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Emotional Expressions as an Implicit Dimension of Categorization

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Abstract

In this pre-registered study, we investigated whether facial expressions were implicitly encoded when forming impressions of others, and whether differences between people in their encoding of angry and happy facial expressions were related to depressive symptoms. These questions were addressed using the category confusion or Who Said What (WSW) paradigm. Results indicated that both angry and happy emotional expressions from human faces were encoded when forming impressions of others, with no difference in strength of encoding between both. We observed no evidence for associations between encoding of angry or happy facial expressions and depressive symptoms.

Keywords: who said what; facial expressions; depressive symptoms; encoding; attention

Introduction

Is a puppy more similar to a parade or to a beetle? Research has suggested that the answer depends on your emotional state (Niedenthal, Halberstadt, & Innes-Ker, 1999). For example, people who received a mood induction were more likely to pick 'parade' in the example above, compared to people who did not receive a mood induction. Apparently, after a mood induction, people focus more on the emotional equivalence of happiness in both a puppy and a parade than on the taxonomic connection between a puppy and a beetle. The same holds for words with sad emotional equivalence: Participants who received a mood induction, relied more on the sad emotional equivalence in words during a triad task, compared to people in a neutral state (e.g. selecting 'poverty' more than 'wheelbarrow', with 'ambulance' as target). The increased focus on emotional equivalence was not necessarily mood-congruent, in the sense that it was irrelevant whether a happy or sad mood was induced, and whether the words were equivalent in terms of happiness or sadness.

Interestingly, compared to people with low depressive symptoms, people with high depressive symptoms were more likely to rely on emotional equivalence in the triad task when the relevant emotion was sadness, but less likely when the relevant emotion was happiness (Niedenthal et al., 1999). Thus, unlike with experimentally induced mood states, individuals with elevated depressive symptoms appear to rely on mood-congruent (i.e. sad) emotional equivalence. This suggests that elevated depressive symptoms are associated with encoding of mood-congruent content in words.

In the current study, we extended this work on encoding of mood-related information in four ways. First, instead of verbal stimuli, we used pictures of people with varying facial expressions. Second, we used happiness and anger as emotional content, rather than happiness and sadness, because high depressive symptoms are associated with increased fear for interpersonal rejection (e.g. Mellin, 2008), and thus angry expressions, as they are signaling the possibility of interpersonal rejection (Leyman, De Raedt, Schacht, & Koster, 2007), could be especially salient in the context of depression. Thus, we thought maybe not only mood-congruent words, but also angry facial expressions might be more strongly encoded by individuals with high depressive symptoms, compared to individuals with low depressive symptoms. Third, rather than a triad task, we relied on the category confusion or Who Said What (WSW) paradigm, traditionally used to investigate dimensions of implicit social categorization (Taylor, Fiske, Etcoff, & Ruderman; 1978). Finally, before data collection, this study was registered at https://osf.io/bzqyj/.

Pre-registered Hypotheses

The goal of our study was to investigate whether people suffering from depressive symptoms would encode angry emotional expressions more strongly than happy emotional expressions Our first pre-registered hypothesis was as follows: "When asked to form impressions of others, we expected people to rely on emotional categorical information. In particular, we expected people to encode both angry and happy facial expressions". Our second pre-registered hypothesis concerned: "The positive association between depressive symptoms and attentional encoding of angry

emotional expressions is greater than between depressive symptoms and attentional encoding of happy emotional expressions."

To test both hypotheses, we created a WSW task in which pictures involving different people with either an emotional or a neutral expression were shown. Two versions of the task were created: One involving pictures with happy or neutral, and one with angry or neutral emotional expressions. Participants were randomly assigned to either the angry or happy condition, in which respectively, the angry or happy version of the task was administered.

Pre-registered Exploratory Questions

Although not the main focus of our study, we also investigated whether people with high (compared to low) depressive symptoms processed information in a more piecemeal manner, as opposed to a categorical manner. Evidence supporting this hypothesis was already obtained in a task where people (with high or low depressive symptoms) could rely on either individual traits (piecemeal processing) or social category membership (categorical processing) when they judged how much they liked someone else (Edwards, & Weary, 1993). In the current study, the question concerned whether even in the case of emotional categorical information (e.g. angry vs neutral facial expressions), depressive symptoms would be related to piecemeal processing, as opposed to categorical processing.

For exploratory purposes, we also investigated the associations between participants' current mood, brooding (or depressive rumination), emotional stability, social anxiety, and their encoding of angry and happy facial expressions. Current mood was included because in Niedenthal et al.'s (1999) study, people in a sad or happy mood were found to be more likely to categorize words based on their emotional valence in general. Brooding was included because it has been associated with an attentional bias for negative information (Donaldson, Lam, & Mathews, 2007). Though in a WSW task it is hard to isolate attentional processes from other cognitive operations, attentional processing is necessary in order for encoding to occur (Crabb & Dark, 1999). Emotional stability was included because there is evidence for preferential processing of negatively valenced verbal material in people low in emotional stability (or inversely high in neuroticism), in the sense that people high in neuroticism have been found to classify negative words faster than positive (Chan, Goodwin, & Harmer, 2007). Finally, social anxiety was included because people high in social anxiety were found to show increased attentional processing of sources of interpersonal threat, such as angry facial expressions (Horley, Williams, Gonsalvez, & Gordon, 2004).

Method

We followed our pre-registered protocol exactly, unless otherwise noted. We reported all data exclusions, all included questionnaires or measures, and all study conditions. The exact stimulus statements, the experimental protocol, the data and the code can be found on https://osf.io/tw7cx/. For all analyses, we relied on the BayesFactor package, using default priors (Morey & Rouder, 2018).[1]

Participants

A total of 391 psychology students from the University of Leuven (Belgium) participated in exchange for 0.5 course credit. Their mean age was 18.36 (SD = 1.14, range = 17-25) and 85% were women. The sample size was determined as the number of participants showing up during the two weeks of data collection (7 November 2017 – 19 November 2017), available for all first-year psychology students of the University of Leuven.

Materials

Self-report Questionnaires The Quick Inventory of Depressive Symptomatology 16-Items Self-Report (QIDS 16-SR, score range = 0-27; Rush et al., 2003) was used to assess depressive symptoms. By extracting the valence score of the affect grid (score range = 0-8; Russel, Weiss, & Mendelsohn, 1989), we assessed current mood. Depressive rumination was assessed with the brooding subscale of the Ruminative Response scale (RRS, score range = 5-20; Nolen-Hoeksema & Morrow, 1991). The Ten Item Personality Inventory (TIPI, score range = 1-7; Gosling, Rentfrow, & Swann, 2003) assessed the personality trait emotional stability, and social anxiety was assessed using the Social Interaction Anxiety Scale (SIAS, score range = 0-80; Mattick & Clarke, 1998).

Stimuli For the WSW task, a total of 12 pictures were selected from the Radboud faces database (Langner et al., 2010). These pictures were chosen based on the results of a pilot task in which participants had to indicate for a larger set of 28 pictures which emotional expression they perceived, and how natural and recognizable they thought the expression was. The final set of 12 stimuli were all pictures of different people, four expressing anger, four happiness, and four having a neutral expression. The pictures with angry expressions were only used in the angry condition, and the pictures with happy expressions only in the happy condition, whereas the pictures with neutral expressions were used in both. Additionally, twenty-four ambiguous statements (could be interpreted positively, negatively or in a neutral way) were created with a length of 37 to 71 characters, loosely based on Pietraszewski, Cosmides, and Tooby (2014).

[1] The pre-registration protocol did not detail whether our analyses would rely on Bayesian or frequentist analyses.

Task In the WSW task, pictures of different individuals were shown, together with statements they made during a fictional interview. Participants were asked to observe and read the photograph-statement combinations carefully and to form an impression of all individuals participating in the interview. After viewing all pictures and statements, participants received an unexpected recall task and were asked to match each statement with the correct picture.

This is a difficult task, usually resulting in many errors. Due to the particular construction of the stimulus material, the type of errors are informative as to which stimulus dimensions were encoded. If, for example, one erroneously assigns a statement made by individual X to individual Y, it is assumed that the common attributes between X and Y were encoded when following the conversation and thus responsible for the error. For example, if a participant makes most mistakes by erroneously assigning statements of people with angry expressions to other people with angry expressions, and of people with neutral expressions to other people with neutral expressions (within-category errors), it is likely that the dimension facial expression (angry-neutral) was encoded. Contrarily, if mostly between-category errors are made, in which for example people showing angry expressions are confused with people showing neutral expressions, and the other way around, then it is likely that facial expressions (angry-neutral) were not encoded. As encoding is assessed by analyzing the errors made on the matching task, and not by asking for participants' explicit recall of the previously seen facial expressions, this can be interpreted as implicit encoding (Crabb & Dark, 1999).

The WSW task involved the facial expressions as crucial organizational principle within the pictures. Other possible dimensions of categorization, such as gender or age were held constant. As cover story, again loosely based on Pietraszewski et al. (2014), participants were told they would be viewing fragments of an interview about community life and neighbors, consisting of decontextualized statements together with photographs of the individuals making the statement. Eight unique individuals were presented, each combined with three different statements, for a total of 24 photograph-statement combinations. Participants were asked to form an impression of all interviewed individuals.

Procedure

After signing the informed consent and answering questions about their age, gender, and mother tongue, participants completed the WSW paradigm, either with angry or happy pictures, depending on the condition they were assigned to (between-participant design with two conditions, involving the two task versions).

After viewing each combination during 15 seconds, participants were subjected to a filler task of one minute, in which they were asked to think of as many European countries and capitals as they could. Then, participants received an unexpected recall task in which they were asked to recall who said which statements by matching photographs and statements. All 24 statements were presented in a random order, and for each statement, participants were asked to select the individual that supposedly made the statement.

After the WSW task, participants received, in randomized order, the QIDS 16-SR, the affect grid, the RRS brooding subscale, the TIPI emotional stability subscale, and the SIAS. The experiment ended with a forced-choice affect recognition task in which participants were asked to indicate for each of the 12 WSW photographs whether they judged the expression to be neutral or angry (in the angry condition), or neutral or happy (in the happy condition).

Data Preparation and Analyses

Exclusion Participants with missing values (N = 12), and participants who did not correctly identify the emotional expression in at least one of the relevant[2] pictures in the affect recognition task (N = 42), were excluded from the analyses. Furthermore, 11 data lines with non-unique id numbers were excluded from analyses because the according WSW results were impossible to link to the correct questionnaire data.[3] As a result, the analyses were performed on a final sample of 326 participants.

Processing The dependent variable was the difference between same-expression errors and (adjusted) different-expression errors for each participant. In particular, for each participant, we counted the number of errors in the recall task involving the erroneous selection of an individual that had not made the statement but shared the same facial expression (same-expression error). Additionally, we counted the number of errors consisting of the erroneous selection of an individual with an emotionally different facial expression (different-expression error). Because the same-expression errors were less probable a priori, we created adjusted different-expression errors[4], which were the different-expression errors multiplied by 0.75. The rationale behind this is that for every statement, there are eight possible responses: One is correct, three are erroneous options with the same facial expression and four are erroneous and have a different facial expression. After the appropriate correction, different-expression errors were subtracted from same-expression errors. A positive difference score (same minus adjusted different errors) indicated more within-category confusion than between-category confusing, meaning that the corresponding participant implicitly encoded the stimuli's facial expressions. If emotional expressions were not encoded, we expected the difference score to be zero, because in that case there should be an equal number of same-expression and (adjusted) different-expression errors (the

[2] The relevant pictures were angry and neutral pictures in the angry condition, and, because of a technical error, only happy pictures in the happy condition.

[3] This exclusion was not specified in the pre-registration protocol.

[4] This adjustment was not described in the pre-registration protocol, but is standard practice (Taylor et al., 1978).

errors should be independent of whether the emotional expressions match or not).[5]

Analyses We used a one-sided one sample t-test[6] to test whether the mean difference score was greater than zero, the expected value if responses were random regarding encoding of emotional expressions. To test whether severity of depressive symptoms was related to stronger encoding of angry, but not happy expressions, we correlated the difference scores with depressive symptoms, separately for each condition.

To investigate whether depressive symptoms might be associated with more piecemeal processing, and less categorical processing in general, we correlated depressive symptoms with the difference scores in general, across both conditions. Given that a lower difference score reflects less categorical processing, with a difference score around zero indicating no categorical processing, a negative correlation between depressive symptoms and the difference scores in general would indicate less categorical processing, and consequently a higher tendency for piecemeal processing. Regarding all other variables, such as current mood or brooding, the correlations with the difference scores were calculated separately for each condition.

Results

Focusing on the WSW task, the error rate was 62%, which is lower than 87.5%, the error rate when participants would have guessed the answers.

Across both conditions, people made more same-expression errors (M = 7.10, SD = 2.74) than (adjusted) different-expression errors (M = 5.89, SD = 2.20). The difference score (same minus adjusted different errors) was convincingly greater than zero (BF10 > 1000, d = 0.35)[7]. This suggests that participants implicitly encoded other's facial expressions. The same pattern was observed when analyzing the data of both conditions separately: BF10 > 250, with d = 0.31 in the happy condition and BF10 > 1000 with d = 0.39 in the angry condition. When comparing the difference scores of both conditions using an independent samples t-test (angry condition: M = 1.26, SD = 3.17, happy condition: M = 1.16, SD = 3.70), we obtained a Bayes factor substantially favoring the null model: BF01 = 7.91, meaning that the average difference scores of both conditions were not different from each other. Thus, angry and happy expressions were encoded to the same extent.[8]

After having established that the emotional dimensions were encoded in both conditions, we investigated the relation between elevated depressive symptoms (M = 7.98, SD = 4.82) and encoding of facial expressions. No evidence was observed for correlations between encoding of angry or happy expressions and depressive symptoms (r = .14, BF01 = 1.08 in the angry condition, indicating no evidence for either model, and r = .00, BF01 = 5.46 in the happy condition, indicating some evidence for the absence of a correlation). Thus, we found no evidence for the hypothesis that depressive symptoms are related to stronger encoding of either angry or happy expressions.

Regarding piecemeal processing in people with elevated depressive symptoms, we again observed no evidence for a correlation between depressive symptoms and the difference scores across both conditions: r = .07, BF01 = 3.10, with the Bayes factor providing medium evidence for no association between depressive symptoms and more piecemeal processing.

Exploratory analyses examining the relation with current mood, brooding, emotional stability and social anxiety did not reveal evidence for associations with encoding of emotional expressions. An overview of all correlation coefficients and Bayes factors can be found in Table 1, together with the descriptive statistics.[9]

Table 1: Descriptive statistics, Pearson correlation coefficients and associated Bayes factor for the angry and happy conditions.

	M	SD	angry		happy	
			r	BF01	r	BF01
Brooding	10.60	2.94	.09	2.77	-.02	5.27
Stability	4.17	1.36	-.06	4.16	-.03	5.16
Anxiety	26.97	13.79	.05	4.42	-.07	3.83
Mood	4.68	1.94	-.02	5.36	.01	5.36

Note. brooding = RRS brooding subscale score, stability = inversed TIPI neuroticism subscale score, anxiety = SIAS score, mood = valence score of the affect grid.

[5] As is standard practice in analyzing WSW data, this analysis assumes that the confusion is on the level of the pictures only, and not on the level of the statements.

[6] In the pre-registration document, we incorrectly referred to this one sample t test as a paired t-test.

[7] For ease of interpretation, we report Bayes factors (BF) with the most likely model in the numerator, with BF10 reflecting the alternative model in the numerator, and BF01 the null model in the numerator.

[8] These condition-specific analyses were not included in the pre-registered protocol.

[9] Though we mentioned in the pre-registration document we would assess these additional variables, we did not explicitly mention the correlational analyses.

Discussion

In this study, we found evidence for more same-expression errors than adjusted different-expression errors. This suggests that facial expressions were implicitly encoded, and both angry and happy expressions were encoded to the same extent.

The results did not confirm our prediction that higher depressive symptoms would be associated with stronger encoding of angry as opposed to happy expressions, as the data in the angry condition were inconclusive, and the data in the happy condition provided evidence for the absence of a correlation. The same was true regarding piecemeal processing and depressive symptoms: There was no evidence for depressive symptoms being associated with piecemeal processing in this study.

Also for current mood, brooding, emotional stability, and social anxiety, no increased or decreased encoding of either angry or happy expressions was observed for any of these variables.

There are a number of possible reasons, some of which could be considered as limitations of this study, why no meaningful correlations were found concerning the mood and trait variables. First, regarding the absence of a strong association between depressive symptoms and encoding of angry expressions, it is remarkable that Niedenthal et al. (1999) did observe a greater focus on sad emotional equivalence in people with depressive symptoms. We could question whether sad, as opposed to angry, emotional expressions would have been better suited to investigate distortions in cognitive processing in the context of depression. However, no association was found between current mood and encoding of happy expressions either, contrasting Niedenthal et al.'s (1999) findings again. This makes it unlikely that merely the nature of the expressions (angry instead of sad) could explain the null results.

A second possible reason for the null results, could be the use of emotional expressions as stimulus material, instead of words. However, regarding social anxiety, angry expressions are considered particularly suited to investigate distortions in cognitive processes (Horley et al., 2004), and even social anxiety was not related to increased encoding of angry expressions in this study.

Third, given that both in Niedenthal et al.'s (1999), and Edwards and Weary's (1993) study, the analyses were conducted on a selected sample consisting of people with either very low or high depressive symptoms, it could be possible that only carefully selected samples show meaningful differences in encoding of emotional material. To test whether people with extreme scores on the QIDS would show differential encoding of angry versus happy emotional expressions, independent t-tests were conducted comparing the average difference scores of groups with either a score higher than 15 (severe to very severe symptoms) on the QIDS or a score lower than 6 (absent to mild symptoms; Rush et al., 2006).[10] People belonging to the severe depressive symptoms group appeared to show stronger encoding of angry expressions (difference score: M = 2.79, SD = 3.40) than people belonging to the absent symptoms group (difference score: M = 1, SD = 3.38), but an independent samples t-test showed an inconclusive Bayes factor (BF10 = 1.30). Similarly, in the happy condition, no evidence was found for a difference between both groups, with a difference score M = 3.04, SD = 2.92 in the severe symptoms group, and difference score M = 1.53, SD = 3.86 in the absent symptoms group (BF01 = 1.90). Thus, comparing a group with extremely low depressive symptoms, with a group having extremely high depressive symptoms did not result in a convincing difference in encoding of angry (or happy) expressions either. One important caveat is that the extreme groups in the current study might have been too small to detect meaningful differences, as in the angry condition for example, the group with a QIDS score greater than 15 consisted of only 18 people, and the group with a QIDS score lower than 6 consisted of 55 people. Preselecting could be a way to avoid this problem.

Fourth, concerning the absence of piecemeal processing related to depressive symptoms, it is possible that the presence of *emotional* categorical information in this study, which was not the case in Edwards and Weary's (1993) study, triggered the use of categorical information and countered the expected piecemeal processing.

To conclude, despite the absence of meaningful associations between encoding of emotional expressions and mood or trait variables, the general finding that emotional expressions are encoded when forming impressions of others, does provide an interesting insight into the way people organize their perceptions of newly encountered individuals. Future research could elaborate on the facilitating conditions and consequences of implicit facial expression encoding.

[10] These analyses were not pre-registered.

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