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High Hostility Among Smokers Predicts Slower Recognition of Positive Facial Emotion

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Abstract

High levels of trait hostility are associated with wide-ranging interpersonal deficits and heightened physiological response to social stressors. These deficits may be attributable in part to individual differences in the perception of social cues. The present study evaluated the ability to recognize facial emotion among 48 high hostile (HH) and 48 low hostile (LH) smokers and whether experimentally-manipulated acute nicotine deprivation moderated relations between hostility and facial emotion recognition. A computer program presented series of pictures of faces that morphed from a neutral emotion into increasing intensities of happiness, sadness, fear, or anger, and participants were asked to identify the emotion displayed as quickly as possible. Results indicated that HH smokers, relative to LH smokers, required a significantly greater intensity of emotion expression to recognize happiness. No differences were found for other emotions across HH and LH individuals, nor did nicotine deprivation moderate relations between hostility and emotion recognition. This is the first study to show that HH individuals are slower to recognize happy facial expressions and that this occurs regardless of recent tobacco abstinence. Difficulty recognizing happiness in others may impact the degree to which HH individuals are able to identify social approach signals and to receive social reinforcement.

Keywords

hostility; facial emotion recognition; smoking; nicotine

1. Introduction

Hostility is a sociocognitive personality trait characterized by cynical attitudes and mistrust about others' behaviors and intentions (Miller, Smith, Turner, Guijarro, & Hallet, 1996). These cognitive biases may have important implications for social functioning. High hostility is associated with greater interpersonal stress (Benotsch, Christensen, & McKelvey, 1997), expression of hostile emotion during social situations (Brummett et al., 1998), and reports of anger and negative interactions (Brondolo et al., 2003; Shapiro, Jamner, & Goldstein, 1997). High hostile (HH) individuals report lower perceived social support

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relative to low hostile (LH) individuals (Benotsch et al., 1997; Hardy & Smith, 1988) and may benefit less from social support (Holt-Lunstad, Smith, & Uchino, 2008; Lepore, 1995; Vahtera, Kivimaki, Uutela, & Pentti, 2000; Vella, Kamarck, & Shiffman, 2008). Such interpersonal deficits may affect key health outcomes. HH individuals have particularly strong physiological responses to interpersonal stressors (Brondolo et al., 2009; Christensen et al., 1996; Fredrickson et al., 2000; Guerrero & Palmero, 2010; Suarez, Kuhn, Schanberg, Williams, & Zimmermann, 1998) and are at greater risk for cardiovascular disease and mortality (Aldwin, Spiro, Levenson, & Cupertino, 2001; Barefoot, Dahlstrom, & Williams, 1983; Haukkala, Konttinen, Laatikainen, Kawachi, & Uutela, 2010; Niaura et al., 2002; Smith & Ruiz, 2002). Greater understanding of the cognitive processes that underlie social deficits in HH individuals may be important for elucidating how this important personality trait influences health.

Cognitive theories of psychiatric disorders suggest that emotional processing biases cause people to misinterpret situations and respond in a maladaptive manner that exacerbates psychopathologic behavior (Williams, Watts, MacLeod, & Mathews, 1990). Accordingly, cognitive biases may cause HH individuals, compared to LH individuals, to interpret emotional reactions of others as being more threatening (angry) and less positive (happy), which in turn may lead to greater interpersonal stress, more negative emotions, less positive emotions and less perceived social support. Misinterpretation of social cues and corresponding poor mood states may cause further maladaptive interpersonal reactions by HH individuals. These reactions may provoke negatives social responses from others, which ultimately confirm interpretive biases. Indeed, HH individuals tend to perceive others as hostile and controlling (Smith, McGonigle, & Benjamin, 1998), are more likely to interpret ambiguous social situations as threatening (Chen & Matthews, 2003), and show information processing schema that facilitate processing of negative information about others and inhibit processing of positive information (Guyll & Madon, 2003). Whether hostility is associated with distinct deficits in the recognition of emotion in others has rarely been studied, however, and may offer important insights into mechanisms relating hostility and interpersonal stress.

Deficits in the recognition of facial emotion characterize a number of psychological disorders such as schizophrenia (Feinberg, Rifkin, Schaffer, & Walker, 1986; Kohler et al., 2003), depression (Demenescu, Kortekaas, den Boer, & Aleman, 2010; Rubinow & Post, 1992), anxiety (Demenescu et al., 2010), autism (Wallace et al., in press), and antisocial personality disorder/psychopathy (Dolan & Fullam, 2006; Pham & Phillipot, 2010). Poor recognition of emotion is associated with interpersonal difficulty and other functional impairment (Kee, Green, Mintz, & Brekke, 2003), whereas accurate detection is associated with prosocial behavior (Marsh, Kozak, & Ambady, 2007). Although research has yielded mixed results with respect to the specificity of these deficits to discrete emotions, several studies suggest that the type of emotion is relevant to recognition deficits. For example, there is evidence for specific deficits in recognizing negative relative to positive emotional faces in schizophrenia (Bediou et al., 2005; Kohler et al., 2003). Likewise, there is evidence for enhanced recognition of certain types of facial emotions, such as recognition of sad faces in depression (Gollan, McCloskey, Hoxha, & Coccaro, 2010). Thus, deficits in recognition of specific emotions appear to characterize certain disorders or traits.

Only two studies have examined facial emotion recognition in HH vs. LH individuals; both focused on brain laterality. HH participants were more likely than LH participants to identify neutral faces as angry, but only when the stimulus was presented in the left visual field (Harrison & Gorelczenko 1990). HH participants were less accurate than LH participants classifying angry, happy, and neutral faces presented in the left visual field but more accurately classifying angry and happy faces presented in the right visual field.

(Herridge, Harrison, Mollet, & Shenal, 2004). Neither of these studies addressed whether HH individuals had deficits recognizing different intensities of specific emotions presented in the center of the visual field, which is crucial to understanding the potential effect of hostility on social-emotional processing.

A group for which hostility may be particularly relevant is cigarette smokers. Current smokers have higher levels of hostility than non-smokers (Bunde & Suls, 2006; Kahler, Daughters, et al., 2009), and HH smokers have particular difficulties in quitting smoking (Brummett et al., 2002; Iribarren et al., 2000; Lipkus, Barefoot, Williams, & Siegler, 1994; Kahler, Spillane, et al., 2009; Kahler, Strong, Niaura, & Brown, 2004). Among HH smokers, compared to LH smokers, smoking following a social stressor more strongly buffers against negative affect increases (Kahler, Leventhal, et al., 2009), suggesting that HH individuals may smoke, in part, as a means of managing affective reactions to interpersonal stress. Conversely, abstinence from smoking, which reliably increases negative affect, may exacerbate interpersonal deficits in HH smokers, heightening their biases in the interpretation of others' emotions.

This study examined the effect of hostility in adult smokers on recognition of positive and negative facial emotions. In this secondary analysis of a previous study (Kahler, Leventhal, et al., 2009), two hypotheses were tested: (1) that HH smokers would be slower to recognize positive emotion and quicker to recognize anger compared to LH smokers and (2) that smoking abstinence would accentuate differences in facial emotion recognition related to hostility.

2. Method

2. 1. Participants

Participants were LH (n = 48) and HH (n = 48) smokers recruited from the community. Participants had to: (a) be 18 years of age or older, (b) have smoked cigarettes regularly for at least one year, (c) currently smoke at least 10 cigarettes per day, (d) currently be using no other tobacco products or nicotine replacement, and (e) be able to read English, and were excluded if they were currently dependent on alcohol or drugs other than tobacco or met criteria for a current affective disorder. Participants had to score either a 5 or lower (LH) or a 10 or higher (HH) on the 17-item version of the Cook-Medley Hostility Scale (Strong, Kahler, Greene, & Schinka, 2005) during a telephone screen, which corresponds closely with the upper and lower thirds of scores from previous community samples (Han, Weed, Calhoun, & Butcher, 1995). Groups were balanced on gender and level of tobacco dependence as assessed by the Fagerström Test for Nicotine Dependence (FTND; Heatherton, Kozlowski, Frecker, & Fagerstrom, 1991). In total, 8 separate blocks were recruited with 12 participants in each block of this 2 (high versus low FTND) × 2 (LH versus HH) by 2 (male versus female) design.

The sample was 50% female, averaged 13.0 (SD = 2.0) years of education, averaged 5.4 (SD = 2.1) on the FTND, and smoked 21.6 (SD = 8.9) cigarettes per day. Race/ethnicity was 70.3% non-Hispanic White, 15.6% African-American, 6.3% of more than one race, 5.2% Hispanic/Latino, 1.0% Asian, and 1.0% American Indian. HH participants were significantly younger (37.4 years, SD = 12.5) than LH participants (43.0 years, SD = 13.2).

2.2. Procedure

All participants completed an experimental session when they had been smoking ad lib (non-deprived) and a session when they abstained from smoking for at least 12 hours (deprived) with the order counterbalanced across participants. For further description of study design see Kahler, Leventhal, et al. (2009). Following a phone screen, eligible

participants were invited for a baseline session, and if eligible, two additional experimental sessions. At baseline, participants completed an informed consent approved by the Brown University Institutional Review Board. They then completed an alcohol breath analysis (those with a positive result were rescheduled) and psychiatric interview to confirm eligibility. They also completed baseline measures of mood, smoking characteristics, and recent alcohol and drug use.

At the end of the baseline session, participants were informed whether they were to smoke ad lib prior to the first experimental session or to abstain from smoking for a minimum of 12 hrs. On the session in which they were assigned to smoking deprivation, participants were instructed not to smoke cigarettes after midnight on the day before that session. All sessions occurred between 12 and 6 pm. Those who did not complete both sessions successfully were replaced so that we achieved our desired sample size of 96. Overall, 13 out of 109 participants (11.9%) who were eligible following a baseline interview did not complete both experimental sessions. Non-completers did not differ significantly from completers on hostility, sex, or level of tobacco dependence.

At the outset of experimental sessions, a breath carbon monoxide (CO) reading was obtained. In the deprivation condition, individuals were required to have a reading of 10 ppm or less. Following the CO reading, participants completed self-report and computerized cognitive measures. Prior analyses indicated that deprivation significantly increased nicotine withdrawal symptoms including negative affect (Kahler, Leventhal et al., 2009). Additional procedures occurring after the cognitive measures have been analyzed and reported elsewhere (Kahler, Leventhal, et al., 2009) and are not described here since they are not the focus of this paper.

2.3. Measures

Diagnostic exclusions were determined by the substance use and affective disorders sections of the Structured Clinical Interview for DSM-IV-Non Patient Version (SCID-NP, First, Spitzer, Gibbon, & Williams, 2002).

The intensity threshold at which participants perceived anger, happiness, sadness, and fear in faces was assessed using a facial emotion change detection task. This task uses facial morphing technology as implemented in the Morph Man 4.0 software package (Stoik Software Inc.). Procedures closely mirrored tasks described by Blair, Colledge, Murray, and Mitchell (2001) and Coupland et al. (2004), which have been shown to be sensitive to differences in psychopathology and mood. In this task, images from the Pictures of Facial Affect (Ekman & Friesen, 1976) series were morphed to produce a continuum of emotion expression intensity from neutral to the full expression of the emotion. Twelve different models (6 male and 6 female) were used to show each of the four emotions for a total of 48 slides, 24 of which were rated in the first session and 24 of which were rated in the second session counterbalanced across participants. For each stimulus, the expressions were morphed from neutral to 100% in 40 increments of 2.5% at a rate of 5% per second so that the total length of presentation of each stimulus was 20 s. Participants were instructed to respond as soon as they could perceive the emotion being displayed by clicking on one of four different labels on the screen corresponding to the four target emotions and that they could change their response at any time during a particular trial by clicking on another label. The dependent variables for this task were the mean affective intensities (ranging from 2.5% to 100%) at which participants correctly perceived the target emotions. If participants did not give a correct response or changed a correct response to an incorrect response and did not correct the error, they were assigned a value of 102.5% following the procedure of Coupland et al. (2004).

2.4. Data Analysis Plan

Repeated-measures mixed-model analyses were run separately for each type of facial stimulus (happy, angry, fearful, and sad) with the level of intensity at which the emotion was recognized as the dependent variable using PROC MIXED in SAS (SAS Institute Inc., 2005). The mixed model analyses allowed for random missing data and included all participants in all analyses. The association between hostility and recognition was evaluated controlling for age, sex, and deprivation condition. Hostility X deprivation condition interaction effects were tested to determine whether deprivation moderated the association between hostility and recognition.

There was strong evidence for individual differences in average speed of response *across* emotions. At the first session, the correlations between the mean intensity of emotion recognized for one emotion and the mean intensity for another emotion averaged $r = .45$; at the second presentation, these correlations averaged .58. To control for these individual differences in speed of responding, we covaried the average intensity of emotion recognized across all four stimuli types on that day; thus, analyses reflected how emotion recognition differed for a *specific* emotion controlling for *average* intensity recognized across emotions. Average intensity of emotion recognized was not associated with hostility at either session, *p*s > .70.

3. Results

The average speed to recognition of facial emotion was 12.82 seconds (*SD* = 1.72) at Time 1 and 12.75 seconds (*SD* = 1.92) at Time 2. There were no main effects of order, nicotine deprivation, or hostility on average speed, nor were there significant interactions among these variables. Average intensity at which emotion was recognized at Time 1 was 54.68% (*SD* = 14.62) for happiness, 73.50% (*SD* = 11.41) for anger, 70.15% (*SD* = 11.06) for fear, and 76.72% (9.61) for sadness. Results were similar for Time 2 with 54.75% (*SD* = 14.37) for happiness, 73.01% (*SD* = 11.32) for anger, 77.66% (*SD* = 11.69) for fear, and 75.08% (*SD* = 10.23) for sadness. Table 1 presents the average intensity recognized for each emotion by group and deprivation condition.

As intended, higher average intensity at which emotions were recognized across emotions was associated positively with the intensity at which each emotion was recognized, *p*s<. 0001, reflecting general individual differences in recognition speed. Controlling for that difference, HH participants required greater intensity to recognize happy faces relative to LH participants (B = 2.52, *SE* = 1.14, $p < .05$). The main effect of nicotine deprivation and its interaction with hostility were nonsignificant.

The main effect of hostility on recognition of angry faces was nonsignificant (B = −1.18, *SE* = 1.29, $p = .37$). Higher age was associated with significantly slower recognition of anger (B = 0.14, *SE* = 0.05, $p < .01$). There was no significant effect of hostility group on recognition of fearful (B = −1.15, *SE* = 1.23, $p = .35$) or sad (B = −1.52, *SE* = 1.34, $p = .26$) faces. Nicotine deprivation, compared to ad lib smoking, was associated with significantly quicker recognition of fearful faces (B = −2.69, *SE* = 1.15, $p < .05$).

4. Discussion

We hypothesized that cynical beliefs about others' behaviors and intentions would bias HH participants towards more quickly recognizing facial anger and less quickly recognizing facial happiness. Results only supported a relative deficit in recognizing happiness. This deficit may have real-world implications as facial displays of positive emotion have important signaling value for availability of social reward/support and the absence of social

threat. HH individuals' relative deficit in recognizing mild positive emotions in others may contribute to their experiences of social interactions as stressful and unsupportive, which may in turn maintain hostile attitudes and antagonistic behavior. The mechanisms for these differences in emotion recognition are not clear, however. Results could reflect differences in attention to facial indicators of happiness or differences in interpretation of these cues.

Results from a study conducted in a subsample of the present study indicated that HH smokers, compared to LH smokers, showed lower attentional interference from angry faces when coding the gender of a face (Leventhal & Kahler, 2010). The present study suggests that difficulty recognizing facial anger is unlikely to explain that result. HH smokers compared to LH smokers recognize facial anger readily, but facial anger may be less likely to automatically grab their attention, suggesting a relative insensitivity to angry social cues rather than a deficit in anger recognition per se.

That all participants were smokers afforded the opportunity to examine facial emotion recognition when participants smoked ad lib and when they were deprived of smoking overnight. The experience of nicotine withdrawal generally did not alter responses on the facial emotion recognition task with the exception of increasing recognition of fearful faces. This result was not expected but could reflect a tendency for smokers to perceive threat more readily when in nicotine withdrawal. Hostility did not interact with deprivation to predict facial emotion recognition. This result is consistent with studies that have generally been equivocal regarding whether hostility affects nicotine withdrawal (Kahler et al., 2004; Kahler, Spillane et al., 2009).

4.1. Limitations

The parent study examined hostility's role in smoking. All participants were smokers, and therefore, generalization to HH individuals who do not smoke should be done cautiously. The only emotional provocation analyzed was smoking abstinence. Whether other emotional provocations enhance differences in emotion recognition between LH and HH individuals is unknown.

4.2. Conclusions

Study results have potential clinical implications. Recent studies have supported the use of training to reduce cognitive biases, such as hypervigilance toward threat among individuals with anxiety disorders (e.g., Amir et al., 2009; See, MacLeod, & Bridle, 2009). If deficits in positive facial emotion recognition underlie interpersonal deficits in HH individuals, training to improve recognition of positive facial emotion in HH individuals may improve interpersonal functioning. Although such applications may be of interest clinically, a necessary next step for research is to establish causal links between deficits in positive facial emotion recognition and deficits in interpersonal functioning among HH individuals.

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- We examined recognition of facial emotion among low and high hostile smokers.
- High hostile smokers were slower to recognize happiness but not other emotions.
- Smoking abstinence did not enhance differences in recognition of facial emotion.
- Social deficits in high hostiles may reflect poor recognition of positive emotion.

Table 1

Average percent intensity (*SD*) at which facial emotion was recognized by deprivation condition and hostility

Type of Stimulus	Deprived		Non-Deprived	
	LH	HH	LH	HH
happiness	51.7 (15.2)	58.4 (12.2)	53.6 (14.0)	55.1 (15.9)
anger	71.9 (11.1)	75.9 (10.7)	75.2 (11.4)	69.8 (11.5)
fear	67.3 (9.7)	69.0 (10.3)	70.6 (14.0)	68.7 (11.3)
sadness	75.1 (10.2)	76.9 (9.3)	77.8 (10.3)	73.8 (9.8)

Note. LH = low hostiles, HH = high hostiles.