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Social cognition and sex: Are men and women really different?

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| 30 | Social cognition and sex: Are men and women really different? |
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Social cognition and sex: are men and women really different?

57

58 Abstract

59 Social cognition includes the ability to represent other people's intentions and beliefs, and the 60 ability to share and recognise the emotions of others. Here, the main aim was to assess the 61 possible presence of sex differences across four aspects of social cognition: (1) recognition of 62 dynamic facial expressions; (2) representation of other people's mental states (both affective 63 and cognitive Theory of Mind, ToM); (3) empathy; (4) identification and regulation of one's 64 own emotions. Measures assessing social cognition were administrated to two hundred ten 65 participants equally divided between men and women. Results showed no significant sex differences in affective and cognitive ToM, in the recognition of emotional facial expressions 66 67 (with the exception of anger: women were more accurate than men), and in the ability to 68 identify and regulate one's own emotions. A different result was found for empathy, with 69 women reporting higher scores than men. No significant differences between women during 70 follicular vs. luteal phase of menstrual cycle for all the social cognition measures were found. 71 These results are discussed in light of the existing literature. To our knowledge, this study 72 represents one of the few attempts to analyse in a single work sex differences across multiple 73 areas of social cognition.

74

Keywords: Emotion recognition; Emotional functioning; Empathy; Sex differences; Social
cognition; Theory of Mind.

77 **1. Introduction**

The ability to decipher information about the intentions and affective states of social partners is crucial for appropriate social interactions. This complex process is part of the so-called social cognition domain, which includes both the ability to represent other people's intentions and beliefs (i.e., Theory of Mind, ToM) (Leslie, 1987; Tettamanti et al., 2017), and the ability to share and recognise the emotions of others (Lieberman, 2007).

83 From an evolutionary point of view the evolution of sex differences in social 84 cognition have been linked to differential natural selection and sexual selection pressures 85 acting on the two sexes (e.g., Geary, 2002; Kenrick, 1995) but the actual presence and nature of sex differences in social cognition is still discussed. The available evidence suggests a 86 87 female advantage in the recognition of other people's emotions and mental states, and in the 88 ability to understand and share others' feelings (Campbell et al., 2002; Courtain & Glowacz, 89 2019; McClure, 2000; Mestre, Samper, Frías, & Tur, 2009; Thayer & Johnsen, 2000). Indeed, 90 previous studies have highlighted that women are more accurate than men in recognising 91 facial expressions, particularly negative emotions, such as fear and sadness (Campbell et al., 92 2002; Mandal & Palchoudhury, 1985; Montagne, Kessels, Frigerio, de Haan, & Perrett, 2015; 93 Whittle, Yücel, Yap, & Allen, 2011). Similarly, women compared to men seem to be more 94 accurate in the representation of others' mental states, with better performance especially on 95 ToM tasks involving an affective component (Baron-Cohen, 2003; Carroll & Chiew, 2006; 96 Krach et al., 2009; Xia Wu, & Su, 2012), and appear to show a higher tendency to empathy 97 (Courtain & Glowacz, 2019; Mestre et al. 2009). 98 These results may depend on several factors. Biological determinants, such as

99 hormonal production, can influence emotional responses and consequently performance on

- 100 social cognition tasks (Derntl et al., 2008; Hines, 2000; Pearson & Lewis, 2005). Particularly,
- 101 Derntl et al. (2008) compared women during their follicular and luteal phases on the

recognition of facial expressions of emotions, showing higher accuracy in the follicular groupwith respect to the luteal one.

104 Despite the suggestion that women perform better on social cognition tasks, not all 105 evidence is consistent. Indeed, other studies have found mixed results (Bradley, Codispoti, Sabatinelli, & Lang, 2001; Kempton et al., 2009; Rahman, Wilson, & Abrahams, 2004; 106 107 Russell, Tchanturia, Rahman, & Schmidt, 2007) or no difference at all (Barrett, Robin, 108 Pietromonaco, & Eyssell, 1998; Derntl et al., 2010; Grimshaw, Bulman-Fleming, & Ngo, 109 2004). For instance, Rahman et al. (2004) showed that women were faster in correctly 110 classifying facial expressions of emotions, particularly happiness and sadness, although they 111 were no more accurate than men overall. Similarly, Kempton et al. (2009) reported no sex differences in the recognition of fearful facial expressions. However, they found an effect of 112 113 sex on brain activation; females, in fact, demonstrated increased activations with respect to 114 males in the left amygdala and right temporal pole, while in men no brain regions showed 115 more activation than in women.

One of the major issues in investigating the presence of sex differences in social cognition is a circumscribed approach that does not consider the different components of social cognition (Enrici et al., 2015; Happé, Cook, & Bird, 2017). Indeed, the majority of previous studies have been limited by only considering one aspect of social cognition (e.g., emotion recognition but not mental state understanding). In order to elucidate the presence of sex differences in social cognition, it is essential to use multiple instruments to assess all areas of this domain in the same individuals.

Moreover, most of previous research has been carried out on children and adolescents, while a limited number of studies have attempted to assess the presence of sex differences on social cognition in healthy adults.

126 Assessing social cognition abilities in adult samples can also allow to acquire important information on the presence of sex differences in the behavioural manifestation of 127 128 clinical conditions. For instance, differences in the symptoms between men and women have 129 been well-documented in schizophrenia. Social withdrawal, difficulties in recognising 130 negative facial expressions, and social maladjustment are more common among male patients 131 with schizophrenia, while social adaptation and superior mentalising abilities have been more 132 frequently observed in female patients (Abu-Akel & Bo, 2013; Grossman, Harrow, Rosen, 133 Faull, & Strauss, 2008; Kohler et al., 2003; Ritsner, Arbitman, Lisker, & Ponizovsky, 2012). 134 Based on this uncertain evidence, the main aim of the present study was to throw light 135 on the possible presence of sex differences across multiple areas of social cognition. Four different aspects were examined: (1) recognition of dynamic facial expressions; (2) 136 137 representation of other people's mental states (both affective and cognitive ToM); (3) 138 empathy; (4) identification and regulation of one's own emotions. The possible effect of 139 hormone levels on those components of social cognition was also investigated by comparing 140 women during follicular vs. luteal phase of their menstrual cycle. Finally, since several studies showed significant associations between anxiety/depressive symptoms and social 141 142 cognition, particularly in its affective dimensions (e.g., Adenzato, Todisco, & Ardito, 2012; 143 Hale, Jansen, Bouhuys, & van den Hoofdakker, 1998; Imperatori et al., 2019; Richards et al., 144 2002; Washburn, Wilson, Roes, Rnic, & Harkness, 2016), the levels of anxiety/depressive 145 symptoms in female and male participants were also evaluated.

146

147 **2. Material and methods**

148 2.1. Participants and procedure

Three hundred participants were recruited through advertisements. The exclusion criteria
were: less than 18-years-old, low educational level (< 5 years), insufficient knowledge of the

Italian language, and the presence or history of a neurological or severe psychiatric disorder. Two hundred ten participants were eligible for the study and completed the questionnaires, making up the final sample. The final sample was equally divided between men (105, 50%) and women. The sample size was determined ahead of time based on a priori power analysis, using the software G* Power 3.1 (Faul et al., 2009).

156 All the measures were administered to the participants through an online survey 157 software. An anonymised, individual, and unique code to complete the survey was provided 158 to those who gave their agreement to take part in the study.

Participants were asked to complete a battery of measures as part of a wider
investigation. In the present manuscript, only the instruments relevant to the current research

aims will be discussed.

162 The study was approved by the local ethics committee and was conducted in 163 accordance with the Declaration of Helsinki. All the participants gave their written informed 164 consent to participate in the study.

165

166 2.2. Materials and Methods

167 2.2.1. Sociodemographic and clinical information

168 All participants were asked to provide sociodemographic (i.e., age, educational level, marital 169 status, and occupation) and clinical information (i.e., history or presence of psychiatric or 170 neurological disorders). Female participants were also asked to provide information about 171 their menstrual cycle, in order to evaluate the possible association between hormone levels and social cognition skills. Particularly, women were asked to indicate the date of their last 172 173 menstruation and if they had a regular menstrual cycle (they were explicitly asked to report if 174 they had a 28-days cycle). Otherwise, they were asked to specify the duration of their 175 menstrual cycle in days. Only women who were not on hormone treatments or who were able 176 to provide accurate information about the duration of their menstrual cycle were considered 177 for the second goal of this study.

178

179 2.2.2. Social cognition assessment

180 2.2.2.1. Recognition of facial expressions in others

181 The Montréal Pain and Affective Face Clips (MPAFC) are standardized stimuli of dynamic, 182 prototypical facial expressions (Simon, Craig, Gosselin, Belin, & Rainville, 2007). The 183 MPAFC is formed by 60 one-second film clips, in which eight actors (four females and four 184 males) display the six basic emotions (viz., anger, disgust, fear, happiness, sadness, and 185 surprise), expressions of pain, and neutral facial expressions. The facial expressions are 'prototypical' and 'natural' insofar as they possess the key features identified by Ekman and 186 187 Friesen (1976), using the Facial Action Coding System, as being representative of everyday 188 facial expressions (Simon et al., 2007). The clips were presented one-at-a-time in random 189 order. A black screen was displayed to the participants at the beginning and end of each clip, 190 in order to avoid a possible facilitating effect, due to the last static frame of the videos. 191 Participants were asked to choose one of eight options displayed below each video, using the 192 criterion of which word best describes the emotion of the person shown. 193

194 2.2.2.2. Representation of other people's affective mental states

195 The Italian translation of the Reading the Mind in the Eyes Test (RME) was employed to

196 assess the ability to represent other people's affective mental states (Baron-Cohen,

197 Wheelwright, Hill, Raste, & Plumb, 2001; Serafin & Surian, 2004). In the test, the

198 experimenter presents a set of 36 photographs of the eye region of various human faces.

199 Participants are required to choose among four words that are printed on the page that the

200 picture appears on, using the criterion of which word best describes the mental state of the 201 person depicted in the photograph. Participants have to put themselves into the mind of
202 another person to recognise his or her complex mental state. The maximum score is 36.
203

204 2.2.2.3. Representation of other people's cognitive mental states

205 The Italian translation of the Strange Stories test has been used for the assessment of 206 cognitive ToM (Happé, Brownell, & Winner, 1999; Liverta Sempio, Marchetti, & Castelli, 207 2005; Mazzola & Camaioni, 2002). It consists of two types of short stories: ToM stories and 208 physical stories. The eight ToM stories require the participants to comprise characters' 209 mental states and concern double bluff, mistakes, persuasion, and white lies. Conversely, the 210 eight physical control stories did not involve mental states but require participants to make 211 global inferences that went beyond what was explicitly mentioned in the text. 212 Each story is followed by a question assessing the ability to infer the characters'

thoughts and feelings, for ToM passages, while for non-metal stories, to understand, forexample, physical causation.

The total score for both ToM and physical stories ranges from 0 to 16, with higher scores indicating a better performance. For the present study only the ToM Strange Stories score was used.

218

219 2.2.2.4. Empathy

The Italian version of the Interpersonal Reactivity Index (IRI) (Albiero, Ingoglia, & Lo Coco,
2006; Davis 1980, 1983) was administered for the assessment of empathy. The IRI is made of
28 items, rated on a 5-point Likert scale, which explore four dimensions of empathy: Fantasy,
Perspective-Taking, Empathic Concern, and Personal Distress (Davis 1980, 1983).

- The scale has shown good internal consistency (Cronbach's α ranging from .70 to .78) and test-retest reliability (Davis 1980; Ingoglia, Lo Coco, & Albiero, 2016). In line with these results, in our sample the Cronbach's alpha was good for the IRI (α score = .75).
- 227

228 2.2.2.5. Alexithymia

229 Alexithymia was assessed using the Italian version of the Toronto Alexithymia Scale (TAS-230 20) (Bressi et al., 1996; Taylor, Bagby, & Parker, 2003). It comprises 20 items, each scored 231 on a 5-point Likert-type scale. The results provide a TAS-20 total score and three subscale 232 scores assessing different aspects of alexithymia: difficulty identifying feelings (DIF), which 233 measures the inability to distinguish specific emotions or between emotions and the bodily 234 sensations of emotional arousal; difficulty describing feelings (DDF), which assesses the 235 inability to verbalize one's emotions to other people; and externally-oriented thinking (EOT), 236 which evaluates the tendency of individuals to focus their attention externally and not on the inner emotional experience (Taylor et al., 2003). The TAS-20 cut-off scores are: ≤51 no 237 238 alexithymia, 52–60 borderline alexithymia, ≥61 alexithymia. 239 The scale has shown good internal consistency (Cronbach's alpha coefficient: \geq .70)

and test-retest reliability (Taylor et al., 2003). In line with these results, in our sample the

241 Cronbach's alpha was good for the TAS-20 (α score = .79).

242

243 2.2.2.6. Difficulties in emotion regulation

The Italian adaptation of the brief version of the Difficulties in Emotion Regulation Scale (DERS-16) was employed for the evaluation of difficulties in emotion regulation (Bjureberg et al., 2016). The DERS-16 is formed by 16 items, rated on a 5-point Likert scale, which assesses the following dimensions of emotion regulation difficulties: non-acceptance of negative emotions, inability to engage in goal-directed behaviours when distressed,

difficulties controlling impulsive behaviours when experiencing negative emotions, limited
access to emotion regulation strategies perceived as effective, and lack of emotional clarity.
Total scores on the DERS-16 can range from 16 to 80, with higher scores reflecting greater
levels of emotion dysregulation.

The DERS-16 has been found to have excellent internal consistency (Cronbach's α ranging from .92 to .95), good test-retest reliability, and good convergent and discriminant validity (Bjureberg et al., 2016). In line with these results, in our sample the Cronbach's alpha was excellent for the DERS-16 (α score = .89).

257

258 2.2.3. Psychological assessment

259 2.2.3.1. Anxiety symptoms

260 To assess the presence of anxiety symptoms the Form Y of the State-Trait Anxiety Inventory 261 (STAI-Y) was used (Pedrabissi & Santinello, 1989; Spielberger, Gorsuch, Lushene, Vagg, 262 Jacobs, 1983). It is divided into two sections that can be used independently, each consisting 263 of 20 items that are scored using a 4-point Likert-type scale: the STAI-Y1 assesses current 264 feelings of apprehension and tension (state anxiety), while the STAI-Y2 evaluates persistent 265 anxiety traits (trait anxiety). Each section has a total score ranging from 20 to 80, with higher 266 scores indicating greater anxiety. In the present study, the STAI-Y2 for trait anxiety was 267 administered. The STAI-Y has shown good psychometric properties including adequate 268 internal consistency (Cronbach's $\alpha = .86-.95$), test-retest reliability and construct validity 269 (Julian, 2011). In line with these results, in our sample the Cronbach's alpha was excellent for 270 the STAI-Y2 ($\alpha = .91$).

271

272 *2.2.3.2. Depressive symptoms*

273 The presence of depressive symptoms was assessed using the Beck Depression

274 Inventory-II (BDI-II) (Beck, Steer, Ball, & Ranieri, 1996a; Ghisi, Flebus, Montano, Sanavio,

275 Sica, 2006). It consists of 21 items, each scored using a 4-point Likert-type scale. The total

score ranges from 0 (no depressive symptoms) to 63 (severe depression). The BDI-II has

shown good psychometric properties, with good internal consistency (Cronbach's $\alpha = .91$),

test-retest reliability and construct validity (Beck, Steer, & Brown, 1996b). In line with these

279 results, in our sample the Cronbach's alpha was good for the BDI-II ($\alpha = .87$).

280

281 2.3. Statistical analyses

The statistical analyses were carried out with the Statistical Package for Social Science,
version 25.0 (IBM SPSS Statistics for Macintosh, Armonk, USA: IBM).

Indices of asymmetry and kurtosis were used to test for normality of data. Values for asymmetry and kurtosis between -1 and +1 were considered acceptable in order to prove normal univariate distribution. Group comparisons were performed by means of independent *t*-tests or non-parametric equivalent tests, as appropriate. The effect size was determined by calculating Cohen's *d* or Pearson's correlation coefficient *r*.

289 A p < .01 significance level was used to reduce the likelihood of Type I errors that 290 may result from the conventionally used significance level of p < .05.

291

3. Results

293 **3.1. Sociodemographic characteristics**

Sociodemographic characteristics for the female and male groups are presented in Table 1.
The groups were matched for both age and educational level, as well as for the presence of
anxiety/depressive symptoms.

297

| 298 | Table 1 |
|-----|---|
| 299 | |
| 300 | |
| 301 | 3.2. Social cognition assessment |
| 302 | The differences in emotion recognition (MPAFC), affective ToM (RMET), empathic |
| 303 | capacities (IRI), emotion regulation (DERS), and alexithymia (TAS-20) between the female |
| 304 | and male groups are presented in Tables 2 and 3. |
| 305 | Concerning the recognition of emotional facial expressions, a statistically significant |
| 306 | difference between the two groups was detected only for the anger scores ($p = .010$; $r = 0.18$), |
| 307 | with women reporting higher scores than man. Particularly, women were found to be more |
| 308 | accurate than men in the recognition of anger in male faces (women vs. men, mean rank, |
| 309 | mean \pm SD: 111.89, 3.78 \pm 0.52 vs. 99.11, 3.66 \pm 0.55; $U = 4842.000$, $z = -2.041$, $p = .041$; r |
| 310 | = 0.14). |
| 311 | As regards the representation of other people's mental states (i.e., affective and |
| 312 | cognitive ToM), no statistically significant difference between the two groups was found on |
| 313 | either the RMET ($p = .089$) or the Strange Stories scores (ToM stories: $p = .136$; Physical |
| 314 | stories: $p = .727$). |
| 315 | |
| 316 | Table 2 |
| 317 | |
| 318 | Concerning, instead, empathy, independent <i>t</i> -tests showed the presence of significant |
| 319 | differences between the female and male groups on the 'Fantasy' ($p = .003$; $d = 0.12$) and |
| 320 | 'Personal Distress' ($p = <.001$; $d = 0.55$) subscales scores of the IRI, with women reporting |
| 321 | higher scores than men. |

Finally, regarding the presence of difficulties in identifying and regulating one's own emotions, no statistically significant differences were found between the two groups on the TAS-20 and on the DERS-16 scores.

325 _____ 326 Table 3 327 328 Further analyses (i.e., t-tests or Mann-Whitney U tests, as appropriate) were 329 performed in order to assess the possible role of hormone levels during menstrual cycle in 330 female participants. The sample consisted of 33 women during the follicular phase of their 331 menstrual cycle and 33 women during the luteal phase. Thirty-nine women were excluded 332 from the analyses due to hormone treatments or missing/inaccurate information. 333 Of the 66 women included in the analyses, 50% reported to have a 28-days cycle, 334 while the remaining 50% indicated a different duration of their menstrual cycle (from 17 to 40 days). For the latter, follicular and luteal phases were calculated by means of proportions 335 336 based on the duration in days of their cycle. 337 Results showed the presence of non-significant differences between women during follicular vs. luteal phase for all the social cognition measures we employed (all p > .01). 338 339 Considering the high number of women who reported not to have a 28-days cycle, 340 factorial Analyses of Variance were also performed, in order to ascertain the possible and 341 additional role of 'regular cycle' variable in the relationship between hormone levels and 342 social cognition skills. Results showed the presence of no significant results for either the 343 'regular cycle' variable or the interaction term (regular cycle x cycle phase) in all social 344 cognition measures (all p > .01). 345

346 **4. Discussion**

The present study mainly aimed at throwing light on the presence of sex differences on social cognition abilities. In doing this, we employed a broad range of measures assessing all the main components of social cognition. As a secondary goal, we evaluated the possible effect of hormone levels on social cognition tasks, by comparing women during follicular vs. luteal phase of their menstrual cycle.

352 As far as the main aim of the study is concerned, our results showed no significant sex 353 differences in the representation of other people's mental states (i.e., both affective and 354 cognitive ToM). Regarding the affective dimension, we only found a trend towards statistical 355 significance (p = .089, d = 0.24) in favour of women. Interestingly, this result is in line with 356 the findings shown by Baron-Cohen et al. (2001) in their validation of the RMET, in which 357 sex difference approached but not reached significance (p = .067, effect size not reported), 358 with women scoring higher than males. Similarly, concerning the cognitive dimension of 359 ToM, no significant sex differences were found on the performance of either ToM or 360 Physical passages of the Strange Stories test.

We found no sex differences even in the recognition of emotional facial expressions in others. The only exception was the expression of anger; women, in fact, were more accurate than men in the recognition of anger particularly in male faces. This result is in line with previous studies showing a lager female advantage in the recognition of negative emotions (e.g., anger, sadness, fear or disgust) than positive emotions (e.g., happiness) (Thompson & Voyer, 2014).

Therefore, taken as a whole, these findings let us hypothesise that the differences in the performance on social cognition tasks favouring female children and adolescents may not extend into adulthood. This would make social competences like many other aspects of cognition, such as verbal intelligence quotient, in which girls mature faster than boys but the female advantage dissipates by adulthood (e.g., Kimura, 1999).

372 Another possible explanation is that women might recruit different neural regions 373 with respect to men, particularly during the processing of emotional information, which may 374 lead to differences in performance in some, but not all, cases, depending on the specific 375 experimental conditions (Grimshaw et al., 2004; Whittle et al., 2011). For instance, it is 376 plausible that sex differences in emotion recognition are revealed under conditions of rapid 377 visual presentation, when participants have high levels of uncertainty (Grimshaw et al., 2004; 378 Kirouac & Dore, 1984), and this may be due to the different ways in which females and 379 males typically process emotional stimuli (Hall, Witelson, Szechtman, & Nahmias, 2004). 380 Indeed, women often show greater limbic (i.e., amygdala, anterior cingulate, thalamus) 381 activation than men, which suggests that emotional information may be elaborated most 382 likely at a primary level (i.e., emotions arisen from processing innately significant 383 environmental stimuli – basic responses like 'flight-or-fight' behaviours). On the contrary, 384 men frequently report greater activation in prefrontal and parietal cortical regions compared 385 to women, relying more on second level emotional processing (i.e., emotions evoked by 386 stimuli that have acquired significance through learning processes in the social context) 387 (Damasio, 1994; Whittle et al., 2011). As a result, women may show guicker and more 388 accurate emotional perception, while in men emotion processing style may be more analytical 389 and potentially slower, leading to the sex differences found in some, but not all, previous 390 studies (Kempton et al., 2009; Wildgruber, Pihan, Ackermann, Erb, Grodd, 2002). 391 Similarly, women and men might employ different routes for processing social 392 cognitive information. Indeed, men have been found to use more 'systemising' strategies 393 (i.e., the analysis of rule-driven behaviour in systems), while women usually report to use 394 more 'empathising' routes (i.e., identifying another's thoughts and emotions and responding 395 appropriately) (Baron-Cohen, Richler, Bisarya, Gurunathan, & Wheelwright, 2003). The

396 majority of cognitive ToM measures require the understanding and prediction of law-

governed behaviour and this might explain why some previous evidence, in line with our
results, found that men performed as well as women on cognitive ToM tasks (e.g., NavarraVentura et al., 2018), while in other studies males were found to be even more accurate than
females (e.g., Russell et al., 2007).

401 In the same way as emotion recognition and ToM assessment, no significant sex 402 differences were found on the ability to correctly identify and regulate one's own emotions 403 (i.e., TAS-20 and DERS-16). The available evidence shows contrasting results. Indeed, some 404 previous studies reported than men have greater difficulties in identifying and expressing 405 emotions compared to women in both clinical and non-clinical samples (de Barros, Furlan, 406 Marques, & de Araújo Filho, 2019; Larsen, van Strien, Eisinga, & Engels, 2006; Levant, 407 1992; Levant, Hall, Williams, & Hasan, 2009; Peng et al., 2019), while other studies found 408 no significant (Heesacker et al., 1999; Mallinckrodt, King, & Coble, 1998; Wester, Vogel, 409 Pressly, & Heesacker, 2002) or even opposite results (i.e., females reporting higher 410 alexithymia scores than males) (Scimeca et al., 2014). Interestingly, the meta-analysis of 411 Levant et al. (2009) reported that men scored higher, on average, than women across different 412 measures of alexithymia in both clinical and non-clinical samples. However, the estimated 413 effect size they found was not large, and the distributions of alexithymia scores in males and 414 females substantially overlapped. As a possible explanation, the authors suggested that only 415 those men who received strong traditionally masculine gender role socialisation as boys 416 would manifest alexithymic traits. Conversely, men who have been encouraged as boys to 417 express and talk about their emotions by parents, peers, or school teachers, are likely to have 418 developed a proper emotional vocabulary and consequently adequate abilities to identify and 419 describe their own feelings (Levant et al., 2009).

420 Concerning empathy, a different pattern of results was found. Indeed, statistically
421 significant differences between female and male were found on the 'Fantasy' and 'Personal

422 Distress' subscales scores of the IRI, with women reporting higher scores than men. These 423 results are in line with previous studies reporting in women greater abilities to understand and 424 share others' feelings compared to men (Courtain & Glowacz, 2019; Mestre et al. 2009; 425 Worly et al., 2019). Particularly, Courtain and Glowacz (2019) assessed empathic dimensions 426 in relation to positive conflict resolution strategies in a large group of young adults. They 427 found that females had a higher propensity toward empathy than males, reporting higher 428 scores on the 'Fantasy', 'Personal distress', and 'Empathic concern' subscales of the IRI. 429 Similarly, Worly et al. (2019) investigated sex differences in burnout, perceived stress, and 430 empathic concern in a group of medical students, showing that women reported higher scores 431 on the 'Fantasy', 'Empathic Concern', and 'Personal Distress' subscales of the IRI compared 432 to men. The evolutionary roots of this sex differences are well discussed by Preston and de 433 Waal (2002) and are mainly related to the facilitation of the mother-infant bonding, as 434 originally proposed by Darwin (1872).

435 As far as the second goal of this study is concerned, we investigated the possible 436 effect of hormone levels on the above-mentioned areas of social cognition, in order to assess 437 if any differences could be found between women during follicular vs. luteal phase of their 438 menstrual cycle. Despite previous evidence showing higher accuracy in the follicular group 439 with respect to the luteal one in the recognition of facial expressions of emotions (e.g., Derntl 440 et al., 2008), we found no significant differences between the two groups in the performance 441 on social cognition tasks. These contrasting results may be due to the different methodology 442 employed. For instance, in the study of Derntl et al. (2008) participants were asked to take a 443 blood sample on the day of testing, to obtain the actual levels of ovarian hormones. Another 444 study (Pearson & Lewis, 2005), which adopted the same procedure as our study (i.e., asking 445 female participants to indicate information about their menstrual cycle), found that accuracy 446 was greater during the pre-ovulation stage than the other phases only for the recognition of

447 fear (no significant difference was found for all the other basic emotions). However, the 448 authors recruited a quite small number of participants for each stage of menstrual cycle, so 449 that it is hard to extend these results to the general female population. What it more, a series 450 of meta-analyses (Gangestad et al., 2016; Gildersleeve, Haselton, & Fales, 2014; Wood, Kressel, Joshi, & Louie, 2014) tried to shed light on the validity of the different methods used 451 452 to assess fertile and non-fertile phases of the cycle and on the psychological changes across 453 women's ovulatory cycles. Results of these meta-analyses indicated that there is a 454 considerable variation in the methods studies employed to examine cycle shifts (e.g., the use 455 of between vs. within-subject design or different counting methods, which rely on women's 456 reports of retrospectively recalled or predicted dates of menstrual onset to estimate their position in the ovulatory cycle). As a result, studies are often difficult to be compared and 457 458 especially for counting methods, which are not as accurate as methods testing hormone levels 459 (e.g., luteinizing hormone tests), very large sample sizes are required to achieve acceptable 460 levels of statistical power.

Given the uncertain evidence and the heterogeneity in the assessment of menstrual cycle's phases, future studies are needed to clarify the effect of hormone levels on the different components of social cognition.

464

465 4.1. Limitations

The study has some limitations. First, we used self-reported instruments for the assessment of social cognition. Performance-based instruments or structured interviews, less dependent on the individuals' awareness, should be employed in addition to traditional self-reported measures. Secondly, we examined the presence of sex differences in social cognition abilities only in a sample of young adults. Thirdly, hormone levels were not determined by means of blood samples. Future studies should be carried out assessing more rigorously the effect of 472 hormonal changes across multiple areas of social cognition in different age groups. Finally, a number of authors have emphasised the problem of the equilibrium between experimental 473 474 control and ecological validity in testing social cognition (e.g., Bara et al., 2016; Enrici et al., 475 2019; Henry et al., 2015). To date, literature shows that the studies investigating social cognition with tasks having more ecological validity have mostly replicated the findings 476 obtained with traditional tasks like those we used here, at both neural (e.g., Spunt et al., 2011; 477 478 Yoshida et al., 2010) and behavioural level (e.g., Bazin et al., 2009; Mathersul et al., 2013). 479 That said, future studies should integrate standardised and controlled tasks with more 480 ecological ones for a more thorough investigation of social cognition functioning.

481

482 **5.** Conclusions

The findings reported in the present study highlight the absence of significant sex differences in the different components of social cognition we investigated. The only exception seems to be represented by empathy, with women reporting higher scores than men at least on some empathic dimensions. In spite of the limitations described, the current study represents, to the best of our knowledge, one of the few attempts to analyse, in a single work, the presence of sex differences across multiple areas of social cognition contributing to a wider analysis and comprehension of this important topic.

490 **References**

- 491 Abu-Akel, A., & Bo, S. (2013). Superior mentalizing abilities of female patients with
- 492 schizophrenia. *Psychiatry research*, 210(3), 794–799.
- 493 https://doi.org/10.1016/j.psychres.2013.09.013
- 494 Adenzato, M., Todisco, P., & Ardito, R.B. (2012). Social cognition in anorexia nervosa:
- 495 evidence of preserved theory of mind and impaired emotional functioning. *PloS one*,
- 496 7(8), e44414. https://doi.org/10.1371/journal.pone.0044414
- 497 Albiero, P., Ingoglia, S., & Lo Coco, A. (2006). Contributo all'adattamento italiano
- 498 dell'Interpersonal Reactivity Index. *Testing Psicometria Metodologia*, *13*(2), 107–
 499 125.
- Bara B.G., Enrici I., Adenzato M. (2016). At the core of pragmatics: The neural substrates of
 communicative intentions. In: G.S. Hickok, S.L. Small (Eds.), *Neurobiology of*
- 502 *Language* (pp. 675-685). New York: Elsevier/Academic Press.
- 503 Baron-Cohen, S. (2003). The Essential Difference: Men, Women and the Extreme Male
- 504 Brain. London, UK: Penguin Books Ltd.
- 505 Baron-Cohen, S., Richler, J., Bisarya, D., Gurunathan, N., & Wheelwright, S. (2003). The
- 506 systemizing quotient: An investigation of adults with Asperger syndrome or high-
- 507 functioning autism, and normal sex differences. *Philosophical Transactions of the*
- 508 Royal Society of London, Series B: Biological Sciences, 358(1430), 361–374.
- 509 https://doi.org/10.1098/rstb.2002.1206
- 510 Baron-Cohen, S., Wheelwright, S., Hill, J., Raste, Y., & Plumb, I. (2001). The "Reading the
- 511 Mind in the Eyes" Test revised version: a study with normal adults, and adults with
- 512 Asperger syndrome or high-functioning autism. *The Journal of Child Psychology and*
- 513 *Psychiatry and Allied Disciplines*, 42(2), 241–251. https://doi.org/10.1111/1469-
- 514 7610.00715

Barrett, L.F., Robin, L., Pietromonaco, P.R., & Eyssell, K.M. (1998). Are women the "more
emotional" sex? Evidence from emotional experiences in social context. *Cognition* &

517 *Emotion*, *12*(4), 555–578. https://psycnet.apa.org/doi/10.1080/026999398379565

- 518 Bazin, N., Brunet-Gouet, E., Bourdet, C., Kayser, N., Falissard, B., Hardy-Baylé, M.-C.,
- 519 Passerieux, C. (2009). Quantitative assessment of attribution of intentions to others in
- 520 schizophrenia using an ecological video-based task: A comparison with manic and
- 521 depressed patients. *Psychiatry Research*, *167*, 28-35.
- 522 https://doi.org/10.1016/j.psychres.2007.12.010
- 523 Beck, A.T., Steer, R.A., Ball, R., & Ranieri, W.F. (1996). Comparison of Beck Depression
- 524 Inventories-IA and-II in psychiatric outpatients. *Journal of personality*

525 *assessment*, 67(3), 588–597. https://doi.org/10.1207/s15327752jpa6703_13

- Beck, A.T., Steer, R.A., & Brown, G.K. (1996b). *Manual for the Beck Depression Inventory- II*. San Antonio, TX: Psychological Corporation.
- 528 Bjureberg, J., Ljótsson, B., Tull, M.T., Hedman, E., Sahlin, H., Lundh, L.G., ... & Gratz, K.L.
- 529 (2016). Development and validation of a brief version of the difficulties in emotion
- 530 regulation scale: the DERS-16. *Journal of psychopathology and behavioral*

531 assessment, 38(2), 284–296. https://doi.org/10.1007/s10862-015-9514-x

532 Bradley, M.M., Codispoti, M., Sabatinelli, D., & Lang, P.J. (2001). Emotion and motivation

533 II: sex differences in picture processing. *Emotion*, *1*(3), 300.

- 534 https://doi.org/10.1037%2f1528-3542.1.3.300
- 535 Bressi, C., Taylor, G., Parker, J., Bressi, S., Brambilla, V., Aguglia, E., ... & Todarello, O.
- 536 (1996). Cross validation of the factor structure of the 20-item Toronto Alexithymia
- 537 Scale: an Italian multicenter study. Journal of psychosomatic research, 41(6), 551–
- 538 559. https://doi.org/10.1016/s0022-3999(96)00228-0

| 539 | Campbell, R., Elgar, K., Kuntsi, J., Akers, R., Terstegge, J., Coleman, M., & Skuse, D. | | | | |
|-----|--|--|--|--|--|
| 540 | (2002). The classification of 'fear' from faces is associated with face recognition skill | | | | |
| 541 | in women. Neuropsychologia, 40(6), 575-584. https://doi.org/10.1016/s0028- | | | | |
| 542 | 3932(01)00164-6 | | | | |
| 543 | Carroll, J.M., & Chiew, K.Y. (2006). Sex and discipline differences in empathising, | | | | |
| 544 | systemising and autistic symptomatology: Evidence from a student population. | | | | |
| 545 | Journal of Autism and Developmental Disorders, 36(7), 949–957. | | | | |
| 546 | https://doi.org/10.1007/s10803-006-0127-9 | | | | |
| 547 | Courtain, A., & Glowacz, F. (2019). Youth's conflict resolution strategies in their dating | | | | |
| 548 | relationships. Journal of youth and adolescence, 48(2), 256–268. | | | | |
| 549 | https://doi.org/10.1007/s10964-018-0930-6 | | | | |
| 550 | Damasio, A.R. (1994). Decartes Error: Emotion, Reason, and the Human Brain. New York, | | | | |
| 551 | NY: Harper Collins. | | | | |
| 552 | Darwin, C.R. 1872. The expression of the emotions in man and animals (1st ed.). London, | | | | |
| 553 | UK: John Murray. | | | | |
| 554 | Davis, M.H. (1980). A multidimensional approach to individual differences in empathy. JSAS | | | | |
| 555 | Catalog of Selected Documents in Psychology, 10, 85. | | | | |
| 556 | Davis, M.H. (1983). Measuring individual differences in empathy: evidence for a | | | | |
| 557 | multidimensional approach. Journal of Personality and Social Psychology, 44(1), | | | | |
| 558 | 113-126. https://psycnet.apa.org/doi/10.1037/0022-3514.44.1.113 | | | | |
| 559 | de Barros, A.C.S., Furlan, A.E.R., Marques, L.H.N., & de Araújo Filho, G.M. (2018). Gender | | | | |
| 560 | differences in prevalence of psychiatric disorders, levels of alexithymia, and coping | | | | |
| 561 | strategies in patients with refractory mesial temporal epilepsy and comorbid | | | | |
| 562 | psychogenic nonepileptic seizures. Epilepsy and Behavior, 82, 1-5. | | | | |
| 563 | https://doi.org/10.1016/j.yebeh.2018.02.026 | | | | |
| | | | | | |

| 564 | Derntl, B., Finkelmeyer, A., Eickhoff, S., Kellermann, T., Falkenberg, D.I., Schneider, F., & |
|-----|---|
| 565 | Habel, U. (2010). Multidimensional assessment of empathic abilities: neural |
| 566 | correlates and gender differences. Psychoneuroendocrinology, 35(1), 67-82. |
| 567 | https://doi.org/10.1016/j.psyneuen.2009.10.006 |
| 568 | Derntl, B., Kryspin-Exner, I., Fernbach, E., Moser, E., & Habel, U. (2008). Emotion |
| 569 | recognition accuracy in healthy young females is associated with cycle phase. |
| 570 | Hormones and Behavior, 53(1), 90-95. https://doi.org/10.1016/j.yhbeh.2007.09.006 |
| 571 | Ekman, P., & Friesen, W.V. (1976). Pictures of facial affect. Palo Alto, CA: Consulting |
| 572 | Psychologist Press. |
| 573 | Enrici, I., Adenzato, M., Ardito, R.B., Mitkova, A., Cavallo, M., Zibetti, M., & Castelli, L. |
| 574 | (2015). Emotion processing in Parkinson's disease: a three-level study on recognition, |
| 575 | representation, and regulation. PLoS One, 10(6), e0131470. |
| 576 | https://doi.org/10.1371/journal.pone.0131470 |
| 577 | Enrici I., Bara B.G., Adenzato M. (2019). Theory of Mind, pragmatics, and the brain: |
| 578 | Converging evidence for the role of intention processing as a core feature of human |
| 579 | communication. Pragmatics & Cognition, 26(1), 5-38. |
| 580 | https://doi.org/10.1075/pc.19010.enr |
| 581 | Faul, F., Erdfelder, E., Buchner, A., & Lang, AG. (2009). Statistical power analyses using |
| 582 | G*Power 3.1: Tests for correlation and regression analyses. Behavior Research |
| 583 | Methods, 41, 1149-1160. https://doi.org/10.3758/BRM.41.4.1149 |
| 584 | Gangestad, S.W., Haselton, M.G., Welling, L.L., Gildersleeve, K., Pillsworth, E.G., Burriss, |
| 585 | R.P., & Puts, D.A. (2016). How valid are assessments of conception probability in |
| 586 | ovulatory cycle research? Evaluations, recommendations, and theoretical |
| 587 | implications. Evolution and Human Behavior, 37(2), 85-96. |
| 588 | https://doi.org/10.1016/j.evolhumbehav.2015.09.001 |
| | |

- 589 Geary, D.C. (2002). Sexual selection and sex differences in social cognition. In A.V.
- 590 McGillicuddy-De Lisi & R. De Lisi (Eds.), *Biology, society, and behavior: The*

591 *development of sex differences in cognition* (p. 23–53). Greenwich, CT: Ablex.

- 592 Ghisi, M., Flebus, G.B., Montano, A., Sanavio, E., & Sica, C. (2006). *Beck depression*593 *inventory. Adattamento Italiano: Manuale*. Florence, IT: Giunti Organizzazioni
 594 Speciali.
- Gildersleeve, K., Haselton, M.G., & Fales, M.R. (2014). Do women's mate preferences
 change across the ovulatory cycle? A meta-analytic review. *Psychological Bulletin*,
- 597 *140*(5), 1205. 10.1037/a0035438
- 598 Grimshaw, G.M., Bulman-Fleming, M.B., & Ngo, C. (2004). A signal-detection analysis of
- sex differences in the perception of emotional faces. *Brain and Cognition*, 54(3), 248–
 250. https://doi.org/10.1016/j.bandc.2004.02.029
- Grossman, L.S., Harrow, M., Rosen, C., Faull, R., & Strauss, G.P. (2008). Sex differences in
 schizophrenia and other psychotic disorders: a 20-year longitudinal study of psychosis
- and recovery. *Comprehensive psychiatry*, 49(6), 523–529.
- 604 https://doi.org/10.1016/j.comppsych.2008.03.004
- Hall, G.B.C., Witelson, S.F., Szechtman, H., & Nahmias, C. (2004). Sex differences in
- 606 functional activation patterns revealed by increased emotion processing demands.
- 607 *Neuroreport, 15*(2), 219–223. https://doi.org/10.1097/00001756-200402090-00001
- Hale III, W.W., Jansen, J.H., Bouhuys, A.L., & van den Hoofdakker, R.H. (1998). The
- 509 judgment of facial expressions by depressed patients, their partners and
- 610 controls. *Journal of affective disorders*, 47(1-3), 63–70.
- 611 https://doi.org/10.1016/s0165-0327(97)00112-2

| 612 | Happé, F.G., Brownell, H., & Winner, E. (1999). Acquired "theory of mind" impairments |
|-----|---|
| 613 | following stroke. Cognition, 70(3), 211-240. https://doi.org/10.1016/s0010- |
| 614 | 0277(99)00005-0 |

- 615 Happé, F., Cook, J.L., & Bird, G. (2017). The structure of social cognition: In (ter)
- dependence of sociocognitive processes. *Annual review of psychology*, *68*, 243–267.
 https://doi.org/10.1146/annurev-psych-010416-044046
- 618 Heesacker, M., Wester, S.R., Vogel, D.L., Wentzel, J.T., Mejia-Millan, C.M., & Goodholm,
- 619 C.R. (1999). Gender-based emotional stereotyping. *Journal of Counseling*
- 620 *Psychology*, *46*(4), 483–495. https://psycnet.apa.org/doi/10.1037/0022-0167.46.4.483
- Henry, J.D., Cowan, D.G., Lee, T., Sachdev, P.S. (2015). Recent trends in testing social
- 622 cognition. *Current Opinion in Psychiatry*, 28, 133-140.
- 623 10.1097/YCO.00000000000139
- Hines, M. (2000). Gonadal hormones and sexual differentiation of human behaviour: Effects
- on psychosexual and cognitive development. In A. Matsumoto (Ed.), Sexual
- 626 *differentiation of the brain* (pp. 257–278). Boca Raton, FL: CRC Press.
- 627 Imperatori C., Farina B., Adenzato M., Valenti E.M., Murgia C., Della Marca G., ... &
- 628 Ardito R.B. (2019). Default Mode Network alterations in individuals with high-trait-
- 629 anxiety: An EEG functional connectivity study. *Journal of Affective Disorders*, 246,
- 630 611-618. https://doi.org/10.1016/j.jad.2018.12.071.
- 631 Ingoglia, S., Lo Coco, A., & Albiero, P. (2016). Development of a brief form of the
- 632 Interpersonal Reactivity Index (B–IRI). Journal of personality assessment, 98(5),
- 633 461–471. https://doi.org/10.1080/00223891.2016.1149858
- Julian, L.J. (2011). Measures of anxiety: state-trait anxiety inventory (STAI), Beck anxiety
- 635 inventory (BAI), and Hospital anxiety and Depression scale-anxiety (HADS-
- 636 A). Arthritis care & research, 63(S11), S467–S472. https://doi.org/10.1002/acr.20561

- 637 Kempton, M.J., Haldane, M., Jogia, J., Christodoulou, T., Powell, J., Collier, D., ... &
- 638 Frangou, S. (2009). The effects of gender and COMT Val158Met polymorphism on
- 639 fearful facial affect recognition: a fMRI study. *International Journal of*
- 640 *Neuropsychopharmacology*, *12*(3), 371–381.
- 641 https://doi.org/10.1017/S1461145708009395
- 642 Kenrick, D.T. (1994). Evolutionary social psychology: From sexual selection to social
- 643 cognition. Advances in Experimental Social Psychology, 26, 75-121.
- 644 https://doi.org/10.1016/S0065-2601(08)60152-5
- 645 Kimura, D. (1999). Sex and cognition. Cambridge, MA: The MIT Press.
- 646 Kirouac, G., & Dore, F.Y. (1984). Judgment of facial expressions of emotion as a function of
- 647 exposure time. *Perceptual and Motor Skills*, 59(1), 147–150.
- 648 https://doi.org/10.2466/pms.1984.59.1.147
- 649 Kohler, C.G., Turner, T.H., Bilker, W.B., Brensinger, C.M., Siegel, S.J., Kanes, S.J., ... &
- 650 Gur, R.C. (2003). Facial emotion recognition in schizophrenia: intensity effects and
- 651 error pattern. American Journal of Psychiatry, 160(10), 1768–1774.
- 652 https://doi.org/10.1176/appi.ajp.160.10.1768
- Krach, S., Blümel, I., Marjoram, D., Lataster, T., Krabbendam, L., Weber, J., ... & Kircher, T.
- 654 (2009). Are women better mindreaders? Sex differences in neural correlates of
- 655 mentalizing detected with functional MRI. *BMC neuroscience*, *10*(1), 9.
- 656 https://doi.org/10.1186/1471-2202-10-9
- Larsen, J.K., van Strien, T., Eisinga, R., & Engels, R.C. (2006). Gender differences in the
- association between alexithymia and emotional eating in obese individuals. *Journal of*
- 659 *psychosomatic research, 60*(3), 237-243.
- 660 https://doi.org/10.1016/j.jpsychores.2005.07.006

- 661 Leslie, A.M. (1987). Pretense and representation: The origins of "theory of mind".
- 662 *Psychological review*, *94*(4), 412. https://psycnet.apa.org/doi/10.1037/0033663 295X.94.4.412
- Levant, R. (1992). Toward the reconstruction of masculinity. *Journal of Family Psychology*,
 5(3-4), 379–402. https://psycnet.apa.org/doi/10.1037/0893-3200.5.3-4.379
- Levant, R.F., Hall, R.J., Williams, C.M., & Hasan, N.T. (2009). Gender differences in

alexithymia. *Psychology of men & masculinity*, 10(3), 190.

- 668 https://psycnet.apa.org/doi/10.1037/a0015652
- Lieberman, M.D. (2007). Social cognitive neuroscience: a review of core processes. *Annual Review of Psychology*, *58*, 259-289.
- 671 https://doi.org/10.1146/annurev.psych.58.110405.085654
- 672 Liverta Sempio, O., Marchetti, A., & Castelli, I. (2004). Traduzione italiana delle storie
- 673 fisiche. Unità di Ricerca sulla Teoria della Mente, Dipartimento di Psicologia,
- 674 Università Cattolica del Sacro Cuore, Milano.
- 675 Mallinckrodt, B., King, J. L., & Coble, H.M. (1998). Family dysfunction, alexithymia, and
- 676 client attachment to therapist. *Journal of Counseling Psychology*, 45(4), 497–504.
- 677 https://psycnet.apa.org/doi/10.1037/0022-0167.45.4.497
- 678 Mandal, M.K., & Palchoudhury, S. (1985). Perceptual skill in decoding facial affect.
- 679 *Perceptual and Motor Skills*, 60(1), 96–98. https://doi.org/10.2466/pms.1985.60.1.96
- 680 Mathersul, D., McDonald, S., Rushby, J.A. (2013). Understanding advanced theory of mind
- and empathy in high-functioning adults with autism spectrum disorder. *Journal of*
- 682 *Clinical and Experimental Neuropsychology*, *35*, 655-668.
- 683 https://doi.org/10.1080/13803395.2013.809700

| 684 | Mazzola, V., & Camaioni, L. (2002). Strane Storie: versione italiana a cura di Mazzola e |
|-----|--|
| 685 | Camaioni. Dipartimento di Psicologia dinamica e clinica, Università "La Sapienza", |
| 686 | Roma. |
| 687 | McClure, E.B. (2000). A meta-analytic review of sex differences in facial expression |
| 688 | processing and their development in infants, children and adolescents. Psychological |
| 689 | Bulletin, 126(3), 424-453. https://doi.org/10.1037/0033-2909.126.3.424 |
| 690 | Mestre, M.V., Samper, P., Frías, M.D., & Tur, A.M. (2009). Are women more empathetic |
| 691 | than men? A longitudinal study in adolescence. The Spanish journal of psychology, |
| 692 | 12(1), 76-83. https://doi.org/10.1017/s1138741600001499 |
| 693 | Montagne, B., Kessels, R.P., Frigerio, E., de Haan, E.H., & Perrett, D.I. (2005). Sex |
| 694 | differences in the perception of affective facial expressions: Do men really lack |
| 695 | emotional sensitivity? Cognitive processing, 6(2), 136-141. |
| 696 | https://doi.org/10.1007/s10339-005-0050-6 |
| 697 | Navarra-Ventura, G., Fernandez-Gonzalo, S., Turon, M., Pousa, E., Palao, D., Cardoner, N., |
| 698 | & Jodar, M. (2018). Gender differences in social cognition: A cross-sectional pilot |
| 699 | study of recently diagnosed patients with schizophrenia and healthy subjects. The |
| 700 | Canadian Journal of Psychiatry, 63(8), 538-546. |
| 701 | https://doi.org/10.1177/0706743717746661 |
| 702 | Pearson, R., & Lewis, M.B. (2005). Fear recognition across the menstrual cycle. Hormones |
| 703 | and Behavior, 47(3), 267-271. https://doi.org/10.1016/j.yhbeh.2004.11.003 |
| 704 | Pedrabissi, L., & Santinello, M. (1989). Inventario per l'ansia di «Stato» e di «Tratto»: |
| 705 | nuova versione italiana dello STAI Forma Y: Manuale. Florence, IT: Giunti |
| 706 | Organizzazioni Speciali. |
| 707 | Peng, W., Yang, H., Liu, Q., Liu, Z., Ling, Y., Zhong, M., & Yi, J. (2019). Measurement |

708 invariance and latent mean differences of the 20-item toronto alexithymia scale across

- 709 genders and across clinical and non-clinical samples. *Personality and Individual*
- 710 *Differences*, *151*, 109466. https://doi.org/10.1016/j.paid.2019.06.009
- 711 Preston, S.D., & De Waal, F.B. (2002). Empathy: Its ultimate and proximate
- 712 bases. *Behavioral and brain sciences*, 25(1), 1–20.
- 713 https://doi.org/10.1017/s0140525x02000018
- 714 Rahman, Q., Wilson, G.D., & Abrahams, S. (2004). Sex, sexual orientation, and
- 715 identification of positive and negative facial affect. *Brain and cognition*, 54(3), 179–
- 716 185. https://doi.org/10.1016/j.bandc.2004.01.002
- 717 Richards, A., French, C.C., Calder, A.J., Webb, B., Fox, R., & Young, A.W. (2002). Anxiety-

related bias in the classification of emotionally ambiguous facial

- 719 expressions. *Emotion*, 2(3), 273. https://doi.org/10.1037/1528-3542.2.3.273
- Ritsner, M.S., Arbitman, M., Lisker, A., & Ponizovsky, A.M. (2012). Ten-year quality of life
 outcomes among patients with schizophrenia and schizoaffective disorder II.
- Predictive value of psychosocial factors. *Quality of Life Research*, *21*(6), 1075–1084.
- 723 https://doi.org/10.1007/s11136-011-0015-4
- Russell, T.A., Tchanturia, K., Rahman, Q., & Schmidt, U. (2007). Sex differences in theory
- of mind: A male advantage on Happé's "cartoon" task. *Cognition and Emotion*, 21(7),
- 726 1554–1564. https://doi.org/10.1080/02699930601117096
- 727 Scimeca, G., Bruno, A., Cava, L., Pandolfo, G., Muscatello, M.R.A., & Zoccali, R. (2014).
- The relationship between alexithymia, anxiety, depression, and internet addiction
- severity in a sample of Italian high school students. *The Scientific World Journal*,
- 730 2014. http://dx.doi.org/10.1155/2014/504376
- Serafin, M., & Surian, L. (2004). Il Test degli Occhi: uno strumento per valutare la "teoria
 della mente". *Giornale italiano di psicologia*, *31*(4), 839–862. 10.1421/18849

- 733 Simon, D., Craig, K.D., Gosselin, F., Belin, P., & Rainville, P. (2008). Recognition and
- discrimination of prototypical dynamic expressions of pain and emotions. *PAIN*®,

735 *135*(1-2), 55–64. https://doi.org/10.1016/j.pain.2007.05.008

- Spielberger, C. D., Gorsuch, R.L., Lushene, R., Vagg, P.R., & Jacobs, G.A. (1983). *State- trait anxiety inventory (form Y)*. Palo Alto, CA: Mind Garden.
- 738 Spunt, R.P., Satpute, A.B., Lieberman, M.D. (2011). Identifying the what, why, and how of
- an observed action: An fMRI study of mentalizing and mechanizing during action
 observation. *Journal of Cognitive Neuroscience*, *23*, 63-74.
- 741 https://doi.org/10.1162/jocn.2010.21446
- 742 Taylor, G.J., Bagby, R.M. & Parker, J.D. (2003). The 20-Item Toronto Alexithymia Scale:
- 743 IV. Reliability and factorial validity in different languages and cultures. *Journal of*
- 744 Psychosomatic Research, 55(3), 277–283. https://doi.org/10.1016/s0022-
- 745 3999(02)00601-3
- Tettamanti, M., Vaghi, M., Bara, B.G., Cappa, S., Enrici, I., Adenzato, M. (2017). Effective
 connectivity gateways to the Theory of Mind network in processing communicative
- 748 intention. NeuroImage, 155, 169-176. 10.1016/j.neuroimage.2017.04.050.
- 749 Thayer, J., & Johnsen, B.H. (2000). Sex differences in judgement of facial affect: A
- 750 multivariate analysis of recognition errors. *Scandinavian journal of psychology*, *41*(3),
- 751 243–246. https://doi.org/10.1111/1467-9450.00193
- Thompson, A.E., & Voyer, D. (2014). Sex differences in the ability to recognise non-verbal
- displays of emotion: A meta-analysis. *Cognition and Emotion*, 28(7), 1164–1195.
- 754 https://doi.org/10.1080/02699931.2013.875889
- Washburn, D., Wilson, G., Roes, M., Rnic, K., & Harkness, K.L. (2016). Theory of mind in
 social anxiety disorder, depression, and comorbid conditions. *Journal of anxiety*
- 757 *disorders*, 37, 71–77. https://doi.org/10.1016/j.janxdis.2015.11.004

| 759 | emotion: A critical review of the literature and implications for counseling |
|-----|---|
| 760 | psychology. The Counseling Psychologist, 30(4), 630-652. |
| 761 | https://doi.org/10.1177%2F00100002030004008 |
| 762 | Whittle, S., Yücel, M., Yap, M.B., & Allen, N.B. (2011). Sex differences in the neural |
| 763 | correlates of emotion: evidence from neuroimaging. Biological psychology, 87(3), |
| 764 | 319-333. https://doi.org/10.1016/j.biopsycho.2011.05.003 |
| 765 | Wildgruber, D., Pihan, H., Ackermann, H., Erb, M., Grodd, W. (2002). Dynamic brain |
| 766 | activation during processing of emotional intonation: influence of acoustic |
| 767 | parameters, emotional valence, and sex. Neuroimage, 15(4), 856-869. |
| 768 | https://doi.org/10.1006/nimg.2001.0998 |
| 769 | Wood, W., Kressel, L., Joshi, P.D., & Louie, B. (2014). Meta-analysis of menstrual cycle |
| 770 | effects on women's mate preferences. Emotion Review, 6, 229-249. |
| 771 | https://doi.org/10.1177/1754073914523073 |
| 772 | Worly, B., Verbeck, N., Walker, C., & Clinchot, D.M. (2019). Burnout, perceived stress, and |
| 773 | empathic concern: differences in female and male Millennial medical students. |
| 774 | Psychology, health & medicine, 24(4), 429–438. |
| 775 | https://doi.org/10.1080/13548506.2018.1529329 |
| 776 | Xia, H., Wu, N., & Su, Y. (2012). Investigating the genetic basis of theory of mind (ToM): |
| 777 | the role of catechol-O-methyltransferase (COMT) gene polymorphisms. PLoS One, |
| 778 | 7(11), e49768. 10.1371/journal.pone.0049768 |
| 779 | Yoshida, W., Seymour, B., Friston, K.J., Dolan, R.J. (2010). Neural mechanisms of belief |
| 780 | inference during cooperative games. Journal of Neuroscience, 30, 10744-10751. |
| 781 | 10.1523/JNEUROSCI.5895-09.2010 |
| 782 | |
| | |

Wester, S.R., Vogel, D.L., Pressly, P.K., & Heesacker, M. (2002). Sex differences in

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Table 1. Socio-demographic characteristics of the female and male groups. Mean (SD), mean
rank [mean (SD)] or percentage, *t*-test or Mann–Whitney *U* test are listed.

| | Women | Men | | |
|---------------------------|----------------|----------------|-----------------|------|
| | (N = 105) | (N = 105) | Test (df) | р |
| Age (years) | 21.32 (2.09) | 21.46 (2.22) | t(208) = -0.449 | .654 |
| Educational level (vears) | 101.57 | 109.43 | U = 5099 500 | 077 |
| Educational level (years) | [13.26 (1.00)] | [13.53 (1.42)] | 0 0000.000 | .077 |
| STAI Y2 | 46.50 (10.99) | 43.17 (9.25) | t(208) = 2.372 | .019 |
| | 113.17 | 97.83 | | 0.67 |
| BDI-II | [12.95 (9.26)] | [10.02 (6.18)] | U = 4707.000 | .067 |
| Marital status | | | | |
| Never-married | 98 (93.3%) | 102 (97.1%) | | |
| Cohabitant | 6 (5.7%) | 3 (2.9%) | | |
| Married | 1 (1.0%) | _ | | |
| Occupation | | | | |
| Student | 99 (94.3%) | 95 (90.5%) | | |
| Employed | 5 (4.8%) | 8 (7.6%) | | |
| Unemployed | 1 (1.0%) | 2 (1.9%) | | |

785

786 df = Degrees of freedom; STAI Y2 = State-Trait Anxiety Inventory Form Y2; BDI-II = Beck

787 Depression Inventory.

| 789 | Table 2. Emotion recognition and Theory of Mind measures scores. Mean (SD) or mean rank |
|-----|--|
| 790 | [mean (SD)], <i>t</i> -test or Mann–Whitney U test are listed. |

| | Women | Men | | | D.C. | | |
|--|---------------|---------------|-----------------|------|-----------------|--|--|
| | (N = 105) | (N = 105) | l est (df) | р | Effect size | | |
| Recognition of other's emotions | | | | | | | |
| | 115.27 | 95.73 | | | | | |
| Anger | [7.40 (0.99)] | [7.15 (0.95)] | U = 4487.000 | .010 | r = 0.18 | | |
| | 107.04 | 103.96 | U = 5350.500 | | r = 0.02 | | |
| Disgust | [7.25 (0.92)] | [7.21 (0.91)] | | .690 | | | |
| Fear | 5.08 (1.73) | 5.29 (1.86) | t(208) = -0.845 | .399 | <i>d</i> = 0.17 | | |
| | 101.75 | 109.25 | U = 5118.500 | .239 | r = 0.05 | | |
| Happiness | [7.59 (0.78)] | [7.67 (0.72)] | | | | | |
| | 107.43 | 108.18 | U = 5345.500 | | | | |
| Neutral | [7.16 (1.15)] | [7.10 (1.28)] | | .678 | r = 0.03 | | |
| Pain | 6.10 (1.66) | 5.77 (1.96) | t(208) = 1.330 | .185 | <i>d</i> = 0.18 | | |
| | 105.34 | 105.66 | | | | | |
| Surprise | [7.54 (0.77)] | [7.56 (0.72)] | U = 5495.500 | .963 | r = 0.01 | | |
| Sadness | 6.27 (1.50) | 5.87 (1.62) | t(208) = 1.875 | .065 | <i>d</i> = 0.23 | | |
| Total score (0-64) | 54.39 (4.04) | 53.61 (5.05) | t(208) = 1.238 | .217 | <i>d</i> = 0.17 | | |
| Representation of other people's affective mental states (affective ToM) | | | | | | | |
| RMET (0-36) | 26.94 (2.84) | 26.21 (3.35) | t(208) = 1.711 | .089 | <i>d</i> = 0.24 | | |

| Representation | ofot | ther people | 's cognitive | mental states | (cognitive T | ГоМ) |
|----------------|------|-------------|--------------|---------------|--------------|------|
|----------------|------|-------------|--------------|---------------|--------------|------|

| ToM Strange Stories | 10.60 (2.56) | 12.12 (2.51) | t(208) = -1.498 | .136 | <i>d</i> = 0.21 |
|------------------------|--------------|--------------|-----------------|------|------------------|
| Physical Strange | 10.40 (2.76) | 10.53 (2.76) | t(208) = -0.350 | .727 | <i>d</i> = 0. 05 |

Stories 791 792 df = Degrees of freedom; ToM = Theory of Mind; RMET = Reading the Mind in the Eyes. 793

Table 3. Emotional functioning measures scores. Mean (SD) or mean rank [mean (SD)], *t*795 test or Mann–Whitney *U* test are listed.

| | Women | Men | | | Effect | | |
|----------------------------------|------------------|----------------------|-----------------|-------|-----------------|--|--|
| | (N = 105) | | Test (df) | р | size | | |
| Empathic capacitie | S | | | | | | |
| IRI Perspective | 25.12 (4.57) | 24.04 (4.25) | t(208) = 0.200 | 757 | 1-0.04 | | |
| Taking | 25.13 (4.57) | 24.94 (4.33) | l(208) = 0.309 | ./3/ | <i>a</i> – 0.04 | | |
| IRI Fantasy | 26.70 (3.84) | 25.01 (4.27) | t(208) = 3.008 | .003 | <i>d</i> = 0.42 | | |
| IRI Empathic | 22 41 (2 57) | 11 01 (1 07) | t(209) = 1.572 | 117 | 1-0.22 | | |
| Concern | 23.41 (2.37) | 22.82 (2.87) | l(208) = 1.372 | .11/ | a = 0.22 | | |
| IRI Personal | | 15.25 (4.20) | | | 1 0 55 | | |
| Distress | 19.87 (4.84) | 17.35 (4.30) | t(208) = 3.967 | <.001 | d = 0.55 | | |
| Identification of on | e's own emotions | (Alexithymia) | | | | | |
| TAS-20 DIF | 18.68 (5.96) | 17.29 (5.41) | t(207) = 1.761 | .080 | <i>d</i> = 0.24 | | |
| TAS-20 DDF | 14.47 (4.80) | 14.64 (4.39) | t(207) = -0.279 | .781 | <i>d</i> = 0.04 | | |
| TAS-20 EOT | 15.22 (3.95) | 15.95 (4.23) | t(207) = -1.248 | .214 | <i>d</i> = 0.17 | | |
| TAS-20 Total | 48.36 (10.84) | 47.88 (10.37) | t(207) = 0.325 | .745 | <i>d</i> = 0.05 | | |
| Regulation of one's own emotions | | | | | | | |
| DERS | 7 29 (2 89) | 6 49 (2 67) | t(207) = 2.087 | 038 | d = 0.29 | | |
| Nonacceptance | (2.0) | 0.19 (2.07) | (207) 2.007 | .050 | u ().2) | | |
| DERS Goals | 9.13 (3.22) | 8.78 (3.07) | t(207) = 0.812 | .418 | <i>d</i> = 0.11 | | |
| DERS Impulse | 7.32 (2.65) | 6.88 (2.43) | t(207) = 1.253 | .212 | <i>d</i> = 0.17 | | |
| DERS Strategies | 12.13 (5.04) | 11.11 (4.63) | t(207) = 1.510 | .133 | <i>d</i> = 0.21 | | |
| DERS Clarity | 109.06 | 100.98 | U = 5038.000 | .312 | <i>r</i> = 0.07 | | |

| | | [4.36 (1.57)] | [4.13 (1.55)] | | | |
|-----|--|--------------------|------------------|-----------------------|-----------------|--|
| | DERS Total | 40.22 (12.40) | 37.39 (10.18) | t(196.686) = 1.803 | .073 $d = 0.25$ | |
| 796 | | | | | | |
| 797 | df = Degrees of fre | eedom; IRI = Inter | personal Reactiv | ity Index; TAS-20 = T | wenty-item | |
| 798 | Toronto Alexithymia Scale; TAS-20 DIF = Difficult identifying feelings factor of Toronto | | | | | |
| 799 | Alexithymia Scale; TAS-20 DDF = difficulty describing feelings factor of Toronto | | | | | |
| 800 | Alexithymia Scale; TAS-20 EOT = externally-oriented thinking factor of Toronto | | | | | |
| 801 | Alexithymia Scale; DERS = Difficulties in Emotion Regulation Scale. | | | | | |
| 802 | | | | | | |
| 803 | | | | | | |