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Deficits in recognizing female facial expressions related to social network in cocaine-addicted men

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ABSTRACT

Background: The ability to accurately recognise facial expressions of emotion is crucial for social functioning and maintaining healthy relationships. Recognising the emotional state of others allows us to respond to their needs and adjust our behaviour appropriately. Impairments in facial affect recognition have been reported in chronic cocaine users but little is known whether these contribute to their difficulties in social situations.
Methods: We assessed facial emotional expression recognition in forty-five men with cocaine use disorder (CUD) and forty-four healthy control participants. Using standardised questionnaires, we also collected information on perceived social support, social provision and community integration.
Results: Our results found that male cocaine users had greater difficulty in recognising female emotional facial expressions than male controls. This effect was not explained by demographic variables but it was associated with their social network; including social support, social provisions and community integration.
Conclusion: Our findings suggest that men with CUD have greater difficulty in identifying emotional expression in female faces, which is linked with their social support networks. This may play an important role in misunderstanding non-verbal communications that contribute to destabilising friendship and family ties typically seen in drug addiction. Addressing deficits in recognising female emotional expressions may be an important piece of information for counselling and other interventions.

1. Introduction

The emotional toll of drug addiction, which includes relationship break-ups and breaks with family ties that even lead to social exclusion, remains immeasurable. Whilst much research has been focussed on understanding the effects of drugs to curtail further use, relatively less is known how chronic drug use affect social functioning and how this knowledge could be used improve psychosocial interventions. For example, accumulating evidence indicates impairments in recognising emotional facial expressions (Ersche et al., 2015; Kuypers et al., 2015; Morgan and Marshall, 2013; Verdejo-García and Bechara, 2009; Kemmis et al., 2007) and deficits in social cognition, including perspective-taking and social decision-making (Quednow, 2017; Romero-Martínez and Moya-Albiol, 2015; Preller et al., 2014). As facial expressions reflect the emotional state of others, enabling us to adapt our behaviour appropriately to other people's need, failure to recognise facial affect has been shown to be predictive of a pattern of social cognitive deficits (Trubanova et al., 2016; Corden et al., 2006). Specifically, failure to recognise negative emotions, such as fear, have been linked with an inability to inhibit socially inappropriate behaviours (Blair, 1995) and may create difficulties maintaining interpersonal relationships. It is thus conceivable that such deficits contribute to the difficulties frequently reported by chronic cocaine users such as maintaining healthy and rewarding relationships (Pachado et al., 2018).

Recognition of emotional expressions is largely affected by social influences such as biases towards one's own gender (Wright and Sladden, 2003), ethnicity and culture (Lee et al., 2008; Rehnman and Herlitz, 2006). Gender-specific effects in emotion recognition have to the best of our knowledge not been investigated in cocaine addiction, although it may have far reaching consequences on drug users' social lives.We therefore sought to first replicate previous findings showing facial affect recognition deficits in cocaine-addicted men and subsequently investigate the influence of facial gender. We hypothesised that men with chronic cocaine use show deficits in facial affect recognition, specifically in female faces. We further hypothesised that participants' ability in recognising emotional expressions of others is associated with social aspects of their lives.

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2. Methods

A total of eighty-nine male volunteers, with a mean age of 40.3 years (s.d. ± 10.7), were recruited via adverts in the local region and by word-of-mouth. Forty-five males were not seeking treatment for their cocaine use and have been using cocaine for an average of 13.2 years. Participants were assessed using the SCID for the DSM-IV-TR (Spitzer et al., 2002) and diagnoses were then followed up with DSM-5 (American Psychiatric Association, 2013) criteria for cocaine use disorder, subsequently referred to as CUD. The remaining forty-four men were healthy and without a personal and family history of drug abuse. All CUD men were active users of cocaine, as verified by a cocaine-positive urine sample prior to testing which has a detection window for cocaine of 2–3 days; urine samples provided by control participants were negative. Prior to testing, the absence of withdrawal and acute intoxication were checked. All participants were also breathalysed prior to testing to ensure no alcohol intoxication and completed the National Adult Reading Test (NART; Nelson and Willison, 1991) to estimate verbal intelligence and the Depression, Anxiety and Stress Scale (DASS-21; Lovibond and Lovibond, 1995) to assess affective states. The Multidimensional Scale of Perceived Social Support (MSPSS; Zimet et al., 1988), the Community Integration Questionnaire (CIQ-II; Sander et al., 1999) and the Social Provisions Scale (SPS; Cutrona and Russell, 1987) were used to evaluate the quality of participants' social networks. Ninety-one percent of both groups reported being heterosexual; subsequent exclusion of non-heterosexual participants did not change the results. Whist the majority of CUD participants reported being single (82 %) and 18 % reported being divorced or separated, only 43 % of control participants reported being single, 9 % divorced or separated; the rest of the control group was married (47 %). Further details can be found in the supplemental material. The protocol was approved by the Psychological Research Ethics Committee .

We first verified participants' ability to perceptually discriminate faces using the Benton Facial Recognition Test (Benton et al., 1983) and identified three CUD participants with severe difficulties, who were subsequently excluded from further analysis.

2.1. Emotional intensity morphing task

The Emotional Intensity Morphing Task (EIMT) of the EMOTICOM neuropsychological test battery (Bland et al., 2016), assesses the point of emotional intensity at which participants can recognize an emotional facial expression. Participants view faces that either increase or decrease in emotional intensity and are instructed to respond when they either (a) detect the presence of emotion or (b) no longer detect the presence of emotion. The task includes five different emotions: happiness, sadness, anger, fear and disgust. The point of detection was calculated by taking the level of intensity in the facial expression needed in order to detect (increasing) or no longer detect (decreasing) each emotion (see supplemental material).

2.2. Statistical analysis

Data were analysed using the Statistical Package for the Social Sciences (SPSS, V25; IBM). Group differences regarding demographics and face recognition performance were analysed using independent samples *t*-tests. Performance on the EIMT was analysed using repeated-measures and multivariate ANOVA models. Pearson's correlation coefficients were used to establish relationships between participants' task performance and social network indicators. All statistical tests were two-tailed with significance levels set at 0.05.

3. Results

As shown in Table 1, the two groups were well-matched for age but differed significantly with regard to verbal IQ, current emotional state, social support, social provisions and community integration. As differences in IQ were not correlated with task performance in CUD participants, they were not included in the analysis.

Results, depicted in Fig. 1, showed that CUD participants required significantly greater intensities to recognise facial emotion expressions [$F(1,84) = 9.095, p = 0.003, \eta_p^2 = 0.10$)]. Moreover, the group-by-gender interaction [$F(1,84) = 5.76, p = 0.019, \eta_p^2 = 0.06$)] revealed that CUD participants required significantly greater intensities to recognise emotional female faces [$F(1,84) = 13.42, p = 0.001, \eta_p^2 = 0.14$)] but did not differ from controls in their ability to recognise emotional male faces [$F(1,84) = 1.61, p = 0.208, \eta_p^2 = 0.02$)].

Multivariate analyses further revealed that CUD participants exhibited specific impairments in recognising happiness [$F(1,84) = 7.90, p = 0.018, \eta_p^2 = 0.09$)], fearfulness [$F(1,84) = 6.15, p = 0.015, \eta_p^2 = 0.07$)] and disgust in female faces [$F(1,84) = 9.13, p = 0.003, \eta_p^2 = 0.10$)], whereas sadness ($p = 0.477$) and anger ($p = 0.590$) were recognised similarly to control participants. However, recognition of fearful female faces was inversely correlated with level of community integration (CIQ-II-total: $r = -0.24, p = 0.026$), perceived social support (MSPSS-total: $r = -0.20, p = 0.007$) and social provisions (SPS-total: $r = -0.24, p = 0.022$). When further co-varying for DASS-21 scores, recognition of fearful female faces remained correlated with level of community integration (CIQ-II-total: $r = -0.21, p = 0.05$) and perceived social support (MSPSS-total: $r = -0.25, p = 0.022$) with a trend towards social provisions (SPS-total: $r = -0.20$, $p = 0.077$). However, we found that task performance was not associated with duration of cocaine use ($r = -0.09, p = 0.53$), age of onset of cocaine use ($r = -0.06, p = 0.69$), or the compulsive pattern of cocaine use, as reflected by the obsessive-compulsive drug use (OCDUS) score ($r = 0.22, p = 0.31$).

4. Discussion

Here we provide novel insights into facial affect recognition impairments in cocaine-addicted men by examining the effects of gender and their association with social aspects of participants' lives. In line with previous studies (Ersche et al., 2015; Kuypers et al., 2015; Morgan and Marshall, 2013; Verdejo-García and Bechara, 2009; Kemmis et al., 2007), we showed that CUD participants exhibit deficits in facial affect recognition. In fact, these impairments were specific to female facial expressions, which were in turn, associated with participants' level of social integration – an observation, which to best of our knowledge has not yet been reported.

Although CUD participants were significantly impaired in recognising the facial affect of others, this effect was, however, dependent upon the gender of the emotional face. Importantly, for the recognition of male facial affect, CUD participants were not measurably different from control participants across all five emotions tested, but they showed robust deficits in recognising female facial emotions. In fact, CUD participants required significantly greater intensity to detect emotions such as happy, fear and disgust in female faces compared with their non-drug using peers. Several accounts for this effect are conceivable. First, gender differences in expression of emotion is widely recognised, possibly due to an increased proneness of women to communicate nonverbally (Eagly, 1997; Eagly and Steffen, 1984). The cognitive deficits associated with CUD may present a particular disadvantage for CUD men, as they may not benefit as much from experiences with non-verbal strategies as much as women would (Thompson and Voyer, 2014). Consequently, they require greater intensity of emotional expressions to recognise emotion in female faces. Second, although both male and female faces were presented to participants, we only recruited men into the study, which means they could use their own-gender bias for 50 % of the trials. Own-gender bias describes the advantage of recognising facial expressions in faces of one's own gender (Herlitz and Lovén, 2013). Consequently, CUD men may have benefitted more from this bias than their non-drug using peers.

Table 1
Demographics and clinical variables for male volunteers with and without CUD.

Measure	Control Group		CUD Group		Group Comparison	
	Mean	SD	Mean	SD	*t*	P
Age (years)	40.19	12.46	40.33	8.82	−0.58	0.950
Verbal IQ (NART score)	115.49	6.14	102.53	7.29	8.45	* < 0.001
Affective state (DASS-21)	10.33	8.20	45.53	22.58	−9.61	* < 0.001
Perceived social support (MSPSS)	72.05	12.24	51.14	17.88	6.32	* < 0.001
Social Provisions (SPS)	83.00	9.49	66.05	7.92	8.93	* < 0.001
Community integration (CIQ-II)	17.60	3.16	13.83	3.96	4.86	* < 0.001

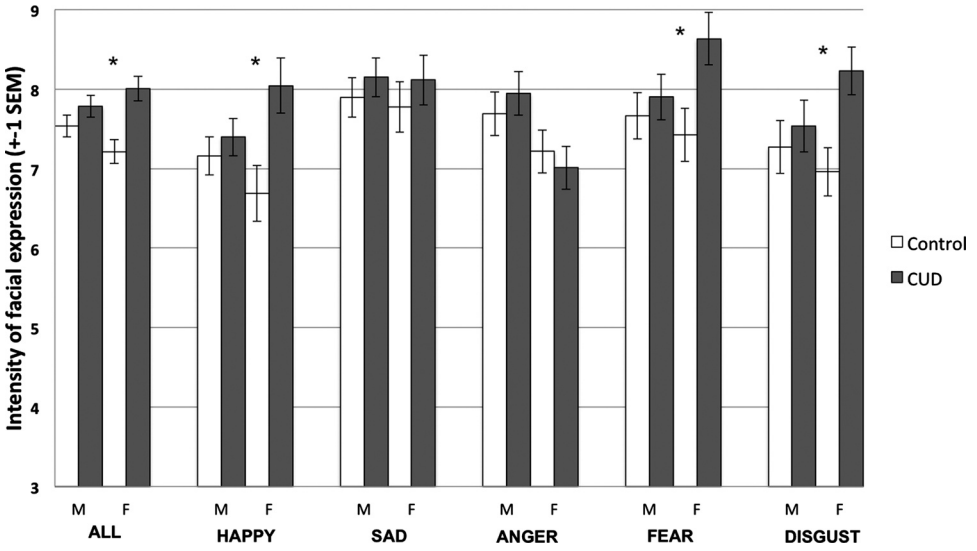

Fig. 1. Bar chart depicting recognition performance of male and female facial affect across five emotions. Men with CUD require greater intensity of affect in recognising happiness, fearfulness and disgust in female faces both compared with male faces and compared with intensities required by their non-drug using counterparts.

Future studies should use female CUD participants to further examine this possibility. Third, facial emotion recognition has been associated with the ability to empathise with others (Besel and Yuille, 2010) – an ability that has been suggested to be impaired in CUD (Preller et al., 2014). Possibly, CUD participants, who are unsure how to interpret a female facial emotional expression might not be able to compensate using empathetic intuition, and as a result, they are more likely to make wrong inferences about other people's emotional states. It is unclear why CUD participants did not show deficits in recognising sadness or anger in female faces.

Whilst previous research has speculated about the potential neurobiological nature of facial affect recognition impairment in CUD, the selective deficits for female facial expressions runs counter to such views and point more strongly towards social influences. Our results support the notion that the degree to which men recognise negative facial affect in women is associated with their social support, community integration, and social provisions such as guidance, attachment and perceived social support from friends and family. Social ties are strongly related to cocaine use trajectories (Hamil-Luker et al., 2004) and social support has been shown to be protective factors against current drug use (Williams and Latkin, 2007). Therefore suggesting an important role for social networks in emotion recognition ability in CUD.

Although drug addiction is known to destabilise friendships and family ties, such deficits in non-verbal communication are likely to further exacerbate existing tensions. This is in line with previous studies suggesting that problems with negative information processing have repercussion on social functioning in cocaine addiction and can predict treatment success (Forster et al., 2017; Turner et al., 2009). Indeed, drug-induced alterations in social perception may influence social behaviour (Wardle et al., 2012). Therefore, this impairment profile is more likely to reflect an interaction between vulnerability and the effect of the drug, which may also explain why we did not find any associations between cocaine-related variables such as the duration or compulsive pattern of use and task performance. The extent to which the impairment profile observed in the present study might be caused by cocaine specifically, should be tested by pharmacological studies using cocaine or methylphenidate (which is pharmacologically very similar to cocaine; Volkow et al., 1995) in healthy volunteers. Clearly, our work requires replication and research is warranted into whether specific training may help alleviate or improve social functioning in CUD patients.

The results of the present study are also consistent with a growing body of literature suggesting that negative emotions such as fear and disgust recognition are a particularly relevant for cocaine addiction (Albein-Urios et al., 2019; Ersche et al., 2015; Morgan and Marshall, 2013; Fernández-Serrano et al., 2010; Verdejo-García and Bechara, 2009; Kemmis et al., 2007). Facial expressions of these two emotions have been suggested to convey social signs of inhibition and avoidance – functions that are known to be impaired in CUD individuals (Ersche et al., 2016; Morein-Zamir and Robbins, 2015). Recognition of both fear and disgust is an adaptive function involving the ability to anticipate dangers, signal aversion and consequently trigger protective behaviours. CUD men did not exhibit complete impairment of these emotions with impairments only evident in recognising female faces. Specific deficits in fear and disgust recognition in female faces may therefore interfere with social functioning and lead to difficulties with relationships. Indeed, this was also reflected by fewer CUD participants being in a close relationship compared to controls.

We acknowledge a number of limitations of the present study such as the use of only male participants. It still remains unclear whether women with CUD would exhibit any gender biases in facial emotion recognition. Second, CUD and control participants significantly differed in IQ and emotional states, which is not unusual for this group (Buckley

et al., 2001; Crum et al., 1993). Third, complementary measures such as theory of mind and empathy measures were not obtained and would be useful in elucidating the underlying processes in this observed gender bias as would neuroimaging data. Importantly, whilst facial emotion recognition has a neurological basis (Sprengelmeyer et al., 1998), neurological change is unlikely to explain a gender bias. Nor can it be explained by culture or age biases as there were no observed cultural differences between CUD and control participants, who came from the same local community and age was not significantly correlated with the outcome variables. Finally, given that our CUD sample were either single or separated, future research is needed to explore the relationship between gender biases in emotion recognition and links specifically with interpersonal relationships. This is particularly important considering that relationships are known to be stabilising factors during recovery and potential treatments should address these links.

In conclusion, the present study provides novel evidence of gender specific deficits in facial emotion recognition in CUD men. Specific impairments in recognising fear in female faces may provide a potential marker of social integration and functioning, which would be important for informing recovery interventions.

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Role of the funder/sponsor

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Author contribution

Obtained funding, concept and design: KDE.
Data analysis and interpretation: ARB, KDE.
Writing of the manuscript: ARB, KDE.
Critical revision of the manuscript for important intellectual content: ARB, KDE.
Approved the final article: ARB, KDE.

Declaration of Competing Interest

The authors report no declarations of interest.

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Appendix A. Supplementary data

Supplementary material related to this article can be found, in the online version, at doi:https://doi.org/10.1016/j.drugalcdep.2020.108247.

References

Albein-Urios, N., Martinez-Gonzalez, J.M., Lozano-Rojas, O., Verdejo-Garcia, A., 2019. Dysfunctional personality beliefs linked to emotion recognition deficits in individuals with cocaine addiction and personality disorders. Front. Psychiatry 10, 431.
American Psychiatric Association, 2013. Diagnostic and Statistical Manual of Mental Disorders, 5th ed. Arlington, VA.
Benton, A.L., Sivan, P.A., de S. Hamsher, K., Varney, D., Spreen, N., Sivan, A.B., Vareny, N.R., Spreen, O., Varney, S., 1983. Facial Recognition: Stimulus and Multiple Choice Pictures.
Besel, L.D.S., Yuille, J.C., 2010. Individual differences in empathy: the role of facial expression recognition. Pers. Individ. Dif. 49, 107–112.
Blair, R.J., 1995. A cognitive developmental approach to mortality: investigating the psychopath. Cognition 57, 1–29.
Bland, A.R., Roiser, J.P., Mehta, M.A., Schei, T., Boland, H., Campbell-Meiklejohn, D.K., Emsley, R.A., Munafo, M.R., Penton-Voak, I.S., Seara-Cardoso, A., Viding, E., Voon, V., Sahakian, B.J., Robbins, T.W., Elliott, R., 2016. EMOTICOM: A Neuropsychological Test Battery to Evaluate Emotion, Motivation, Impulsivity, and Social Cognition. Front Behav Neurosci https://doi.org/10.3389/fnbeh.2016.00025.
Buckley, T.C., Parker, J.D., Heggie, J., 2001. A psychometric evaluation of the BDI-II in treatment-seeking substance abusers. J. Subst. Abuse Treat. 20, 197–204.
Corden, B., Critchley, H.D., Skuse, D., Dolan, R.J., 2006. Fear recognition ability predicts differences in social cognitive and neural functioning in men. J. Cogn. Neurosci. 18, 889–897.
Crum, R.M., Helzer, J.E., Anthony, J.C., 1993. Level of education and alcohol abuse and dependence in adulthood: a further inquiry. Am. J. Public Health 83, 830–837.
Cutrona, C.E., Russell, D.W., 1987. The provisions of social relationships and adaptation to stress. Adv. Pers. Relationships 1, 37–67.
Eagly, A.H., 1997. Sex differences in social behavior: Comparing social role theory and evolutionary psychology. American Psychologist 52 (12), 1380–1383. https://doi.org/10.1037/0003-066X.52.12.1380.b.
Eagly, A.H., Steffen, V.J., 1984. Gender stereotypes stem from the distribution of women and men into social roles. J. Pers. Soc. Psychol. 46, 735.
Ersche, K.D., Hagan, C.C., Smith, D.G., Jones, P.S., Calder, A.J., Williams, G.B., 2015. In the face of threat: neural and endocrine correlates of impaired facial emotion recognition in cocaine dependence. Transl. Psychiatry 5 e570–e570.
Ersche, K.D., Gillan, C.M., Jones, P.S., Williams, G.B., Ward, L.H.E., Luijten, M., de Wit, S., Sahakian, B.J., Bullmore, E.T., Robbins, T.W., 2016. Carrots and sticks fail to change behavior in cocaine addiction. Science (80) 352 1468 – 1471.
Fernández-Serrano, M.J., Lozano, Ó., Pérez-García, M., Verdejo-García, A., 2010. Impact of severity of drug use on discrete emotions recognition in polysubstance abusers. Drug Alcohol Depend. 109, 57–64.
Forster, S.E., Finn, P.R., Brown, J.W., 2017. Neural responses to negative outcomes predict success in community-based substance use treatment. Addiction 112, 884–896.
Hamil-Luker, J., Land, K.C., Blau, J., 2004. Diverse trajectories of cocaine use through early adulthood among rebellious and socially conforming youth. Soc. Sci. Res. 33, 300–321.
Herlitz, A., Lovén, J., 2013. Sex differences and the own-gender bias in face recognition: a meta-analytic review. Vis. Cogn. 21, 1306–1336.
Kemmis, L., Hall, J.K., Kingston, R., Morgan, M.J., 2007. Impaired fear recognition in regular recreational cocaine users. Psychopharmacology (Berl.) 194, 151–159.
Kuypers, K.P.C., Steenbergen, L., Theunissen, E.L., Toennes, S.W., Ramaekers, J.G., 2015. Emotion recognition during cocaine intoxication. Eur. Neuropsychopharmacol. 25, 1914–1921.
Lee, K.-U., Khang, H.S., Kim, K.-T., Kim, Y.-J., Kweon, Y.-S., Shin, Y.-W., Kwon, J.S., Ho, S.-H., Garfinkel, S.N., Chae, J.-H., Liberzon, I., 2008. Distinct processing of facial emotion of own-race versus other-race. Neuroreport 19.
Lovibond, P.F., Lovibond, S.H., 1995. The structure of negative emotional states: Comparison of the Depression Anxiety Stress Scales (DASS) with the Beck Depression and Anxiety Inventories. Behav. Res. Ther. 33, 335–343.
Morein-Zamir, S., Robbins, T.W., 2015. Fronto-striatal circuits in response-inhibition: relevance to addiction. Brain Res. 1628, 117–129.
Morgan, M.J., Marshall, J.P., 2013. Deficient fear recognition in regular cocaine users is not attributable to elevated impulsivity or conduct disorder prior to cocaine use. J. Psychopharmacol. (Oxford) 27, 526–532.
Nelson, H.E., Willison, J., 1991. National Adult Reading Test (NART). Nfer-Nelson Windsor.
Pachado, M.P., Scherer, J.N., Guimarães, L.S.P., von Diemen, L., Pechansky, F., Kessler, F.H.P., de Almeida, R.M.M., 2018. Markers for severity of problems in interpersonal relationships of crack cocaine users from a Brazilian multicenter study. Psychiatr. Q. 89, 923–936.
Preller, K.H., Hulka, L.M., Vonmoos, M., Jenni, D., Baumgartner, M.R., Seifritz, E., Dziobek, I., Quednow, B.B., 2014. Impaired emotional empathy and related social network deficits in cocaine users. Addict. Biol. 19, 452–466.
Quednow, B.B., 2017. Social cognition and interaction in stimulant use disorders. Curr Opin Behav Sci 13, 55–62.
Rehnman, J., Herlitz, A., 2006. Higher face recognition ability in girls: magnified by own-sex and own-ethnicity bias. Memory 14, 289–296.
Romero-Martínez, A., Moya-Albiol, L., 2015. Neuropsychological impairments associated with the relation between cocaine abuse and violence: neurological facilitation mechanisms. Adicciones . 27 (1), 64–74 Published 2015 Mar 1.
Sander, A.M., Fuchs, K.L., High Jr, W.M., Hall, K.M., Kreutzer, J.S., Rosenthal, M., 1999. The Community Integration Questionnaire revisited: an assessment of factor structure and validity. Arch. Phys. Med. Rehabil. 80, 1303–1308.
Spitzer, R.L., Gibbon, M.E., Skodol, A.E., Williams, J.B.W., First, M.B., 2002. DSM-IV-TR Casebook: a Learning Companion to the Diagnostic and Statistical Manual of Mental Disorders, Text Rev. American Psychiatric Publishing, Inc.
Sprengelmeyer, R., Rausch, M., Eysel, U.T., Przuntek, H., 1998. Neural structures associated with recognition of facial expressions of basic emotions. Proc. R. Soc. Lond. Ser. B Biol. Sci. 265, 1927–1931.
Thompson, A.E., Voyer, D., 2014. Sex differences in the ability to recognise non-verbal

displays of emotion: a meta-analysis. Cogn. Emot. 28, 1164–1195.
Trubanova, A., Kim, I., Coffman, M.C., Bell, M.A., Richey, J.A., LaConte, S.M., Gracanin, D., White, S.W., 2016. The role of perspective-taking on ability to recognize fear. Curr. Res. Psychol. 6, 22–30.
Turner, T.H., LaRowe, S., Horner, M.D., Herron, J., Malcolm, R., 2009. Measures of cognitive functioning as predictors of treatment outcome for cocaine dependence. J. Subst. Abuse Treat. 37, 328–334.
Verdejo-García, A., Bechara, A., 2009. A somatic marker theory of addiction. Neuropharmacology 56, 48–62.
Volkow, N.D., Ding, Y.-S., Fowler, J.S., Wang, G.-J., Logan, J., Gatley, J.S., Dewey, S., Ashby, C., Liebermann, J., Hitzemann, R., Wolf, A.P., 1995. Is methylphenidate like cocaine?: studies on their pharmacokinetics and distribution in the human brain. Arch. Gen. Psychiatry 52, 456–463.
Wardle, M.C., Garner, M.J., Munafò, M.R., de Wit, H., 2012. Amphetamine as a social drug: effects of d-amphetamine on social processing and behavior. Psychopharmacology (Berl.) 223, 199–210.
Williams, C.T., Latkin, C.A., 2007. Neighborhood socioeconomic status, personal network attributes, and use of heroin and cocaine. Am. J. Prev. Med. 32, S203–S210.
Wright, D.B., Sladden, B., 2003. An own gender bias and the importance of hair in face recognition. Acta Psychol. (Amst) 114, 101–114.
Zimet, G.D., Dahlem, N.W., Zimet, S.G., Farley, G.K., 1988. The multidimensional scale of perceived social support. J. Pers. Assess. 52, 30–41.