HHS Public Access

Author manuscript

Psychiatry Res. Author manuscript; available in PMC 2018 June 01.

Published in final edited form as:

Psychiatry Res. 2017 June ; 252: 29–37. doi:10.1016/j.psychres.2017.01.098.

Emotional word usage in groups at risk for schizophrenia-spectrum disorders: An objective investigation of attention to emotion

Christie K. Fung[a], **Melody M. Moore**[a], **Nicole R. Karcher**[b], **John G. Kerns**[b], and **Elizabeth A. Martin**[a,*]

[a]Department of Psychology and Social Behavior, University of California, Irvine, Irvine, CA, USA

[b]Department of Psychological Sciences, University of Missouri, Columbia, MO, USA

Abstract

Both extreme levels of social anhedonia (SocAnh) and extreme levels of perceptual aberration/magical ideation (PerMag) indicate increased risk for schizophrenia-spectrum disorders and are associated with emotional deficits. For SocAnh, there is evidence of self-reported decreased trait positive affect and abnormalities in emotional attention. For PerMag, there is evidence of increased trait negative affect and increased attention to negative emotion. Yet, the nature of more objective emotional abnormalities in these groups is unclear. The goal of this study was to assess attention to emotions more objectively in a SocAnh, PerMag, and control group by using a positive (vs. neutral) mood induction procedure followed by a free writing period. Linguistic analyses revealed that the SocAnh group used fewer positive emotion words than the control group, with the PerMag group falling in between the others. In addition, both at-risk groups used more negative emotion words than the control group. Also, for the control group only, those in the positive mood induction used more positive emotion words, suggesting their emotions influenced their linguistic expression. Overall, SocAnh is associated with decreased positive emotional expression and at-risk groups are associated with increased negative emotional expression and a decreased influence of emotions on linguistic expression.

1. Introduction

People at risk for developing schizophrenia-spectrum disorders, such as individuals with elevated levels of social anhedonia (SocAnh) or perceptual aberrations and magical ideation (PerMag), are characterized with abnormalities in emotion traits (e.g., Martin et al., 2011a; Kerns, 2005). Importantly, previous research suggests that SocAnh and PerMag have both shared and unique emotion abnormalities. For example, both SocAnh and PerMag are associated with increased trait negative affect but only SocAnh is associated with decreased

*Corresponding author: Elizabeth A. Martin, 949-824-6986 (phone), 949-824-3002 (fax), emartin8@uci.edu.

Conflicts of interest: None.

trait positive affect (e.g., Gooding and Pflum, 2014; Gooding and Tallent, 2003; Martin et al., 2011a). In addition, both SocAnh and PerMag are associated with increased neural reactivity to negative stimuli (Martin et al., 2016; Karcher and Shean, 2012) but only SocAnh is associated with decreased neural reactivity to positive stimuli (Hooker et al., 2014; Martin et al., 2016). Relatedly, both SocAnh and PerMag are associated with increased self-reported attention to negative emotion but only SocAnh is associated with decreased self-reported attention to positive emotions (Martin et al., 2011a). At the same time, both SocAnh and PerMag individuals reporting increased perceptual aberrations measured by the Schizotypal Personality Questionnaire (Raine, 1991) have been associated with aspects of alexithymia, such as increased difficulty identifying emotions (Van't Wout et al., 2004). However, only SocAnh has been associated with increased difficulty describing emotions, another facet of alexithymia (Gooding and Tallent, 2003; Martin et al., 2015). Overall, these results provide evidence that SocAnh and PerMag exhibit shared (e.g., increased attention to negative information, increased reactivity to negative stimuli) but also unique emotion abnormalities (e.g., decreased attention to positive information in SocAnh only). Because both SocAnh and PerMag are associated with the development of schizophrenia-spectrum disorders (e.g. Horan et al., 2008; Kwapil, 1998, Gooding et al., 2005), and they are both associated with emotion abnormalities (e.g., Gooding and Tallent, 2003; Martin et al., 2011a; Martin et al., 2011b), understanding these abnormalities could have important implications for future prevention and intervention in schizophrenia-spectrum disorders.

1.1 Measures of emotion abnormalities

Although emotion abnormalities are considered core deficits of these at-risk groups, previous studies have largely approached measuring these abnormalities only by directly asking individuals about their emotional experiences and trait tendencies. Thus, it is unclear the extent to which these abnormalities are reflected in more objective measures of attention to emotion. It is important to consider whether such abnormalities are reflected in objective measures because currently it is not clear whether they are consistent under different circumstances. Although some studies have used experience sampling methodology to investigate daily, real-time emotional experiences and expression in at-risk individuals (e.g. Barrantes-Vidal et al., 2013; Kwapil et al., 2012), participants were still directly asked about their emotions. Directly asking participants questions related to the construct of interest might activate participants' pre-existing beliefs and attitudes (Feldman and Lynch, 1988), or they may even form those beliefs or attitudes only after being asked the researcher's question (Fazio et al., 1984). Thus, rather than tapping into strongly endorsed or long-held beliefs which guide behavior, self-report questionnaires may lead participants to form judgments they otherwise would not form, resulting in responses that do not truly reflect the intended construct of interests. Although there is also some support of emotion abnormalities in SocAnh from non-self-report behavioral priming tasks (Martin and Kerns, 2010, Martin et al., 2011b), emotion delayed match-to-sample memory tasks (Gooding and Tallent, 2003), and in at-risk groups from neural measures (Martin et al., 2016; Karcher and Shean, 2012), it is still unclear whether the results could be reflected in a more objective, naturalistic measure. That is, it is unclear the extent to which these groups attend to emotional information naturally without being explicitly instructed to do so. One way to

assess this is using a free writing paradigm, in which participants write naturally without any restrictions or instructions. This measure can give a more objective assessment of how one attends to emotions, which may be beneficial in clarifying part of the nature in emotion abnormalities in groups at risk for the development of schizophrenia-spectrum disorders. Thus, the current research examined whether differences in attention to emotions between two at-risk groups, SocAnh and PerMag, and a control group are reflected in a free writing paradigm, in which participants are given no prompt and can write freely about anything they want.

1.2 Significance of free writing and linguistic analysis

Extensive research has investigated the relationship between expressive writing and health outcomes in healthy participants (for a review, see Frattaroli, 2006). This body of work suggests that writing about positive experiences is associated with enhanced positive mood and better physical and psychological outcomes compared to control conditions (i.e., writing about emotionally neutral topics; Burton and King, 2008; Pennebaker et al., 1988; Smyth, 1998). At the same time, previous research suggests that writing about experienced traumatic events, as a possible way to find meaning in those events, is also associated with positive outcomes (e.g., Pennebaker, 1985). Together, these studies provide evidence that writing about emotional (compared to neutral topics) is more beneficial to one's mental and physical health. However, participants in those studies all received prompts to guide their writing. The presence of any prompt could influence one's natural word use since participants could spontaneously engage in attitude formation when they are prompted to express an opinion on questions in relation to the construct of interest (Fazio et al., 1984). Importantly, natural word use is crucial in revealing aspects of our social and psychological states (Pennebaker et al., 2003) and may only be reflected in unprompted, open-ended responses. Thus, in order to objectively measure naturalistic linguistic expression, the current study adopted a free-writing paradigm in which participants were asked to write freely about anything they wished. The free-writing task is therefore an objective, alternative measure that operationalizes affective tendencies by measuring natural emotion word use.

In previous studies, this same objective measure of word use has also been utilized to measure affective tendencies in writing and speech samples of individuals with schizophrenia (Junghaenel et al., 2008; Minor et al., 2015) and with schizotypy (Najolia et al., 2011), which refers to a personality organization that reflects liability for schizophrenia (Meehl, 1962). These studies suggest differences exist in emotional word use between people at risk for a schizophrenia-spectrum disorder, those already diagnosed, and healthy individuals. Considering linguistic analysis of word use has provided evidence of emotional differences between these groups, word analysis could be an alternative measure over self-report questionnaires to understand emotion deficits more objectively. At the same time, previous research suggests schizotypy is dimensional (Kwapil et al., 2008) and that there are differential relationships within facets of schizotypy to cognitive control, emotion processing, and emotional experience (Kerns, 2006; Martin et al., 2011a). The current research extends knowledge about schizotypy by characterizing the relationship between schizotypy facets (i.e., SocAnh vs. PerMag) and specific emotional attention traits.

1.3 Using affect as information to guide behaviors

Our current affective state is related to multiple outcomes, such as thinking, judgments and behaviors. The "affect-as-information" theory suggests that people often use their own feelings as diagnostic information to make judgments, as if asking, "How do I feel?" before making a decision or conclusion (Schwarz and Clore, 2003). For example, previous research has found that healthy individuals who experienced a negative mood induction tended to have higher risk estimates than those in the positive mood condition (Gasper and Clore, 2000). In line with this research, Martin et al. (2011) investigated the link between negative mood and judgment of risk in SocAnh, PerMag and control groups. They found this relationship was only present in the PerMag and control groups (both rs < 0.42, both ps < 0.05) but not in the SocAnh group [$t(54) = 0.00$, $p = 0.99$]. That is, there was a relationship between negative mood and judgments in both the PerMag and control groups but not in the SocAnh group. This finding suggests only the PerMag and control groups, but not the SocAnh group, use their negative mood as information when making judgments. This effect has been found not only for negative moods, but also for current positive mood and judgments (e.g., decreased stereotypic judgments; Bodenhausen et al., 1994) in healthy individuals. Though the relationship between current negative mood and judgment has been examined in SocAnh and PerMag, it is unknown whether a relationship exists between current positive mood and actual behaviors, such as the content of naturalistic writing samples. Thus, the current research examined if similar relationships between positive mood and writing would be found for these groups.

Because SocAnh is associated with lower baseline positive affect compared to the other groups (Gooding and Tallent, 2003), the relationship between positive mood and free writing in SocAnh could be attenuated compared to the relationship found for the PerMag and control groups. Thus, in the current study, half of each group's participants underwent a pleasant mood induction in order to increase their positive moods. Past research has found that both affiliative and comedic videos produced a significant increase in positive affect for individuals with SocAnh and healthy participants (Leung et al., 2010). Therefore, including a positive induction to raise levels of positive affect allows for an investigation of a more definite relationship between current positive mood and word usage in a free writing paradigm.

1.4 The current study

Overall, the current study aimed to examine whether there are differences in emotional word use between the at-risk and control groups through a free writing task. Because people with SocAnh report decreased positive affect and decreased attention to positive emotion, we expected that there would be fewer positive emotion words used compared to both PerMag and control groups. Also, because there are some reports of both SocAnh and PerMag having increased negative affect and increased attention to negative emotion, we expected there to be more negative emotion words used by both at-risk groups compared to the control group. In addition, we examined if current positive mood is associated with positive emotion word use. Because only SocAnh has been previously associated with decreased attention to positive emotion, we expected that they would not use positive "affect as information" to guide their writing. Thus, we expected there to be no relationship between

being in the positive mood condition and positive word use for the SocAnh group. At the same time, we expected both the PerMag and control groups to attend to their emotions and use their "affect as information", resulting in a relationship between being in the positive mood condition and positive emotion word use. Also, given the previous association between both SocAnh and PerMag and alexithymia, we tested whether emotional word usage in the free writing task is related to self-reports of difficulty identifying or describing emotions. We expected that greater levels of alexithymia would be associated with less emotional word usage.

2. Methods

2.1. Participants

We used an extreme-groups approach (Preacher et al., 2005) that compared (a) people with extremely elevated SocAnh, (b) people with extremely elevated perceptual aberrations (Chapman et al., 1978) and magical ideation (Eckblad and Chapman, 1983) scores, and (c) a control group. Recruitment strategies were similar to our previous investigations that have successfully combined a psychometric high risk approach with psychotic-like experience semi-structured interview (Cicero et al., 2014; Karcher et al., 2015).

In the current study, there were 59 people in the SocAnh group who scored 1.96 *SD* above the same-sex mean on the Revised Social Anhedonia Scale. People with extremely elevated SocAnh have been found to be at increased risk for schizophrenia-spectrum disorders (Gooding et al., 2005; Kwapil, 1998). There were 73 people in the PerMag group who scored above 1.96 *SD* above the same-sex mean on the Perceptual Aberration or Magical Ideation scales or had a summed, standardized score from the Perceptual Aberration and Magical Ideation scales above 3.0. People with extremely elevated Perceptual Aberration/Magical Ideation scores have been found to be at increased risk for psychotic disorders (Chapman et al., 1994). There were 80 people in the control group who scored less than 0.5 standard deviations below the mean on the Revised Social Anhedonia Scale, Perceptual Aberration Scale, and Magical Ideation Scale. Five participants in the SocAnh and all participants the PerMag groups had both lifetime and current ratings ≥ 2 (2 = "mild psychotic-like experiences") on Unusual Thought Content/Delusional Ideation and Perceptual Abnormalities/Hallucinations subscales of the Structured Interview for Prodromal Syndromes (SIPS; Miller et al., 2003).

2.2. Materials

2.2.1. Psychosis-proneness scales—In total, 1166 participants completed the psychosis-proneness scales. Participants (n = 212) who met the criteria of either: A) scoring in 1.96 SD above the mean on the Perceptual Aberration, Magical Ideation, or Revised Social Anhedonia Scales; B) a combined 3 SD above the mean on the Perceptual Aberration and Magical Ideation scale; or C) less than 0.5 SD below the mean on all three scales were invited to participate the current study. The Revised Social Anhedonia Scale (Eckblad et al., 1982; α in current study = 0.90; M = 19.96, SD = 6.26), is a 40-item questionnaire, (Eckblad et al., 1982; α in current study = 0.90; M = 19.96, SD = 6.26), which is designed to measure lack of relationships and lack of pleasure from relationships (e.g., "I sometimes become

deeply attached to people I spend a lot of time with."). They also completed the 35-item Perceptual Aberration Scale (Chapman et al., 1978; α in current study = 0.92, *M* = 16.32, *SD* = 6.19) and the 30-item Magical Ideation Scale (Eckblad and Chapman, 1983; α in current study = 0.88, *M* = 17.83, *SD* = 5.28), which are designed to measure psychotic-like distortions and unusual beliefs respectively (e.g., "Parts of my body occasionally seem dead or unreal"; "Good luck charms don't work"). In addition, participants completed the Chapman Infrequency Scale (Chapman and Chapman, 1983) to screen for careless or invalid responses. Based on previous research (Chapman et al., 1994) those who endorsed 3 or more items on this 13-item, true-false scale were eliminated from analyses. The 118-items from these four scales were presented to participants in random order.

2.2.2. Structured Interview for Prodromal Syndromes—The Structured Interview for Prodromal Syndromes (Miller et al., 2003) was used to assess lifetime and current psychotic-like symptoms. The SIPS is a semi-structured interview and includes assessment of both Unusual Thought Content/Delusional Ideation and Perceptual Abnormalities/ Hallucinations. These two types of psychotic-like symptoms are rated on a 0–6 scale, ranging from "absent" to "severe and psychotic", with a rating of 2 indicating a "mild" psychotic-like symptom. All the SIPS interviews were videotaped and conducted by two graduate student interviewers extensively trained in SIPS administration and scoring (EAM and NRK; inter-rater reliability between the two raters was 0.93 for the Perceptual Abnormalities/Hallucinations and 0.95 for Unusual Thought Content/Delusional Ideation). Interviewers were blind to group membership and questionnaire scores of the participants prior to the interview.

2.2.3. Mood induction procedure—To manipulate people's moods, participants watched either a positive or neutral video. In the positive mood induction group, participants watched a 10-minute clip from Jerry Seinfeld's stand-up comedy show entitled, "I'm telling you for the last time" (Columbus 81 Productions, 1988). In these videos, Seinfeld gives a commentary on Halloween, the Olympics and scuba diving without using any vulgar or derogatory language. A previous study has also used this video clip to elicit positive mood (Martin et al., 2011a). Participants in the neutral condition watched a 10-minute clip of an instructional video entitled, "How do I? Flooring" (How do I? Productions, 2004). These clips explain how to install different kinds of flooring, including vinyl sheet flooring and baseboards. Two trade people discuss and demonstrate important safety rules, tools, products, preparation, installation and clean-up procedures.

2.2.4. Free writing task—Instructions for this task were as follows: "This is a free-writing task. Type whatever comes to mind. You'll have 10 minutes to type whatever comes to mind." In fact, the writing session was constrained to 6 minutes but participants were told they had longer in order to encourage them to write for the entire period of time. Each participant's writing sample was subjected to the Linguistic Inquiry and Word Count (LIWC, Pennebaker et al., 2007), a computer-based text analysis program. The LIWC uses a word count strategy to provide categorization of the text on several dimensions (e.g., positive emotion words, negative emotion words). The current investigation focused specifically on

including the percentage of words written during the free writing task that are positively and negatively valenced.

2.2.5. Current mood—Current mood was assessed at three time points: 1) before the mood induction, 2) after the mood induction and 3) after the free-writing task. Participants were shown 16 positively and negatively valenced words with both high and low arousal levels (e.g. serene, elated, sad, anger). They were asked, "How are you feeling right now?" and were given a 5-point scale (1 = *not at all* to 5 = *very strongly*) to respond. These words have been used frequently in previous research to assess self-reported mood (Martin et al., 2011a; in the current study, for measuring positive mood at three time points, all αs > 0.78; for measuring negative mood at three time points, all αs > 0.77). Due to computer malfunction, some participants did not complete the first, (PerMag: $N = 1$) second, (PerMag: $N = 6$, SocAnh: $N = 1$), and third mood measure (PerMag: $N = 2$, Control: $N = 2$).

2.2.6. Identifying and describing emotions—To measure alexithymia, participants completed the 20-item Toronto Alexithymia Scale (TAS) to assess self-reported difficulty in identifying emotions (Identifying Emotions subscale; in current study, α = 0.85) and describing emotions (Describing Emotions subscale; α = 0.78), as well as the degree to which individuals report that they focus their attention externally (Externally-Oriented Thinking subscale; α = 0.44) (Bagby et al., 1994). Given the low internal consistency of the Externally-Oriented Thinking subscale, we did not consider this subscale for further data analysis. Participants were asked to rate each item on a 5-point scale (1 = *strongly disagree* to 5 = *strongly agree*).

2.3. Procedure

The current study was carried out in accordance with the Declaration of Helsinki and took approximately 60 minutes. Participants first completed the mood measure and then were randomized to a mood condition. After the mood induction procedure, participants completed a second mood measure followed by the free writing task. Following the writing task, participants completed the mood measure a third time. Finally, they completed the questionnaires and some other unrelated tasks. All questionnaire measures were administered through E-prime software (Psychology Software Tools, 2006) and the writing task was completed using Microsoft Word.

2.4. Data Analysis

First, to examine whether there were group differences in levels of positive mood across three time points (baseline, after the mood induction, after the writing task), a repeated measures analysis of variance (ANOVA) was conducted and was followed by post-hoc T-tests. Second, in order to examine whether previous self-report findings on attentional deficits in emotions in the at-risk groups could be reflected in their emotion words use, a repeated measures ANOVA was conducted that included both positive and negative emotion word use and was followed by a series of post-hoc T-tests. Next, to examine if group differences on emotion word use was related to the mood induction conditions, another ANOVA was employed and was followed by post-hoc T-tests. In an exploratory analysis, we also examined if there were group differences on specific types of negative emotion word

use (anxiety, anger, sadness) using three one-way ANOVAs, followed by post-hoc pairwise comparisons.[1] Finally, we assessed whether there were group differences in reports of difficulty identifying and describing emotions using ANOVAs (followed by post-hoc T-tests) and then correlated these scores with emotion word usage.

3. Results

As can be seen in Table 1, the groups did not differ on any demographic variables collected, including sex, $X^2(2) = 0.64$, $p = 0.72$, race, $X^2(10) = 8.08$, $p = 0.62$, or age, $F(2,215) = 2.37$, $p = 0.95$. In addition, there were no differences between the mood conditions for any group for any demographic variable or psychosis-proneness scale, all ps > 0.1.

3.1. The positive mood induction was associated with higher levels of positive mood across all groups

We tested whether the groups differed in their report of positive mood for all time points by conducting a 3 (Group: SocAnh, PerMag, Control) by 3 (Time: 1, 2, 3) by 2 (Video: Positive, Neutral) ANOVA. There was not a significant 3-way interaction between group, time, and video, $F(4,380) = 0.93$, $p = .44$, $\eta_p^2 = 0.01$, but there was a significant 2-way interaction between time and video, $F(2,380) = 15.65$, $p < 0.001$, $\eta_p^2 = 0.07$. As seen in Figure 1, participants in the positive mood induction group felt significantly more positively than the neutral group after the mood induction (i.e., from Time 1 to Time 2), $t(200) = 2.43$, $p = 0.01$, $d = 0.35$. There were no significant differences in positive mood for participants in both induction groups after the free writing paradigm (i.e., from Time 2 to Time 3), $t(203) = -0.02$, $p = 0.98$, $d = 0.002$.

There was also a significant 2-way interaction between group and video for positive mood, $F(2, 190) = 4.07$, $p = 0.01$, $\eta_p^2 = 0.04$. Follow-up tests indicated that control participants in the neutral mood condition tended to have higher baseline positive mood than those in the positive mood condition, $t(79) = 1.78$, $p = 0.07$, $d = 0.40$, but there were no differences in baseline positive mood between the video conditions for either the SocAnh or PerMag participants, both ps > 0.42, ds < 0.19. Last, there was a non-significant trend for a 2-way interaction between time and group, $F(4, 280) = 2.20$, $p = 0.06$, $\eta_p^2 = 0.02$. This non-significant interaction indicates that the control group had the highest positive mood ratings at Time 1, the PerMag group had the highest ratings at Time 2 and 3, and the SocAnh group tended to have the lowest ratings at each time point.

3.2. SocAnh used fewer positive emotion words, while both SocAnh and PerMag used more negative emotion words, than the control group during the free-writing task

First, to ensure any differences we found regarding the types of words used were not due to the total number of words used, we tested whether the groups differed in the total number of words they wrote during the free writing task. We did not find a significant group difference in the total number of words used, $F(2,209) = 0.418$, $p = 0.65$, $\eta^2 = 0.003$.

[1] In contrast to negative words, the LIWC does not have a more specific break-down of types of positive words used.

Next, we conducted a 3 (Group: SocAnh, PerMag, Control) by 2 (Word type: Positive, Negative) ANOVA to test whether the groups differed on the types of emotion words used during the free writing task. We found a significant interaction between group and word type, $F(2,209) = 6.31$, $p = 0.002$, $\eta_p^2 = 0.05$. As seen in Table 1, planned post-hoc tests indicated that the SocAnh group wrote significantly fewer positive emotion words than the control group, $t(137) = -2.43$, $p = 0.01$, $d = -0.42$. No significant differences were found between the SocAnh and the PerMag group, $t(130) = -1.27$, $p = 0.20$, $d = 0.22$, or between the PerMag and control group, $t(151) = -1.23$, $p = 0.21$, $d = 0.20$.

In addition, planned post-hoc tests indicated that both the SocAnh and the PerMag groups used significantly more negative emotion words than the control group [SocAnh vs. Controls, $t(137) = 2.94$, $p = 0.004$, $d = 0.49$; PerMag vs. Controls, $t(151) = 2.02$, $p = 0.04$, $d = 0.33$]. The PerMag group and the SocAnh group did not significantly differ from each other, $t(130) = 0.57$, $p = 0.56$, $d = 0.10$. Overall, although the groups did not differ in the total number of words used during the free writing task, they did differ in the emotion words used—the SocAnh group used fewer positive emotion words than the control group, and both the SocAnh and PerMag groups used more negative emotion words than the control group.

3.3. For the control group only, those in the positive mood condition used more positive emotion words than those in the neutral mood condition

To test whether the groups differed in percentage of positive emotion words used in different mood induction conditions, we ran a 3 (Group: SocAnh, PerMag, Control) by 2 (Video: Positive, Neutral) ANOVA. There was not a significant interaction, $F(2, 200) = 0.39$, $p = 0.67$, $\eta_p^2 = 0.004$, but there was a significant main effect for video, $F(1,202) = 6.91$, $p = 0.009$, $\eta_p^2 = 0.03$, such that participants in the positive mood induction group wrote more positive emotion words than those in the neutral group, $t(204) = 2.55$, $p = 0.01$. In addition, there was a significant main effect for group, $F(2,202) = 3.23$, $p = 0.04$, $\eta_p^2 = 0.03$. Planned post-hoc tests revealed that there was a significant within-group difference only for the control group, such that the control participants in the positive mood condition wrote significantly more positive emotion words than those in the neutral condition, $t(72) = 2.11$, $p = 0.03$, $d = 0.50$. No significant within-group differences were found for the SocAnh group, $t(55) = 1.50$, $p = 0.13$, $d = 0.40$, and the PerMag group, $t(69) = 0.89$, $p = 0.37$, $d = 0.22$. Overall, only the control group, but not the at-risk groups, wrote more positive emotion words in the positive mood induction condition comparing to the neutral condition.

3.4. Exploratory analysis revealed no significant group difference in subtype of negative emotion word use

To test whether the groups differed in percentage of subtype of negative emotion words used, we conducted 3 one-way ANOVAs for each negative subtype (anxiety, anger, sadness). We found no main effect of group in the use of anxiety words, $F(2,209) = 2.38$, $p = 0.09$, $\eta^2 = 0.02$; anger words, $F(2,209) = 2.18$, $p = 0.11$, $\eta^2 = 0.02$; or sadness words, $F(2,209) = 1.42$, $p = 0.24$, $\eta^2 = 0.01$, such that the participants did not write differently in the percentage of anxiety, anger of sadness words.

3.5. The at-risk groups had more difficulty identifying and describing emotions

To test for group differences in difficulty in identifying and describing emotions, a 3 (Group: SocAnh, PerMag, Control) by 2 (Difficulty with emotions: Difficulty Identifying, Difficulty Describing) ANOVA was carried out, and there was a significant interaction between group and difficulty with emotions, $F(2,209) = 18.17$, $p < 0.001$, $\eta_p^2 = 0.14$. As seen in Table 1, the PerMag group reported significantly more difficulty identifying emotions compared to both the control and SocAnh groups [PerMag vs. Controls, $t(150) = 9.65$, $p < 0.001$, $d = 1.53$; PerMag vs. SocAnh, $t(129) = 3.04$, $p = 0.003$, $d = 0.53$]. At the same time, the SocAnh reported more difficulty identifying emotions compared to the control group, $t(139 = 5.39$, $p < 0.001$, $d = 0.87$. In addition, both the PerMag groups and the SocAnh groups reported more difficulty describing emotion than the control group [PerMag vs. Controls, $t(150) = 3.85$, $p < 0.001$, $d = 0.62$; SocAnh vs. Controls, $t(139) = 4.79$, $p < 0.001$, $d = 0.80$], but these groups did not significantly differ from each other, $t(129) = -0.99$, $p = 0.32$, d = −0.17. Thus, as expected, the at-risk groups reported more difficulty identifying and describing emotions compared to the control group. At the same time, the PerMag group reported more difficulty identifying, but not describing, emotions compared to the SocAnh group.

3.6. For the at-risk groups, more difficulty describing emotions is associated with less positive emotion word use

Last, we tested whether there were relationships between difficulty identifying or describing emotions and positive emotion words used during the free writing task in each group. No significant associations were found between difficulty identifying emotions and positive emotion words used for either the SocAnh and control groups, both rs < −0.16, all ps > 0.21, but a trend was found for the PerMag group, $r = -0.22$, $p = 0.06$ (i.e., more difficulty identifying emotions was marginally associated with fewer positive words). In contrast, negative significant associations were found between difficulty describing emotions and positive emotion words used for both the SocAnh, $r(58) = -0.27$, $p = 0.03$, and the PerMag group, $r(71) = -0.34$, $p = 0.004$, but no significant association was found for the control group, $r(78) = -0.14$, $p = 0.19$. In contrast to the results for positive words, there were no significant associations between difficulty identifying or describing emotions and negative emotion words in any group, all rs < −0.11, all ps > 0.32. Thus, overall, these results suggest that more difficulty describing emotions is related to using fewer positive emotion words for the at-risk but not control group.

4. Discussion

Using linguistic analysis on responses to a free writing paradigm, we examined whether there are differences in emotion word use between groups at risk of developing schizophrenia-spectrum disorders and healthy controls. We found individuals with elevated SocAnh, but not PerMag, used fewer positive emotion words than controls and that the more difficulty the SocAnh and PerMag groups reported in describing emotions, the fewer positive words they used. Additionally, we found both at-risk groups used more negative emotion words than healthy controls. We also found that a positive mood induction was associated with increased use of positive emotion words in the healthy controls only but not in either at-risk group.

To our knowledge, this is the first study to investigate emotion word use using a free writing paradigm for people at risk for schizophrenia-spectrum disorders. Previous research has relied on the use of prompts. For example, in a previous study that investigated emotion word use in speech samples from people with schizotypy provided prompts to guide participants' response (Najolia et al., 2011) and utilized lexical analysis to investigate the impact of a mood induction by presenting pleasant, unpleasant and neutral pictures on in-the-moment verbal responses. Similar to our current findings, they found that these individuals used a higher percentage of negative words and a lower percentage of positive words when asked about their emotional experiences during the positive mood induction. Another study also examined differences in emotion word use in verbal expression between schizophrenia patients with or without elevated anhedonia and healthy participants when they were asked to describe positive autobiographical memories (Cohen et al., 2009). The researchers reported that individuals with elevated anhedonia had an increase in negative emotion word use but no difference in positive emotion word use. Both studies utilized prompts to guide participants' verbal response and any prompt may influence one's most natural thought processes and word usage, which in turn will influence the linguistic analysis. Therefore, in the current study, the use of a free writing paradigm allowed us to capture an unsolicited measure of attention emotion, which is important for achieving ecological validity (Schmuckler, 2001). At the same time, free writing can ameliorate some of the potential self-report biases that limit the validity of self-report questionnaires. Thus, a free writing paradigm is a relatively innovative assessment tool to measure attention to emotion in a less biased way, resulting in data that more closely reflects and generalizes to real-world situations.

Our current result of fewer positive emotion words use in the SocAnh group compared to the control group is consistent with previous self-report findings on attention to emotions (e.g. Martin et al., 2011a) and findings on neural reactivity to emotional stimuli in at-risk groups (e.g. Martin et al., 2016), as well as previous behavioral work investigating the link between anhedonia and attention to emotion in individuals with schizophrenia (Martin et al., 2013). For example, Kerns and colleagues (2008) found that social anhedonia was also associated with providing less emotional content when describing what it is like to experience positive situations. In addition, previous research found that social anhedonia is associated with diminished experience of positive affect to lab stimuli and daily life situations (Brown et al., 2007; Martin et al., 2011a; Kerns et al., 2008) as well as less positive facial expressions in response to comedic film clips (Leung et al., 2010). However, there was some physiological evidence that social anhedonia is associated with similar affective responses to lab stimuli as control participants (Gooding et al., 2002). Gooding and colleagues (2002) found that compared to control participants, SocAnh was not associated with any alteration of blink magnitude in a startle probe response paradigm using both positive and negative stimuli. Importantly though, blink magnitude reflects a defensive reflex (Lang et al., 1990) that is mediated by direct projections from the amygdala to the nucleus reticularis pontis caudalis, a structure in the brainstem (e.g., Davis, 1989; Hitchcock and Davis, 1987; Miserendino and Davis, 1993). Thus, the startle probe is thought to reflect the influence of primarily subcortical brain regions. In contrast, a previous fMRI study found evidence of cortical deficits in SocAnh (Hooker et al., 2014) and a recent study also found a SocAnh deficit in

the late positive potential (Martin, Karcher, Bartholow, Siegle, and Kerns, under review), which thought to reflect predominantly cortical influences. Taken together, this suggests that affective deficits in SocAnh related to greater neural response to negative than to positive stimuli might reflect primarily cortical influences. Thus, the different findings between paradigms and physiological measures might indicate something important about the nature of affective deficits in SocAnh.

At the same time, we found that the PerMag group did not significantly differ from the control group in the number of positive words used. This is consistent with previous findings of similar amounts of emotional content between the PerMag and control groups when describing what it is like to experience positive situations (Kerns et al., 2008). Our finding is also consistent with previous research that found that the PerMag group did not significantly differ from the control group in self-reported daily experiences of positive affect (Martin et al., 2011a; Kerns et al., 2008) and response bias to positive words (Kerns, 2005). Overall, the current finding regarding positive word use (i.e., compared to controls, decreased in SocAnh but no different in PerMag) is consistent with previous work on emotions with these groups and extends research by utilizing a more naturalistic measure.

Meanwhile, the current result of both SocAnh and PerMag using significantly more negative words both supports and extends on previous self-report findings of increase in attention to negative emotion for these groups (e.g. Martin et al., 2011a). The evidence of both at-risk groups using more negative emotion words is also consistent with evidence of elevated trait negative affect (Gooding and Pflum, 2014; Martin et al., 2011a). A recent study that utilized lexical analysis to assess speech in individuals with either schizophrenia or schizoaffective disorder concluded that anger words predict greater symptoms and lower quality of life (Minor et al., 2015). Because the current study did not find significant group differences between subtypes of negative emotion word use (i.e., anxiety, anger, sadness) in the at-risk groups, taken together, these results suggest that there is a continuum of linguistic abnormalities between people who are at risk and are diagnosed with schizophrenia-spectrum disorders. In future research, examining anger word use in particular could be an objective way to differentiate these groups.

On the other hand, the current finding on SocAnh associated with increased negative emotion is inconsistent with some other evidence. For instance, a previous study found that only people with social anxiety, but not high levels of self-reported social anhedonia, were associated with increased negative affect (Brown et al., 2007). However, another study reported increased negative affect in individuals with elevated SocAnh compared to a control group (Martin et al., 2011a). The inconsistency in results could reflect a limitation of the Revised Social Anhedonia Scales, which may tap both positive and negative dimensions of schizotypy. That is, the scale contains items that tap anxiety and discomfort, as well as asociality and disinterest in social contact (Kwapil et al., 2008; Lewandowski et al., 2006). Future research is needed in order to clarify which constructs this scale truly assesses, and perhaps utilizing different measures to understand the underlying nature of SocAnh.

To our knowledge, the current study is the first to investigate downstream effects of positive mood induction on free-writing linguistic expression in at-risk individuals. If participants

attended to emotions, and emotion in turn influenced behavior, then a positive mood induction should be associated with higher rates of positive emotion word use. Consistent with previous research, participants in the control group who experienced the positive mood induction reported increases in positive affect and used more positive emotion words when compared to controls not experiencing a positive mood induction, suggesting affect influenced behavior. At the same time, not attending to one's emotions should interrupt the influence of mood on behavior such that a positive mood induction would not be related to positive linguistic expression. If SocAnh is associated with decreased attention to positive emotion (e.g., Martin et al., 2011a), we would expect rates of positive word use by individuals in the SocAnh group to remain stable regardless of mood induction. Indeed, we found participants with SocAnh who experienced the positive mood induction reported increases in positive affect yet did not use more positive emotion words when compared to SocAnh participants who did not experience the mood induction. Given that participants with SocAnh in the positive mood condition also reported increases in positive affect, it is unlikely trait differences in baseline affect in the SocAnh group can explain why their positive word usage did not differ between neutral and positive mood inductions. Thus, unlike healthy controls, experiencing a positive mood was not reflected in linguistic response patterns for people with SocAnh.

Although not hypothesized, we found that similar to the SocAnh group, individuals in the PerMag group who experienced the positive mood induction reported increases in positive affect but did not use more positive emotion words compared to PerMag participants who did not experience the mood induction. One possible explanation for this result is that PerMag participants in the positive mood induction indeed paid attention to positive emotion but for a briefer period of time than controls, thus experiencing and expressing fewer behavioral impacts of positive affect. Future research is needed to assess the duration of attention to emotion in this group. For example, one way to objectively assess the extent to which individuals attend to, and elaborate on, emotion is to measure gamma band activity in response to valenced stimuli (Siegle et al., 2010; Martin et al., 2016).

In addition, the current findings of the at-risk groups having more difficulty identifying and describing emotions are consistent with previous research that reported increased alexithymia in these groups (e.g., Martin et al., 2015). The current research extends previous research by suggesting more difficulty describing emotions is associated with less positive emotion word use in the at-risk groups, which to our knowledge, has not be reported using a more objective measure as used here. Of note, in the current study, participants completed the alexithymia scales after the mood induction and the free writing task. Though emotion elicitation research suggests that the elicited affect from a film is likely to fade and/or be distorted by errors or systematic biases in recall as time elapses (Levenson, 1988), it is still possible that any elicited affect from the mood induction could affect participants' performance on the alexithymia scale. Future research is needed to assess the extent to which the duration between a mood induction and completion of an alexithymia measure might affect the scores on the measure.

Given that mood has been found to influence various cognitive processes, such as memory, our findings raise questions not only about in-the-moment linguistic expressions of affect,

but also future recollection of emotional experiences and information for at-risk individuals. For example, there has been evidence suggesting mood may facilitate mood-congruent information recall (e.g., Bower, 1981; Eich and Forgas, 2003; Mayer et al., 1995) and that affective states orient attention toward information, which could explain current feelings (Wyer and Carlston, 1979). Unlike healthy controls, responses by participants in at-risk groups did not show a bias for mood-congruent language, suggesting their mood state might not facilitate recall for similar experiences nor guide attention toward information able to account for positive affect. Considering research which linearly links positive word use to positive health outcomes (Pennebaker, 1997), this finding might aid in explaining the relationship between SocAnh and PerMag and worse outcomes, such as poor social functioning (Blanchard et al., 1998).

A plethora of research suggests affect is only used as information when people do not question the origin of their affect (Schwarz, 2011). In other words, positive mood will only inform judgment if a person does not attribute the positive mood to an external event or object (e.g., Schwarz and Clore, 1983). Thus, an alternative explanation for our findings is that participants in the at-risk groups questioned their positive affect and attributed positive feelings to the positive mood induction, resulting in a pattern of responses that appear as if participants were not experiencing a positive mood. One weakness of this explanation is the assumption that healthy controls, unlike the at-risk groups, did not question and attribute their positive mood to the mood induction. Future research should examine and compare attributional styles among SocAnh, PerMag, and healthy controls in order to test whether attributional and discounting effects are responsible for differential response patterns following a positive mood induction.

Finally, though the current study aimed at reducing self-report biases and increasing generalizability of results by using a naturalistic measure to assess attention to emotion, some limitations of the study reflect the limitations of the LIWC itself. Although the LIWC analysis provides insightful implications on social and psychological phenomena (Pennebaker et al., 2003), its analytic approach only focuses on word count so the context of the word is often disregarded. Since the meaning of a sentence depends on the context, most of the meaning of the writing sample is therefore dismissed. Another limitation in the LIWC program is that it does not detect irony, sarcasm, idioms, novel slangs or emoticons. The word “mad”, for example, is coded as an anger word even if it is phrased as, “He is as mad as a hatter”. The meaning and intention of the sentence is therefore misinterpreted and miscoded (Tausczik and Pennebaker, 2010). Future research could employ latent semantic analysis (Landauer and Dutnais, 1997), a technique that mathematically detects how words covary across large samples of texts, to identify shared concepts across writing samples and address some of the limitations of the LIWC.

Acknowledgments

We would like to thank Sarah Pressman for her help with data analysis.

References

Bagby RM, Parker JDA, Taylor GJ. The twenty-item Toronto Alexithymia scale-I. Item selection and cross-validation of the factor structure. J Psychosom Res. 1994; 38:23–32. DOI: 10.1016/0022-3999(94)90005-1 [PubMed: 8126686]

Barrantes-Vidal N, Chun Ca, Myin-Germeys I, Kwapil TR. Psychometric schizotypy predicts psychotic-like, paranoid, and negative symptoms in daily life. J Abnorm Psychol. 2013; 122:1077–87. DOI: 10.1037/a0034793 [PubMed: 24364610]

Blanchard JJ, Mueser KT, Bellack aS. Anhedonia, positive and negative affect, and social functioning in schizophrenia. Schizophr Bull. 1998; 24:413–24. DOI: 10.1093/oxfordjournals.schbul.a033336 [PubMed: 9718633]

Bodenhausen GV, Kramer GP, Süsser K. Happiness and stereotypic thinking in social judgment. J Pers Soc Psychol. 1994; 66:621–632. DOI: 10.1037/0022-3514.66.4.621

Bower GH. Commentary on mood and memory. Behav Res Ther. 1981; 25:443–455. DOI: 10.1016/0005-7967(87)90052-0

Brown LH, Silvia PJ, Myin-Germeys I, Kwapil TR. When the need to belong goes wrong. Psychol Sci. 2007; 18:778–782. [PubMed: 17760772]

Burton CM, King La. Effects of (very) brief writing on health: the two-minute miracle. Br J Health Psychol. 2008; 13:9–14. DOI: 10.1348/135910707X250910 [PubMed: 18230223]

Chapman LJ, Chapman JP. Infrequency Scale. Unpubl test. 1983

Chapman LJ, Chapman JP, Kwapil TR, Eckblad M, Zinser MC. Putatively psychosis-prone subjects 10 years later. J Abnorm Psychol. 1994; 103:171–183. DOI: 10.1037/0021-843X.103.2.171 [PubMed: 8040487]

Chapman LJ, Chapman JP, Raulin ML. Body-image aberration in Schizophrenia. J Abnorm Psychol. 1978; 87:399–407. DOI: 10.1037/0021-843X.87.4.399 [PubMed: 681612]

Cicero DC, Martin EA, Becker TM, Docherty AR, Kerns JG. Correspondence between psychometric and clinical high risk for psychosis in an undergraduate population. Psychol Assess. 2014; 26:901–15. DOI: 10.1037/a0036432 [PubMed: 24708081]

Cohen A, Aakre JM, Docherty NM, St-Hillaire A. Understanding anhedonia in schizophrenia through lexical analysis of natural speech. Cogn Emot. 2009; 23:569–586. DOI: 10.1080/02699930802044651

Columbus 81 Productions. Jerry Seinfeld's I'm telling you for the last time [DVD]. USA: Time Warner Entertainment Company; 1988.

Eckblad M, Chapman LJ. Magical ideation as an indicator of schizotypy. J Consult Clin Psychol. 1983; 51:215–225. DOI: 10.1037/0022-006X.51.2.215 [PubMed: 6841765]

Eckblad ML, Chapman LJ, Chapman J, Mishlove M. The Revised Social Anhedonia Scale. Unpubl test. 1982

Eich, E., Forgas, JP. Handbook of Psychology: Experimental Psychology. Wiley; New York: 2003. Mood, cognition, and memory; p. 61-83.

Fazio RH, Lenn TM, Effrein Ea. Spontaneous Attitude Formation. Soc Cogn. 1984; 2:217–234. DOI: 10.1521/soco.1984.2.3.217

Feldman JM, Lynch JG. Self-Generated Validity and Other Effects of Measurement on Belief, Attitude, Intention, and Behavior. J Appl Psychol. 1988; 73:421–435. DOI: 10.1037/0021-9010.73.3.421

Frattaroli J. Experimental disclosure and its moderators: A meta-analysis. Psychol Bull. 2006; 132:823–865. DOI: 10.1037/0033-2909.132.6.823 [PubMed: 17073523]

Gasper K, Clore GL. Do You have to Pay Attention to Your Feelings to be Influenced by Them? Personal Soc Psychol Bull. 2000; 26:698–711. DOI: 10.1177/0146167200268005

Gooding DC, Davidson RJ, Putnam KM, Tallent KA. Normative emotion-modulated startle response in individuals at risk for schizophrenia-spectrum disorders. Schizophr Res. 2002; 57:109–120. DOI: 10.1016/S0920-9964(01)00295-X [PubMed: 12165381]

Gooding DC, Pflum MJ. The assessment of interpersonal pleasure: Introduction of the Anticipatory and Consummatory Interpersonal Pleasure Scale (ACIPS) and preliminary findings. Psychiatry Res. 2014; 215:237–243. DOI: 10.1016/j.psychres.2013.10.012 [PubMed: 24210182]

Gooding DC, Tallent KA. Spatial, object, and affective working memory in social anhedonia: An exploratory study. Schizophr Res. 2003; 63:247–260. DOI: 10.1016/S0920-9964(02)00326-2 [PubMed: 12957704]

Gooding DC, Tallent KA, Matts CW. Clinical status of at-risk individuals 5 years later: further validation of the psychometric high-risk strategy. J Abnorm Psychol. 2005; 114:170–175. [PubMed: 15709824]

Hitchcock JM, Davis M. Fear-Potentiated Startle Using an Auditory Conditioned-Stimulus - Effect of Lesions of the Amygdala. Physiol Behav. 1987; 39:403–408. DOI: 10.1016/0031-9384(87)90242-3 [PubMed: 3575483]

Hooker CI, Benson TL, Gyurak A, Yin H, Tully LM, Lincoln SH. Neural activity to positive expressions predicts daily experience of schizophrenia-spectrum symptoms in adults with high social anhedonia. J Abnorm Psychol. 2014; 123:190–204. DOI: 10.1037/a0035223 [PubMed: 24661170]

Horan WP, Blanchard JJ, Clark LA, Green MF. Affective traits in schizophrenia and schizotypy. Schizophr Bull. 2008; 34:856–874. DOI: 10.1093/schbul/sbn083 [PubMed: 18667393]

How do I? Productions, 2004. How do I? Flooring [DVD].

Junghaenel D, Smyth J, Santer L. Linguistic Dimensions of Psychopathology. 2008; 27:36–55.

Karcher N, Shean G. Magical ideation, schizotypy and the impact of emotions. Psychiatry Res. 2012; 197:36–40. DOI: 10.1016/j.psychres.2011.12.033 [PubMed: 22417932]

Karcher NR, Martin EA, Kerns JG. Examining associations between psychosis risk, social anhedonia, and performance of striatum-related behavioral tasks. J Abnorm Psychol. 2015; 124:507–18. DOI: 10.1037/abn0000067 [PubMed: 26075968]

Kerns JG. Schizotypy facets, cognitive control, and emotion. J Abnorm Psychol. 2006; 115:418–427. DOI: 10.1037/0021-843X.115.3.418 [PubMed: 16866583]

Kerns JG. Positive schizotypy and emotion processing. J Abnorm Psychol. 2005; 114:392–401. DOI: 10.1037/0021-843X.114.3.392 [PubMed: 16117576]

Kerns JG, Docherty AR, Martin Ea. Social and physical anhedonia and valence and arousal aspects of emotional experience. J Abnorm Psychol. 2008; 117:735–46. DOI: 10.1037/a0013601 [PubMed: 19025222]

Kwapil TR. Social anhedonia as a predictor of the development of schizophrenia-spectrum disorders. J Abnorm Psychol. 1998; 107:558–565. DOI: 10.1037/0021-843X.107.4.558 [PubMed: 9830243]

Kwapil TR, Barrantes-Vidal N, Silvia PJ. The dimensional structure of the wisconsin schizotypy scales: Factor identification and construct validity. Schizophr Bull. 2008; 34:444–457. DOI: 10.1093/schbul/sbm098 [PubMed: 17768308]

Kwapil TR, Brown LH, Silvia PJ, Myin-Germeys I, Barrantes-Vidal N. The expression of positive and negative schizotypy in daily life: an experience sampling study. Psychol Med. 2012; 42:2555–2566. DOI: 10.1017/S0033291712000827 [PubMed: 22716971]

Landauer TK, Dutnais ST. A Solution to Plato's Problem: The Latent Semantic Analysis Theory of Acquisition, Induction, and Representation of Knowledge. Psychol Rev. 1997; 1:211–240. DOI: 10.1037/0033-295X.104.2.211

Lang PJ, Bradley MM, Cuthbert BN. Emotion, Attention, and the Startle Reflex. Psych Rev. 1990; 97:377–395. DOI: 10.1037/0033-295X.97.3.377

Leung WW, Couture SM, Blanchard JJ, Lin S, Llerena K. Is social anhedonia related to emotional responsivity and expressivity? A laboratory study in women. Schizophr Res. 2010; 124:66–73. DOI: 10.1016/j.schres.2010.06.012 [PubMed: 20620020]

Levenson, RW. Social Psychophysiology and Emotion: Theory and Clinical Applications. Wiley; Chichester: 1988. Emotion and the autonomic nervous system: a prospectus for research on autonomic specificity; p. 17-42.

Lewandowski KE, Barrantes-Vidal N, Nelson-Gray RO, Clancy C, Kepley HO, Kwapil TR. Anxiety and depression symptoms in psychometrically identified schizotypy. Schizophr Res. 2006; 83:225–235. DOI: 10.1016/j.schres.2005.11.024 [PubMed: 16448805]

Martin EA, Becker TM, Cicero DC, Docherty AR, Kerns JG. Differential associations between schizotypy facets and emotion traits. Psychiatry Res. 2011a; 187:94–99. DOI: 10.1016/j.psychres.2010.12.028 [PubMed: 21262540]

Martin EA, Becker TM, Cicero DC, Kerns JG. Examination of affective and cognitive interference in schizophrenia and relation to symptoms. J Abnorm Psychol. 2013; 122:733–44. DOI: 10.1037/a0033956 [PubMed: 24016013]

Martin EA, Cicero DC, Bailey DH, Karcher NR, Kerns JG. Social Anhedonia is not just extreme introversion: Empirical evidence of distinct constructs. J Pers Disord. 2015; 29:1–18. DOI: 10.1521/pedi [PubMed: 24932873]

Martin EA, Karcher NR, BB, Siegle GJ, Kerns JG. An electrophysiological investigation of emotional abnormalities in social anhedonia and psychosis risk. 2016 Under Rev.

Martin EA, Kerns JG. Social anhedonia associated with poor evaluative processing but not with poor cognitive control. Psychiatry Res. 2010; 178:419–424. DOI: 10.1016/j.psychres.2009.08.018 [PubMed: 20493541]

Martin, Ea, Cicero, DC., Kerns, JG. Social anhedonia, but not positive schizotypy, is associated with poor affective control. Personal Disord. 2011b; 3:263–72. DOI: 10.1037/a0024488 [PubMed: 22452767]

Mayer JD, McCormick LJ, Strong SE. Mood-congruent memory and natural mood: new evidence. Personal Soc Psychol Bull. 1995; 21(7):736–746.

Meehl PE. Schizotaxia, schizotypy, schizophrenia. Am Psychol. 1962; 17:827–838. DOI: 10.1037/h0041029

Miller TJ, Mcglashan TH, Rosen JL, Cadenhead K, Ventura J, Mcfarlane W, Perkins D, Pearlson GD, Woods SW. Prodromal Assessment with the Structured Interview for Prodromal Syndromes and the Scale of Prodromal Symptoms: predictive validity, interrater reliability, and training to reliability. Schizophr Bull. 2003; 29:703–716. [PubMed: 14989408]

Minor KS, Bonfils KA, Luther L, Firmin RL, Kukla M, MacLain VR, Buck B, Lysaker PH, Salyers MP. Lexical analysis in schizophrenia: How emotion and social word use informs our understanding of clinical presentation. J Psychiatr Res. 2015; 64:74–78. DOI: 10.1016/j.jpsychires.2015.02.024 [PubMed: 25777474]

Miserendino MJD, Davis M. NMDA and non-NMDA antagonists infused into the nucleus reticularis pontis caudalis depress the acoustic startle reflex. Brain Res. 1993; 623:215–222. DOI: 10.1016/0006-8993(93)91430-Z [PubMed: 8106121]

Najolia GM, Cohen AS, Minor KS. A laboratory study of affectivity in schizotypy: Subjective and lexical analysis. Psychiatry Res. 2011; 189:233–238. DOI: 10.1016/j.psychres.2011.07.012 [PubMed: 21816487]

Pennebaker JW. Writing about emotional experiences as a therapeutic process. Psychol Sci. 1997; 8:162–166.

Pennebaker JW. Traumatic experience and psychosomatic disease: Exploring the roles of behavioural inhibition, obsession, and confiding. Can Psychol Can. 1985; 26:82–95. DOI: 10.1037/h0080025

Pennebaker JW, Booth RJ, Francis ME. Operator's Manual: Linguistic Inquiry and Word Count - LIWC2007. 2007:1–11.

Pennebaker JW, Kiecolt-Glaser JK, Glaser R. Disclosure of traumas and immune function: health implications for psychotherapy. J Consult Clin Psychol. 1988; 56:239–245. DOI: 10.1037/0022-006X.56.2.239 [PubMed: 3372832]

Pennebaker JW, Mehl MR, Niederhoffer KG. Psychological aspects of natural language. use: our words, our selves. Annu Rev Psychol. 2003; 54:547–77. DOI: 10.1146/annurev.psych.54.101601.145041 [PubMed: 12185209]

Preacher KJ, Rucker DD, MacCallum RC, Nicewander WA. Use of the extreme groups approach: a critical reexamination and new recommendations. Psychol Methods. 2005; 10:178–192. DOI: 10.1037/1082-989X.10.2.178 [PubMed: 15998176]

Psychology Software Tools, I., 2006. V2.0., E-prime

Raine A. The SPQ: a scale for the assessment of schizotypal personality based on DSM-III-R criteria. Schizophr Bull. 1991; 17:555–564. DOI: 10.1093/schbul/17.4.555 [PubMed: 1805349]

Schmuckler. Role of clinical diagnosis and medication use in effects of maternal depression on infant-directed speech. Infancy. 2001; 2:537–548.

Schwarz, N. Handbook of Theories of Social Psychology. Thousand Oaks, CA: 2011. Feelings-as-information theory; p. 289-308.

Schwarz N, Clore G. Mood as information: 20 years later. Psychol Inq. 2003; 14:296–303. DOI: 10.1207/S15327965PLI1403&4_20

Schwarz N, Clore GL. Mood, misattribution, and judgments of well-being: Informative and directive functions of affective states. J Pers Soc Psychol. 1983; 45:513–523. DOI: 10.1037/0022-3514.45.3.513

Siegle GJ, Condray R, Thase ME, Keshavan M, Steinhauer SR. Sustained gamma-band EEG following negative words in depression and schizophrenia. Int J Psychophysiol. 2010; 75:107–118. DOI: 10.1016/j.ijpsycho.2008.04.008 [PubMed: 20005267]

Smyth JM. Written emotional expression: effect sizes, outcome types, and moderating variables. Am Psychol Assoc. 1998; 66:174–184.

Tausczik YR, Pennebaker JW. The psychological meaning of words: LIWC and computerized text analysis methods. J Lang Soc Psychol. 2010; 29:24–54.

Van't Wout M, Aleman A, Kessels RPC, Larøi F, Kahn RS. Emotional processing in a non-clinical psychosis-prone sample. Schizophr Res. 2004; 68:271–281. DOI: 10.1016/j.schres.2003.09.006 [PubMed: 15099609]

Wyer, RS., Carlston, D. Social Cognition, Inference, and Attribution. Lawrence Erlbaum; Hillsdale, NJ: 1979.

Highlights

- This study used a positive mood induction followed by a free writing period
- SocAnh used fewer positive emotion words than the control group
- Both SocAnh and PerMag used more negative emotion words than the control group
- For controls only, those in the positive mood condition used more positive words

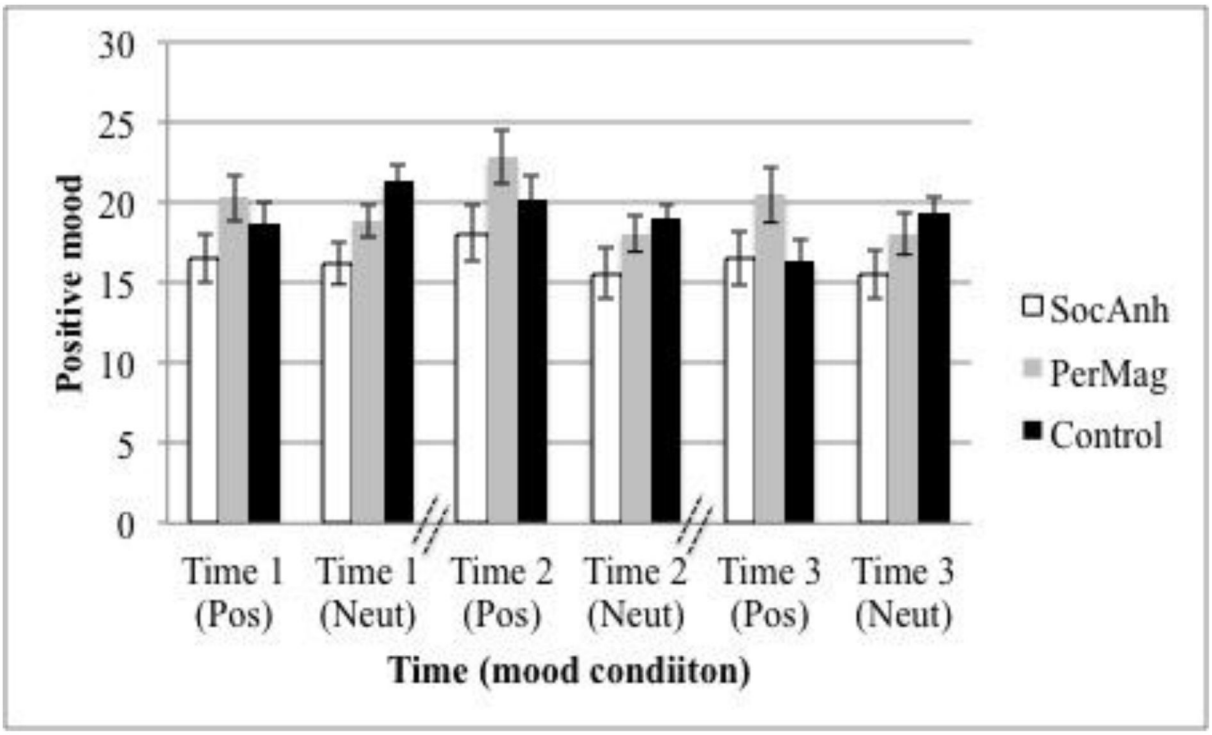

Fig. 1.
Positive mood for 3 time points for the SocAnh, PerMag and control group.

Table 1

Descriptive Statistics [Means (standard deviations)] for Demographics, Questionnaires and Task Measures

		SocAnh (*n* = 59)		PerMag (*n* = 73)		Controls (*n* = 80)	
Sex [*n* (%)]	Female	43 (69.4%)		48 (65.8%)		55 (66.3%)	
Age		19.45 (0.78)		19.25 (0.57)		19.39 (0.86)	
Race [*n* (%)]							
	Asian	2 (4.8%)		2 (3.8%)		1 (1.6%)	
	African American	9 (21.4%)		10(18.9%)		8 (12.7%)	
	Caucasian	24 (57.1%)		31 (58.5)		49 (77.8%)	
	Latino/Latina	2 (4.8%)		4 (7.5%)		1 (1.6%)	
	Biracial	2 (4.8%)		2 (3.8%)		1 (1.6%)	
	Other	3 (7.1%)		4 (7.5%)		3 (4.8%)	
TAS							
	Difficulty Identifying Emotions	5.35 (4.25) ^{**o}		7.65 (4.33) **		2.41 (2.10)	
	Difficulty Describing Emotions	7.65 (3.63) **		7.03 (3.53) **		5.01 (2.90)	
		SocAnh		**PerMag**		**Controls**	
	Mood Condition	Positive	Neutral	Positive	Neutral	Positive	Neutral
LIWC							
	Positive emotion words	3.89 (1.93)	3.16 (1.68)	4.14 (2.00)	3.69 (1.96)	4.95 (2.11) *	3.91 (2.03)
	Negative emotion words	2.40 (1.30)	2.20 (1.56)	1.84 (2.12)	2.20 (1.47)	1.45 (0.98)	1.78 (1.08)

Note. TAS = Toronto Alexithymia Scale, LIWC = Linguistic Inquiry and Word Count; Significant differences compared to the neutral condition:

* $p < 0.05$; Significant differences compared to the control group:

** $p < 0.001$; Significant differences compared to the PerMag group:

^{o} $p < 0.01$