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

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Declarations of interest: none

Funding

This study was supported by Ministero dell'Istruzione, dell'Università e della Ricerca – MIUR project "Dipartimenti di Eccellenza 2018 – 2022" to Department of Neuroscience "Rita Levi Montalcini". MA and RBA were supported by University of Turin grants ("Ricerca scientifica finanziata dall'Università").

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Abstract

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

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

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).

From an evolutionary point of view the evolution of sex differences in social cognition have been linked to differential natural selection and sexual selection pressures 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 female advantage in the recognition of other people's emotions and mental states, and in the ability to understand and share others' feelings (Campbell et al., 2002; Courtain & Glowacz, 2019; McClure, 2000; Mestre, Samper, Frías, & Tur, 2009; Thayer & Johnsen, 2000). Indeed, previous studies have highlighted that women are more accurate than men in recognising facial expressions, particularly negative emotions, such as fear and sadness (Campbell et al., 2002; Mandal & Palchoudhury, 1985; Montagne, Kessels, Frigerio, de Haan, & Perrett, 2015; Whittle, Yücel, Yap, & Allen, 2011). Similarly, women compared to men seem to be more accurate in the representation of others' mental states, with better performance especially on ToM tasks involving an affective component (Baron-Cohen, 2003; Carroll & Chiew, 2006; Krach et al., 2009; Xia Wu, & Su, 2012), and appear to show a higher tendency to empathy (Courtain & Glowacz, 2019; Mestre et al. 2009).

These results may depend on several factors. Biological determinants, such as hormonal production, can influence emotional responses and consequently performance on social cognition tasks (Derntl et al., 2008; Hines, 2000; Pearson & Lewis, 2005). Particularly, 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 group with respect to the luteal one.

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

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 clinical conditions. For instance, differences in the symptoms between men and women have been well-documented in schizophrenia. Social withdrawal, difficulties in recognising negative facial expressions, and social maladjustment are more common among male patients with schizophrenia, while social adaptation and superior mentalising abilities have been more frequently observed in female patients (Abu-Akel & Bo, 2013; Grossman, Harrow, Rosen, Faull, & Strauss, 2008; Kohler et al., 2003; Ritsner, Arbitman, Lisker, & Ponizovsky, 2012).

Based on this uncertain evidence, the main aim of the present study was to throw light 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) representation of other people's mental states (both affective and cognitive ToM); (3) empathy; (4) identification and regulation of one's own emotions. The possible effect of hormone levels on those components of social cognition was also investigated by comparing women during follicular vs. luteal phase of their menstrual cycle. Finally, since several studies showed significant associations between anxiety/depressive symptoms and social cognition, particularly in its affective dimensions (e.g., Adenzato, Todisco, & Ardito, 2012; Hale, Jansen, Bouhuys, & van den Hoofdakker, 1998; Imperatori et al., 2019; Richards et al., 2002; Washburn, Wilson, Roes, Rnic, & Harkness, 2016), the levels of anxiety/depressive symptoms in female and male participants were also evaluated.

2. Material and methods

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).

All the measures were administered to the participants through an online survey software. An anonymised, individual, and unique code to complete the survey was provided 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.

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

2.2. Materials and Methods

2.2.1. Sociodemographic and clinical information

All participants were asked to provide sociodemographic (i.e., age, educational level, marital status, and occupation) and clinical information (i.e., history or presence of psychiatric or neurological disorders). Female participants were also asked to provide information about 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 menstruation and if they had a regular menstrual cycle (they were explicitly asked to report if they had a 28-days cycle). Otherwise, they were asked to specify the duration of their 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
186 'prototypical' and 'natural' insofar as they possess the key features identified by Ekman and
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

person depicted in the photograph. Participants have to put themselves into the mind of another person to recognise his or her complex mental state. The maximum score is 36.

2.2.2.3. Representation of other people's cognitive mental states

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

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, for example, 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.

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).

2.2.2.5. Alexithymia

Alexithymia was assessed using the Italian version of the Toronto Alexithymia Scale (TAS-20) (Bressi et al., 1996; Taylor, Bagby, & Parker, 2003). It comprises 20 items, each scored on a 5-point Likert-type scale. The results provide a TAS-20 total score and three subscale scores assessing different aspects of alexithymia: difficulty identifying feelings (DIF), which measures the inability to distinguish specific emotions or between emotions and the bodily sensations of emotional arousal; difficulty describing feelings (DDF), which assesses the inability to verbalize one's emotions to other people; and externally-oriented thinking (EOT), 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 alexithymia, 52–60 borderline alexithymia, ≥61 alexithymia.

The scale has shown good internal consistency (Cronbach's alpha coefficient: ≥ .70) and test-retest reliability (Taylor et al., 2003). In line with these results, in our sample the Cronbach's alpha was good for the TAS-20 (α score = .79).

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).

2.2.3. Psychological assessment

2.2.3.1. Anxiety symptoms

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

2.2.3.2. Depressive symptoms

The presence of depressive symptoms was assessed using the Beck Depression Inventory-II (BDI-II) (Beck, Steer, Ball, & Ranieri, 1996a; Ghisi, Flebus, Montano, Sanavio, 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 results, in our sample the Cronbach's alpha was good for the BDI-II ($\alpha = .87$).

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*.

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

3. Results

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.

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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 ± SD: 111.89, 3.78 ± 0.52 vs. 99.11, 3.66 ± 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 t-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.

Table 3

Further analyses (i.e., *t*-tests or *Mann-Whitney* U tests, as appropriate) were performed in order to assess the possible role of hormone levels during menstrual cycle in female participants. The sample consisted of 33 women during the follicular phase of their menstrual cycle and 33 women during the luteal phase. Thirty-nine women were excluded from the analyses due to hormone treatments or missing/inaccurate information.

Of the 66 women included in the analyses, 50% reported to have a 28-days cycle, 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 based on the duration in days of their cycle.

Results showed the presence of non-significant differences between women during follicular vs. luteal phase for all the social cognition measures we employed (all $p > .01$).

Considering the high number of women who reported not to have a 28-days cycle, factorial Analyses of Variance were also performed, in order to ascertain the possible and additional role of 'regular cycle' variable in the relationship between hormone levels and social cognition skills. Results showed the presence of no significant results for either the 'regular cycle' variable or the interaction term (regular cycle x cycle phase) in all social cognition measures (all $p > .01$).

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.

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

Another possible explanation is that women might recruit different neural regions with respect to men, particularly during the processing of emotional information, which may lead to differences in performance in some, but not all, cases, depending on the specific experimental conditions (Grimshaw et al., 2004; Whittle et al., 2011). For instance, it is plausible that sex differences in emotion recognition are revealed under conditions of rapid visual presentation, when participants have high levels of uncertainty (Grimshaw et al., 2004; Kirouac & Dore, 1984), and this may be due to the different ways in which females and males typically process emotional stimuli (Hall, Witelson, Szechtman, & Nahmias, 2004). Indeed, women often show greater limbic (i.e., amygdala, anterior cingulate, thalamus) activation than men, which suggests that emotional information may be elaborated most likely at a primary level (i.e., emotions arisen from processing innately significant environmental stimuli – basic responses like 'flight-or-fight' behaviours). On the contrary, men frequently report greater activation in prefrontal and parietal cortical regions compared to women, relying more on second level emotional processing (i.e., emotions evoked by stimuli that have acquired significance through learning processes in the social context) (Damasio, 1994; Whittle et al., 2011). As a result, women may show quicker and more accurate emotional perception, while in men emotion processing style may be more analytical and potentially slower, leading to the sex differences found in some, but not all, previous studies (Kempton et al., 2009; Wildgruber, Pihan, Ackermann, Erb, Grodd, 2002).

Similarly, women and men might employ different routes for processing social cognitive information. Indeed, men have been found to use more 'systemising' strategies (i.e., the analysis of rule-driven behaviour in systems), while women usually report to use more 'empathising' routes (i.e., identifying another's thoughts and emotions and responding appropriately) (Baron-Cohen, Richler, Bisarya, Gurunathan, & Wheelwright, 2003). The majority of cognitive ToM measures require the understanding and prediction of law-

397 governed behaviour and this might explain why some previous evidence, in line with our
398 results, found that men performed as well as women on cognitive ToM tasks (e.g., Navarra-
399 Ventura et al., 2018), while in other studies males were found to be even more accurate than
400 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

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

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

fear (no significant difference was found for all the other basic emotions). However, the authors recruited a quite small number of participants for each stage of menstrual cycle, so that it is hard to extend these results to the general female population. What it more, a series 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 to assess fertile and non-fertile phases of the cycle and on the psychological changes across women's ovulatory cycles. Results of these meta-analyses indicated that there is a considerable variation in the methods studies employed to examine cycle shifts (e.g., the use of between vs. within-subject design or different counting methods, which rely on women's 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 especially for counting methods, which are not as accurate as methods testing hormone levels (e.g., luteinizing hormone tests), very large sample sizes are required to achieve acceptable 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.

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

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 control and ecological validity in testing social cognition (e.g., Bara et al., 2016; Enrici et al., 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 obtained with traditional tasks like those we used here, at both neural (e.g., Spunt et al., 2011; Yoshida et al., 2010) and behavioural level (e.g., Bazin et al., 2009; Mathersul et al., 2013). That said, future studies should integrate standardised and controlled tasks with more ecological ones for a more thorough investigation of social cognition functioning.

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.

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

	Women (N = 105)	**Men (N = 105)**	**Test (df)**	***p***
Age (years)	21.32 (2.09)	21.46 (2.22)	t(208) = -0.449	.654
Educational level (years)	101.57 [13.26 (1.00)]	109.43 [13.53 (1.42)]	U = 5099.500	.077
STAI Y2	46.50 (10.99)	43.17 (9.25)	t(208) = 2.372	.019
BDI-II	113.17 [12.95 (9.26)]	97.83 [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%)		

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

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Table 2. Emotion recognition and Theory of Mind measures scores. Mean (SD) or mean rank [mean (SD)], *t*-test or Mann–Whitney *U* test are listed.

	Women (N = 105)	**Men (N = 105)**	**Test (df)**	***p***	**Effect size**
Recognition of other's emotions					
Anger	115.27 [7.40 (0.99)]	95.73 [7.15 (0.95)]	U = 4487.000	**.010**	$r = 0.18$
Disgust	107.04 [7.25 (0.92)]	103.96 [7.21 (0.91)]	U = 5350.500	.690	$r = 0.02$
Fear	5.08 (1.73)	5.29 (1.86)	t(208) = -0.845	.399	$d = 0.17$
Happiness	101.75 [7.59 (0.78)]	109.25 [7.67 (0.72)]	U = 5118.500	.239	$r = 0.05$
Neutral	107.43 [7.16 (1.15)]	108.18 [7.10 (1.28)]	U = 5345.500	.678	$r = 0.03$
Pain	6.10 (1.66)	5.77 (1.96)	t(208) = 1.330	.185	$d = 0.18$
Surprise	105.34 [7.54 (0.77)]	105.66 [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	$d = 0.23$
Total score (0-64)	54.39 (4.04)	53.61 (5.05)	t(208) = 1.238	.217	$d = 0.17$
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	$d = 0.24$
Representation of other people's cognitive mental states (cognitive ToM)					
ToM Strange Stories	10.60 (2.56)	12.12 (2.51)	t(208) = -1.498	.136	$d = 0.21$
Physical Strange	10.40 (2.76)	10.53 (2.76)	t(208) = -0.350	.727	$d = 0.05$

	Stories

df = Degrees of freedom; ToM = Theory of Mind; RMET = Reading the Mind in the Eyes.

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

	Women (N = 105)	**Men (N = 105)**	**Test (df)**	***p***	**Effect size**
Empathic capacities					
IRI Perspective Taking	25.13 (4.57)	24.94 (4.35)	t(208) = 0.309	.757	*d* = 0.04
IRI Fantasy	26.70 (3.84)	25.01 (4.27)	t(208) = 3.008	**.003**	*d* = 0.42
IRI Empathic Concern	23.41 (2.57)	22.82 (2.87)	t(208) = 1.572	.117	*d* = 0.22
IRI Personal Distress	19.87 (4.84)	17.35 (4.30)	t(208) = 3.967	**<.001**	*d* = 0.55
Identification of one's own emotions (Alexithymia)					
TAS-20 DIF	18.68 (5.96)	17.29 (5.41)	t(207) = 1.761	.080	*d* = 0.24
TAS-20 DDF	14.47 (4.80)	14.64 (4.39)	t(207) = -0.279	.781	*d* = 0.04
TAS-20 EOT	15.22 (3.95)	15.95 (4.23)	t(207) = -1.248	.214	*d* = 0.17
TAS-20 Total	48.36 (10.84)	47.88 (10.37)	t(207) = 0.325	.745	*d* = 0.05
Regulation of one's own emotions					
DERS Nonacceptance	7.29 (2.89)	6.49 (2.67)	t(207) = 2.087	.038	*d* = 0.29
DERS Goals	9.13 (3.22)	8.78 (3.07)	t(207) = 0.812	.418	*d* = 0.11
DERS Impulse	7.32 (2.65)	6.88 (2.43)	t(207) = 1.253	.212	*d* = 0.17
DERS Strategies	12.13 (5.04)	11.11 (4.63)	t(207) = 1.510	.133	*d* = 0.21
DERS Clarity	109.06	100.98	U = 5038.000	.312	*r* = 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

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797 df = Degrees of freedom; IRI = Interpersonal Reactivity Index; TAS-20 = Twenty-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.

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