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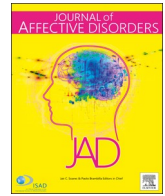
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## Research paper

## Emotional complexity across the life story: Elevated negative emodiversity and diminished positive emodiversity in sufferers of recurrent depression

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## A B S T R A C T

**Background:** Greater diversity in the experience of negative and positive emotions – emodiversity - is associated with better mental health outcomes in the general population (Quoidbach et al. 2014). However, conceptual accounts of depression suggest this might differ in clinical depression. In this study, the diversity of negative and positive emotion experiences as remembered by a recurrently depressed sample and a never-depressed control group were compared.

**Methods:** Emodiversity was assessed using a life structure card sort task which allowed for the assessment of memory for emotional experience over the life course. Depressed ( $n = 34$ ) and non-depressed ( $n = 34$ ) participants completed the card sort task, from which emodiversity metrics were calculated for negative and positive emotion experience.

**Results:** Depressed individuals showed recollections of enhanced emodiversity across negative emotion but reduced emodiversity across positive emotion, relative to never-depressed individuals.

**Limitations:** This study involved a relatively small sample size.

**Discussion:** This study indicates that greater diversity of negative emotion experience, which has been interpreted as a protective factor against depressed mood in community samples (Quoidbach et al., 2014), instead characterises the remembered experience of recurrent clinical depression. The finding that positive emodiversity is adaptive in depression suggests that therapeutic outcomes may be improved by facilitating exposure to a diverse range of positive emotions. These findings indicate that the relationship between emotion diversity and mental health is more complex than hitherto assumed.

*“People sometimes talk of feeling alive, dead, distant, detached, dislodged, estranged, isolated, otherworldly, indifferent to everything, overwhelmed, suffocated, cut off, lost, disconnected, out of sorts, not oneself, out of touch with things, out of it, not quite with it, separate, in harmony with things, at peace with things or part of things. There are references to feelings of unreality, heightened existence, surreality, familiarity, unfamiliarity, strangeness, isolation, emptiness, belonging, being at home in the world, being at one with things, significance, insignificance and the list goes on.”* (Ratcliffe, 2008).

Emotions sit at the core of human experience. The nature of subjective emotional experiences has provoked much philosophical debate and more recently scientific investigation (Power & Dalgleish, 2015). A robust finding is that mental health and wellbeing are predicated upon the experience of relatively high levels of positive emotions, and lower levels of negative emotions (e.g., Fredrickson, 2001). However, this represents an incomplete picture and there is increasing interest in how the complexity of emotion experience, over and above the balance of positive and negative felt emotions, can underpin mental health (Barrett, 2017).

The prototypical methodology for examining emotional complexity has been to ask people in detail how they feel, and then interrogate these responses (Lindquist & Barrett, 2008). Two proposed key aspects of emotion complexity have emerged from this work. Dialecticism or covariation refers to the experience of both positive and negative emotional states in a contemporaneous way, or in ways that are temporally related (Bagozzi, Wong, & Yi, 1999). Greater complexity is associated with greater dialecticism due to the requisite ability to conceptualize and experience contradiction. Granularity (Barrett, 1998, 2004; Barrett, Gross, Christensen, & Benvenuto, 2001) refers to the degree to which individuals can describe their emotional life with precision, using discrete emotion descriptors to precisely characterize different emotions, in place of broader superordinate terms reflecting the pleasantness or unpleasantness of experience. Both forms of complexity reflect the underlying conceptual structure of a person's knowledge of emotions – a construct that varies considerably across development, culture, gender and mental health status (Lane & Schwartz, 1987; Lindquist & Barrett, 2008). More recently, attention has turned to examining the diversity of emotion experiences

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(Quoidbach et al., 2014; although see Sommers, 1981, for discussion of ‘emotional range’). It has been suggested that more differentiation in experienced emotion states (e.g., excitement, joy) has greater adaptive value than less differentiated global states (e.g., feeling good) because differentiated states can be more easily identified and understood by others, are less subject to misattribution, and provide richer information to guide the use of emotion regulation strategies in affective contexts (Barrett & Gross, 2001). This reflects a broader notion that psychological flexibility is beneficial for adaptive mental functioning and health (e.g., Kashdan & Rottenberg, 2010).

The putative benefits of greater emotional diversity – or emodiversity as it was termed – were examined by Quoidbach et al. (2014) where a survey of 37,000 participants from the general population were surveyed with measures of depressive symptoms and diversity of experienced emotion (emodiversity) recorded. Quoidbach et al. (2014) modified the Shannon biodiversity index, which quantifies the number of species and the evenness of species in an ecosystem (Shannon, 1948), to assess the number of specific emotions experienced (richness), and the relative proportions with which those specific emotions were experienced (evenness), as reported on a standardized questionnaire. Results suggested that greater levels of emodiversity, regardless of emotion valence, was associated with better mental health (Quoidbach et al., 2014; see also Brown & Coyne, 2017, and Quoidbach, Mikolajczak, Gruber, Kotsou, Kogan & Norton, 2018, for further discussion).

In the current study we sought to expand Quoidbach et al.’s (2014) findings and extend the investigation of the relationship between emodiversity and depression to look at clinical manifestations of depression. Complexity in the reported experience of emotion is believed to reflect greater sophistication in the underlying conceptual structure of emotions. Models of the development of the conceptual understanding of emotions, for example the Levels of Emotional Awareness (LEA) approach (Lane & Schwarz, 1987), propose that increased granularity, dialecticism and diversity within emotion experience evolve as a function of the underlying development of emotion schemas, beginning in early childhood. It is proposed that the individual differences in emotional awareness and complexity that develop across time reflect differences in the sophistication of the underlying schema structure that arise in part as a function of differential exposure to more complex emotional experiences (Lane & Nadel, 2000).

Within this analysis, individuals who have experienced chronic depression may display enhanced complexity and diversity across the myriad negative emotional experiences that characterize the depressed state, due to their lifelong immersion in such negative affective constructs (Beck, Rush, Shaw, & Emery, 1979; Ratcliffe, 2015; Watson, Clark, & Carey, 1988). If this was the case, one would predict that individuals with chronic depression, unlike those with elevated depression scores in a general population community sample (Quoidbach et al., 2014), would in fact present with higher levels of emodiversity for negative emotions relative to those who have never suffered depression. Here, the emodiversity reflects lifelong ‘expertise’ rather than acting as some form of protective factor (cf. Quoidbach et al., 2014).

Emodiversity for positive emotions in chronically depressed individuals, on the other hand, would be expected to be reduced, relative to healthy controls, in line with the results of Quoidbach et al. (2014) showing that lower positive emodiversity was associated with higher self-reported depressive symptoms. This is because depressed individuals experience profound deficits in the experience of general positive affect (Bylsma, Morris, & Rottenberg, 2008; Rottenberg, Kasch, Gross, & Gotlib, 2002), with some indication of deficits across discrete positive emotions such as pride, happiness and amusement (Gruber, Oveis, Keltner, & Johnson, 2011).

We examined these hypotheses by measuring emodiversity for positive and negative emotion constructs as recalled by a treatment-resistant chronically depressed clinical sample, relative to participants

who had never experienced depression. Our predictions were for greater emodiversity in negative memory recollection by the depressed group, and reduced emodiversity in the positive domain, relative to never-depressed controls.

To evaluate these questions, we extended the methodology used by Quoidbach et al. (2014), utilising an approach employed by Clifford et al. (2020). In the original Quoidbach et al. study, a standardized 18-item questionnaire was completed by participants to indicate how frequently they experience a discrete set of emotions, from which emodiversity calculations were made (Philippot, Schaefer, & Herbette, 2003). In the current study, we wanted to explicitly measure emotion experience retrospectively across the life course. To do this, we employed a card-sorting task that we have used previously to investigate how individuals think about and remember their emotional life history (Dalgleish, Hill, Golden, Morant, & Dunn, 2011). In this procedure, participants construct autobiographical timelines by dividing their lives into subjectively defined discrete chapters (e.g., ‘being a student’; ‘intimate relationships’; ‘parenting’). Participants are then presented with a set of cards, each showing an emotion construct that could be used to describe a period of one’s life. Relevant cards are then sorted into life chapters. For example, using the adjective *joyful*, a participant must decide first, whether this description applies to any of their identified life chapters, and if so, whether it applies to one (e.g., being a student), or multiple (e.g., being a student and being a parent) chapters. Cards are then allocated to chapters accordingly and participants choose whether each card gets used repeatedly, once, or not at all (Showers, 1992). The advantage of using this method is that it captures important information across the life course (Clifford et al., 2020), and extends on previous work which has been focused on recent emotion experience only.

We previously showed (Dalgleish et al., 2011) that depressed individuals reported greater negativity (overall proportion of cards selected that are negative in valence, relative to number of total cards selected), greater negative redundancy and reduced positive redundancy (the extent to which the same cards are used repeatedly across the life story); and greater compartmentalization (degree of separation of clusters of positive and negative words into different chapters), relative to never-depressed individuals. We calculated these metrics and verified these relationships in the present study because we wanted to evaluate whether emodiversity in a given affective domain is isomorphic to a greater propensity to simply use more descriptors from that domain (cf. Quoidbach et al., 2014). We also wanted to explore the relationship between emodiversity and redundancy.

## 1. Method

### 1.2. Participants

Power calculations for minimal sample size estimations per group were made on the basis of the smallest effect size (Cohen’s  $d = .96$ ) for the life structure metrics assessed via the card-sort test between the MDD and control groups in Dalgleish et al. (2011). With 80% power and alpha set at .05 (two-tailed), this indicated minimum sample sizes of 19 per group. A chronically/recurrently-depressed group ( $n = 34$ ) and a never-depressed comparison group ( $n = 34$ ) were included in this study<sup>1</sup>. Participants in the depressed group were recruited through two avenues. Fourteen participants had consented to take part in a clinical trial examining treatment for refractory unipolar depressive disorder (Morris et al., 2016). The inclusion criteria for this trial were a primary diagnosis of recurrent depression, with continuous care being received from at least one health care professional in the preceding six months,

<sup>1</sup> An additional never-depressed participant was recruited but selected no negative adjectives in the task and so their data were set aside. Results including these data were the same as the presented analyses.

and currently being under the care of a secondary-care community mental health team. Individuals who reported depression in the context of Bipolar Disorder were not eligible. The remaining 20 participants were recruited from a community-based patient panel and had previously responded to advertisements requesting volunteers with depression to assist with research. Inclusion criteria applied to these participants were a diagnosis of chronic or recurrent depression with at least 3 episodes<sup>2</sup>. For trial participants, this research study took place approximately 2-3 weeks after the baseline assessment for trial entry, and before participants were randomized to a treatment condition. To ascertain depression status, depression history and other Axis I psychiatric comorbidity, participants were administered the Structured Clinical Interview for the *DSM-IV* Axis I Disorders-Clinician Version (SCID-IV; First, Spitzer, Gibbons, & Williams, 1996). These interviews were audio-taped and 60% were independently rated by a senior Clinical Psychologist (TD). There were no discrepancies in diagnosis.

An age-matched never-depressed control group was recruited from the Cognition and Brain Sciences Unit Volunteer Panel, which comprises community members who have previously responded to advertisements requesting volunteers for research. These individuals were administered the Mood Module of the SCID-IV by phone prior to being invited into the study. During the screen, prospective participants were also questioned about general emotional health and anxiety. Participants with no previous history of mental health difficulties were then invited to participate. To be eligible for the study participants needed to be over the age of 18 years and fluent in English.

### 1.3. Materials and Measures

**Life Structure Card Sort Task.** The card sort task was used exactly as described previously (Dalglish et al., 2011). In brief, participants were asked to think back over their life and divide it into chapters. Participants then provided a heading for each chapter and completed the card sort task. For this, participants use a deck of 46 randomly ordered cards, with each containing an emotional adjective or phrase potentially described a predominant feeling characterizing a particular period of one's life (e.g., 'gloomy', 'overjoyed' 'insecure', 'happy', 'depressing', 'joyful'). The adjectives were positive or negative (23 of each) and valence ratings had previously been validated in pilot testing to ensure comparable intensity levels for the positive and negative sets (see Dalglish et al., 2011 for details). Participants were instructed to select relevant cards for each life chapter in turn, using as many or as few adjectives as were relevant, with repetitions across different chapters permitted. The adjectives assigned to each chapter were recorded by the experimenter. We used a lower age limit for the earliest chapter of 11-12 years old to avoid the possibility that differential levels of childhood amnesia could influence the narratives that were generated.

**Emodiversity.** Emodiversity was calculated based on the formula provided by Quoidbach et al (2014), and originally derived from the Shannon biodiversity index (Shannon, 1948), as follows:

$$\text{Emodiversity} = \sum_{i=1}^s (p_i \times \ln p_i)$$

Where  $s$  = the number of total number emotional trait adjective cards used in the card sort task by a given participant, and  $p_i$  is the proportion of  $s$  made up by cards for each emotion trait experienced. A value is calculated for each distinct trait card used, which is then imputed into the above formula. This calculation takes into account both the number of traits reported as experienced (richness), and the degree to which different traits make up an individual's emotional experience

<sup>2</sup>Life structure data for 16 of the depressed sample were reported in our previous study (Dalglish et al., 2011) and we extended this sample to the current  $n=34$  for the emodiversity analyses.

**Table 1**  
Means (and standard deviations) of participant characteristics

	Depressed ( $n = 34$ )	Never-Depressed ( $n = 34$ )
Age (years)	48.79 (12.43)	48.71 (10.60)
Gender (male:female)	13:21	7:27
BDI-II	25.94 (10.43)	3.08 (4.13)
STAI-Trait	57.07 (10.58)	33.48 (9.00)
PANAS (negative emotion)	20.75 (8.99)	12.96 (4.11)
PANAS (positive emotion)	25.51 (8.09)	36.69 (7.05)

BDI-II = Beck Depression Inventory (version II). STAI-State Trait Anxiety Inventory (Trait version). PANAS = Positive and Negative Affect Schedule.

(evenness/abundance)<sup>3</sup>. High values represent a more diverse emotional experience, and emodiversity indices are calculated separately for negative and positive emotions.

### 1.4. Life Structure Metrics

Four life structure metrics (proportion of negative cards used, compartmentalization, and positive and negative redundancy), as outlined in the Introduction, were measured in the same way as reported in Dalglish et al. (2011). The first metric, proportion of negative cards used, indexes degree of negative words associated with the life story overall; the second metric, compartmentalization, indicates the degree of separation of clusters of negative and positive words into separate life chapters; the third and fourth metrics refer to negative and positive redundancy, which are indexed by the extent to which the same cards are used repeatedly across life chapters. See Supplementary Materials for details.

### 1.5. Self-Report Measures

The Beck Depression Inventory-II (BDI-II; Beck et al., 1996) is a widely used measure of depressive symptoms over the previous two weeks and was included to verify symptom severity. The Spielberger State Trait Anxiety Inventory (STAI; Spielberger, Gorsuch, Lushene, Vagg, & Jacobs, 1983) is a psychometrically sound instrument used to measure anxiety and the trait version was included; the Positive and Negative Affect Schedule (PANAS; Watson, Clark, & Tellegen, 1988) is a 20-item measure of positive and negative affect. The 10-item negative and 10-item positive emotion scales was administered respectively.

### 1.6. Procedure

Ethical approval was obtained from the UK National Research Ethics Committee ('Mnemonics'; East of England, 11/H0305/1). After providing informed consent, participants completed the tasks and measures individually and face-to-face with the experimenter, in a quiet testing room. Testing occurred over two face-to-face sessions for the experimental group (a clinical interview session and the experimental session), and over one phone session (in which the Mood Module of the SCID-IV was administered) and one face-to-face session for the never-depressed group. In the experimental session, no more than two weeks after the SCID-IV session, participants completed the life structure card sort task. These experimental procedures took 1.5-2 hours. After the study, participants were debriefed and received a small honorarium (£6/hour).

<sup>3</sup>There are several different biodiversity metrics that can be used to assess emodiversity (Benson, Ram, Almeida, Zautra, & Ong, 2017). The Shannon Index was selected in this study because it provides a measure of both evenness and richness, while others do not.

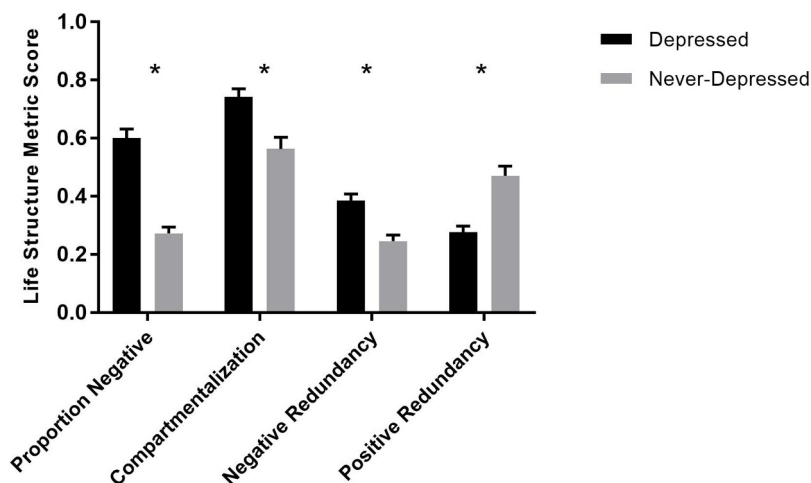


Figure 1. Mean (+1 SE) scores on life chapter metrics for proportion of negative cards used, compartmentalization, and positive and negative redundancy.

## 2. Results

### 2.1. Participant Characteristics

Participants in the depressed group had experienced a long history of depression (19 of the 34 participants had experienced more Major Depressive Episodes (MDEs) than they were able to count). All but three of these participants were taking antidepressant medication.

The remaining descriptive group data are presented in Table 1. The groups did not differ in age,  $t(66) = .03$ ,  $p = .96$ , or gender ratio,  $p = .11$  ( $\chi^2 = 2.55$ ). As expected, there were differences in BDI-II score,  $t(43.10) = 11.88$ ,  $p < .001$ , STAI-Trait score,  $t(66) = 9.90$ ,  $p < .001$ , and state negative emotion,  $t(46.22) = 4.60$ ,  $p < .001$ , with the depressed group scoring higher in all three cases. There was also a difference in state positive emotion,  $t(66) = 6.07$ ,  $p < .001$ , with the depressed group scoring lower.

### 2.2. Life Structure Metrics

All participants identified multiple chapters to describe their autobiographical history (smallest number of chapters = 3). The groups did not differ in terms of number of chapters (dep = 9.71 (2.63); control = 9.56 (2.97)),  $t(66) = .22$ ,  $p = .83$ , nor in the total number of cards (including repetitions) used in the card sort (dep = 129.94 (64.13); control = 126.03 (50.02)),  $t(66) = .28$ ,  $p = .78$ , suggesting that both groups were similarly engaged in the task and any differences on emodiversity and structure metrics were not merely a function of chapter quantity and/or number of cards used in the sort.

The life structure data are presented in Figure 1. We first examined whether life structure differed between the two groups on the four metrics of interest to establish that the effect reported in our previous study (Dagleish et al., 2011) held up in our extended sample. To do this we conducted a MANOVA with the four past life structure metrics as the univariate dependent variables (cf. Dagleish et al., 2011). There was a significant multivariate effect of Group, Wilks' Lambda = .43,  $F(4,63) = 21.04$ ,  $p < .0001$ ,  $\eta_p^2 = .57$ , which was supported by significant univariate Group effects for all four metrics, with the depressed group using a greater proportion of negative words,  $F(1,66) = 74.68$ ,  $p < .001$ ,  $\eta_p^2 = .53$ , greater compartmentalization (greater separation of clustered positive and negative trait word use across different chapters),  $F(1,66) = 13.56$ ,  $p < .001$ ,  $\eta_p^2 = .17$ , greater negative redundancy (the tendency to endorse the same negative adjectives across the whole life structure),  $F(1,66) = 19.77$ ,  $p < .001$ ,  $\eta_p^2 = .23$  and lower positive redundancy (the tendency to endorse fewer of the same positive adjectives across the whole life structure),  $F(1,66) = 24.27$ ,  $p < .001$ ,  $\eta_p^2 = .27$ , than their never-depressed peers.

### 2.3. Emodiversity

The emodiversity data are presented in Figure 2. Across all participants, negative and positive emodiversity scores were not significantly correlated,  $r(66) = -.08^4$ ,  $p = .54$  supporting the view that it is valid to examine diversity indices separately across different valence domains (Quoidbach et al., 2014). To examine patterns of positive and negative emodiversity across groups, we conducted a mixed model ANOVA with Valence (negative, positive) as the within-subjects factor, Group (depressed, never-depressed) as the between-groups factor, and emodiversity index as the dependent variable. There were no significant effects of Valence  $F(1,66) = 2.84$ ,  $p = .10$ ,  $\eta_p^2 = .04$ , or Group  $F < 1$ , providing no support for overall differences in emodiversity as a function of depression. As hypothesized, there was a significant Valence  $\times$  Group interaction,  $F(1,66) = 29.32$ ,  $p < .001$ ,  $\eta_p^2 = .31$ . Follow-up analyses showed, that those in the depressed group evidenced greater emodiversity for negative emotions, relative to controls,  $t(60.53) = 3.73$ ,  $p = .001$ ,  $d = 0.92$  (95%CI: 0.41-1.41) but lower levels of emodiversity with respect to positive emotions,  $t(46.93) = 3.55$ ,  $p = .001$ ,  $d = -0.87$  (95%CI: -1.36-(-0.37)).

An alternative way to examine the relationship between emotional diversity and overall emotionality is to use the number of negative cards selected in the card sort. Clearly, greater emotional diversity necessarily requires the selection of a greater number of negative cards so we cannot simply use the latter in our analyses. However, we can compute the number of times a given diverse set of selected negative cards is used repeatedly by a particular participant across their life structure (Negative Repetitions). To calculate this we used the following formula: Negative Repetitions = (Total number of negative cards used – number of distinct negative cards used)/number of distinct negative cards used.

Unsurprisingly, the depressed group had higher level of Negative Repetitions reflecting a greater repeated endorsement of their diverse set of negative cards across the life course ( $M = 2.70$ ,  $SD = 1.68$ ) relative to the never-depressed group ( $M = 1.17$ ,  $SD = 0.90$ ),  $t(50.56) = 4.66$ ,  $p < .001$ ,  $d = 1.13$ . However, when we entered these Negative Repetition scores into our main emodiversity analyses the pattern of results was again unchanged, with a significant Valence  $\times$  Group interaction,  $F(1,65) = 16.10$ ,  $p = .001$ ,  $\eta_p^2 = .20$  and follow-up tests showing greater emodiversity for negative emotion among depressed compared to never-depressed participants,  $F(1,65) = 4.61$ ,  $p = .036$ ,  $\eta_p^2 = .07$  but

<sup>4</sup> Correlations between negative and positive emodiversity were examined separately in each group, and were not significantly associated in either the depressed group,  $r(32) = .17$ ,  $p = .34$ , or the control group,  $r(32) = .06$ ,  $p = .75$ .

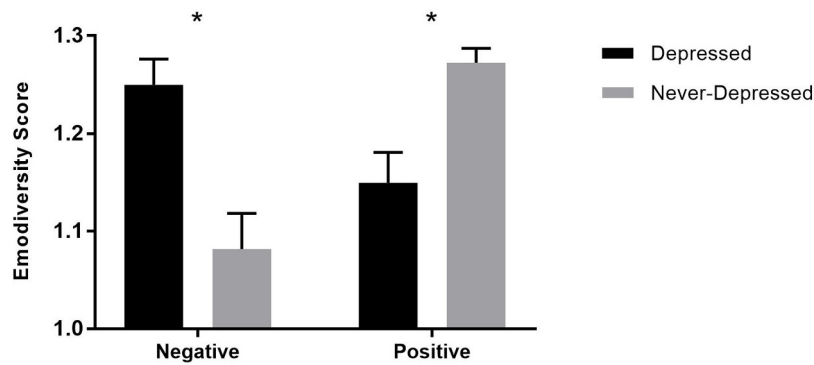


Figure 2. Mean (+1 SE) emodiversity scores for negative emotions and positive emotions.

Table 2  
Correlation matrix of emodiversity and life structure indices

	Depressed Participants (n = 34)	Negative Emodiversity	Positive Emodiversity	Proportion Negative	Compartment-alisation	Negative Redundancy	Positive Redundancy
<b>Emodiversity</b>							
Negative Emodiversity	1	-	-	-	-	-	-
Positive Emodiversity	.17	1	-	-	-	-	-
<b>Life Structure Indices</b>							
Proportion Negative	.28	-.58**	1	-	-	-	-
Compartmentalization	.002	-.08	-.04	1	-	-	-
Negative Redundancy	.43*	-.07	.63**	-.33	1	-	-
Positive Redundancy	.07	.58**	.65**	-.19	.08	1	-
<b>Never-Depressed Participants (n = 34)</b>							
<b>Emodiversity</b>							
Negative Emodiversity	1	-	-	-	-	-	-
Positive Emodiversity	.06	1	-	-	-	-	-
<b>Life Structure Indices</b>							
Proportion Negative	.77**	-.10	1	-	-	-	-
Compartmentalization	.26	-.13	.20	1	-	-	-
Negative Redundancy	.27	.19	.39*	.58**	1	-	-
Positive Redundancy	-.10	.23	-.39*	.73**	.54**	1	-

Note: Zero-order correlations. \*significant at .05 level; \*\*significant at .01 level

lower levels of emodiversity for positive emotion,  $F(1,65)=12.03$ ,  $p = .001$ ,  $\eta_p^2 = .16$ .

### 2.4. Emodiversity and Redundancy

Finally, we examined how greater diversity in emotional memory was related to across the life structure. For example, are those participants who exhibit greater diversity simply those who tend to endorse the experience of different trait emotions across different chapters of their life (i.e., who show reduced redundancy)? In fact, the opposite appeared to be the case. For both groups (see Table 2 for the pattern of correlations across emodiversity and life structure metrics), negative emodiversity was associated with greater negative redundancy and positive emodiversity was associated with greater positive redundancy (although these associations were not statistically significant in the never-depressed participants). This indicates that greater diversity in the usage of emotional descriptors was associated with a greater tendency to apply that diverse set of descriptors consistently across the life course.

### 3. Discussion

We sought to investigate diversity of remembered emotion experience – emodiversity – in a chronically depressed sample, and a sample of never previously depressed healthy individuals. Consistent with predictions, and previous work (Quoidbach et al., 2014), depression was associated with reduced diversity in autobiographical memory of positive emotion experience, relative to never-depressed controls. This finding fits with literature suggesting that positive emotion experience

is impoverished in those with symptoms of depression (e.g., Dunn, 2012) but extends this literature by showing this is also the case specifically in relation to emodiversity of recalled experience over the lifespan.

However, in the negative emotion domain, in contrast to the results of Quoidbach et al (2014), clinically depressed individuals reported greater emodiversity in their reflections of their lives, relative to never-depressed peers<sup>5</sup>. This concurs with a view that extensive and prolonged immersion in negative emotional states fosters a greater diversity across the experience of negative emotions (Lane & Schwartz, 1987). In this analysis, those with recurrent depression develop and remember a more diverse experience of the nuances of different kinds of negative emotion states, and indeed experience a greater variety of these states (e.g., sadness, fear, shame, guilt, hopelessness), relative to those who have not been depressed. This was the case even when we accounted for the influence of group differences in the intensity and frequency of emotion experience. This finding of memory for greater negative emotion diversity in those with recurrent depression makes sense from the perspective of extant models (e.g. the Levels of Emotional Awareness approach; Lane & Schwartz, 1987) of how the underlying conceptual structure of emotional knowledge develops. The present results, alongside those of Quoidbach et al. (2014) in a community sample, suggest that in the general population greater

<sup>5</sup> It is important to reiterate that, for theoretical reasons focused on tapping affective experience across the life story, we measured emodiversity differently in the present study relative to the questionnaire approach of Quoidbach et al. (2014) and so any differences in the profile of results may have been influenced by these methodological differences.

emodiversity, as it is experienced at the time, irrespective of valence can offer some protection against depression (Quoidbach et al., 2014), but that for those in whom clinical depression has become established, sustained immersion in a negative emotional personal narrative may extend and develop experience and memory for emodiversity in the negative domain.

These findings are also consistent with results reported recently which found elevated negative emodiversity and reduced positive emodiversity across two studies of female survivors of sexual abuse and assault with posttraumatic stress disorder (Clifford et al., 2020). The consistency in the findings between the current studies and those of Clifford et al. (2020) lends support to the suggestion that chronic mental health conditions including post-traumatic stress and depression are associated with elevated expertise in the domain of negative affective experience. One can therefore argue that the protective effect of greater (negative) emodiversity found in general population groups (Quoidbach et al., 2014) does not extend to those with chronic mental health difficulties.

Other findings from the present study are consistent with the broader emotion and depression literature, particularly as it relates to the growing profile of depression-related deficits associated with positive emotion experience and recollection (Bylsma, Morris, & Rottenberg, 2008; Dalgleish & Werner-Seidler, 2014; Gotlib & Joormann, 2010). In light of the increasingly recognised need to address these positive emotion deficits (Dunn, 2012; Santos et al., 2013), the results reported here suggest that an additional focus on enhancing the *diversity* of positive emotion experience and its recollection could add value to existing interventions which focus on positive-related deficits. For example, novel interventions currently being trialled in the UK (Augmented Depression Therapy, ADepT; Dunn et al., 2019) and the US (Positive Affect Therapy, PAT; Craske, Meuret, Ritz, Treanor, Dour & Rosenfield, 2019) focus on reversing positive emotion deficits and enhancing wellbeing, which are often overlooked in traditional treatment approaches. Expanding this to specifically incorporate an intentional focus on engaging in activities likely to elicit more diverse positive experiences and importantly, attending to these experiences, is likely to have additional psychological benefits. Similarly, discrete therapeutic strategies which are used to improve access to positive autobiographical material in depression (e.g., the Method-of-Loci technique) might also be enhanced by introducing a focus on recalling memories which capture a broader range of different positive emotions (e.g., Dalgleish, Navrady, Bird, Hill, Dunn & Golden, 2013; Werner-Seidler & Dalgleish, 2016).

An important area for future research will be to explore how emotional complexity and diversity relate to other aspects of both emotional memory and current emotion experience. For example, there is individual variation in the degree to which multiple emotions are experienced together in the same context (emotion differentiation), and in the repertoire of different emotions that are available for experience (Sommers, 1981). Research into emotion differentiation has shown that depression appears to be associated with low differentiation for negative emotions (feeling many specific emotions simultaneously; e.g., Demiralp et al., 2012). A recent investigation found that the relationship between depressive symptoms and low differentiation in a non-clinical sample was driven predominantly by sadness-related emotions (Willroth, Flett & Mauss, 2019). Whether something similar may apply to greater emodiversity in clinical depression will need to be examined in future research. Likewise, individual differences exist in the ability to regulate emotion, to attend to or disengage from emotional stimuli and situations, and to shift between emotion states (Lane, Weidenbacher, Smith, Fort, Thayer & Allen, 2013; Malooly, Genet, & Siemer, 2013). How emodiversity and emotional complexity more generally relate to these other aspects of emotion, and how these relationships may be different in those with affective disorders represent important questions.

Several limitations to the current study design warrant discussion. First, we were unable to control for mean negative emotion over the

lifespan given the retrospective nature of our methodology, which means there is a risk that results were partly confounded with mean lifetime levels of emotion. Second, the way that depressed individuals were recruited into the study differed slightly from the process used for the control group, with control participants being required to complete a depression status and history screening assessment over the phone while those who indicated a history of depression were administered a full face-to-face diagnostic interview.

The current study provides insight into the relationship between emotional memory, emodiversity and depression. Mentally healthy individuals exhibit higher levels of diversity in recollected positive emotions from throughout their lives, while those with depression show a relatively reduced diversity in their recollected positive emotional experience. This aligns with the view (e.g., Quoidbach et al., 2014) that positive emodiversity is psychologically adaptive and that access to a wider variety of positive emotions may enhance resilience or provide some buffer against depression. However, greater negative emodiversity appears characteristic of those with recurrent clinical depression, and likely reflects the long history with different negative emotional states often experienced by such individuals. The data suggest that therapeutic outcomes may be improved by helping depressed individuals to experience a broader range of diverse positive emotions (Dalgleish & Werner-Seidler, 2014).

#### 4. Author Statement

Author contributions: TD conceived of the study idea and design. Testing and data collection were conducted by AWS, CH, EH, LB, RM and RR. AWS performed the analysis under the supervision of TD. AWS and TD drafted the paper and all authors provided critical revisions. All authors approved the final version of the paper.

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The funding body had no role in any aspect of the study design, the collection, analysis or interpretation of data, the writing of this manuscript or the decision to submit it for publication.

#### Conflict of Interest

Declaration of interests: The authors declare that they have no competing interests.

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#### Supplementary materials

Supplementary material associated with this article can be found, in the online version, at [doi:10.1016/j.jad.2020.04.060](https://doi.org/10.1016/j.jad.2020.04.060).

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