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Selective impairment of sadness and disgust recognition in abstinent ecstasy users

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Abstract

Previous data have suggested that ecstasy use may affect cognitive functions. The relationship between ecstasy use and emotion recognition remains largely unknown. This study reports the findings on the neuropsychological effects of ecstasy use on recognition of basic human emotions among 100 abstinent ecstasy users, along with 100 demographically matched nonusers. Recognition of both facial and prosodic emotions was studied. In addition, neuropsychological predictors of emotion recognition for abstinent ecstasy users were examined. The results showed that abstinent ecstasy users were impaired, relative to nonusers, on overall emotion recognition. In particular, recognition of sadness and disgust was significantly affected. The emotion-recognition deficits observed among the abstinent ecstasy users may reflect a complex derangement of monoamines and/or general degenerative change observed in the addicted populations. The length of time in months since ecstasy was last consumed, cumulative ecstasy dosage, and years of education negatively predicted various domains of emotion recognition. The observation that nonverbal and verbal fluency functions were significant predictors of emotion identification, as well as of recognition of sadness and disgust, suggests that the frontal executive system might be affected by ecstasy use.
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1. Introduction

Animal studies have provided evidence suggesting that 3,4-methylenedioxymethamphetamine (MDMA, "ecstasy") affects the functioning of the serotoninergic system (Battaglia, Yeh, & De Souza, 1988; Molliver et al., 1990; O'Hearn, Battaglia, De Souza, Kuhar, & Molliver, 1988; Ricaurte, Bryan, Strauss, Seiden, & Schuster, 1985; Ricaurte, DeLanney, Irwin, & Langston, 1988; Ricaurte, Martello, Katz, & Martello, 1992; Schmidt, 1987; Schmidt, Wu, & Lovenberg, 1986; Stone, Stahl, Hanson, & Gibb, 1986; Wilson, Ricaurte, & Molliver, 1989) as well as dopaminergic nerve terminals (Gerra et al., 2002; O'Shea & Colado, 2003; Ricaurte, Yuan, Hatzidimitriou, Cord, & McCann, 2002; see Green, Mechan, Elliott, O'Shea, & Colado, 2003, for a review). Furthermore, the possibility of adverse effects of MDMA use on the human brain has been suggested (Gerra et al., 2002). Previous ecstasy consumption can

affect a wide range of neuropsychological performance (Yip & Lee, 2005). Impairment of emotion recognition may be associated with the progressive impairment of brain functions (Lavenu & Pasquier, 2005) resulting from ecstasy use. Indeed, studies have reported the acute effect of ecstasy on emotion processing (e.g., Curren, Rees, Hoare, Hoshi, & Bond, 2004; Hoshi, Bisla, & Curran, 2004).

Recent findings and discussions on the ability to recognize the facial expressions of basic emotions (e.g., happiness, sadness, anger, surprise, disgust, and fear) have advocated specific neural systems for the recognition of different facial emotions (see Calder, Lawrence, & Young, 2001, for a review). For example, basal ganglia have been implicated in the recognition of facial disgust in patients with Huntington's disease or its gene-carriers (Calder, Keane, Manes, Antoun, & Young, 2000; Gray, Young, Barker, Curtis, & Gibson, 1997; Kuhl et al., 1982; Phillips et al., 1997; Speedie, Brake, Folstein, Bowers, & Heilman, 1990; Sprengelmeyer et al., 1996, 1997), in patients with basal ganglia damage (Cancelliere & Kertesz, 1990; Fromm, Holland, Swindell, & Reinmuth, 1985; Gorelick & Ross, 1987; Ross, 1981; Starkstein, Federoff, Price, Leiguarda, & Robinson,

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1994), and specifically in patients with idiopathic Parkinson's disease (PD) (Sprengelmeyer et al., 2003; Yip, Lee, Ho, Tsang, & Li, 2003). Sprengelmeyer et al. (2003) further investigated the role of the dopaminergic system for recognizing morphed facial emotions by comparing the performances of patients with idiopathic PD who were either medicated or unmedicated with dopaminergic medications. The recognition of facial sadness and disgust was found to be impaired, relative to healthy controls, only for those who were unmedicated.

This study examined the long-term effect of ecstasy use on emotion recognition. We speculated that emotion recognition would be impaired in people who had used ecstasy. Furthermore, since damage to the serotonin system has been widely documented among ecstasy users (and may secondarily contribute to dopamine system dysfunction), we further speculated that the recognition of disgust and sadness would be selectively impaired (e.g., Yip et al., 2003). Neuropsychological variables affected by ecstasy use may predict performance of emotion recognition. Furthermore, the dose of ecstasy relative to how much time has elapsed since the ecstasy was last taken (in months) and cumulative previous ecstasy usage (in tablets) may predict the performance of emotion recognition in ecstasy users, as may other demographic variables, such as chronological age and years of education (which has robust association with cognitive function). We therefore examined whether the chosen clinical and demographic variables were predictive of emotion-recognition performance among abstinent ecstasy users.

This study used a large sample of ecstasy users who reported no significant history of substance abuse or smoking to investigate whether emotion recognition was impaired in ecstasy users relative to nonusers. Borod et al. (2000) found a statistically significant positive relationship between facial and prosodic emotion-recognition ability among healthy volunteers. This particular finding, coupled with the finding that the insula has been found to subserve both facial (Phillips et al., 1997; Sprengelmeyer et al., 1996, 1997) and prosodic (Calder et al., 2000; Sprengelmeyer et al., 1996) disgust recognition, provides some support for the expectation that emotion-recognition performance would be similar across different modalities of stimulus presentation, namely facial and prosodic emotion.

2. Methods

2.1. Participants

As part of a larger neuropsychological investigation on abstinent MDMA users in Hong Kong (Yip & Lee, 2005), 100 abstinent ecstasy users (50 males and 50 females) in Hong Kong were recruited from local bars and dance clubs for this study, using Solowij, Hall, and Lee (1992) "snowball" sampling technique, from July through November 2001. These participants were screened from an initial total of 572 individuals, of whom 165 regularly consumed alcohol (one drink per week for 6 months or longer within the past 2 years), 82 regularly smoked (10 cigarettes per week for 6 months or longer within the past 2 years), 83 were polydrug users, and 42 had a combination of alcohol, nicotine, or polydrug consumption. No demographic or clinical data were collected from these excluded participants. Exclusion criteria included self-reports of (1) previous smoking or consumption of alcohol, (2) a history of illicit substance use, (3) consumption of other pharmacological drugs on a regular basis (e.g., pain relievers), (4) a current diagnosis or previous history of neurological or psychiatric illness(es)

according to the DSM-IV criteria, and (5) a history of head injury. All ecstasy users in our study reported an orange appearance of the tablets taken during the period of 2000–2001. As reported by Cheng, Poon, & Chan (2003), ecstasy tablets in Hong Kong during this time period contained approximately 50% MDMA, with ketamine as a common additive in these tablets. Informed consent was obtained from and debriefing was provided for all participants in this study. None of the participants were paid for their participation. Ethics approval was obtained from the research committee of the University of Hong Kong. This study was conducted in accordance with the Declaration of Helsinki.

2.2. Measures of emotion recognition

2.2.1. Facial emotion recognition

Photographs of six Japanese males and six Japanese females were selected from the Japanese and Caucasian facial expressions of emotion (JACFEE) photo set, based primarily on agreement levels obtained in their original validation study using Japanese raters (Matsumoto & Ekman, 1988). Each photograph showed a different individual and conveyed one of six basic emotions (i.e., happiness, sadness, anger, surprise, disgust, and fear). These photographs were taken together and administered in an identification task (12 test items) and a discrimination task (30 test items). The identification tasks were administered before the discrimination tasks. For the former, the photographs were presented individually for 10 s on a personal computer. Participants were asked to indicate which of the six basic emotions was conveyed in each photograph by pointing to one of the six emotion labels or by verbally referring to the emotion labels (or the associated numerical reference).

For the discrimination task, all possible (same gender) pairs of photographs were formulated and placed side by side on the computer screen. Each pair was presented for 10 s, counterbalanced for order of presentation between male and female photographs, and participants were asked to indicate which of the two photographs conveyed a specified emotion (e.g., happiness) by pointing to or verbally referring to "1" or "2" on the screen. Only photographs of the same gender were paired in the discrimination task. All participants understood the emotion labels prior to the commencement of the study. Participants were given a score of "1" for each of their correct responses during both identification and discrimination tasks. An overall facial emotion-recognition (OFER) score was calculated by adding together the scores on individual test items. Separate scores were calculated for overall facial emotion recognition (OFER), facial emotion identification (FEI), and facial emotion discrimination (FED), as well as for each individual emotion (happiness, sadness, anger, surprise, disgust, and fear).

2.2.2. Prosodic emotion recognition

This measure was formulated with a neutral sentence, "I want to go to see a movie," and one neutral Chinese character (word), each verbally produced with each of the six basic emotions (Ekman & Friesen, 1975), using a male and female speaker. These prosodic stimuli had been previously validated in 44 psychology undergraduate students (where agreement levels ranged from 86.4% to 100% for the sentence stimulus, and 72.7% to 97.7% for the word stimulus). These items were presented to the participants on a personal computer through separate digital speakers. For the identification task, participants were asked to listen to each of the 24 test stimuli and indicate the conveyed emotion. For the discrimination task, participants were asked to listen to each of the 60 pairs of test stimuli (with each stimulus 2 s apart) and indicate which of the two stimuli conveyed a particular emotion (e.g., happiness). Similar to the facial emotion-recognition measure above, only same-gender pairings were used, and the order of presentation was counterbalanced between female and male stimuli. The identification tasks were always administered before the discrimination tasks. Scoring procedures were identical to those used for facial emotion recognition, yielding separate scores for overall prosodic emotion recognition (OPER), prosodic emotion identification (PEI), and prosodic emotion discrimination (PED).

2.3. Neuropsychological measures

Neuropsychological variables appropriate for use with people in Hong Kong (demonstrated in Lee, Yuen, & Chan, 2002a) as well as with significantly differentiated ecstasy users and nonusers (Yip & Lee, 2005; see Table 1) were studied.