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Negative verbal self-relevant feedback is recognized with greater accuracy than facial feedback regardless of depression or social anxiety

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ABSTRACT

Background and objectives: Self-referent information is critical for navigating the social realm, as we constantly use both verbal and non-verbal feedback in our interactions to understand ourselves and the world. In non-clinical samples, a memory bias for positive self-referent information has been observed, while a negativity bias has been observed among those with depression and anxiety. While research suggests that visual and auditory information is processed differently, no study has yet examined if memory biases persist for self-referent information presented by either means. We examined differences in memory for self-relevant social information presented as verbal or facial feedback, and whether symptoms of depression or anxiety influence memory for such information. We predicted that participants would remember more positive feedback overall, and that depression and anxiety would be positively related to memory for negative items.

Methods: Participants gave a speech, and were provided with positive and negative feedback via facial expressions, (n = 25) or verbal feedback presented aurally (n = 26). Participants then did a recognition test for the feedback they recieved.

Results: Recognition was higher for negative compared to positive feedback in the verbal condition, regardless of depression or anxiety. No memory biases were observed in the facial feedback condition. *Limitations*: No neutral stimuli was presented.

Conclusions: Findings suggest that the type of social feedback one receives may influence how information is remembered, regardless of symptomatology. Future studies should examine the mechanisms by which memory biases exist for different types of self-relevant feedback.

1. Introduction

Social information is an important part of our world, as individuals are constantly receiving feedback about themselves and their performance at work, school, and in their personal lives. This information is used to appraise and understand others' intentions and actions, to express our own, and to inform our behaviour. Characteristics of social information (e.g., self-relevancy, valence, mode of communication) influence how the information is processed and remembered. For instance, research has demonstrated that self-relevant information enhances mental processes and results in enhanced memory compared to non-self-relevant information (Symons & Johnson, 1997). This effect is attributed primarily to the notion that the self is a salient and frequently used construct, utilized to organize and elaborate information efficiently (Klein & Loftus, 1988; Symons & Johnson, 1997). For example, it appears that other-relevant information is not processed as deeply as self-relevant information, but that information related to an intimate other is processed on a deeper level than information related to a non-intimate other (D'Argembeau, Comblain, & Linden, 2005; Hess, Popham, Dennis, & Emery, 2013; Symons & Johnson, 1997). This suggests that the closer in relevance information is to the self-concept, the greater the depth of processing and the better that information is retained (Sedikides, Green, & Pinter, 2004). Self-relevent information is additionally less easily forgotten compared to non self-relevent information (Mao, Wang, Wu, & Guo, 2017). These findings are pertinent to the processing of social information since what we remember about our social interactions has a significant impact on the development and maintenance of the schemata we rely on to understand ourselves and the world (Korn, Prehn, Park, Walter, & Heekeren, 2012).

A self-schema is an individual's core concept of themselves, used to process, organize, and evaluate self-relevant and other-relevant information (Green & Sedikides, 2001). Psychologically healthy

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individuals tend to have positive self-schemas and remember more positive than negative feedback about themselves (D'Argembeau & Van der Linden, 2007; Sedikides et al., 2004), whereas individuals with depression and social anxiety tend to have negative self-schemas and remember more negative than positive personal feedback (Caouette, Ruiz, Lee, Anbari, Schriber & Guyer, 2015; Disner, Shumake, & Beevers, 2017; Sedikides et al., 2004). Congruent with cognitive theories of mental illness (e.g., Beck, 1967), these findings support the notion that dominant self-schemata are readily accessible when we process social information, and influence how it is interpreted and remembered (Green & Sedikides, 2001; Korn et al., 2012; Sedikides et al., 2004; Symons & Johnson, 1997).

Most research on memory for self-relevant information has examined either verbal or visual stimuli, without comparing both modalities (Gotlib et al., 2004; Green & Sedikides, 2001; Korn et al., 2012). This is an important limitation of the literature, as social information is presented in a variety of ways in our daily lives, including visually through body language and facial expressions, as well as aurally through what people say. Indeed, research shows that humans process and remember visual and auditory information differently (Cohen, Evans, Horowitz, & Wolfe, 2011; Cohen, Horowitz, & Wolfe, 2009; Olszewska, Reuter-Lorenz, Munier, & Bendler, 2015), and that processing of information presented through different modalities depends on the type of stimuli, its valence, its self-relevance, as well as the context in which stimuli are presented (e.g., Cohen et al., 2009, 2011; Durbin, Mitchell, & Johnson, 2017; Hess et al., 2013; Olszewska et al., 2015). For instance, recognition of naturalistic stimuli has been shown to be stronger for visual compared to auditory information (Cohen et al., 2011, 2009), whereas recognition of linguistic stimuli is stronger when it is presented aurally compared to visually (Olszewska et al., 2015). Regarding context and the self-relevance of information presented, findings demonstrate a positive memory bias for both imagery and verbal information. For instance, studies have shown that memory for positive words is stronger when task instructions prompt participants to reflect on how words presented described themselves (D'Argembeau et al., 2005; Durbin et al., 2017). In a study of memory for social and non-social images, Hess et al. (2013) found memory for negative images was better than for positive images, but observed the opposite effect when participants were prompted to encode the images within a self-referential paradigm (i.e., imagining pictured individuals as friends). This latter finding was replicated in a recent study by Durbin et al. (2017). Further, the negativity bias observed in people who are depressed has been found only under conditions of self-focus rather than external focus (Pyszczynski, Hamilton, Herring, & Greenberg, 1989). Memory biases for negative information are also most apparent when the information is related to the self (Breck & Smith, 1983; Gotlib et al., 2004; Smith, Ingram, & Brehm, 1983). Of note, stimuli in these studies were all presented visually and, to our knowledge, no study has examined memory biases for social or self-relevant information presented aurally.

Regarding memory for social information, research primarily focuses on faces. Memory for faces improves if participants are asked to rate faces based on traits, such as honesty, instead of on physical facial features, such as sex (e.g., Bower & Karlin, 1974; D'Argembeau & Van der Linden, 2007; Strnad & Mueller, 1997; Wells & Hryciw, 1984; Winograd, 1981). This may be due to greater depth of processing afforded by rating faces on semantic information (i.e., traits) rather than physical features (Bower & Karlin, 1974; Craik, 2002; Winograd, 1981).

Research has also examined the impact of positive versus negative facial expressions during encoding on face recognition. Similar to findings about self-relevant information, recognition for faces depicting positive emotions is superior than for faces depicting negative emotions, particularly when the negative expression is of anger (D'Argembeau, Van der Linden, Comblain, & Etienne, 2003; D'Argembeau, Van der Linden, Etienne, & Comblain, 2003; D'Argembeau & Van der Linden, 2007; Foa, Gilboa- Schechtman, Amir & Freshman, 2000; Gilboa-Schechtman, Erhard-Weiss, & Jeczemien, 2002; Leigland, Schulz, & Janowsky, 2004; Lundh & Öst, 1996; Ridout, Astell, Reid, Glen & O'Carroll, 2003; Shimamura, Ross, & Bennett, 2006). Exceptions have been observed where happy faces are either not better recognized than neutral or negative faces, or negative faces are better recognized than positive faces (Coles & Heimberg, 2005; Hagemann, Straube, & Schulz, 2016; Pine et al., 2004). This discrepancy could be due to different encoding tasks used. For example, Pine et al. (2004) found a memory bias for angry faces when the encoding task asked participants to rate how anxious the face made them, how hostile the face appeared, and to rate the characteristics of the faces. This type of encoding task may have encouraged deeper processing of faces that were deamed threatening or hostile.

As mentioned, social information processing is of particular relevance within the context of psychopathology, most notably in depression and social anxiety. Individuals without depression or social anxiety typically recognize more happy than neutral or negative faces (Green & Sedikides, 2001). In contrast, individuals who are depressed have better recognition for sad or angry faces than happy or neutral faces (Gilboa-Schechtman et al., 2002; Ridout, Astell, Reid, Glen, & O'Carroll, 2003), and are more accurate in recognizing fearful faces compared to individuals without depression (Pine et al., 2004). Individuals with social anxiety disorder remember more negative than nonnegative faces (Foa, Gilboa-Schechtman, Amir, & Freshman, 2000), and fewer happy faces compared to participants without social anxiety (D'Argembeau, Van der Linden, Etienne, & Comblain, 2003). Though other studies have found that individuals with social anxiety were more likely to recognize faces that were rated as accepting rather than critical (Lundh & Öst, 1996), others have failed to find such a memory bias in social anxiety disorder (Coles & Heimberg, 2005). One explanation for why findings may be mixed with regards to the relationship between psychopathology and memory bias is that negative attentional bias is more prominent when the individual is in a negative mood state. Indeed, research has consistently found that the induction of negative affective states biases what is remembered from a task (Coles & Heimberg, 2002; Matt, Vázquez, & Campbell, 1992; Nelson, Purdon, Quigley, Carriere, & Smilek, 2015; Pyszczynski et al., 1989; Quigley, Nelson, Carriere, Smilek, & Purdon, 2012; Teasdale & Russell, 1983; Watkins, Matthews, Williamson, & Fuller, 1992), a finding that may help explain negative memory biases observed in depression and social anxiety (i.e., individuals with these symptoms find themselves more often in these mood states, which biases their attention and memory).

Importantly, these findings mirror results described concerning memory for self-relevant information. Individuals without symptoms of depression and social anxiety tend to show a positive memory bias for facial expressions and self-relevant information. In contrast, individuals with symptoms of depression or social anxiety tend to have a negativity bias for the same information. What remains to be seen is whether these biases persist when the information encoded is directly related to how others perceive us (e.g., social feedback). As noted, the social information we receive in daily life comes from a variety of sources and is subject to appraisal, which is in part guided by our self-schemata. Very few studies conducted to date have accounted for this complex process and have focused on either self-evaluations or evaluations of others, rather than how cues from others are interpreted in relation to the self. Additionally, no study has yet examined memory for self-referential verbal feedback that is aurally presented, or compared verbal versus facial feedback within the same experimental paradigm, despite the fact that both forms of feedback are regularly available to us and may impact our self-perceptions.

1.1. Current study

The objectives of this study were to evaluate whether a positivity bias persists for social feedback that is presented either as verbal feedback or facial feedback, and to examine the effects of symptoms of

depression and anxiety on this relationship. Participants did a speech task and were told that their speech was being evaluated by audience members in another room, although they were not. Participants were provided with standardized feedback consisting of either facial expressions of purported audience members (e.g., a smiling face) or verbal feedback in the form of short spoken sentences recorded by audience members (e.g., "You were great"). For both conditions, half of the stimuli presented were positive, and half were negative. Participants were then given a recognition task to asses their memory for the feedback.

We predicted that overall participants would remember more positive than negative social feedback regardless of how it was presented. The current study is the first to explore the influence of feedback modality on memory for social feedback, therefore no specific hypotheses regarding modality driven memory differences for aurally and visually presented social feedback were outlined. Exploring the impact of feedback modality is important for two reasons: 1) no study has yet examined whether feedback modality impacts memory for social feedback and 2) sensory modality has proven important for memory of other types of stimuli (e.g., naturalistic stimuli). Finally, we also anticipated that memory for positive feedback would be negatively related to symptoms of depression and anxiety (as assessed by pre-speech anticipatory anxiety ratings, and a measure of social anxiety), whereas memory for negative feedback would be positively related to symptoms of depression and anxiety. Given that social feedback is an integral part of daily experiences, and can impact psychopathology (e.g., social anxiety disorder), understanding how visually versus aurally presented feedback influences memory is important.

2. Method

The study was approved by the University of Ottawa Health Research Ethics Board.

2.1. Participants

Participants were 51 undergraduate students (83.3% female; M_{age} = 19.8, SD = 4.1) from the University of Ottawa. A priori power analyses determined that a sample size of 48 (24 per condition) was adequate to achieve 80% power in detecting an effect size of 0.25. We oversampled to ensure that there were at least 48 participants to account for missing data and attrition. Most participants were in their first year of study (57.4%), single (77.8%), and of Caucasian descent (38.9%). No between-condition differences were found for these characteristics (all $p > .10$). Participants received course credit for participation.

2.2. Materials

2.2.1. Feedback stimuli

Facial stimuli were 10 positive (e.g., smiling) and 10 negative faces (e.g., angry) selected from the University of Pennsylvania 2D-Emotional Stimuli bank (Gur et al., 2002). The facial expressions ranged in intensity of emotional expression (e.g., broad smile, slight smile) and ages (e.g., from young adult to middle-aged persons). An equal number of male and female faces was presented to each participant, with an equal number of positive and negative faces for each gender. Each image presented was from a different individual, in order to retain the guise of having individual audience members providing feedback.

Verbal stimuli were 10 positive (e.g., "sincere") and 10 negative (e.g., "awful") adjectives taken from a previous study examining memory for words (Edwards, Rapee, & Franklin, 2003) and from the Toronto word bank (Friendly, Hoffman, & Rubin, 1982). Using the SUBTLEX-US word frequency database (Brysbart & New, 2009), we established that there were no significant differences between word frequency of positive versus negative words in American English (t (38) = 0.28, p = .79). Auditory recordings were made of male and female confederates stating in a neutral voice each word in a sentence (e.g., "You were awful"). An equal number of male and female voices was presented to each participant, with an equal number of positive and negative adjectives per gender.

2.2.2. Social Phobia Scale (SPS)

The SPS (Mattick & Clarke, 1998) is a 20-item measure of social anxiety. Ratings range from 0 (not at all characteristic or true of me) to 4 (extremely characteristic or true of me). Cronbach's alpha was .92 for this sample.

2.2.3. Depression anxiety Stress Scale - 21 (DASS-21)

The DASS-21 (Lovibond & Lovibond, 1995) consists of 21 items assessing symptoms of anxiety, depression, and stress on scale from 0 (did not apply to me) to 3 (applied to me very much). The 7-item depression subscale was used, on which total scores range from 0 to 42. Cronbach's alpha for this subscale was .88 in this sample.

2.2.4. Subjective units of distress (SUDS)

Participants were asked before (time 1) and after (time 2) the speech to rate how anxious they felt using a scale from 0 (not at all anxious) to 9 (the most anxious I have ever felt). SUDS ratings were examined to ensure that the speech task produced anxiety in research participants (i.e., that participants felt some pressure about being evaluated), and time 1 SUDS was included as a measure of anticipatory anxiety in the regression models to test the moderating effects of this variable on memory for social feedback.

2.3. Procedure

2.3.1. Speech task

After providing consent, participants completed the SPS and the DASS-21. Participants were then told that they were to give a speech about their last vacation, which would be evaluated by members of an audience watching from a separate room, and that they would receive feedback from audience members on their performance after the speech. Participants were given 5 minutes to prepare and then asked to rate their anxiety using the SUDS. Participants then gave a 5-minute speech in front of a video camera. When finished, participants again completed the SUDS.

2.3.2. Performance feedback

Following a 10-minute break, participants were provided with standardized feedback about their performance. Participants in the facial feedback condition (n = 25) were told that audience members were asked to display a face that expressed their evaluation of the performance. Participants then saw 20 faces, half positive and half negative (randomized). Each was presented for 4 seconds on the computer screen.

Participants in the verbal feedback condition (n = 26) were told that audience members were asked to record a sentence with an adjective that best represented their evaluation of the participant's performance, which were listened to via headphones connected to the computer. To ensure length of exposure to feedback was equal across conditions, each statement was repeated twice.

After each feedback item, participants rated on a scale from 1 (not at all) to 5 (very) how accurate, how relevant each was to their performance, and how they perceived the audience member evaluated their performance from 1 (very poor) to 5 (excellent). These ratings serve to enhance self-referential endoding of the stimuli presented.

Participants then completed a 10-minute distraction task as a break (paper and pencil mazes).

2.3.3. Recognition task

Participants were given 40 recognition trials (half old, half new) and were asked to indicate if each item was "old" or "new." Old (i.e.,

presented as feedback) and new (i.e., never seen before) items were randomly presented and included the same number of positive and negative stimuli. Positive and negative items displayed during feedback were counterbalanced across participants, where items presented as "new" were "old" items for every other participant, and vice-versa.

2.3.4. Believability rating

At the end of the study, participants were asked to indicate the extent to which they believed an audience was watching their performance by drawing a line intersecting a 15-cm visual analog scale ranging from 0 (not believable) to 100 (totally believable). The proportion of the line measured from the left side was recorded to the nearest milimeter (e.g., 7 cm of 15 recorded as 0.47).

2.4. Analyses

Several manipulation checks were first conducted. First, to ensure stimuli selected to be positive and negative in valence were perceived as such, a mixed ANOVA (feedback condition x valence) was conducted to examine the influence of these variables on perceived evaluation. Second, to ensure that the speech task was anxiety provoking, a series of t-tests were conducted to examine pre- and post-speech anxiety ratings. Lastly, to establish that participants at least somewhat believed the task and most importantly that there was no difference across participants in the degree to which they believed the study, believability ratings were compared between feedback groups.

Signal detection theory was applied to evaluate recognition accuracy. Hit and false alarm rates were calculated for negative and positive stimuli, from which *d'*, a measure of sensitivity reflecting the degree of overlap between signal and noise distributions, was calculated. For *d',* higher values reflect greater sensitivity, as expressed in standard deviation units (Macmillan & Creelman, 2004). Response bias was assessed using criterion c, which reflects the distance between participants' responses and the neutral point where neither "old" or "new" responses are favoured, expressed in standard deviation units.

A series of mixed ANOVAs (feedback modality x valence) were conducted to examine the influence of these variables on recognition, perceived feedback accuracy, relevance, and sensitivity (*d'*). Additionally, moderated regression models were conducted separately for positive and negative feedback with *d'* as the dependent variable. Feedback modality was the independent variable, and social anxiety (SPS), anticipatory anxiety (time 1 SUDS) and depression (DASS depression) were included as moderators. Analyses were conducted using SPSS (IBM Corp., 2012). No multicollinearity was observed among predictor variables. Assumptions of multivariate normality, linearity, homogeneity of variance, and homoscedasticity were met.

3. Results

3.1. Manipulation checks

3.1.1. Perceived evaluations

To establish that stimuli selected to be negative or positive were perceived as such, we examined participants' perceived ratings of audience members' evaluations (see Table 1). Consistent with expectations, there was a significant main effect of valence, F (1, 49) = 279.69, $p < .001$, $\eta_p^2 = 0.85$, indicating that negative stimuli received lower ratings than positive stimuli. Neither the main effect of condition, F (1, 49) = 1.00, $p = .32$, $\eta_p^2 = 0.02$, nor the interaction, F (1, 49) = 1.60, $p = .21$, $\eta_p^2 = 0.03$, were significant, suggesting that positive and negative stimuli were rated similarly across conditions.

3.1.2. Pre- and post-speech anxiety ratings

Participants' SUDS ratings averaged 4.94 (SD = 2.28) before the speech, and 4.27 (SD = 2.81) after the speech, indicating that participants were moderately anxious about the evaluative task. There was no difference in anxiety ratings between conditions at time 1, t (49) = −1.04, $p = .30$, or time 2, t (49) = −1.11, $p = .27$. Across conditions, anxiety ratings were significantly higher at time 1 than at time 2, t (50) = 2.20, $p = .03$, suggesting that the evaluative nature of the task produced significant anticipatory anxiety.

3.1.3. Believability

Regarding believability of the manipulation, the mean rating was 0.33 (SD = 0.27), with no significant difference between conditions, t (48) = 0.65, $p = .52$ (1 missing), indicating that participants in both groups believed the fabricated circumstances of the study to the same degree.

3.2. Psychopathology

Of the sample, 15.7% had previously been diagnosed with either an anxiety (n = 6) or depressive disorder (n = 1), or both (n = 1). In the facial feedback condition, 20% (n = 5) had previously been diagnosed with an anxiety disorder, with one participant having previously been diagnosed with both depression and anxiety. In the verbal feedback condition, 7.7% (n = 2) were previously diagnosed with and anxiety, with 3.8% (n = 1) previously diagnosed with a depressive disorder. There were no differences between groups regarding previous diagnosis, x^2 (4, N = 51) = 4.16, $p > .05$). Scores on the SPS ranged from 2 to 60 (M = 20.80, SD = 12.03) and DASS-21 depression scores ranged from 0 to 36 (M = 8.86, SD = 8.6) with no difference in scores on either measure between groups (both $p > .05$; see Table 1).

3.3. Encoding task

3.3.1. Feedback accuracy

For perceived accuracy, there was no main effect of valence, F (1, 49) = 1.70, $p = .20$, $\eta_p^2 = 0.03$, or condition, F (1, 49) = 0.22, $p = .65$, $\eta_p^2 = 0.004$, nor was there a significant interaction, F (1, 49) = 0.08, $p = .78$, $\eta_p^2 = 0.002$. This indicates that positive and negative feedback was perceived to be equally accurate regardless of condition.

3.3.2. Feedback relevance

A significant main effect of valence was observed, F (1, 49) = 4.03, $p = .05$, $\eta_p^2 = 0.08$, suggesting that participants found positive stimuli more relevant than negative stimuli. There was no main effect of condition, F (1, 49) = 0.13, $p = .72$, $\eta_p^2 = 0.003$, nor a significant interaction, F (1, 49) = 0.11, $p = .73$, $\eta_p^2 = 0.002$.

3.4. Recognition task

3.4.1. Recognition accuracy (d')

Contrary to predictions, no main effect of valence was observed, F (1, 49) = 0.33, $p = .57$, $\eta_p^2 = 0.01$, however the main effect of condition was significant, F (1, 49) = 13.00, $p = .00$, $\eta_p^2 = 0.21$, suggesting that those in the verbal condition remembered more feedback overall compared to those in the facial feedback condition. There was also a significant valence by feedback type interaction, F (1, 49) = 15.54, $p = .00$, $\eta_p^2 = 0.25$, indicating that individuals in the verbal feedback condition more accurately recognized negative feedback compared to participants in the facial feedback condition, whereas positive feedback was recognized at a similar rate for individuals in both feedback groups (see Fig. 1).

The moderation model examining negative, F(7, 46) = 4.85, $p < .001$, $R^2 = 0.42$, but not positive feedback, F(7, 46) = 1.39, $p > .05$, $R^2 = 0.18$, was statistically significant. Results demonstrated that feedback modality was the only significant predictor of memory accuracy for negative feedback, and no other main effects or interactions emerged significant in either model (Table 2). This indicates that individuals in the verbal feedback group recognized more negative stimuli than those in the facial feedback condition, regardless of level of

Table 1
Descriptive data for psychopathological measures and for positive versus negative feedback items.

	Facial Feedback (n = 25)			Verbal Feedback (n = 26)		
	Total	Positive	Negative	Total	Positive	Negative
	M (SD)	*M (SD)*	*M (SD)*	*M (SD)*	*M (SD)*	*M (SD)*
DASS-21 depression	10.80 (8.39)			7.00 (8.55)		
SPS	22.60 (13.19)			19.08 (10.78)		
Perceived valence	2.63 (0.46)	3.36 (0.69)	1.92 (0.44)	2.80 (0.48)	3.67 (0.64)	1.94 (0.55)
Feedback accuracy	2.53 (0.55)	2.68 (0.73)	2.41 (0.67)	2.66 (0.45)	2.77 (0.78)	2.55 (0.79)
Feedback relevance	2.56 (0.53)	2.68 (0.67)	2.46 (0.72)	2.65 (0.44)	2.83 (0.72)	2.47 (0.62)
Sensitivity (*d'*)	1.11 (0.27)	1.23 (0.35)	1.00 (0.30)	1.36 (0.23)	1.29 (0.31)	1.45 (0.25)

self-reported social anxiety, anticipatory anxiety, or depression.

Response bias was considered in order to rule out the possibility that differences in hit rate were due to the tendency to identify feedback as "old" or "new" during the recognition task, however these analyses yielded no significant results (all $p > .05$) indicating that participants likely responded without bias during the recognition task.

4. Discussion

This study examined the influence of modality of social feedback (aurally presented verbal feedback vs. facial feedback) on self-referential encoding and memory. We hypothesized that overall recognition accuracy would be higher for positive compared to negative social feedback, regardless of whether feedback was presented verbally or as facial expressions. Contrary to expectations, we did not find an overall positivity bias. We did find that feedback modality influenced memory such that recognition accuracy was superior for verbal rather than facial social feedback. Further, we found that recognition accuracy for negative feedback was higher in the verbal condition than the facial feedback condition. We also found that participants rated positive feedback as more relevant to their performance, regardless of the type of feedback presented, though they did not report a difference with regards to how accurate they found positive or negative feedback. Contrary to expectations, anticipatory anxiety, social anxiety and depression did not influence how the social feedback was remembered. The implications of each of these findings are considered separately.

To the best of our knowledge, this is the first study to compare memory for verbal versus facial evaluative social information. With regards to the sensory modality of the feedback, our findings are similar to previous research showing that verbal information presented aurally is better retained than verbal information presented visually (e.g., Olszewska, Reuter-Lorenz, Munier & Bendler, 2015), as we found that memory for aurally presented verbal feedback was superior to memory for visual (in this case facial) feedback. While impossible to directly compare sensory modality when examining differences in memory for verbal and facial feedback, our finding that auditory information was better retained by participants in this study speaks to the notion that feedback modality may play an important role in memory, and should be considered when exploring memory for socio-emotional information. Given that this is a first study examining memory for different modalities of socio-emotional information, it is important to emphasize that these findings should be replicated and further explored.

Consistent with previous research, we found that positive information is evaluated as more relevant to the self than negative information (e.g., Hepper, Hart, Gregg, & Sedikides, 2011). However, greater perceived relevance did not translate to enhanced memory for positive self-relevant feedback, as observed in previous studies (both visual and verbal feedback; D'Argembeau et al., 2005; Durbin et al., 2017; Hess et al., 2013). Differences in our experimental paradigm compared to previous studies may help explain these inconsistencies and extend our understanding of the role that type and valence of feedback have on self-referential memory. For example, D'Argembeau et al. (2005) asked participants to think about the degree to which words described them as a person, whereas we asked participants to indicate how the social feedback was related to their performance on a specific task.

Unexpectedly, recognition accuracy was greatest for negative verbal information, however this negative memory bias did not extend to facial memory. Whereas participants remembered more negative than positive verbal feedback, there was no difference in participants' memory for negative versus positive faces. Future research is needed to understand why various modalities of social information influence memory for positive and negative social information differently. One

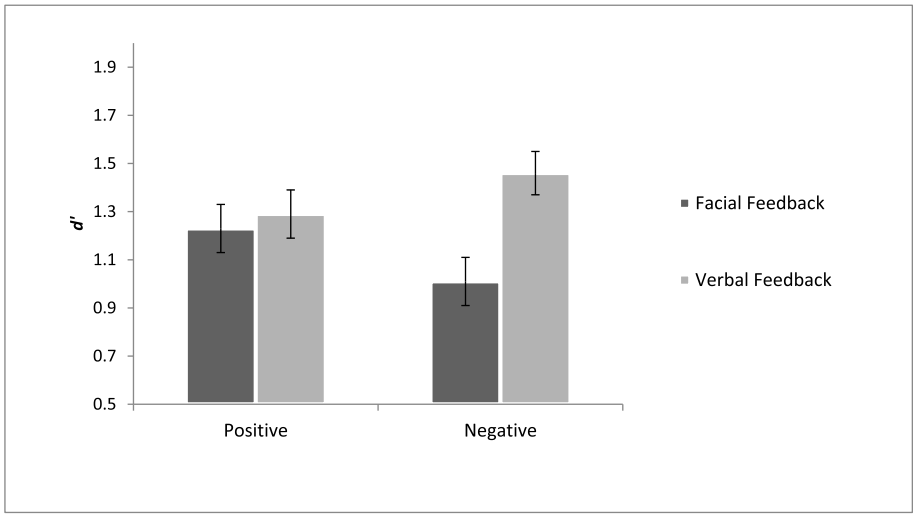

Fig. 1. Differences in recognition accuracy demonstrating an interaction between feedback valence and feedback type. Positive feedback was recognized with similar accuracy across conditions, however negative feedback presented verbally was recognized more accurately than facial feedback. Error bars represent within-participant 95% CIs.

Table 2
Results of moderated regression analyses for sensitivity (d').

	Positive Stimuli					Negative Stimuli				
	B	S.E. (B)	β	*t*	95% CI	B	S.E. (B)	β	*t*	95% CI
Feedback condition	.03	.10	.04	.28	-.17, .23	**.45**	**.09**	**.59**	**5.02***	**.27, .63**
SPS score	.00	.01	.05	.20	-.01, .02	.00	.01	.02	.08	-.01, .01
Anticipatory anxiety	-.03	.04	-.18	-.75	-.11, .05	.00	.03	.01	.04	-.07, .07
DASS depression	-.02	.01	-.41	−1.59	-.04, .00	-.01	.01	-.22	−1.02	-.03, .01
Feedback condition x SPS	-.00	.01	-.09	-.44	-.02, .02	-.00	.01	-.03	-.16	-.02, .02
Feedback condition x Anticipatory anxiety	-.02	.05	-.09	-.34	-.11, .08	-.03	.04	-.02	-.58	-.11, .06
Feedback condition x DASS depression	.01	.01	.22	.99	-.01, .04	.01	.01	.17	.90	-.01, .04

Note: Results examining hit rate (recognition accuracy) demonstrated the same pattern as for *d'* (accuracy), therefore only results of the latter are presented. All continues variables mean-centered for analysis. SPS: Social Phobia Scale; DASS: Depression, Anxiety and Stress Scale – depression subscale; *statistically significant effect at $p < .001$.

possible explanation is that the relative ambiguity of verbal versus facial social feedback may be different. Facial feedback may be more ambiguous (e.g., a smiling face could represent a positive evaluation or ridicule) whereas verbal feedback may be more unambiguous (e.g., "You were awful" certainly represents a negative evaluation). Thus, when participants encountered ambiguous feedback (e.g., a smile) the preferential processing of schema-consistent positive information may have been activated, however when participants were provided with unambiguous feedback (i.e., verbal feedback), they may have encoded information that was either more salient, unexpected (i.e., inconsistent with a positive schema), or that was deemed important for performance, leading to enhanced recognition of negative verbal feedback. These interpretations are speculative, however, and future studies should directly examine the influence mood state, type of feedback, and context have on memory for self-relevant social feedback in individuals with and without symptoms of depression and anxiety.

Contrary to predictions, severity of anxiety and depression were unrelated to memory for social feedback. This contradicts previous research that has found that social anxiety and more consistently depression are associated with a negative memory biases for both linguistic stimuli (e.g., Bradley, Mogg, & Williams, 1995; Breck & Smith, 1983; Gotlib et al., 2004; Rinck & Becker, 2005; Smith et al., 1983; Watkins et al., 1992) and faces (e.g., Gilboa-Schechtman et al., 2002; Lundh & Öst, 1996; Pine et al., 2004; Ridout et al., 2003). However, it is consistent with several studies that have failed to find a memory bias for negative information in social anxiety (e.g., Cloitre, Cancienne, Heimberg, Holt, & Liebowitz, 1995; Pérez-López & Woody, 2001; Rapee, McCallum, Melville, Ravenscroft, & Rodney, 1994).

Nonetheless, our findings have treatment implications. Treatment approaches for social anxiety that involve both visual and auditory feedback have been developed and tested by a number of researchers (Chen, Mak, & Fujita, 2015; Harvey, Clark, Ehlers, & Rapee, 2000; Hirsch & Clark, 2007; Nilsson, Lundh, Faghihi, & Roth-Andersson, 2011; Orr & Moscovitch, 2010; Rodebaugh, 2004; Smits, Powers, Buxkamper, & Telch, 2006), however results with regards to efficacy have been mixed. Our findings suggest that one explanation for this could have to do with the modality with which feedback is provided in these interventions. Though similar interventions have not been specifically developed for the treatment of depression, it is widely understood that depression is associated with deficits in social functioning that can manifest themselves similarly to social anxiety (e.g., social withdrawal due to fear of negative evaluation; Hames, Hagan, & Joiner, 2013), and biases towards attending to and remembering information perceived as threatening to the self-concept. Our results suggest that considering the modality of information collected in behavioural experiments and video feedback in the context of cognitive behavioural therapy may be important.

4.1. Future directions

Results of this study are preliminary, as this is the first study to compare self-relevant facial and verbal social feedback using a social evaluative paradigm. Our findings indicate that the modality of social feedback appears to influence how feedback is processed and remembered, however the mechanisms behind this effect remain unknown, and future research is needed. One approach to understanding such processes would be to replicate these findings using different paradigms (e.g., compare memory for self-relevant trait vs. performance-related information).

Further, visual and auditory information appears to be processed differently, however studies on memory for these different modalities is sparse, and more work is needed to understand how the modality in which feedback is presented, in addition to feedback type (e.g., linguistic vs. non-linguistic), affects processing of self-relevant social information. One way to achieve this is to keep type of feedback consistent, but manipulate presentation (e.g., verbal feedback presented aurally and visually), or to present both types of information simultaneously (e.g., video clips of people providing verbal feedback). Future studies should also consider examining modality differences using within-rather than between-subjects design.

Although it is unclear if ambiguity played a role in the effect observed in this study, a better understanding of this factor in the processing of different types of self-relevant social feedback would also add to our knowledge of how such processes relate to the development and maintenance of social anxiety and depression. Cognitive models of depression and anxiety predict that individuals with depression are characterised by negatively biased information processing (e.g., Beck, 1967), and individuals with social anxiety by threat biased information processing (e.g., Clark & Wells, 1995). This effect has been examined using both ambiguous (Yoon & Zinbarg, 2007), and unambiguous stimuli (Disner et al., 2017), however the role that feedback modality plays in this effect has not been examined. Future studies could account for the ambiguity of stimuli by controlling the semantic nature of stimuli across modalities (e.g., presenting feedback words visually and aurally), or to contrast facial expressions with ambiguous auditory social stimuli (e.g., sounds of laughter, throat clearing).

A potential limitation of the current study was the relatively low believability ratings of the task. Though higher ratings would be ideal, results indicate that participants believed the veracity of the task to some degree. Indeed, participants found the task at least somewhat anxiety provoking, which should activate processes believed to be related to evaluative anxiety. Most importantly, however, the degree to which participants believed the task was similar across conditions, allowing us to rule out differences in believability as a potential explanation for the differences we observed. Future research should continue to strive towards enhancing the ecological validity and personal importance of research tasks.

Another limitation of this study is that no neutral stimuli were

presented. While we might expect the overall effect observed to persist with the inclusion of neutral stimuli, it is possible that the interaction between valence and condition emerges more nuanced. Future studies should include neutral visual and auditory stimuli when assessing memory for different types of self-relevant social feedback. Additionally, we only assessed symptoms of social anxiety and depression dimensionally using self-report measures in a non-clinical sample. Future research should explore the impact of modality of social feedback on self-relevance and memory in clinical samples.

4.2. Conclusions

This study is the first to compare memory for facial and verbal self-relevant social feedback within the same experimental paradigm. Our findings suggest that memory for self-relevant social feedback is influenced by feedback modality, however it remains unclear the mechanisms by which this effect is exerted. Future studies are needed to elucidate these mechanisms, which may include contextual information and ambuiguity of feedback.

Overall, a better understanding of the mechanisms associated with the processing of different types of self-relevant feedback could have widespread implications for our understanding of maintaining factors in social anxiety and depression, and provide important insights relevant for the development and refinement of effective therapies for these disorders.

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