Online writing about positive life experiences reduces depression and

perceived stress reactivity in socially inhibited individuals

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Abstract

Therapeutic writing can enhance psychological and physical health. Recent studies have suggested that these kinds of interventions can be effective when delivered online. The present study investigated whether positive emotional writing online can influence psychological and physical health in individuals reporting high levels of negative affectivity, who are most likely to benefit from psychological intervention (N = 72, M_{age} = 28.5, SD_{age} = 8.7), and further, to investigate the potential moderating role of social inhibition. Participants completed self-report measures of physical symptoms, perceived stress, perceived stress reactivity, depression and generalised anxiety, before completing either i) positive emotional writing, or ii) a non-emotive control writing task on an online portal, for 20 minutes per day over three consecutive days. State anxiety was measured immediately after each writing session, and self-report questionnaires were again administered four weeks post-writing. Socially inhibited individuals exhibited significant reductions in depression and perceived stress reactivity four weeks following positive emotional writing, relative to writing about a neutral topic. The present study supports the efficacy of online therapeutic writing in individuals who, due to their socially inhibited nature, are most likely to benefit from online interventions which avoid interaction with a therapist or other clients.

1. Introduction

Therapeutic writing interventions, which involve writing about intensely emotional experiences, have been associated with a range of psychological and physical health benefits. The earliest therapeutic writing techniques involved Written Emotional Disclosure (WED), where participants are directed to write about negative emotional experiences. The premise underpinning this technique is that inhibiting negative thoughts and feelings is stressful, thus giving an individual an opportunity to disclose inhibited negative thoughts and feelings will reduce stress and benefit health. Further, the act of expressing these negative thoughts and feelings in written form leads to cognitive changes which appear to be particularly beneficial for health and wellbeing (Pennebaker, 1997). WED conveys a range of benefits with respect to a number of health outcomes in both clinical and non-clinical groups (Baikie & Wilhelm, 2005), including a reduction in depression (Krpan et al., 2013), subjectively reported physical symptoms (Greenberg & Stone, 1992), work absenteeism (Francis & Pennebaker, 1992) and GP visits (Baikie, 2008). A similar form of therapeutic writing, which involves disclosure of traumatic life events has also been associated with enhanced functioning of the immune system (Pennebaker, Kiecolt-Glaser, & Glaser, 1988). With respect to further biological outcomes, trauma writing has been associated with attenuated cortisol reactivity in response to reimagining traumatic experiences in individuals with post-traumatic stress disorder (Smyth, Hockemeyer, & Tulloch, 2008). WED has also been associated with reduced cardiovascular responses to stress in alexithymic individuals who used a greater proportion of negative emotion words (O'Connor & Ashley, 2008).

An alternative therapeutic writing technique involves writing about previous positive experiences. Pennebaker and Seagal (1999) observed that those participants who benefit maximally from therapeutic writing tend to use a higher proportion of positive emotion words. Thus, it has been suggested that writing about the positive aspects of a negative experience is beneficial for health (King & Miner, 2000). Indeed, written benefit finding, whereby participants write about the benefits of adverse experiences is associated with increases in positive affect (Guastella & Dadds,

2006), improved clinical outcomes in patients with breast cancer (Low, Stanton, & Danoff-Burg, 2006), lupus and rheumatoid arthritis (Danoff-Burg, Agee, Romanoff, Kremer, & Strosberg, 2006) and reduced distress in parents of children with autism (Lovell, Moss, & Wetherell, 2016). In the general population, it has been observed that writing about previous positive life experiences is associated with a range of benefits, including a reduction in subjectively reported physical symptoms (Burton & King, 2008), increased positive affect (Burton & King, 2004), fewer health centre visits (Burton & King, 2004), decreases in stress and anxiety (Smith, Thompson, Hall, Allen, & Wetherell, 2018) and enhanced emotional intelligence and life satisfaction (Wing, Schutte, & Byrne, 2006). Taken together, these studies highlight the potential for writing about positive emotions to enhance both physical and psychological wellbeing, in both clinical and healthy populations.

The efficacy of these techniques, however, is moderated by a range of individual differences. For example, the effect of written benefit finding on reducing pain was observed most strongly in those individuals who also reported high trait anxiety (Danoff-Burg et al., 2006). Similarly, positive outcomes from written benefit finding in breast cancer patients are suggested to be strongest in individuals with high cancer-related avoidance (Stanton et al., 2002). Further, the effect of positive writing on trait anxiety reported by Smith and colleagues (2018) was moderated by negative affectivity (NA) and social inhibition (SI). Within the positive writing condition, the most substantial reductions in trait anxiety were reported by individuals with high levels of SI, but low levels of NA. This demonstrates the therapeutic potential of positive emotional writing, because individuals with high levels of SI benefitted the most, and it is these individuals who, due to their socially inhibited nature, may be averse to therapeutic techniques that require engagement with a therapist or with other service users in a group setting. However, it is important to note that this superior benefit was only observed for individuals with high SI in the context of low NA. Therefore, the optimal benefit of positive writing wasn't experienced by individuals who report low mood, who may be considered as the main target for psychological intervention.

On this basis, if this psychological intervention is to be optimised for individuals with high levels of SI, with minimal engagement with a therapist, an online, rather than written paper-based mode of delivery might prove to be useful. Increasing evidence is emerging to support the feasibility of eHealth interventions among individuals experiencing psychological morbidity (Naslund, Marsch, McHugo, & Bartels, 2015), and the internet offers opportunities for otherwise isolated individuals experiencing psychological morbidity to disclose their emotional thoughts (Coulson, Bullock, & Rodham, 2017). Previous research has observed that online emotional writing, about either a positive or a negative topic, was associated with a reduction in perceived stress (Baikie, Geerligs, & Wilhelm, 2012). Further, written emotional disclosure, conducted online, has been associated with posttraumatic growth (Stockton, Joseph, & Hunt, 2014), while emotional expression via an 'Emotion Diary' Facebook application has been associated with a reduction in symptoms of depression (Lee et al., 2016). Taken together, it appears that online therapeutic writing interventions may provide a novel approach for delivering psychological interventions, which may be particularly beneficial for individuals with high levels of social inhibition, for whom engagement with face-to-face therapy proves difficult.

The aim of the present study was to investigate the potential benefits of writing online about intensely positive life experiences on self-reported measures of psychological and physical health. Specifically, given the findings of Smith and colleagues (2018) we were interested in investigating whether SI moderates any observed effects. NA represents a general risk factor for physical health problems, psychological distress and low mood (Paulus & Zvolensky, 2017), thus it seems appropriate to investigate whether self-administered activities to alleviate these negative outcomes might be beneficial in high NA individuals. Therefore, we confined our sample to individuals who reported high levels of NA at a pre-screen, in order to target only those individuals who are most likely to need, and therefore benefit from, therapeutic intervention for low mood. To the best of our knowledge, no studies to date have explicitly investigated positive emotional writing conducted online. In line with Smith and colleagues (2018) we hypothesised that SI would moderate

the benefits of positive writing, with greater SI being associated with benefits for the positive writing, relative to neutral writing condition, on the outcome variables under investigation. Additionally, SI has been associated with adverse psychological health outcomes, including predisposition to depression (Crawford et al., 2007), further supporting the exploration of SI as a moderator of positive writing efficacy. To maintain consistency with Smith and colleagues (2018), the outcome variables of interest were physical symptoms, perceived stress and anxiety. However, given that the efficacy of online therapeutic writing has been demonstrated in the context of reducing depression symptoms (Lee et al., 2016), and that all participants in the present study reported high levels of NA, we additionally incorporated self-reported depression symptoms as an outcome measure. Finally, given that expressive writing has been associated with changes in psychobiological stress reactivity (O'Connor & Ashley, 2008; Smyth et al., 2008), we sought to investigate the influence of online positive emotional writing on perceived reactivity to stressors encountered in the real world. A secondary aim was to investigate the influence of SI on word use. It was hypothesised that SI would be associated with emotional, social and first person singular pronoun word use. This secondary hypothesis is predicated by i) a previous finding that SI is related to 'anger' word use (Smith et al., 2018), ii) a further previous study in which extraversion (a personality trait inversely associated with SI; Svansdottir et al., 2013) was inversely associated with social word use (Yarkoni, 2010), and iii) the notion that psychological distress is associated with a greater frequency of first person singular pronoun use (Stirman & Pennebaker, 2001).

2. Method

2.1. Participants

Participants were required to be aged 18-65 years old, fluent in English, and not currently have a diagnosis of depression. The flow of participants through the study, and the number who completed each stage of the study is shown in Figure 1. At the 'pre-screen' stage, participants (n = 278) completed the DS14 (see Materials) to determine self-reported levels of NA and SI. Given that

we wanted to target participants reporting high levels of NA, and based on DS14 cut-off scores (Denollet, 2005), only participants who scored ≥ 10 on the NA scale were invited to take part in the full study. Following the pre-screen, 150 participants were randomised to the positive or neutral conditions. Of these 150 individuals, a full data set were available for analysis for 72 participants (62 females, M_{age} = 28.5, SD_{age} = 8.7), of whom 98.6% were resident in the UK (participants were required to have a UK bank account to facilitate electronic transfer of the participant reimbursement). Participants were reimbursed £10 for their time upon completion of the full study (participants who took part in the pre-screen only were not reimbursed). Participants were recruited using a variety of recommended online platforms (Branley, Covey, & Hardey, 2014) including dedicated participation sites (e.g. callforparticipants.com), social media (e.g. Facebook, Twitter, Reddit, and LinkedIn), university and research group mailing lists, and student participation pools. Snowball sampling was also used to maximise recruitment by encouraging participants to refer the link to friends and family friends, and/or share on social media. The study was also advertised via the distribution of posters and leaflets within Northumbria University.

2.2 Materials

    2.2.1. DS-14. The DS-14 (Denollet, 2005) was employed to measure NA and SI. This 14-item questionnaire comprises two 7-item subscales. The NA scale includes items such as 'I take a gloomy view of things'. The SI scale includes items such as 'I often feel inhibited in social interactions'. Two positively worded items on the SI subscale (e.g. 'I often talk to strangers') were reverse scored. Reponses to each item were made on a five-point scale ranging between 0 and 4, yielding a total score of between 0 and 28 for each subscale. Both subscales have been found to demonstrate good internal consistency (NA: α=.88, SI: α=.86; Denollet, 2005).

    2.2.2. State Anxiety. The State Anxiety Inventory Short Form (Marteau & Bekker, 1992) requires participants to rate how they 'feel right now' with respect to 6 statements on a four-point scale ranging from 'not at all' to 'very much so'. Reverse scoring was used for positively worded

items (e.g. 'I feel content'), so that the highest level of anxiety for an individual item was represented by a score of 4. Total scores were calculated by summing together the scores for all 6 items. Total scores ranged from 6 to 24. This measure was included to provide an indication of participants' state anxiety immediately after completing the writing tasks each day.

      2.2.3. Hospital Anxiety and Depression Scale (HADS). The HADS (Zigmond & Snaith, 1983) was used as a measure of anxiety and depression. The HADS asks participants 14 questions about how they have been feeling in the past week (e.g. Anxiety: 'I feel tense or 'wound up''; Depression: 'I still enjoy the things I used to enjoy'). Participants responded on a four-point scale ranging between 0 and 3 (positively worded items are reversed scored). Seven items measure anxiety (α= 0.83) and 7 items measure depression (α=0.82). Higher scores indicate higher levels of anxiety and depression. Positive writing has previously been associated with a reduction in trait anxiety (Smith et al., 2018), whereas evidence that depression is impacted by emotional writing comes mostly from studies which have employed WED rather than positive emotional writing.

      2.2.4. Perceived Stress Scale-10 (PSS). The PSS (Cohen, Kamarck, & Mermelstein, 1983) is a 10-item questionnaire which was used in the present study as a measure of perceived background stress. The single-factor scale asked the participant to report the extent to which they experienced various potentially stressful events in the previous month (e.g. 'how often have you found that you could not cope with all the things that you had to do?'). Participants responded on a five-point scale ranging from 'never' (0) to 'very often' (4). Four positively worded items were reverse scored and the score for each item summed to yield a total score ranging between 0 and 40. Smith and colleagues (2018) found that positive writing using a pen-and-paper method was associated with a reduction in PSS scores, hence it is of interest here to ascertain whether a similar effect can be observed in an online context.

      2.2.5. Perceived Stress Reactivity Scale (PSRS). The PSRS (Schlotz, Yim, Zoccola, Jansen, & Schulz, 2011) was employed as a measure of subjective reactivity to stress in daily life. The PSRS comprises 23 items across five subscales: Prolonged Reactivity (4 items, e.g. 'When tasks and duties

accumulate to the extent that they are hard to cope with...', α=.69); Reactivity to Work Overload (5 items, e.g. 'When I have many tasks and duties to fulfill...', α=.82), Reactivity to Social Conflict (5 items, e.g. 'When I argue with other people...', α=.77), Reactivity to Failure (4 items, e.g. 'When I make a mistake...', α=.73) and Reactivity to Social Evaluation (5 items, e.g. 'When I have to speak in front of other people...', α=.72). The sum of all subscales provides a total PSRS score (α=.91) with higher scores indicating increased levels of reactivity to stress. Each item provides three possible responses, coded 0 to 2 (12 items are reversed scored), detailing how participants would respond in response to stressful situations encountered during everyday life. Given that expressive writing has been associated with changes in psychobiological stress reactivity (O'Connor & Ashley, 2008; Smyth et al., 2008), it was of interest to investigate the influence of online positive emotional writing on perceived stress reactivity.

2.2.6. Cohen Hoberman Inventory of Physical Symptoms (CHIPS). The CHIPS (Cohen & Hoberman, 1983) was employed as a measure of physical symptoms. Participants indicated how much bother or distress they had experienced, in the past two weeks, as a result of each of 33 common physical symptoms, e.g. 'back pain', 'headache', 'cold or cough'. Participants responded on a five-point scale ranging from 0 (have not been bothered by the problem) to 4 (problem has been an extreme bother.) Responses on each item were summed to provide a total score ranging between 0 and 132. The seminal paper by Burton and King (Burton & King, 2004) found that positive writing was associated with a reduction in health centre visits, justifying the use of a measure of physical symptoms here.

2.3. Procedure

The study procedure was granted ethical approval by the relevant institutional ethics committee. Participation in the study took place entirely online, via the survey platform Qualtrics.

2.3.1. Pre-screen. Participants provided informed consent to take part, and then completed the DS14 to check their eligibility to take part in the full study (NA score ≥ 10). They also provided

their email address, which was used to contact them to invite them to take part in the subsequent phases of the study. Participants provided a unique code which enabled the researchers to anonymously identify and link participants' data between the study phases. Demographic questions which were used to characterise the sample were also answered during this phase.

2.3.2. Main study. Participants who scored ≥ 10 on the NA scale of the DS14 were invited to take part in the remainder of the study via email. They first completed the CHIPS, HADS, PSS and PSRS online. Following completion, they were emailed a link to complete the emotional writing task on three consecutive days within the forthcoming week at a time and place convenient to them. They were asked to avoid the likelihood of disruption where possible, by turning off their phones and choosing a quiet location to write where they were unlikely to be interrupted. On each writing day, participants were required to write for 20 minutes about an assigned topic, by typing into a free text box. A timer on the screen counted down from 20 minutes to indicate the time remaining, and once the timer reached zero, the screen with the free text box was replaced with the state anxiety measure, which participants completed, ensuring that participants spent exactly 20 minutes on the writing task screen.

2.3.3. Positive writing condition. Participants in the positive writing condition were asked to write about 'positive experiences'. They were given the following instructions: "Think of the most wonderful experience or experiences in your life, happiest moments, ecstatic moments, moments of rapture, perhaps from being in love, or from listening to music, or suddenly 'being hit' by a book or painting or from some great creative moment. Choose one such experience or moment. Try to imagine yourself at that moment, including all the feelings and emotions associated with the experience. Now write about the experience in as much detail as possible trying to include the feelings, thoughts, and emotions that were present at the time. Please try your best to re-experience the emotions involved." (Burton & King, 2004; Smith et al., 2018). Participants were asked to follow these same writing instructions on each of the study days, and were told that they could either write about the same experience on each day or write about a new one.

2.3.4. Control condition. Participants in the neutral writing condition were asked to write about 'aspects of daily life' and were asked specifically to write about their plans for the rest of the day (Day 1), a detailed description of the shoes they were wearing (Day 2) and a detailed description of their bedroom (Day 3; Burton & King, 2004; Smith et al., 2018).

2.3.5. Follow-up. Four weeks following the third writing day, all participants were sent a link via email to complete the follow-up questionnaires: CHIPS, HADS, PSS and PSRS. Upon completion of these follow-up questionnaires, participants were presented with a study debrief.

2.4. Treatment of Data

Data were downloaded from Qualtrics and data from the various phases were combined into a single dataset. For the HADS, PSS, PSRS and CHIPS measures, baseline scores were subtracted from 4 week follow-up scores, to derive a change score for each measure. The state anxiety scores were averaged across the three writing days for each participant. The text from each essay was downloaded and entered into the software programme Linguistic Inquiry and Word Count (LIWC; Pennebaker, Booth, Boyd, & Francis, 2015) to enable linguistic analysis. Separate analyses were performed for each linguistic category. An a-priori decision was taken only to consider the 17 LIWC variables which enabled a manipulation check and which directly relate to the second study aim. These variables were chosen to maintain consistency with the previous study by Smith and colleagues (Smith et al., 2018), which also analysed this set of 17 LIWC variables. For the purpose of a manipulation check, the effect of writing condition on affective process word use and 'time orientation' word use (i.e. whether word use reflected past, present or future focus) was analysed. In relation to the second aim, analyses were conducted to investigate associations between SI and affective process, social process and swear word use, as well as use of personal pronouns. For further details of the psychometric properties of LIWC and the number of words per category, see Pennebaker and colleagues (2015).

Data were analysed using multiple linear regression, following the procedure outlined by West and colleagues (1996) for analysing categorical (condition) by continuous (SI) variable interactions. This method is preferable to Analysis of Covariance (ANCOVA), because an ANCOVA assumption is that there is no interaction between the IV and the covariate (Leppink, 2018). SI was mean centred. The following variables were entered as IVs: SI, condition (coded as 0 = neutral writing, 1 = positive writing), and SI x condition. Simple slopes analysis was used to determine the significance of the relationships between SI and each DV, for the positive and neutral writing conditions.

For the analyses performed, the sample size was sufficient to detect a medium effect (f^2 = 0.16), with 0.8 power, at an alpha level of 0.05. Study data are publicly available at: https://osf.io/8egup/.

3. Results

A series of Condition x Gender ANOVAs were performed to ensure that there were no differences between participants randomised to the positive and neutral writing conditions, and that there were no differences by gender as a function of condition. These analyses revealed that there were no significant differences with respect to age (p = 0.67), social inhibition score (p = 0.87) or baseline scores on HADS anxiety (p = 0.23), stress (p = 0.40), depression (p = 0.39), perceived stress reactivity (p = 0.09) and the CHIPS (p = 0.06), between participants randomised to the positive and neutral writing conditions. Further, the Condition x Gender interaction was nonsignificant for all of these variables (all p values ≥ 0.07). Baseline scores on the self-report measures are shown in Table 1. Correlations between baseline scores on the self-report measures are displayed in Supplementary Table 1.

3.1. Manipulation check

A Day x Condition mixed ANOVA was performed on word count data to check whether there were any differences between the positive and neutral writing conditions with respect to the number of words written, and also to ensure that the number of words written was consistent across the three writing days. There was no significant main effect of condition, $F(1, 70) = 0.94$, $p = 0.34$, and the Day x Condition interaction effect was also nonsignificant, $F(2, 69) = 2.52$, $p = 0.09$. However, the main effect of Day was significant, $F(2, 69) = 4.66$, $p = 0.013$. Bonferroni-corrected pairwise comparisons indicated that across both the positive and neutral writing conditions, participants wrote less words on Day 2 than on Day 1 ($p = 0.022$).

There was no significant effect of condition on word count (B = 26.942, $p = 0.19$). There were significant effects of condition, whereby participants assigned to the positive condition used more words categorised as 'affective process' (e.g. 'happy', 'cried'), B = 1.828, $p < 0.001$; 'positive emotion' (e.g. 'love', 'nice', 'sweet'), B = 1.496, $p < 0.001$; negative emotion words (e.g. 'hurt', 'ugly', 'nasty'), B = 0.310, $p < 0.001$; 'social process' (e.g. 'mate', 'talk', 'they'), B = 1.948, $p < 0.001$; and 'past focus' (e.g. 'ago', 'did', 'talked'), B = 3.686, $p < 0.001$. Participants assigned to the neutral condition used more words categorised as 'present focus' (e.g. 'today', 'is', 'now'), B = -3.100, $p < 0.001$; and 'future focus' (e.g. 'may', 'will', 'soon'), B = -0.731, $p < 0.001$. There were no further significant effects for any of the other affective or social process word categories (see Table 2).

3.2. Self-reported mood and physical symptoms

3.2.1. State Anxiety. The effect of condition approached significance, B = -0.623, $p = 0.057$. Participants assigned to the positive writing condition reported lower levels of post-writing state anxiety, averaged across the three writing days compared with those in the control condition. The effects of SI and the interaction term were nonsignificant.

3.2.2. HADS Anxiety. There were no significant effects of condition, SI or the interaction term on the change in HADS anxiety scores between baseline and the four week follow-up.

3.2.4. HADS Depression. For HADS depression, there was a significant SI x Condition interaction effect, B = -0.391, *p* = 0.016. The relationship between SI and change in HADS depression was significant for the positive writing condition, b = -0.17, *p* = 0.030; but not the neutral writing condition, b = 0.19, *p* = 0.07; indicating that for the positive, but not the neutral writing condition, HADS depression scores reduced to a greater extent for those reporting high SI (see Figure 2).

3.2.3. Perceived Stress Scale. There were no significant effects of condition, SI or the interaction term on the change in PSS scores between baseline and the four week follow-up.

3.2.5. Perceived Stress Reactivity Scale. On the PSRS total score, there was a significant SI x Condition interaction effect, B = -0.391, *p* = 0.016. The relationship between SI and change in the PSRS total score was significant for the neutral writing condition, b = 0.49, *p* = 0.046; but not the positive writing condition, b = -0.29, *p* = 0.16; indicating that for the neutral, but not the positive writing condition, PSRS total scores increased to a greater extent for those reporting high SI. On the PSRS subscale scores, there was a significant SI x Condition interaction effect for the Reactivity to Failure subscale, B = -0.071, *p* = 0.045, but the relationship between SI and Reactivity to Failure change scores was not significant for either the neutral, b = 0.08, *p* = 0.09; or positive writing condition b = -0.06, *p* = 0.16. There was also a significant interaction on the Reactivity to Work Overload, B = -0.140, *p* = 0.006, subscale. Simple slopes analysis indicated that the relationship between SI and Reactivity to Work Overload change scores was significant for the positive writing condition, b = -0.15, *p* = 0.018; but not the neutral writing condition, b = 0.13, *p* = 0.51. This finding indicates that for the positive, but not the neutral writing condition, Reactivity to Work Overload scores reduced to a greater extent for those reporting high SI (see Figure 3).

3.2.6. CHIPS. There were no significant effects of condition or any of the interaction terms on the change in CHIPS scores between baseline and the four week follow-up.

3.3. Association between SI and word use

There was a positive effect of the SI x Condition interaction on first person singular pronoun use, B = 0.124, p = 0.018. . Simple slopes analysis indicated that the relationship between SI and first person singular pronoun use was significant for both the positive writing condition, b = 0.11, p = 0.020; and the neutral writing condition, b = -0.14, p = 0.01. This finding indicates that within the positive writing condition, first person singular pronoun use increased for high SI individuals, but for the neutral writing condition, use of these words decreased for high SI individuals (see Figure 4). There were no further associations between SI and any of the other LIWC variables (see Table 2).

4.0. Discussion

The primary aim of the present study was to investigate the psychological and physical health benefits of an online positive emotional writing paradigm in individuals with high levels of NA. It was also of interest to investigate whether SI moderates any benefits observed. Socially inhibited individuals in the positive writing condition exhibited reductions in self-reported depression symptoms, as measured by the HADS depression scale four weeks post-writing. Similarly, socially inhibited individuals reported improvements in perceived stress reactivity four weeks following online positive emotional writing. Lower state anxiety was observed immediately post-writing for the positive writing compared to the neutral writing condition, irrespective of SI, but this effect failed to reach significance. There were no significant effects on the CHIPS, PSS or HADS anxiety scale.

Broadly speaking, these effects are consistent with the findings of Smith and colleagues (2018), supporting the notion that socially inhibited individuals benefit most from positive emotional writing. Further, the present study findings extend those of Smith and colleagues (2018) by suggesting that positive writing is beneficial in an online context. Unlike Smith and colleagues (2018) the present study was confined to participants reporting high levels of NA, suggesting that positive emotional writing is a suitable intervention for improving psychological wellbeing in individuals from the general population reporting low mood, who thus may be in need of low intensity psychological

intervention. However, it is noteworthy that there were differences in the specific outcomes which were impacted by positive emotional writing between the two studies. While Smith and colleagues (2018) observed effects of positive writing on perceived background stress, HADS depression and perceived stress reactivity were the two outcome variables which were influenced by positive writing in high SI individuals in the present study. Perceived background stress, depression and perceived stress reactivity are all characteristics of distress, and as such, the present study offers general support to the notion that positive emotional writing confers benefits upon psychological wellbeing. Neither the previous study by Smith and colleagues (2018), nor the present study, found any evidence that positive emotional writing impacts upon self-reported physical symptoms in the general population. This finding is inconsistent with the notion that positive emotional writing confers benefits upon physical health in the general population, as suggested by the effect of positive writing on health centre visits reported by Burton and King (2004).

The most noteworthy finding to emerge from the present study was that socially inhibited individuals showed the greatest improvement, 4 weeks post-writing for both HADS depression and perceived stress reactivity. For perceived stress reactivity, this finding was most notable for the Reactivity to Work Overload subscale of the PSRS. The implication is that following three days of writing about the most positive experiences of one's life, participants high in SI exhibited a decrease in self-reported depression on the HADS depression scale, and reported that they responded more optimally to being overworked. With respect to the HADS depression finding, the present study extends evidence from other emotional writing studies (Krpan et al., 2013; Lee et al., 2016), to suggest that positive writing can also reduce feelings of depression. If these findings can be replicated, they support the therapeutic potential of online positive emotional writing, in that the paradigm was associated with a reduction in depression for high SI individuals, and benefits with respect to the way that these individuals respond to everyday stressors.

A strength of the present study was that we were able to ascertain participants' adherence to the writing task instructions via the use of LIWC software. We observed differences between the

two conditions with respect to affect and time orientation word use, consistent with the task instructions being followed. For example, participants in the positive writing group used a greater proportion of past focus and positive emotion words, consistent with writing about positive previous life experiences. Participants in the neutral writing condition used more present and future focus words, which is also consistent with the instructions for this condition. Perhaps somewhat counterintuitively, participants in the positive writing condition also used a significantly greater proportion of negative emotion words, but this is consistent with previous observations (e.g. Smith et al., 2018). This is likely explained by a tendency of participants in the positive writing condition to compare an overwhelmingly positive experience with former negative experiences. A further advantage of undertaking this linguistic analysis was the capacity to investigate whether SI was associated with language use. These analyses largely yielded nonsignificant findings, but one significant association was that high SI individuals in the positive writing condition used a higher proportion of first person singular pronouns. This suggests that high SI individuals tend to recollect that their most positive life experiences took place when they were alone, rather than with others. Additionally, greater first person singular pronoun use is an indicator of self-focus, and has been associated with an array of adverse physical and psychological health outcomes. In a previous study, poets who used a greater frequency of first person singular pronouns in their work were more likely to die by suicide than matched poets who used this category of pronouns relatively less frequently (Stirman & Pennebaker, 2001). However, before drawing any conclusions in this regard, it is essential to bear in mind that high SI individuals used a relatively lower proportion of first person personal pronouns in the neutral condition. Therefore, this finding may represent the propensity for socially inhibited individuals to recollect previous positive experiences that did not occur in the company of other people.

Further strengths of the present study included the use of a 4 week follow-up to determine the medium-term influence of positive emotional writing on psychological wellbeing and physical symptoms. The pre-screen ensured that only participants high in NA, who are the group within the

general population most likely in need of low intensity psychological intervention who took part. Further, the use of an online portal to coordinate the questionnaires and writing task meant that this study was conducted entirely online. The efficacy of therapeutic writing delivered in an online context was supported for those individuals high in SI, who are also least likely to want to engage with face-to-face therapeutic intervention. Future work should build on the present study findings to further determine the efficacy, acceptability and feasibility of using online positive emotional writing as an alternative or adjunct to face-to-face low intensity psychological therapies. Such follow-up work is crucial, given the higher drop-out rate from the study among high SI participants, as evidenced by Figure 1. It is also important to consider further study limitations. Given that the study was conducted entirely online, we were reliant on self-reported outcomes. More objective markers of psychological and physical health may have yielded different outcomes, and it wasn't possible to ascertain whether positive writing directly influenced state anxiety, because state anxiety wasn't measured before participants engaged with the writing tasks. Further, future work should ascertain the efficacy of this paradigm using a larger, more diverse sample, given that most of the participants were based in the UK, and many were students.

A further limitation was that the number of words participants wrote each day was inconsistent, in that participants wrote significantly less words on Day 2, compared to Day 1, across both conditions. A possible explanation for this is that participants in the positive writing condition wrote about their most salient positive experience on Day 1 and were able to write less vividly about the same or a less salient experience on Day 2. Participants in the neutral condition may have been able to write more vividly about their plans for the rest of the day on Day 1, but less so when describing their shoes on Day 2, which is arguably a more restrictive task on Day 2. Given that there was a decrease with respect to the amount of words participants wrote on the second day across both conditions, it is unlikely that this adversely influenced the study findings or any conclusions drawn from the data. However, with respect to future research employing this paradigm, it may be important to consider that participants may write less vividly and enthusiastically about positive

experiences after the first writing day. A further consideration may also be whether to modify the neutral writing task to ensure comparability with respect to the potential scope of what people are able to write about across the three days.

A general limitation of this research area as a whole is the lack of consistency with respect to the specific outcome variables which are influenced by emotional writing paradigms. This may be due to a number of factors, including i) differences in the specific writing instructions, ii) subtle differences in the outcome variables between studies, iii) other contextual differences such as differences with respect to the study samples, and iv) the influence of a range of individual differences which are known to moderate the effects of emotional writing. This latter point is particularly noteworthy in the context of the present study, given that the significant benefits observed here were only seen in socially inhibited participants. Other emotional writing studies have reported that other factors, such as trait anxiety (Danoff-Burg et al., 2006), alexithymia (Ashley, O'Connor, & Jones, 2011; O'Connor & Ashley, 2008) and the extent to which participants use emotionally salient words (Pennebaker, 1993; Pennebaker & Seagal, 1999) are important moderators of observed effects. Thus, the precise conditions under which the benefits of positive writing occur are currently uncertain, which is problematic with respect to recommending the technique widely as a low intensity psychological intervention. However, we are gaining a greater understanding of the nuances of this technique, in terms of some specific contexts where there are clear benefits. There is now converging evidence from both the present study and the findings of Smith and colleagues (2018) that socially inhibited individuals are likely to experience enhanced psychological wellbeing from engaging in positive emotional writing.

Taken together the present study broadly supports the notion that positive emotional writing, delivered online over three days, can reduce feelings of depression and benefit the ways that individuals respond to everyday stressors, in socially inhibited individuals reporting high levels of NA. This potentially provides an avenue for low intensity psychological therapy that is most beneficial for people who may not want to engage with a therapist due to their socially inhibited

nature. However, there are inconsistencies in this area with respect to the precise psychological and physical health outcomes that are impacted by therapeutic writing. Further work is therefore needed to enhance our understanding of the conditions under which therapeutic writing enhances psychological and physical health, and to gain a more specific understanding of the individual differences factors that moderate these benefits.

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Table 1

Baseline scores on the self-report measures.

	M	*SD*	Min	Max
Negative Affectivity	15.8	3.7	10	25
Social Inhibition	11.2	5.4	2	24
HADS Anxiety	8.9	4.3	1	19
HADS Depression	5.9	2.8	2	13
PSS	19.3	6.1	6	33
PSRS Total	49.0	7.0	26	64
PSRS Prolonged Reactivity	7.7	1.4	5	11
PSRS Reactivity to Work Overload	10.8	2.2	5	15
PSRS Reactivity to Social Conflict	11.4	2.1	6	15
PSRS Reactivity to Failure	8.5	1.5	5	12
PSRS Reactivity to Social Evaluation	10.3	2.2	6	15
CHIPS	18.3	14.0	1	81

Table 2

Unstandardised regression coefficients representing the relationships between each of the IVs and selected LIWC variables (word count, personal pronouns, affective processes words, social process words, time orientations and swear words).

	Condition	SI	SI x Condition
Word count	26.942	-4.723	3.082
First person singular pronouns	0.227	-0.017	0.124*
First person plural pronouns	0.595***	0.000	0.013
Second person pronouns	0.007	0.009	-0.008
Third person singular pronouns	0.557***	-0.023	-0.031
Third person plural pronouns	-0.476***	-0.007	-0.020
Affective processes	1.828***	0.025	0.013
Positive emotion	1.496***	0.039	0.031
Negative emotion	0.310***	-0.011	-0.015
Anxiety	0.169**	-0.008	-0.004
Anger	0.050*	-0.007	-0.009
Sad	0.089***	0.006	0.001
Social processes	1.948***	-0.040	-0.070
Past focus	3.686***	0.040	0.049
Present focus	-3.100***	-0.034	-0.044
Future focus	-0.731***	-0.019	0.013
Swear words	0.016*	-0.002	-0.002

*p < 0.05, **p < 0.01, ***p < 0.001

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                        ┌─────────────────────────┐
                        │  Pre-screened (n =278)   │
                        └─────────────────────────┘
                                    │
                                    │                    ┌──────────────────────────┐
                                    │◄───────────────────│   NA score < 10 (n=128)   │
                                    │                    └──────────────────────────┘
                                    ▼
                        ┌─────────────────────────┐
                        │ Invited to full study (n=150) │
                        └─────────────────────────┘
                          │                     │
                          ▼                     ▼
                ┌──────────────────┐   ┌──────────────────┐
                │  High SI (n =92) │   │  Low SI (n =58)  │
                └──────────────────┘   └──────────────────┘
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Allocated to positive condition (n =45)	Allocated to neutral condition (n =47)	Allocated to positive condition (n =31)	Allocated to neutral condition (n =27)

Did not complete (n=78)
- Declined to take part in full study (n=45)
- Only completed pre-task questions (n=17)
- Did not finish 3 days writing (n=13)
- Lost at 4 week follow up (n=2)

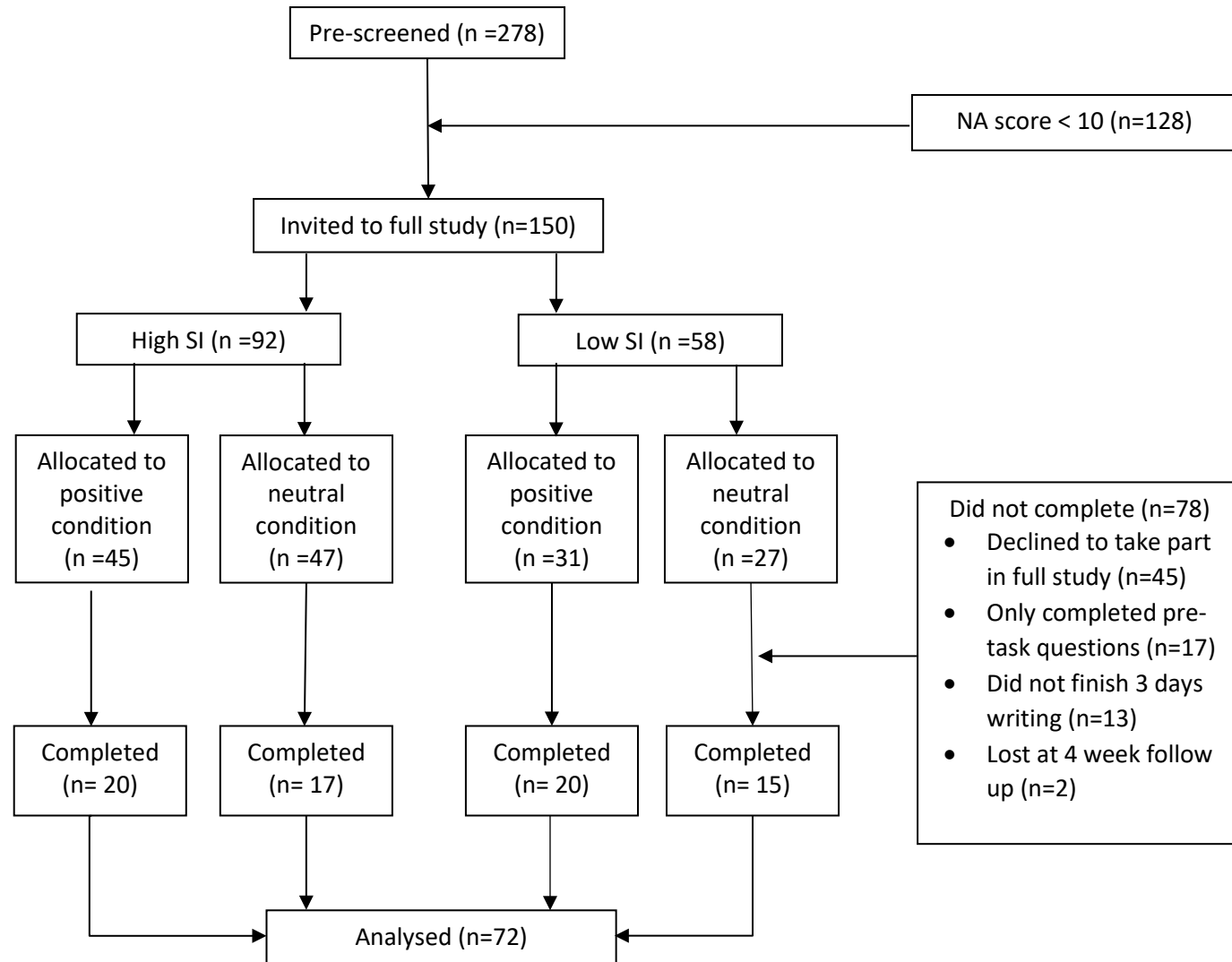| Completed (n= 20)	Completed (n= 17)	Completed (n= 20)	Completed (n= 15)

Analysed (n=72)

Figure 1

Consort diagram showing allocation to each condition and attrition rates
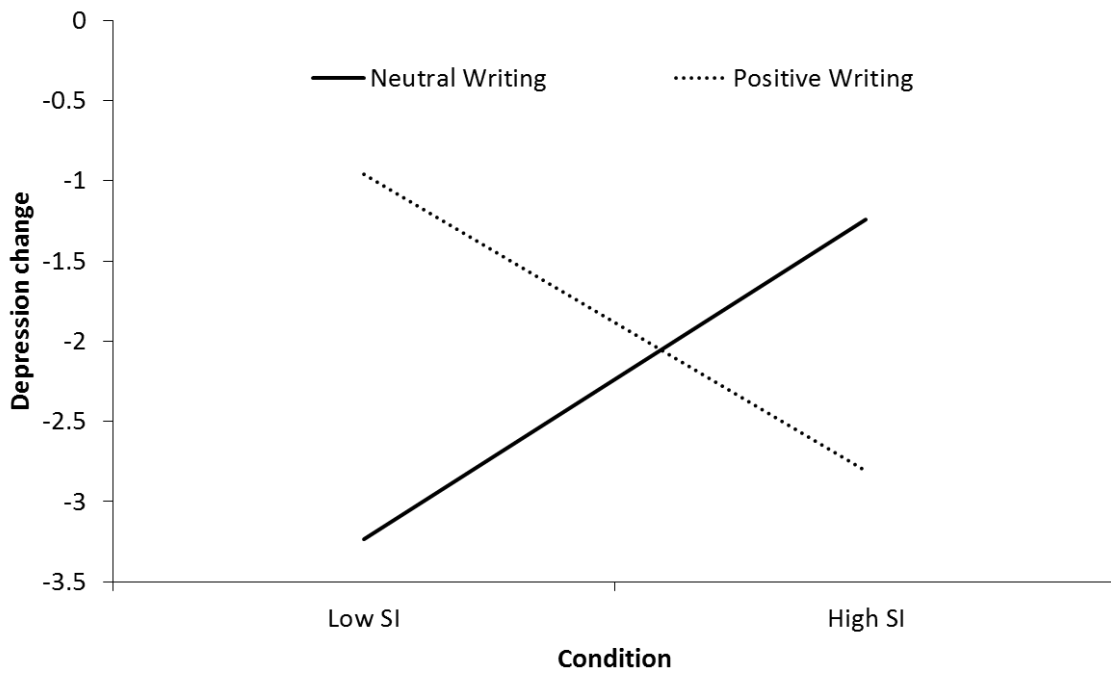
Figure 2

Regression lines showing changes in depression for each emotional writing condition at specified levels of SI (low = 1 standard deviation below the mean; high = 1 standard deviation above the mean).
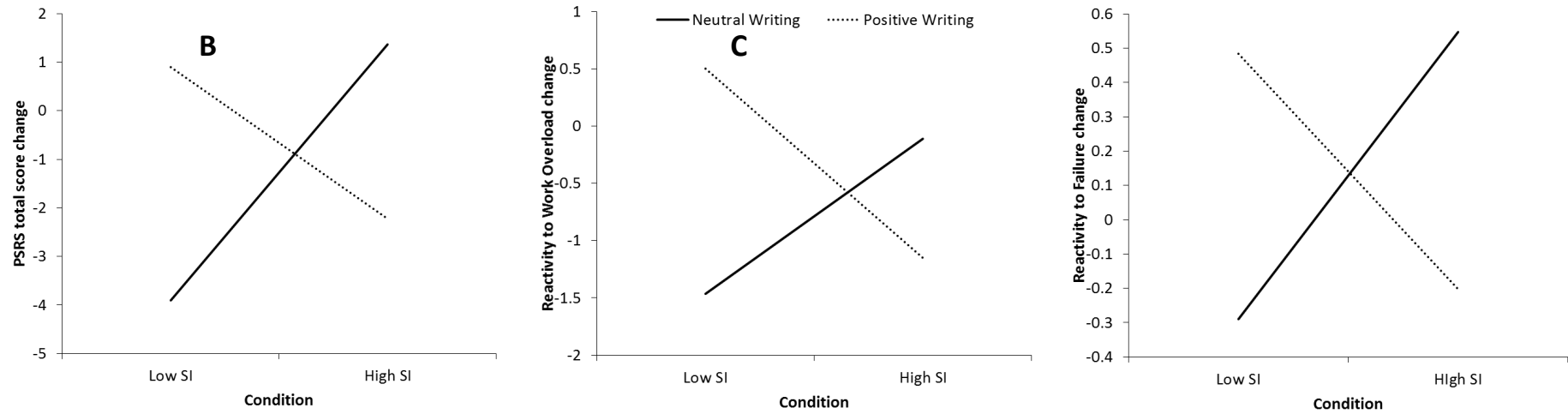
Figure 3

Regression lines showing changes in Perceived Stress Reactivity total score (A), Reactivity to Work Overload (B) and Reactivity to Failure (C) for each

emotional writing condition at specified levels of SI (low = 1 standard deviation below the mean; high = 1 standard deviation above the mean).
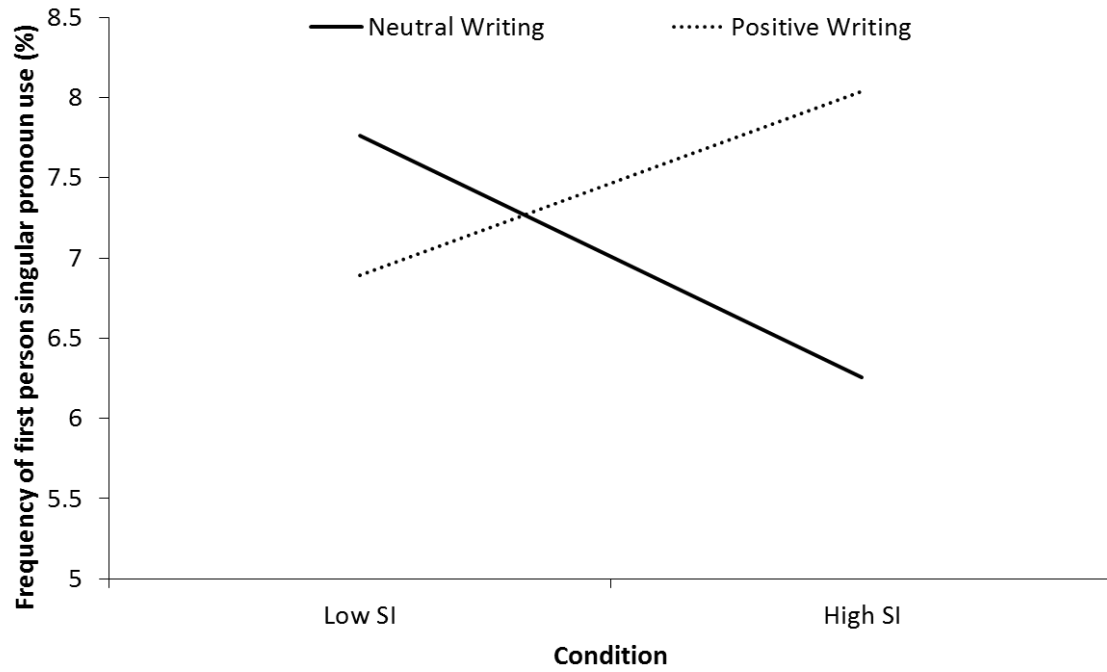
Figure 4

Regression lines showing changes in frequency of first person singular pronoun use for each

emotional writing condition at specified levels of SI (low = 1 standard deviation below the mean;

high = 1 standard deviation above the mean).