Research in Autism Spectrum Disorders 7 (2013) 1221–1227

Contents lists available at ScienceDirect

Research in Autism Spectrum Disorders

Journal homepage: http://ees.elsevier.com/RASD/default.asp

Emotion differentiation in autism spectrum disorder

Yasemin Erbas [a,*], Eva Ceulemans [a], Johanna Boonen [a], Ilse Noens [b,c], Peter Kuppens [a,d]

[a] Faculty of Psychology and Educational Sciences, KU Leuven, Tiensestraat 102, 3000, Leuven, Belgium
[b] Parenting and Special Education Research Unit, KU Leuven, Leopold Vanderkelenstraat 32, 3000, Leuven, Belgium
[c] Leuven Autism Research, KU Leuven, Leuven, Belgium
[d] Melbourne School of Psychological Sciences, University of Melbourne, Parkville Victoria, 3010, Australia

ARTICLE INFO

Article history:
Received 23 May 2013
Received in revised form 4 July 2013
Accepted 9 July 2013

Keywords:
Autism spectrum disorders (ASD)
Emotions
Emotion differentiation
Emotion knowledge
Individual differences

ABSTRACT

Autism spectrum disorder (ASD) is commonly associated with reduced ability to recognize emotions in others. It is less clear however, whether ASD is also associated with impaired knowledge of one's own emotions. In the current study we present a first examination of how much knowledge individuals with ASD have about their emotions by investigating their ability to differentiate between emotions. Across two lab tasks that measured to what extent and how people differentiate between their own feeling states and semantic emotion terms, results showed that ASD individuals differentiated less than typically developing individuals. Yet, both groups of participants similarly categorized emotions according to previously established theoretical categories. These findings indicate that while both give similar meaning to emotions, individuals with ASD make less subtle distinctions between emotions. With low levels of emotion differentiation being linked to reduced well-being, these findings may help to better understand the high prevalence of internalizing problems associated with ASD.

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1. Introduction

Autism spectrum disorder (ASD) has been associated with impairments in the processing of own and others' emotions (Kanner, 1943). So far, empirical research has mainly investigated the difficulties individuals with ASD have in recognizing and processing the emotions of others. In the current study we aimed to examine their knowledge of their own emotions, focusing on the ability to differentiate between different emotional states.

1.1. Emotions in ASD

It is commonly accepted that ASD is associated with difficulties in emotional understanding. One of the most influential theses in this respect states that individuals with ASD show impairments in theory of mind (ToM). Specifically, they have difficulties in attributing mental states such as intentions and beliefs to others (Baron-Cohen, 1995; Baron-Cohen, Tager-Flusberg, & Cohen, 1993, 2000). Indeed, a vast array of empirical studies shows that ASD is related to difficulties in understanding the emotions of others. For example, ASD is associated with difficulties in inferring and differentiating

* Corresponding author at: Department of Psychology, KU Leuven, Tiensestraat 102, Box 3713, 3000, Leuven, Belgium. Tel.: +32 16 326136; fax: +32 16 325993.
E-mail addresses: Yasemin.Erbas@ppw.kuleuven.be (Y. Erbas), Eva.Ceulemans@ppw.kuleuven.be (E. Ceulemans), Johanna.Boonen@student.kuleuven.be (J. Boonen), Ilse.Noens@ppw.kuleuven.be (I. Noens), Peter.Kuppens@ppw.kuleuven.be (P. Kuppens).

1750-9467/$ – see front matter © 2013 Elsevier Ltd. All rights reserved.
http://dx.doi.org/10.1016/j.rasd.2013.07.007

emotional states from others' facial expressions (Harms, Martin, & Wallace, 2010; Pelphrey et al., 2002), body movements (Atkinson, 2009; Hubert et al., 2007; Philip et al., 2010), and vocal stimuli (Philip et al., 2010; For a review on other emotion related problems in ASD, see Begeer et al., 2008). However, there is growing evidence that ASD is also related to deficits in the awareness of the 'psychological self', or 'theory of *own* mind', suggesting that individuals with ASD are at least as impaired at recognizing their own mental states as at recognizing the mental states of others (Frith & Happé, 1999; Williams, 2010). However, much less is known about how individuals with ASD perceive and differentiate their own emotional states. Yet, as we argue below, knowledge about one's own emotional world is important to consider because of its role in psychological health.

1.2. Emotion differentiation

In the past decade, a line of research has emerged which focuses on the extent to which individuals understand or have knowledge of their own emotions, investigating their ability to differentiate between different emotional states (Barrett, Gross, Christensen, & Benvenuto, 2001). This ability is labeled emotion differentiation, and can be observed by looking at how people describe how they feel in response to different emotion-eliciting events (Barrett et al., 2001). The ability to make fine-grained distinctions between emotional states appears to have adaptive value and plays an important role in psychological well-being. It reflects knowledge about the specific antecedents and consequences involved in our emotional life, and the ability to apply this knowledge in emotional situations, leading to differentiated and adaptive emotional responding and regulation. Indeed, higher emotion differentiation is found to be related to a more differentiated use of emotion regulation strategies (Barrett et al., 2001), lower levels of alexithymia (Erbas, Ceulemans, Pe, Koval, & Kuppens, in preparation) and depression (Demiralp et al., 2012; Erbas et al., in preparation), higher self-esteem, and lower levels of neuroticism (Erbas et al., in preparation). Since individuals with ASD seem to suffer from lower psychological well-being, as evidenced by high rates of depression, anxiety and other internalizing problems (Kuusikko et al., 2008; Simonoff et al., 2008; Stewart, Barnard, Pearson, Hasan, & O'Brien, 2006), and indeed seem to be less effective in regulating their emotions (Laurent & Rubin, 2004; Rieffe et al., 2011; Samson, Huber, & Gross, 2012), research on emotion differentiation can be of great potential help in clarifying possible mechanisms underlying this reduced well-being.

1.3. Emotion differentiation and ASD

As far as we know, emotional differentiation abilities have not yet been directly examined in ASD. There are, however, reasons to assume that ASD may be characterized by low levels of differentiation. First, this would dovetail with the general assumption of ToM accounts of the disorder that it involves difficulty in recognizing mental states. Second, there is also indirect empirical evidence that ASD may be characterized by lower emotion differentiation. A study by Rieffe and colleagues suggests that ASD involves less knowledge of one's own emotions, by showing that individuals with ASD more often than typically developing individuals claim not to feel an emotion in response to emotional stimuli, and acknowledge fewer different emotional perspectives in a multiple emotions task (Rieffe, Meerum Terwogt, & Kotronopoulou, 2007). Furthermore, studies on the relationship between alexithymia and ASD suggest that individuals with ASD have more difficulties identifying and describing the emotions they experience (Berthoz & Hill, 2005; Hill, Berthoz & Frith, 2004; Samson et al., 2012). Finally, another study by Rieffe and colleagues showed that in individuals with ASD, various aspects of emotional awareness were negatively related to internalizing symptoms (Rieffe et al., 2011), underlining the importance of further exploring the emotional knowledge of individuals with ASD. However, research on alexithymia and emotional awareness uses direct self-reports to assess emotion differentiation, and the question is to what extent people (with or without ASD) are able to directly report on their ability to differentiate between different emotional states (Dunning, Heath, & Suls, 2004; Kashdan, Ferssizidis, Collins, & Muraven, 2010).

1.4. The current study

In a multi-method study, we aim to provide the first examination of whether individuals with ASD differentiate less between their own emotions compared to individuals without ASD. Next to complementing previous findings relating ASD to difficulties in perceiving emotional states in others, documenting such difficulties regarding one's own emotions would additionally suggest a potential mechanism behind the lower psychological well-being associated with ASD, given the important role emotion differentiation seems to play for various aspects of psychological health.

Specifically, we will investigate whether individuals with ASD have an impaired ability to differentiate between their emotions, compared to that of typically developing (TD) individuals, using a task that has recently been developed to measure emotion differentiation objectively in a lab setting using standardized stimuli (Erbas et al., in preparation). In this task, participants report how they feel in response to a number of emotional stimuli and the covariation between different emotions is taken as a measure of emotion differentiation (Barrett, 1998; Kashdan et al., 2010; Pond et al., 2012; Tugade, Fredrickson, & Barrett, 2004). However, a low level of emotion differentiation on this task can also be an indication of less semantic knowledge about emotions in general, and not necessarily an inability to differentiate between one's own emotional states. Therefore, additionally we will examine whether individuals with ASD show lower ability to differentiate between discrete emotion terms, and whether this conceptual emotion knowledge is related to the degree to which they

differentiate between their own emotions. This will be investigated by examining how both groups perform on an emotional sorting task containing only semantic stimuli and how their performances on both tasks are related to each other. The use of the two differentiation tasks furthermore allows examining in more depth *which* emotions are perceived as similar or different in both groups, and compare this to theoretically informed categorizations of emotional states. This will tell us whether the ASD and TD group use theoretically established normative meanings of emotions to a similar degree. Since previous studies have demonstrated that mainly differentiation of negative (and not positive) emotions is related to well-being (e.g., Demiralp et al., 2012; Kashdan et al., 2010), our study only investigated negative emotions.

2. Methods

2.1. Participants

The ASD group contained twelve male and six female adolescents. They were recruited from a school in Belgium that offers special education to children with hearing disabilities, and that has a special department for children with ASD. The inclusion criteria of the ASD department are an IQ $\geq$ 80 and an official ASD diagnosis. Hence, all participants were relatively high functioning and diagnosed with ASD by a multidisciplinary team of independent diagnosticians using DSM-IV-TR criteria (American Psychiatric Association, 2000). In addition to clinical diagnosis, we also obtained parent-report assessments of the participants using the Dutch adaptation of the Social Responsiveness Scale (for adolescents younger than 18 years of age: SRS; Roeyers, Thys, Druart, De Schryver, & Schittekatte, 2011; for adolescents older than 18: SRS-A; Noens, De la Marche, & Scholte, 2012), which is a quantitative measure of ASD traits (Constantino et al., 2003). Results of the SRS showed that all participants in the ASD group except one had ratings above the cut-off score of 60 (M = 77.94, SD = 10.02; range from 57 to 99). The participants had a mean age of 16.71 years (SD = 1.30; range from 15 to 19) and all were native Dutch speakers. Written consents from both the parents and the participants were obtained prior to their participation.

The TD group originally consisted of 26 participants matched to the ASD group with respect to education level, gender and age. These participants were recruited from two secondary schools located in the same region and of the same educational level as the ASD department. Of these 26 participants, eight participants were not native Dutch speakers. To keep both groups as equal as possible on variables other than clinical diagnosis, these eight participants were excluded from further analyses. The remaining participants were 12 male and six female adolescents with a mean age of 16.56 years (SD = .78; range from 15 to 18).

2.2. Measures

2.2.1. Differentiation of own feelings

Emotion differentiation was assessed in two ways. A first measure consisted of an emotion differentiation task that was developed and validated by Erbas et al. (in preparation) which will be further referred to as the Photo Emotion Differentiation task (PED-task). In this task, participants were asked to rate their emotional responses to a set of 20 standardized emotional photographs taken from the International Affective Picture System (IAPS; Lang, Bradley, & Cuthbert, 1995), which were selected to match 20 emotions. 16 of these emotions represent the four negative discrete emotion categories proposed by Diener, Smith, and Fujita (1995) (FEAR: fear, worry, anxiety, nervousness; ANGER: anger, irritation, disgust, rage; SHAME: shame, guilt, regret, embarrassment; SADNESS: sadness, loneliness, unhappiness, depression). Four emotions (jealous, envious and two Dutch words for inferior) were added to the list to cover an even broader array of negative emotions (Erbas et al., in preparation). When viewing each picture, participants were instructed to indicate the extent to which they experienced each of the 20 emotions in response to the picture, using 7-point Likert scales ranging from 0 (*not at all*) to 6 (*very much*). The relatively large list of negative emotions allows participants to potentially respond with specific, differentiated profiles of emotional responses to the stimuli. In line with previous research, the level of emotion differentiation is computed by calculating the intra-class-correlation coefficients (ICC) measuring consistency between emotion terms, across pictures, for each participant (Shrout & Fleiss, 1979), with high ICCs indicating lower levels of emotion differentiation (e.g., Barrett et al., 2001; Kashdan et al., 2010; Pond et al., 2012; Tugade et al., 2004). We expected the ASD group to have a higher ICC than the TD group, reflecting lower differentiation.

2.2.2. Differentiation of semantic emotion terms

Additionally, a second task was developed which contained only semantic stimuli (words). For this task, the emotional sorting (ES) task, the same 20 emotion words from the original PED-task (Erbas et al., in preparation) were printed in black ink in the middle of white squared paper cards, and participants were instructed to sort these 20 emotion cards and group the emotions they thought belonged together. Individuals who can make subtle, fine-grained distinctions between semantic emotion meanings were expected to perceive the 20 emotions as more distinct from each other, and therefore divide the emotions into more separate groups as compared to individuals who make less subtle distinctions. We expected the ASD group to have a lower number of emotion groups than the TD group, reflecting lower differentiation.

2.3. Procedure

The ASD individuals participated in the study in groups of two, whereas the TD participants completed the tasks during two collective testing sessions. Participants were seated behind a table and given individual booklets to complete. Instructions were presented on a large screen and orally explained. Next, the PED-task stimuli were projected on the screen and participants reported their responses in the booklet. After this task, participants were given the ES-task cards and completed the task at their own pace, after which the experimenter noted the number and content of groupings made during the task. In both groups, the experiment lasted about 45 min.

3. Results

3.1. Descriptive statistics

On average, participants had an ICC of .65 ($SD = .33$) in the PED-task, and divided the 20 emotions into 6.33 groups ($SD = 2.37$) in the ES-task. Kolmogorov–Smirnov tests of normality showed that the data of the TD group were not normally distributed in the PED-task ($D = .24$, $p < .01$) nor in the ES-task ($D = .21$, $p = .03$). Therefore, all analyses rely on non-parametric tests.

3.2. Differences in the level of emotion differentiation between the ASD and the TD group

We compared the performance of the ASD group and the TD group on the PED-task and the ES-task. A Mann–Whitney test showed that the level of ICCs of the two groups significantly differed from each other ($U = 107.00$, $p = .04$, one-tailed) such that the ASD group ($M = .76$, $SD = .15$) was characterized by significantly higher ICCs than the TD group in the PED-tasks ($M = .55$, $SD = .42$), indicating lower emotion differentiation. Similarly, for the ES-task, a comparison of the number of emotion groups from the ASD group ($M = 5.72$, $SD = 2.32$) to that of the TD group ($M = 6.94$, $SD = 2.31$) showed that the difference between the two was marginally significant ($U = 114.00$, $p = .06$, one-tailed),[1] meaning that individuals from the ASD group categorized the emotions in less groups compared to those from the TD group. These results support our expectation that ASD is characterized by lower levels of emotion differentiation.

3.3. Correlations between the two emotion differentiation measures

We next analyzed whether the two measures for emotion differentiation were related to each other. Spearman's correlations on the data of all participants ($r_s(34) = -.113$, *ns*) and of the ASD group alone ($r_s(16) = .348$, $p = .16$) appeared non-significant. However, in the TD group, the ICCs and number of emotion groups were negatively related ($r_s(16) = -.432$, $p = .07$) which means that a high level of differentiation (a low ICC) in the PED-task was positively related to higher differentiation (higher number of groups) in the ES-task in the TD group only.

3.4. Qualitative difference in emotion differentiation

Finally, we looked in more depth at the qualitative difference in emotion differentiation between the ASD and TD group in terms of *which* emotions were grouped together. We first conducted a principal component analysis (PCA) on the data of the PED-task for the ASD and TD group separately. To this end, data from participants were person-mean centered (to avoid that the correlational structure was contaminated by individual differences in mean scores; cfr. person-mean centering in for instance multilevel modeling; Enders & Tofighi, 2007) and stacked underneath each other before being subjected to the PCA. As shown in Fig. 1, solutions with few components explained a larger proportion of the variance in the ASD group compared to the TD group, corroborating that the emotion ratings from the ASD group tend to be lower in dimensionality than those from the TD group. Yet, parallel analysis (which is an objective tool for selecting the number of components by comparing the observed eigenvalues to the eigenvalues of the randomly perturbed data; O'Connor, 2000) indicated that in both groups a solution with five factors should be retained. Target rotating that solution in both groups toward the theoretically expected structure (involving the four factors from Diener et al., 1995, plus one additional factor) yielded similarly high congruencies with the theoretical structure for both groups (congruency ASD group: $M = .89$, $SD = .06$; congruency TD group: $M = .88$, $SD = .05$), meaning that both groups in general apply the theoretical structure to the emotions in a similar way.

Second, we examined which emotion terms were being grouped together in the ES-task in both groups. To this end, we performed a hierarchical cluster analysis with average linkage on matrices reflecting how many times two emotion terms were grouped together in each group. The results showed that the grouping pattern of the TD group was more differentiated compared to the ASD group, in the sense that clusters consist of fewer emotions, and that at a same distance between

[1] When excluding the ASD participant who scored lower on the SRS than the cut-off, the difference between the ASD and TD group on the PED-task remained significant ($U = 101.00$, $p = .04$, one-tailed). For the ES-task the difference became slightly larger when excluding this participant ($U = 98.50$, $p = .04$, one-tailed). Correlating the two emotion differentiation measures gave similar results for the whole sample when excluding this participant ($r_s(33) = -.118$, *ns*), the relationship between the tasks remained insignificant but increased in size in the ASD group ($r_s(16) = .403$, $p = .11$).

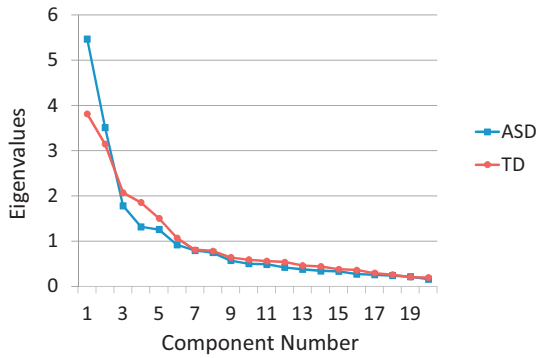

Fig. 1. Scree plot of eigenvalues of principal components in PED-task, separately for the ASD and TD group. The first two components in the ASD group have large eigenvalues (5.47 and 3.51) and explain a relatively large part of the variance (44.92%) compared to the two first components of the TD group (34.82%).

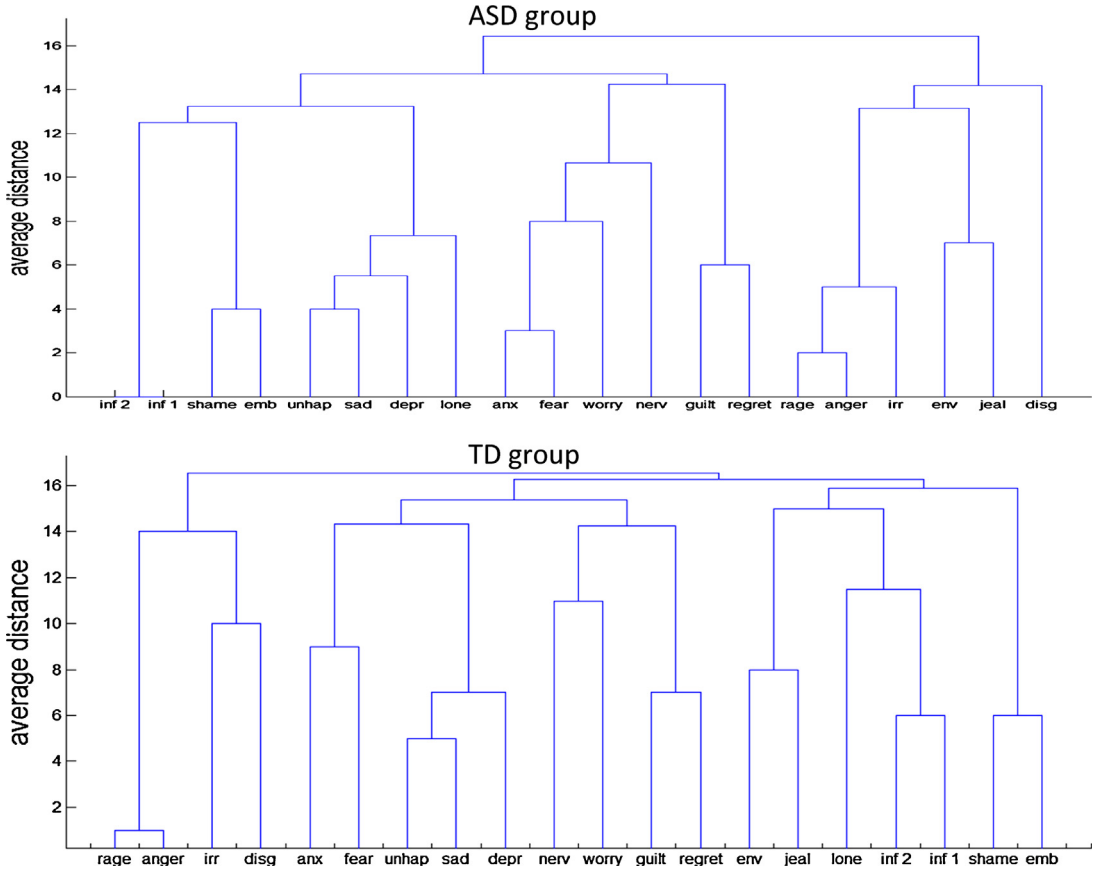

Fig. 2. Hierarchical cluster analysis solutions on the frequency of emotion term groupings in the ES-task, separately for the ASD and TD group (irr = irritation; disg = disgust; anx = anxiety; unhap = unhappiness; sad = sadness; depr = depression; nerv = nervousness; env = envious; jeal = jealous; lone = loneliness; inf = inferior; emb = embarrassment). At equal distances between the clusters (*Y*-axis), the TD group displays consistently a higher number of clusters or groupings than the ASD group. Yet, qualitatively, the groupings end up being similar and both conform to the theoretical structure proposed by Diener et al. (1995).

clusters, the TD group consistently had a higher number of clusters than the ASD group (see Fig. 2). Yet, to a large extent the theoretical structure as suggested by Diener et al. (1995) was again found to be represented in the solution of both groups.

4. Discussion

4.1. Conclusions

The current study is the first to investigate the ability of individuals with ASD to differentiate between negative emotions in comparison to a healthy TD group. By adopting a multi-method approach, our results showed that individuals with ASD differentiate less between their emotions as reflected by higher levels of unidimensionality in the ratings of their emotions in response to emotional pictures (indicated by the higher ICCs in the PED-task), and also between semantic meaning of negative emotions as shown by the lower number of groupings when categorizing emotion terms into distinct groups in the ES-task. Thus, individuals with ASD seem to make less subtle distinctions between different negative emotions compared to their TD counterparts. These findings are in line with the assertion that ASD involves alterations in emotional functioning, and are in accordance with the central tenet of prominent theories such as the ToM that ASD is associated with difficulties in assessing mental states.

While in the TD group the two measures were related in the expected direction, in the ASD group the level of differentiation of their own emotional experiences was found to be independent from how much they semantically differentiate between emotions, suggesting that in ASD the difficulty to differentiate between own emotional states is not a function of lower semantic knowledge of emotions. ASD therefore seems to be characterized by both difficulties to differentiate between own feeling states and the semantic meaning of emotion words.

However, follow-up analyses that examined exactly how ASD and TD participants differentiate between emotions indicated that both groups seem to differentiate and group emotions according to previously established theoretical dimensions (Diener et al., 1995). This suggests that the two groups, to a large extent, have a similar understanding of the emotion terms. Together, these results indicate that individuals with ASD have less differentiated knowledge about their own emotional world and conceptually differentiate less between discrete emotions compared to TD individuals, even though they do not seem to give a radically different meaning to specific emotion terms than theoretically expected or given by TD individuals.

4.2. Implications and directions for future research

The findings of this study are important for a number of reasons. First of all, previous research involving ASD has mainly focused on the perception of emotion in others, while there is limited research on how individuals with ASD perceive and have knowledge of their own emotions. However, it can be argued that the ability to recognize emotions in others may be affected by how well individuals are acquainted with their own emotions. In fact, a recent study suggests that difficulties in the recognition of emotional expressions associated with ASD may well be explained by higher levels of alexithymia in ASD individuals (Cook, Brewer, Shah, & Bird, 2013). In that respect, this first study on emotion differentiation in ASD is relevant because it opens the door to gain a better understanding of emotion perception in the self, and on how this may affect emotion perception in others.

Secondly, ASD is consistently associated with indicators of lower psychological well-being. Research on emotion differentiation has established that a lower ability to differentiate between emotions is a concomitant of for instance depression (Demiralp et al., 2012; Erbas et al., in preparation). Reduced emotional differentiation in ASD could therefore be a contributing factor to their lower well-being. Future research could focus on examining the precise mechanisms involved in emotion differentiation that could contribute to lower psychological health in ASD. Next to its implications for psychological well-being, research on emotion differentiation can also contribute to a further understanding of other impairments related to ASD, such as impairments in social reciprocity and communication. For instance, prior research has demonstrated that the emotional regulatory challenges faced by individuals with ASD negatively affect their social interactions (Laurent & Rubin, 2004). Furthermore, individuals with ASD have less empathetically adequate verbal responses to others' emotions (e.g., Doussard-Roosevelt, Joe, Bazhenova, & Porges, 2003), and mimic the emotions of others less frequently (McIntosh, Reichmann-Decker, Winkielman, & Wilbarger, 2006), which can all be considered important processes for social-emotional functioning, and may well be signs of a reduced understanding of not only others', but also one's own emotions. Therefore it might also be relevant to investigate emotion differentiation in ASD in the context of interpersonal communication and relationships.

It is important for future research to replicate our findings while observing individuals' emotion differentiation capacity in daily life setting (for instance using experience sampling methodology; Csikszentmihalyi & Larsen, 1987). Also, even though the sample size in this study is not small compared to other studies on ASD, it is recommended to conduct component or clustering analyses on larger datasets, which will allow drawing more robust conclusions on the emotion differentiation patterns observed in ASD.

Acknowledgements

This research was supported by KU Leuven Research Council Grants GOA/10/02, OT/11/031, and IDO/080/013. The authors would like to thank Kris Evers for her comments and advice.

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