect labelling also confers emotion regulation properties incidentally (i.e., typically occurring without conscious employment of effort, such as internal reflection or talking to a friend about one's feelings (Berkman and Lieberman, 2009). Affect labelling results in reduced subjective intensity of affective states (Lieberman et al., 2011) and reduced neural responses to negative emotional stimuli (Lieberman et al., 2007). Alexithymia is associated with reduced emotion regulation abilities in a normative sample (Swart et al., 2009) and elevated in clinical disorders and symptoms marked by difficulties regulating emotions, including eating disorders (Westwood et al., 2017), alcohol use disorders (Thorberg et al., 2009), nonsuicidal self-injurious behaviors (Lüdtke et al., 2016) and depressive symptoms (Li et al., 2015).

Given difficulty identifying and describing feelings represent core components of alexithymia as conceptualized by the TAS-20, and given the importance of affect labeling for emotion regulation, it is surprising that little research has examined affect labelling of subjective emotional states, or other aspects of identifying and describing one's own emotions using a laboratory-based design. Limited work in this area demonstrates that when individuals high in alexithymia are asked to generate adjectives describing how they feel in response to evocative images, they generate few or no words in response (Roedema and Simons, 1999). Individuals with heightened alexithymia also use fewer spontaneous emotion words when asked to define and describe a battery of emotion words and situations, an effect independent of vocabulary (Wotschack and Klann-Delius, 2013). Clearly, future research is needed to examine the nature of affect labeling in alexithymia; for example, examining affect labeling in response to more intense emotion inductions, and determining

whether alexithymia influences the types of affect labels utilized to describe emotional experiences. In contrast to a small literature examining affect labeling of one's own emotions, a wealth of literature examines emotional processing of external stimuli. When asked to identify emotions in others, alexithymia is typically associated with reduced accuracy in identifying facial expressions (see Grynberg et al., 2012 for review). Alexithymia is also associated with physiological and neurological abnormalities in the automatic processing of emotional stimuli, such as faces, images and words (see Donges and Suslow, 2017 for review).

The experience of emotion is thought to arise from applying conceptual knowledge to affective states; language is critical in this process as it facilitates the development of emotional concepts and their application to experiences of affect (Lindquist et al., 2015). To this extent, it is important to understand how an individual's perception and description of emotional experiences relates to alexithymia. For simplicity, we refer to these perceptions and descriptions as "emotional experiences." Clarifying how alexithymia relates to affect labeling and aspects of emotional experiences has potential to advance conceptualization and inform the development of laboratory-based assessment of alexithymia.

A number of existing constructs taps into such emotional experiences, and may be applied to further shed light on emotional experiences related to alexithymia. In particular, emotional granularity refers to the ability to make fine-grained distinctions between emotional experiences (Barrett et al., 2001); individuals with high emotional granularity describe their emotional states with greater precision. This can be easily measured in laboratory-based settings: individuals rate their experience of numerous emotion words on a Likert scale, often following an emotion induction. Inter-class correlations between each pair of emotion word are calculated and averaged to form an overall index of granularity at the individual level, whereby high correlations represent less ability to differentiate affective states and are formed as an index of emotional granularity (Barrett et al., 2001). Another construct relevant to awareness of mixed emotions is emotional dialecticism. Emotional dialecticism is one's tendency to simultaneously recognize pleasant and unpleasant states (Bagozzi et al., 1999), and relates to the complexity of one's emotional experience (Lindquist and Barrett, 2008). Experiencing such complexity of emotions is a hallmark of heightened emotional awareness (Lane and Schwartz, 1987).

Little research has examined granularity in relation to alexithymia; what exists suggests a negative relationship. Erbas and colleagues (Erbas et al., 2014) demonstrate a negative relationship between alexithymia and granularity of negative emotions; they showed participants the names of familiar people in their lives and asked them to rate each on a battery of negative emotional terms. To our knowledge, no one has examined emotional dialecticism in relation to alexithymia. Additional research examining granularity and dialecticism in alexithymia may shed light on describing emotions in relation to alexithymia. More research is needed to examine these constructs, as they relate to both negative and positive emotions, particularly following emotion inductions.

Questionnaire assessments of alexithymia, such as the TAS-20, have been critiqued for undue influence of demand characteristics and negative self-bias (Leising et al., 2009).

Affect labelling, emotional granularity and emotional dialecticism can be assessed indirectly (i.e., the participant is naïve to the goals of data collection) in the laboratory using performance-based measures, thereby reducing the confounds of self-report. Furthermore, unlike most questionnaire assessment, assessing emotional constructs utilizing performance-based measures like these can be assessed repeatedly in laboratory-based settings, and manipulated in experimental design.

Critically, these constructs (affect labeling, emotional granularity, emotional dialecticism) also represent malleable behaviors that can be targeted in intervention. When spider phobic individuals are instructed to engage in affect labeling to cope with a spider exposure (e.g., “I feel anxious”), they show greater reduction in skin conductance and increased approach behavior compared to individuals instructed to cope using distraction or reappraisal (Kircanski et al., 2012). Similarly, undergoing an affect labelling task prior to a social anxiety exposure results in faster physiological recovery immediately after the exposure (Niles et al., 2015). In relation to alexithymia, providing conceptual cues during an emotional expression identification task improves accuracy (Nook et al., 2015). Increasing dialectic thinking is a core treatment target of Dialectical Behavior Therapy (Linehan, 1993), resulting in increased emotion regulation and distress tolerance skill (Lynch et al., 2006; Panos et al., 2013). Teaching school children to identify and evaluate their own emotions and the emotions of others is associated with improved social and emotional competence (Brackett et al., 2012).

1.2 Current Study

The current study aims to better clarify emotional experiences in alexithymia as assessed by the TAS-20 using performance-based measures. In particular, we consider constructs with conceptual relevance to alexithymia that can be measured in laboratory-based settings and targeted in intervention. We developed a laboratory-based paradigm for measuring multidimensional emotional experiences concomitantly, the INduction-based multiDimensional Emotional Experiences Paradigm (IN-DEEP), and assessed performance in relation to alexithymia. Participants viewed videos previously demonstrated to elicit a particular discrete emotion well above and beyond other emotions (Gross and Levenson, 1995); participants are asked to identify which emotion they experienced the most. Among included options are “I didn’t experience any emotion.” The standardization of these videos allows comparison of participant’s affect labels relative to large normative participant samples. From a series of additional questions about secondary emotional experiences, indices of negative and positive emotional granularity and dialecticism are formed. The primary aims of the current study were to 1) characterize affect labelling in response to standardized emotion videos in relation to alexithymia, 2) examine associations between emotional granularity and dialecticism, and 3) determine whether these dimensions of emotional experiences are differentially related to TAS-20 subscales.

We hypothesized that affect labeling in relation to alexithymia would deviate from well-established norms. We explored whether this differential pattern emerged from a tendency to identify atypical affect labels as primary emotion experienced or a tendency to report experiencing no emotion). Based on past research (Erbas et al., 2014), we hypothesized that

alexithymia will be negatively associated with emotional granularity. There have been mixed findings with regards to processing positive emotional stimuli, with some studies showing differing patterns of neural correlates associated with viewing positive emotional faces (Reker et al., 2010) and others not (Eichmann et al., 2008). Recent accounts of alexithymia suggest deficits may emerge due to avoidance of negative stimuli (Panayiotou et al., 2015), suggesting potential intact awareness of positive emotions. Thus, we explored differences in positive and negative emotional granularity. Hypotheses related to factors predicting specific TAS-20 subscales were somewhat exploratory, given the novel nature of many included predictors. However, given their conceptual overlap, we hypothesized divergent patterns of affect labeling would relate most strongly to difficulty identifying feelings subscale of the TAS-20, and that emotional granularity and dialecticism would relate most strongly to difficulty describing feelings.

Towards our goal of assessing implicit indices of emotional processing, we also collected response time (RT) for generating affect labels and responding to other questions about emotional experiences (i.e., arousal, intensity) for all participant responses, and explored the relationship between these RT variables and alexithymia. The little work that has investigated RT in alexithymia does not assess reflection of one's own emotions; however, some suggest alexithymia is associated with longer latencies for processing emotional information in others (Constantinou et al., 2014; Grynberg et al., 2012). Finally, we also included self-report levels of intensity and arousal, which are commonly assessed in relation to alexithymia, though we expect more indirect assessments of emotional processing to yield a broader understanding of problematic emotional processing in alexithymia.

2. Methods

2.1 Participants

Participants were 113 undergraduates who received course credit for their participation. Exclusion criteria were past or current diagnosis of depression, anxiety, substance use disorder, or attention-deficit/hyperactivity disorder. Data from two participants were excluded for not following instructions, and from three participants due to equipment failure. Due to technical errors, eight participants were missing data from one of fourteen trials; in this case, data was deemed missing completely at random, and overall averages were created by imputing data from the existing emotion-congruent category for each individual. One participant was missing data from two trials of the same emotion category, so overall averages were excluded from analysis.

The total included sample consisted of 108 participants (67.6% women; mean age = 19.30, SD = .88). Of these participants, 49.5% identified as Caucasian, 21.3% Asian/Pacific Islander, 14.8% African American/African/Black/Caribbean, 1.9% Hispanic/Latino, 7.4% identified as "Multiracial," and 1.0% as "other." 5.0% of students preferred not to respond. All participants gave written informed consent and the protocol and the consent procedure were approved by Vanderbilt University's Internal Review Board.

2.2 Materials

Questionnaires and stimuli were presented via Eprime 2.0 software (Psychology Software Tools, Pittsburg, PA, USA) using a 15" X 10" inch laptop with a black background in a darkened room. Participants wore Audio-Technica (Audio-Technica US, Inc., Stow, Ohio, USA) noise-cancelling headphones through the video portion of the experiment. Stimuli included the 14 film clips identified as reliably eliciting one of 7 discrete emotional experiences (amusement, anger, contentment, disgust, fear, sadness, and surprise); there were two clips for each emotion category (Gross and Levenson, 1995). Participants were given one practice trial during which they viewed a non-standardized film clip from the movie *Zoolander*.

2.3 Questionnaires

Participants completed the TAS-20 (Bagby et al., 1994). TAS-20 consists of 20 items measuring three dimensions of alexithymia: difficulty identifying feelings (DIF), difficulty describing feelings (DDF), and externally-oriented thinking (EOT). Participants rated the extent to which they agree with statements using a five-point Likert scale. In response to film clips, participants rated the intensity they experienced emotions on a 1–9 scale, as well as rated subjective arousal using a 1–9 self-assessment manikin scale (Bradley and Lang, 1994).

2.4 Design and Procedure

Participants first completed written informed consent, then a demographic form and questionnaire battery. They were randomly assigned to one of two counterbalanced IN-DEEP run orders. In both, positive and negative emotion induction videos were evenly distributed. Before beginning the task, participants were asked to read aloud a list of relevant emotion words to ensure familiarity and were then given instructions for the video task. They completed one practice trial and were given multiple opportunities to ask questions. Afterwards, they completed IN-DEEP.

2.4.2. IN-DEEP—Participants viewed fourteen emotion-inducing clips consecutively and were asked a series of questions about their emotional experiences after each clip. First, they were asked a series of questions about their primary emotional experience while watching the clip. They were asked to select from a list of emotion words which one emotion they experienced “the most.” options included the 16 emotions originally presented in Gross and Levenson (1995), which allowed direct comparison of participant responses to norms established in the original study and the many studies since that have replicated original findings.¹ In addition, participants were also given the option to select: “The emotion I experienced is not listed here” and “I did not experience any emotion.” The latter allowed us to test our primary aim of characterizing affect labeling in alexithymia, and parsing whether difficulties relate to identifying non-standard affect labels or reporting the experience of “no emotion.” After identifying an affect label describing their primary emotion, participants reported the intensity of this selected emotion as well as their subjective level of arousal on a

¹Emotion words included: amusement, anger, arousal, confusion, contempt, contentment, disgust, embarrassment, fear, happiness, interest, pain, relief, sadness, surprise, and tension.

1–9 Likert scale, variables which are referred to as “primary intensity” and “primary arousal.” When participants reported not experiencing any emotion, they still completed all subsequent questions.

Next, participants were asked about non-primary emotions experienced during the same film clip, or for the purpose of differentiating variables, “secondary” emotions. The goal of this portion of the experiment is to assess the complexity (i.e., granularity, dialecticism) with which participants describe emotions. We incorporated a wider battery of emotion words to choose from; this decision is consistent with other laboratory-based assessments of emotional granularity, which employ a large battery of emotion words (e.g., Erbas et al., 2014 provide participants with 35 emotion words to choose from). In the current study, participants were presented with 29 consecutive emotion words and asked how intensely they experienced each during the film clip on a 1–9 Likert scale. For variety, emotion words include the 16 words described above (excluding options relating to experiencing no or alternative emotional experiences), non-overlapping words from the Positive and Negative Affect Scales (Watson et al., 1988) and two additional words added after piloting IN-DEEP, “calm” and “pity.”² At the end of each trial, participants were instructed to press the space bar when they were ready to advance to the next trial. The next trial began with a five second emotionally neutral film clip. Response time (RT) was collected for all participant responses, defined as the duration between stimulus onset and participant response.

2.5 Statistical Approach

2.5.1 Variable calculation—The extent to which an individual applied an affect label that aligned with the intended emotion induction (as validated by Gross & Levenson, 1995) formed an index of “consistent affect label.” This variable represented the percentage of emotion endorsements consistent with standardized norms across the entire experiment. “No affect label” represents the percentage of times an individual rated “I didn’t experience any emotion” following evocative videos. “Non-standard affect label” represents the percentage of times an affect label was chosen, but did not align with a previously established norm. The latter two variables were used to further examine the relationship between alexithymia and consistent affect labels.

Granularity and dialecticism variables were formed using intensity ratings of secondary emotions. Emotional granularity indices were formed by calculating intraclass correlations (ICC) with absolute agreement between the intensity ratings of all endorsed 29 secondary emotion words pairs endorsed across the experiment. These resulting ICCs were averaged for each participant, such that a lower ICC indicates greater differentiation between emotional words and a higher ICC indicates lower differentiation (i.e., different words are often rated together and with similar intensity ratings). For each participant, this average ICC was subtracted from one, such that a greater score indicated higher granularity, increasing intuitive interpretation of this value and facilitating comparison with other research findings. This transformed ICC was then subjected to Fisher’s *z* transformation. Separate indices were calculated for granularity of positive and negative emotions. This

²Non-overlapping emotion words adapted from PANAS include: distress, enthusiasm, excitement, guilt, hostility, inspiration, interest, irritated, jittery, nervousness, pride, shame, strength, and upset.

analytical approach follows standard computing for forming emotional granularity indices from emotion intensity ratings (Tugade et al., 2004). Dialecticism variables were formed by calculating a ratio of incongruent to congruent emotion endorsements (e.g., positive dialecticism was calculated as the ratio of endorsements of positive emotion words during a negative emotion induction to endorsements of negative emotion words during a negative emotion induction), generating a continuous index of dialecticism; an emotion was considered “endorsed” when participants rated intensity greater than 1. Because emotion inducing videos were developed to elicit a primarily negative or positive emotional experience, we chose a low threshold for dialecticism (i.e., whether an opposite valence word was endorsed at all). Use of ratios also subverted concern for individual differences in a participant’s use of intensity ratings and number of endorsements. Trials in which no emotion was endorsed were not included in these calculations. Log_{10} transformations were applied to resulting variables to normalize their positive skew.

RTs were influenced by outliers. To address this, outliers were defined as data points 6 SDs greater than the mean within each RT variable, and were winsorized (Ghosh and Vogt, 2012). Because of limited comparison data in the literature for some RT data (e.g., affect labeling one’s own emotions), we chose a liberal cutoff for outliers to ensure only data that resulted from measurement error was excluded: review of the experiment log suggested large outliers were driven by participants using their phone during data collection, despite instructions to turn phone off at the beginning of the experiment. In total, .003% of RTs were adjusted. After adjustment, all task variables met assumptions of linear regression.

2.5.2 Analytical approach—Spearman correlations examined relations between TAS-20 total score and IN-DEEP variables. Spearman correlations were chosen as there was some remaining skew for response time variables, and because of the ordinal nature of the affect labelling variables. Given a negative correlation between TAS-20 and consistent affect label, a multiple regression was conducted in which 1) nonstandard affect labels (i.e., the 9 words presented as options that did not align with standard labels as well as “the emotion I experienced is not listed here”), and 2) endorsements of “no emotion,” predicted TAS-20 total score.

Next, we examined whether IN-DEEP variables differentially predicted TAS-20 subscales. Penalized (elastic net) regression was used to identify models predictive of TAS-20 subscales. Penalized regression has been shown to outperform linear ordinary least squares (OLS) regression in estimating parameters for small samples, choosing models with a greater capacity for generalizability to independent samples (Zou and Hastie, 2005). Given the exploratory nature of predicting TAS-20 subscales with a large set of variables, elastic net regression also minimized risk of multiple comparisons and multicollinearity. We implemented elastic net regression using the “glmnet” package in R (Friedman et al., 2010); R Core Team, 2016), optimizing the alpha parameter by employing jackknife cross-validation (CV) with respect to mean-squared error (Helwig, 2017). Using optimal alpha parameters, three models were then identified. Bootstrapping was used to obtain 90% CIs for penalized regression inference; 90% CIs were chosen because elastic net regression has already considered independent samples in its computation and strongly penalized included

predictors. For each model, 10,000 bootstrap samples were randomly generated; the three identified models were tested on each bootstrap sample independently.

To facilitate interpretation of findings, linear OLS regression models were then computed using the variables identified using elastic net regression to predict each TAS-20 subscale. Models predicting EOT and DIF contained multiple RT variables, which were highly correlated ($.55 > \rho s > .42$; correlation table presented in Appendix A) and contributed to multicollinearity within regression models. To address this, a single RT composite was formed within each predictive model, comprised of RT predictors identified using penalized regression for each TAS-20 subscale. RT composites were formed by applying Fisher's z transformations to RT variables and averaging them. After such corrections, each model met assumptions of multiple regression.

2. Results

3.1 Descriptive Statistics

Mean TAS-20 total was 45.60 (SD=8.53; range = 30 – 73); DDF was 12.39 (SD=3.18); DIF was 14.66 (SD=3.88); and EOT was 18.53 (SD=3.73). Mean alexithymia was comparable to that of a large prevalence study in the general population (Salminen et al., report a mean of 46.0 and SD of 11.6). There was no relationship between gender and TAS-20 total or any of its subscales ($p s > .29$). Mean sex differences were assessed for IN-DEEP variables; males demonstrated significantly lower positive dialecticism ($t(106) = 2.25, p = .027$) and lower positive granularity at the trend level ($t(106) = 1.72, p = .087$) compared to females.

3.2 Relationship between TAS-20 and IN-DEEP variables

Means and standard deviations for main IN-DEEP variables are presented in Table 1. Spearman correlations were calculated to assess relationships between TAS-20 total score and IN-DEEP variables and are reported in Appendix A. TAS-20 total score was associated with reduced use of consistent affect labels ($p = .029$), lower arousal ratings ($p = .017$), and lower negative granularity ($p = .048$). TAS-20 total score was negatively correlated with RTs (i.e., faster response time) for rating intensity of primary ($p = .009$) and secondary ($p = .004$) emotions; correlations between RT for affect labeling ($p = .210$) and arousal ratings ($p = .277$) were not significant, but were both also in the negative direction. At the trend level, alexithymia was negatively correlated with negative dialecticism ($p = .053$).

3.3 Affect labeling in relation to TAS-20 total score

A multiple regression examined the relative influence of nonstandard affect label and no affect label for predicting TAS-20 total score. The overall model significantly predicted TAS-20 total score ($F(2,105) = 3.73, p = .027, R^2 = .07, f^2 = .08$). Within, no affect label significantly predicted TAS-20 total score ($\beta = .25, t = 2.59, p = .011$) but not non-standard affect label ($\beta = .11, t = 1.18, p = .241$).

3.4 Predicting TAS-20 subscales

See Appendix B for results of penalized models that informed OLS linear regression models. Results of linear models are presented in Table 2. The models predicting DDF and

EOT were significant; within, lower primary arousal ratings and higher negative granularity were significant predictors of DDF. Lower negative dialecticism and at the trend level, more frequent endorsements of “no emotion” as primary significantly predicted EOT. The overall model predicting DIF was not significant ($p = .100$); however, within this model, faster RT was a significant predictor. There was a possibility that overall endorsements of “no emotion” confounded results of regression models; this was effectively controlled for in models predicting DIF and EOT, as such endorsements were included in multiple regression models. To account for potential confounding effects in the model predicting DDF model, we conducted the same analysis with endorsements of “no emotion” entered as a covariate: patterns of significance remained the same.

3. Discussion

The current study examined affect labeling and other aspects of emotional experiences in relation to alexithymia in a young, healthy population. Overall, alexithymia was associated with an increased tendency to report experiencing “no emotion” following evocative film clips. Alexithymia was also associated with reduced negative, but not positive, emotional granularity and dialecticism, as well as reduced self-report arousal and faster responding to questions about emotions and reduced self-report arousal. Alexithymia subscales were predicted by unique aspects of emotional experiences. The current study utilized evocative stimuli with demonstrated reliability and validity to elicit particular emotional states, which allowed comparison of affect labeling of one’s own emotions to established norms.

Patterns of divergent affect labeling of one’s own emotions in the current study are in line with the larger literature demonstrating affect labeling deficits of others’ emotions in alexithymia (Grynberg et al., 2012). In particular, alexithymia was associated with endorsing the experience of “no emotion” following film clips, which is consistent with other research showing individuals with elevated alexithymia produce fewer adjectives to describe emotional responses to evocative images (Roedema and Simons, 1999). This pattern emerged despite a wealth of contextual cues (e.g., provision of emotion label words; inclusion of simple and familiar themes, such as death), which have been shown to improve emotion recognition of others in alexithymia (Nook et al., 2015). Alexithymia is associated with inconsistencies between physiological and self-report indices of arousal, an effect described in the literature as a “physiological decoupling” (Stone and Nielson, 2001). For example, individuals with high and low alexithymia show similar electrodermal activity while viewing evocative videos (Stone and Nielson, 2001) and during experimental stressors (Connelly and Denney, 2007; Eastabrook et al., 2013); but see Neumann et al., 2004 for exception), yet report lower subjective arousal ratings. Other studies show that alexithymia is associated with reduced arousal measured physiologically (Constantinou et al., 2014; Peasley-Miklus et al., 2016) but not self-report measures of valence or arousal. Although the current study cannot directly examine this decoupling, as we did not measure physiological arousal, findings that alexithymia was associated with endorsements of “no emotion” as well as reduced subjective arousal is consistent with this account of alexithymia.

Alexithymia was associated with lower negative granularity, consistent with prior research (Erbaş et al., 2014) and consistent with Lane et al.’s (1997) developmental model of

emotional awareness. Alexithymia was also associated with decreased negative dialecticism at the trend level. Emotional granularity is associated with increased well-being and more frequent and successful acts of emotion regulation (Barrett et al., 2001; Erbas et al., 2014). Emotional dialecticism, the subjective co-occurrence of positive and negative emotions (Bagozzi et al., 1999), promotes physical health (Davis et al., 2004; Ong and Bergeman, 2004; Reich et al., 2003) and is associated with greater resilience in older adults (Ong and Bergeman, 2004). Reduced complexity of negative emotion may help explain reduced emotion regulation and elevated rates of mood disorders and symptoms in relation to alexithymia.

Neither total alexithymia nor alexithymia subscales were related to positive granularity or positive dialecticism. Alexithymia is associated with greater experiential avoidance (Panayiotou et al., 2015) and avoidant emotion regulation approaches (Swart et al., 2009). An eye tracking study shows alexithymia is associated with spending less time gazing at depressive images compared to happy, neutral or anxious images (Wiebe et al., 2017). Alexithymia is thought to entail a paucity of conceptual knowledge about emotional states (Kashdan et al., 2015; Lindquist and Barrett, 2008; Nook et al., 2015); it is possible that over time, avoidance of negative emotional states and stimuli impairs development of, or access to, conceptual knowledge of negative emotions. This is an empirical question for future studies. Importantly, the lack of a relationship between alexithymia and positive emotional granularity and dialecticism in the current study is suggestive of intact potential for more nuanced conceptual emotional knowledge within a non-clinical population with elevated alexithymia. Though there were no gender differences in TAS-20, it was interesting that males had lower positive (but not negative) granularity and dialecticism in the current study.

Alexithymia was associated with faster response times to questions about emotion experiences. This is in contrast to research showing emotion recognition in alexithymia may improve with greater time to process external emotional stimuli (Grynberg et al., 2012). Individuals with elevated alexithymia may benefit from taking longer to reflect on their own emotions. Constantinou and colleagues (2014) present individuals with evocative vignettes and instruct them to engage in “deep emotional processing,” imagining their emotions and feelings over a one-minute period. Afterwards, participants rated their valence, arousal, and select experienced affect labels from a list; there was no effect of alexithymia on responses. Given response time was the best predictor of the difficulty identifying feelings subscale of alexithymia, future research should examine whether increasing time spent processing one’s own emotions normalizes emotion identification in individuals with elevated alexithymia.

Regression analyses revealed each alexithymia subscale was differentially associated with a unique set of variables, though overall effects were small, and the model predicting DIF was non-significant. Study variables were most strongly associated with EOT. In particular, EOT was associated with greater endorsements of no emotion, faster RT to questions about emotional intensity, and reduced negative emotional dialecticism. Hock & Krohne (2004) showed that RT for reporting valence slows following ambiguous stimuli, consistent with findings from the present study of positive associations between emotional dialecticism and response. Together, faster RT and lower negative dialecticism are suggestive of reduced awareness of mixed-emotional states associated with EOT; alternatively, these findings may

also reflect a lack of engagement with the task at hand. DDF was associated with reduced negative granularity and self-report arousal ratings; it follows that greater granularity would promote better ability to describe one's feelings. Reduced self-report arousal is consistent with research show in DDF in particular is associated with differential physiological responses (Herbert et al., 2011).

It was surprising that affect labelling did not relate to DDF and DIF in regression models, given the relevance of affect labeling for identifying and describing feelings. There is some precedent for intact affect labeling measured using non-questionnaire assessments of emotional awareness in relation to DDF and DIF: research shows that EOT, but not DDF or DIF, is related to scores on the Levels of Emotional Awareness Scale (LEAS; Lane et al., 1998; Waller and Scheidt, 2004). LEAS is a performance-based emotional awareness assessment scored by measuring the complexity of emotional descriptors used to describe how an individual would feel in response to hypothetical scenarios (Lane et al., 1990). In addition, an important distinction of EOT is its stability over time (Cameron et al., 2014) relative to DDF and DIF, which show more state-like fluctuations (Coffey et al., 2003). Whereas DDF and DIF usually improve with intervention, EOT is more resistant to change (Cameron et al., 2014). Given its more trait-like features, contextual cues provided in the current study may have conferred less benefit for those with heightened EOT, resulting in a more robust predictive model of EOT. The current paradigm, in prompting participants to approach emotional experiences, may better assess aptitude for emotional processing rather than tendency to do so in daily life, the latter of which may be more intact as associated with DDF and DIF, given their more state-like quality. Deficits associated with DDF and DIF may be more apparent with subtler or more ambiguous emotional cues, and/or ecological assessment examining tendency to engage in emotional processes in naturalistic settings. In any case, replication and extension of current findings are essential to better understanding distinct factors underlying TAS-20 subscales, and increasing robustness of predictive models.

4.2 Limitations and Future Directions

The current sample represents healthy participants who endorsed no current or past psychiatric diagnosis. Alexithymia is dimensional and normally distributed; thus, assessing its behavioral composition in a normative sample is an important first step. However, this study would have benefited from consideration of depressive symptoms, known to affect levels of alexithymia. Though participants were screened for psychopathology, it is possible that sub-clinical depressive symptoms were present in this population. Relatedly, though we screened for common psychological disorders, it is possible that study participants had other serious psychological (e.g., eating disorders) or neurodevelopmental conditions (e.g., ASD) related to alexithymia. Replication in a broader sample is an important next step for further characterizing the role of alexithymia in clinical populations marked by heightened alexithymia (e.g., major depressive disorder).

Providing emotion labels was also an important first step for this line of work, as it replicated Gross and Levenson's (1995) initial design, making possible direct comparisons between the current student sample and large normative samples. However, emotion labels

provide cues that might increase the chance of responding based on external cues or demand characteristics. Further, interpretation of “no emotion” endorsements is limited by a lack of a physiological index of arousal; though past research demonstrates affective reactions to evocative stimuli associated with alexithymia, we cannot be certain there were not individual differences in physiology in the current study, explaining “no emotion” endorsements. Future research should examine affect labeling, and affect labeling response time, using a free response format and with physiological assessment.

There were also limitations of the stimuli employed. At 66%, consistent affect labels were lower than rates described in the original study (86%; Gross and Levenson, 1995; though of note, the current study included two additional options). Cultural or demographic differences may have contributed to differential patterns of responding. For example, one positive induction film depicts Robin Williams performing standup comedy. Data collection began shortly after William’s unfortunate death in August 2014, and 28% of participants endorsed sadness as a secondary emotion. This likely interfered with previously established norms. Furthermore, the high intensity, discrete affective states elicited in the current study occur relatively infrequently in everyday life. Similarly, because stimuli were intended to elicit a primarily negative or positive affective state, dialecticism as assessed in the current study should be considered preliminary. Future research investigating mixed emotion in alexithymia using ambiguous film clips and standardized approaches to assessing mixed emotion is an important next step (cf., Kreiberg & Gross, 2017), such as a stimuli set recently validated for eliciting positive, negative and mixed emotional states (Samson, Kreibig et al., 2015). Incorporating film clips with more ambiguous and modern content would improve the ecological validity of current findings related to affect labeling, granularity and dialecticism in relation to alexithymia.

This project was intended to take steps towards developing a phenotype of alexithymia that can be assessed and measured in laboratory-based settings. We subvert some inherent limitations of self-report by assessing constructs implicitly, allowing for a more objective assessment and reducing concern of response biases, problematic in alexithymia research. However, one’s degree of alexithymia is still based on self-report. Future studies can address this limitation by utilizing a broader battery of alexithymia assessment tools; for example, the Levels of Emotional Awareness Scale (LEAS; Lane, Quinlan, Schwartz, Walker, & Zeitlin, 1990), which scores the complexity of emotional descriptors used to describe how an individual would feel in response to hypothetical scenarios. Use of the LEAS also allows standardized assessment of the complexity of emotional descriptors, whereas the current study utilized a battery of emotion words with varying degrees of specificity.

4.2 Conclusions

The current study helps characterize the nature of alexithymia by examining the role of conceptually relevant constructs using performance-based measures, subverting some limitations of self-report. Utilization of standardized film clips allowed novel comparison of affect labeling of own emotions to comparison samples; however, alexithymia was associated with reporting the experience of “no emotion” following evocative film clips. When reporting on experienced emotions, alexithymia was associated with reduced

granularity and dialecticism of negative, but not positive emotions. Results highlight reduced awareness and complexity of emotions in relation to alexithymia, and point to a set of performance-based indicators that can be assessed and manipulated in laboratory-based settings to further clarify the theoretical underpinnings of the alexithymia construct. Replication is needed to continue clarifying affect labelling in alexithymia and importantly, its remediation, in more clinically diverse samples.

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References

- Bagby RM, Parker JD, Taylor GJ. The twenty-item Toronto Alexithymia Scale—I. Item selection and cross-validation of the factor structure. *Journal of psychosomatic research*. 1994; 38(1):23–32. [PubMed: 8126686]
- Bagozzi RP, Wong N, Yi Y. The role of culture and gender in the relationship between positive and negative affect. *Cognition & Emotion*. 1999; 13(6):641–672.
- Barrett LF, Gross J, Christensen TC, Benvenuto M. Knowing what you're feeling and knowing what to do about it: Mapping the relation between emotion differentiation and emotion regulation. *Cognition & Emotion*. 2001; 15(6):713–724.
- Berkman ET, Lieberman MD. Using neuroscience to broaden emotion regulation: Theoretical and methodological considerations. *Social and Personality Psychology Compass*. 2009; 3(4):475–493. [PubMed: 24052803]
- Brackett MA, Rivers SE, Reyes MR, Salovey P. Enhancing academic performance and social and emotional competence with the RULER feeling words curriculum. *Learning and Individual Differences*. 2012; 22(2):218–224.
- Bradley MM, Lang PJ. Measuring emotion: the self-assessment manikin and the semantic differential. *Journal of behavior therapy and experimental psychiatry*. 1994; 25(1):49–59. [PubMed: 7962581]
- Brewer R, Cook R, Bird G. Alexithymia: a general deficit of interoception. *Royal Society open science*. 2016; 3(10):150664. [PubMed: 27853532]
- Burger AJ, Lumley MA, Carty JN, Latsch DV, Thakur ER, Hyde-Nolan ME, Hijazi AM, Schubiner H. The effects of a novel psychological attribution and emotional awareness and expression therapy for chronic musculoskeletal pain: A preliminary, uncontrolled trial. *Journal of psychosomatic research*. 2016:1–8.
- Cameron, Ogrodniczuk J, Hadjipavlou G. Changes in alexithymia following psychological intervention: a review. *Harvard review of psychiatry*. 2014; 22(3):162–178. [PubMed: 24736520]
- Coffey E, Berenbaum H, Kerns J. Brief report. *Cognition & Emotion*. 2003; 17(4):671–679.
- Connelly M, Denney DR. Regulation of emotions during experimental stress in alexithymia. *Journal of Psychosomatic Research*. 2007; 62(6):649–656. [PubMed: 17540222]
- Constantinou E, Panayiotou G, Theodorou M. Emotion processing deficits in alexithymia and response to a depth of processing intervention. *Biological psychology*. 2014; 103:212–222. [PubMed: 25270514]
- Davis MC, Zautra AJ, Smith BW. Chronic pain, stress, and the dynamics of affective differentiation. *Journal of personality*. 2004; 72(6):1133–1160. [PubMed: 15509279]
- Donges US, Suslow T. Alexithymia and automatic processing of emotional stimuli: a systematic review. *Reviews in the Neurosciences*. 2017; 28(3):247–264. [PubMed: 28099136]
- Eastabrook JM, Lantaigne DM, Hollenstein T. Decoupling between physiological, self-reported, and expressed emotional responses in alexithymia. *Personality and Individual Differences*. 2013; 55(8):978–982.

- Eichmann M, Kugel H, Suslow T. Difficulty identifying feelings and automatic activation in the fusiform gyrus in response to facial emotion. *Perceptual and motor skills*. 2008; 107(3):915–922. [PubMed: 19235420]
- Erbas Y, Ceulemans E, Lee Pe M, Koval P, Kuppens P. Negative emotion differentiation: Its personality and well-being correlates and a comparison of different assessment methods. *Cognition and emotion*. 2014; 28(7):1196–1213. [PubMed: 24410047]
- Friedman J, Hastie T, Tibshirani R. Regularization paths for generalized linear models via coordinate descent. *Journal of statistical software*. 2010; 33(1):1. [PubMed: 20808728]
- Ghosh, D., Vogt, A. Outliers: An evaluation of methodologies, Joint Statistical Meetings. American Statistical Association; San Diego, CA: 2012. p. 3455-3460.
- Gross JJ. Emotion regulation: Current status and future prospects. *Psychological Inquiry*. 2015; 26(1): 1–26.
- Gross JJ, Levenson RW. Emotion elicitation using films. *Cognition & Emotion*. 1995; 9(1):87–108.
- Grynberg D, Chang B, Corneille O, Maurage P, Vermeulen N, Berthoz S, Luminet O. Alexithymia and the processing of emotional facial expressions (EFEs): systematic review, unanswered questions and further perspectives. *PLoS One*. 2012; 7(8):e42429. [PubMed: 22927931]
- Helwig NE. Adding bias to reduce variance in psychological results: A tutorial on penalized regression. *TUTORIALS IN QUANTITATIVE METHODS FOR PSYCHOLOGY*. 2017; 13(1):1–19.
- Herbert BM, Herbert C, Pollatos O. On the relationship between interoceptive awareness and alexithymia: is interoceptive awareness related to emotional awareness? *Journal of personality*. 2011; 79(5):1149–1175. [PubMed: 21241306]
- Hock M, Krohne HW. Coping with threat and memory for ambiguous information: testing the repressive discontinuity hypothesis. *Emotion*. 2004; 4(1):65. [PubMed: 15053727]
- Kashdan TB, Barrett LF, McKnight PE. Unpacking emotion differentiation transforming unpleasant experience by perceiving distinctions in negativity. *Current Directions in Psychological Science*. 2015; 24(1):10–16.
- Keefer KV, Taylor GJ, Parker JD, Bagby RM. Taxometric Analysis of the Toronto Structured Interview for Alexithymia: Further Evidence That Alexithymia Is a Dimensional Construct. *Assessment*. 2017 1073191117698220.
- Kircanski K, Lieberman MD, Craske MG. Feelings into words: contributions of language to exposure therapy. *Psychological science*. 2012; 23(10):1086–1091. [PubMed: 22902568]
- Lane RD, Ahern GL, Schwartz GE, Kaszniak AW. Is alexithymia the emotional equivalent of blindsight? *Biological psychiatry*. 1997; 42(9):834–844. [PubMed: 9347133]
- Lane RD, Quinlan DM, Schwartz GE, Walker PA, Zeitlin SB. The Levels of Emotional Awareness Scale: A cognitive-developmental measure of emotion. *Journal of personality assessment*. 1990; 55(1–2):124–134. [PubMed: 2231235]
- Lane RD, Schwartz GE. Levels of emotional awareness: A cognitive-developmental theory and its application to psychopathology. *The American journal of psychiatry*. 1987
- Lane RD, Sechrest L, Riedel R. Sociodemographic correlates of alexithymia. *Comprehensive psychiatry*. 1998; 39(6):377–385. [PubMed: 9829146]
- Leising D, Grande T, Faber R. The Toronto Alexithymia Scale (TAS-20): A measure of general psychological distress. *Journal of research in personality*. 2009; 43(4):707–710.
- Leweke F, Leichsenring F, Kruse J, Hermes S. Is alexithymia associated with specific mental disorders. *Psychopathology*. 2011; 45(1):22–28. [PubMed: 22123513]
- Li S, Zhang B, Guo Y, Zhang J. The association between alexithymia as assessed by the 20-item Toronto Alexithymia Scale and depression: A meta-analysis. *Psychiatry research*. 2015; 227(1):1–9. [PubMed: 25769520]
- Lieberman MD, Eisenberger NI, Crockett MJ, Tom SM, Pfeifer JH, Way BM. Putting feelings into words. *Psychological science*. 2007; 18(5):421–428. [PubMed: 17576282]
- Lieberman MD, Inagaki TK, Tabibnia G, Crockett MJ. Subjective responses to emotional stimuli during labeling, reappraisal, and distraction. *Emotion*. 2011; 11(3):468. [PubMed: 21534661]
- Lindquist KA, Barrett LF. Emotional complexity. *Handbook of emotions*. 2008:513–530.

- Lindquist KA, Satpute AB, Gendron M. Does language do more than communicate emotion? *Current Directions in Psychological Science*. 2015; 24(2):99–108. [PubMed: 25983400]
- Linehan, M. *Cognitive-behavioral treatment of borderline personality disorder*. Guilford Press; 1993.
- Lüdtke J, In-Albon T, Michel C, Schmid M. Predictors for DSM-5 nonsuicidal self-injury in female adolescent inpatients: The role of childhood maltreatment, alexithymia, and dissociation. *Psychiatry research*. 2016; 239:346–352. [PubMed: 27088878]
- Lumley, MA., Beyer, J., Radcliffe, A. *Emotion Regulation*. Springer; 2008. Alexithymia and physical health problems: a critique of potential pathways and a research agenda; p. 43–68.
- Lynch TR, Chapman AL, Rosenthal MZ, Kuo JR, Linehan MM. Mechanisms of change in dialectical behavior therapy: Theoretical and empirical observations. *Journal of clinical psychology*. 2006; 62(4):459–480. [PubMed: 16470714]
- Marchesi C, Bertonni S, Cantoni A, Maggini C. Is alexithymia a personality trait increasing the risk of depression? A prospective study evaluating alexithymia before, during and after a depressive episode. *Psychological medicine*. 2008; 38(12):1717–1722. [PubMed: 18366825]
- Neumann SA, Sollers JJ, Thayer JF, Waldstein SR. Alexithymia predicts attenuated autonomic reactivity, but prolonged recovery to anger recall in young women. *International Journal of Psychophysiology*. 2004; 53(3):183–195. [PubMed: 15246672]
- Niles AN, Craske MG, Lieberman MD, Hur C. Affect labeling enhances exposure effectiveness for public speaking anxiety. *Behaviour research and therapy*. 2015; 68:27–36. [PubMed: 25795524]
- Nook EC, Lindquist KA, Zaki J. A new look at emotion perception: Concepts speed and shape facial emotion recognition. *Emotion*. 2015; 15(5):569. [PubMed: 25938612]
- Ong AD, Bergeman CS. The complexity of emotions in later life. *The Journals of Gerontology Series B: Psychological Sciences and Social Sciences*. 2004; 59(3):P117–P122.
- Panayiotou G, Leonidou C, Constantinou E, Hart J, Rinehart KL, Sy JT, Björgvinsson T. Do alexithymic individuals avoid their feelings? Experiential avoidance mediates the association between alexithymia, psychosomatic, and depressive symptoms in a community and a clinical sample. *Comprehensive psychiatry*. 2015; 56:206–216. [PubMed: 25263517]
- Panos PT, Jackson JW, Hasan O, Panos A. Meta-analysis and systematic review assessing the efficacy of dialectical behavior therapy (DBT). *Research on Social Work Practice*. 2013 1049731513503047.
- Peasley-Miklus CE, Panayiotou G, Vrana SR. Alexithymia predicts arousal-based processing deficits and discordance between emotion response systems during emotional imagery. *Emotion*. 2016; 16(2):164. [PubMed: 26461248]
- Reich JW, Zautra AJ, Davis M. Dimensions of affect relationships: Models and their integrative implications. *Review of General Psychology*. 2003; 7(1):66.
- Reker M, Ohrmann P, Rauch AV, Kugel H, Bauer J, Dannlowski U, Arolt V, Heindel W, Suslow T. Individual differences in alexithymia and brain response to masked emotion faces. *cortex*. 2010; 46(5):658–667. [PubMed: 19524887]
- Roedema TM, Simons RF. Emotion-processing deficit in alexithymia. *Psychophysiology*. 1999; 36(3):379–387. [PubMed: 10352562]
- Saarijärvi S, Salminen J, Toikka T. Temporal stability of alexithymia over a five-year period in outpatients with major depression. *Psychotherapy and psychosomatics*. 2006; 75(2):107–112. [PubMed: 16508346]
- Stone LA, Nielson KA. Intact physiological response to arousal with impaired emotional recognition in alexithymia. *Psychotherapy and psychosomatics*. 2001; 70(2):92–102. [PubMed: 11244390]
- Swart M, Kortekaas R, Aleman A. Dealing with feelings: characterization of trait alexithymia on emotion regulation strategies and cognitive-emotional processing. *PLoS One*. 2009; 4(6):e5751. [PubMed: 19492045]
- Thorberg FA, Young RM, Sullivan KA, Lyvers M. Alexithymia and alcohol use disorders: a critical review. *Addictive behaviors*. 2009; 34(3):237–245. [PubMed: 19010601]
- Tugade MM, Fredrickson BL, Feldman Barrett L. Psychological resilience and positive emotional granularity: Examining the benefits of positive emotions on coping and health. *Journal of personality*. 2004; 72(6):1161–1190. [PubMed: 15509280]

- Waller E, Scheidt CE. Somatoform disorders as disorders of affect regulation: a study comparing the TAS-20 with non-self-report measures of alexithymia. *Journal of psychosomatic research*. 2004; 57(3):239–247. [PubMed: 15507250]
- Watson D, Clark LA, Tellegen A. Development and validation of brief measures of positive and negative affect: the PANAS scales. *Journal of personality and social psychology*. 1988; 54(6):1063. [PubMed: 3397865]
- Westwood H, Kerr-Gaffney J, Stahl D, Tchanturia K. Alexithymia in eating disorders: Systematic review and meta-analyses of studies using the Toronto Alexithymia Scale. *Journal of psychosomatic research*. 2017
- Wiebe A, Kersting A, Suslow T. Deployment of attention to emotional pictures varies as a function of externally-oriented thinking: An eye tracking investigation. *Journal of behavior therapy and experimental psychiatry*. 2017; 55:1–5. [PubMed: 27838297]
- Wotschack C, Klann-Delius G. Alexithymia and the conceptualization of emotions: A study of language use and semantic knowledge. *Journal of research in Personality*. 2013; 47(5):514–523.
- Zou H, Hastie T. Regularization and variable selection via the elastic net. *Journal of the Royal Statistical Society: Series B (Statistical Methodology)*. 2005; 67(2):301–320.

Appendix A

IN-DEEP Variable	1	2	3	4	5	6	7	8	9	10	11
1. Consistent Affect Labeling		0.134	0.225	0.92	0.546	0.983	0.477	0.013	0.788	0.621	0.051
2. Primary Intensity	0.145		<.001	0.211	0.129	0.987	0.016	0.409	0.321	0.039	0.938
3. Primary Arousal	0.118	0.433**		0.875	0.731	0.567	0.178	0.947	0.173	0.014	0.97
4. Affect Labelling RT	0.01	0.121	0.015		<.001	<.001	<.001	0.818	0.245	0.983	0.354
5. Primary Intensity RT	-0.059	-0.147	0.033	.552***		<.001	<.001	0.898	0.281	0.121	0.679
6. Primary Arousal RT	-0.002	0.002	-0.056	.422***	.502***		<.001	0.157	0.627	0.798	0.149
7. Secondary Intensity RT	0.069	0.231*	-0.130	.512***	.525***	.550***		0.79	0.129	0.002	<.001
8. Negative Granularity	.239*	-0.080	-0.006	-0.022	-0.012	-0.137	-0.026		0.143	0.801	0.876
9. Positive Granularity	-0.026	0.096	-0.132	0.113	0.105	0.047	0.147	0.142		0.384	0.756
10. Negative Dialecticism	0.048	0.199*	0.236*	0.002	-0.150	0.025	.300**	-0.025	0.085		0.002
11. Positive Dialecticism	-0.189	-0.008	-0.004	0.09	0.04	0.140	.364***	0.015	0.030	.298***	

Appendix B. Spearman correlations between IN-DEEP task variables. Values below the diagonal represent rho values; values above indicate *p* values.

† *p* < .10;

* *p* < .05;

** *p* < .01;

*** *p* < .001 and correlations remain significant following Bonferroni correction (*p* < .0008).

Appendix B

Predictor	Lower Bound	β Estimate	Upper Bound
DDF			
Primary Arousal	0.00	0.45	0.91
Primary Arousal RT	0.00	0.00	0.00
Negative Granularity	-0.09	0.30	0.68

Predictor	Lower Bound	β Estimate	Upper Bound
DIF			
No Affect Label	−0.75	0.63	0.88
Primary Intensity	−0.73	−0.09	0.55
Affect Label RT	0.00	0.00	0.00
Primary Arousal RT	0.00	0.00	0.00
Primary Intensity RT	0.00	0.00	0.00
Secondary Intensity RT	0.00	0.00	0.00
Negative Granularity	−0.59	0.01	0.61
Negative Dialecticism	−2.24	−0.15	1.95
Positive Granularity	−0.49	0.07	0.62
EOT			
No Affect Label	−0.28	0.33	0.94
Primary Arousal	−0.32	0.18	0.69
Affect Label RT	0.00	0.00	0.00
Primary Intensity RT	0.00	0.00	0.00
Secondary Intensity RT	0.00	0.00	0.00
Negative Dialecticism	−3.00	−1.42	0.16
Positive Granularity	−0.63	−0.89	0.46

Appendix A. Predicting TAS-20 subscales from IN-DEEP using elastic net regression with bootstrapped 90% confidence interval estimates.

Highlights

- Alexithymia associated with experiencing ‘no emotion’ following evocative videos
- Alexithymia associated with reduced complexity of negative emotions
- Complexity of positive emotions intact in alexithymia
- Alexithymia subscales predicted by distinct subsets of emotional variables

Table 1

Means and standard deviations of IN-DEEP variables.

Descriptive Information			Correlation with TAS-20 Total Score	
IN-DEEP Variable	Scale	Mean	SD	ρ
Consistent Affect Label	%	0.66	0.14	−0.211 [*]
Primary Intensity	1–9	5.86	1.02	−0.104
Primary Arousal	1–9	4.55	1.14	0.229 [*]
Emotion Labeling RT	seconds	8.83	2.71	−0.122
Primary Intensity RT	seconds	4.01	1.34	−0.250 ^{**}
Primary Arousal RT	seconds	4.07	1.18	−0.106
Secondary Intensity RT	seconds	1.47	0.4	−0.276 ^{**}
Negative Granularity	z score ^a	0.86	0.15	−0.190 [*]
Positive Granularity	z score ^a	0.92	0.17	−0.076
Negative dialecticism	ratio	0.65	0.65	−0.186 [†]
Positive Dialecticism	ratio	0.26	0.16	−0.076

Note.

[†]
 $p < .10$;^{*}
 $p < .05$;^{**}
 $p < .01$.^a Represents the result of subtracting the average ICC from 1 and applying a z score transformation.

Table 2

Results of linear regression models predicting TAS-20 subscales;

		Coefficients				Model Summary			
		Beta	t	p	R ²	F	p	f ²	
DDF	Primary Arousal	-0.25	-2.75**	0.007					
	Primary Arousal RT	-0.13	-1.44	0.154					
	Negative Granularity	-0.19	2.03*	0.045					
					0.12	4.65**	0.004	0.13	
DIF	"No Emotion" Endorsements	0.16	0.47	0.638					
	Primary Intensity	-0.46	-1.21	0.228					
	RT Overall Composite	-1.02	-2.17*	0.033					
	Negative Granularity	-0.20	0.53	0.599					
	Positive Granularity	-0.35	0.91	0.364					
	Positive Dialecticism	-0.66	-0.33	0.739					
					0.10	1.8	0.100	0.11	
EOT	"No Emotion" Endorsements	0.20	1.95 [†]	0.054					
	Nonstandard Affect Label	0.14	1.54	0.127					
	Primary Arousal	-0.09	-0.87	0.389					
	RT Composite	-0.15	-1.61	0.110					
	Positive Granularity	0.08	-0.89	0.375					
	Negative Dialecticism	-0.19	-2.02*	0.046					
					0.16	3.18**	0.007	0.19	

Note.

[†]
 $p < .10$;*
 $p < .05$;**
 $p < .01$.