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Articles

Gender differences in the interoceptive awareness: a pilot study on Italian people

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Abstract

Background: Bodily self-recognition requires the individual to be able to refer to himself through a reflexive representation, typically a schema or an image of one's own body. Body ownership results from an interplay between exteroception and interoception (i.e., the ability to perceive one's own body from the inside). It has been demonstrated that perceiving sensations inside the body could be associated with better regulation of emotions. Also, it has been reported that interoceptive awareness may be affected by gender. Therefore, this pilot study aimed to investigate gender differences in the interoceptive awareness among Italian people.

Methods: 114 Italian volunteers (57 males and 57 females) completed the 32-item Multidimensional Assessment of Interoceptive Awareness (MAIA) questionnaire to measure the multiple dimensions of interoceptive awareness.

Results: The findings showed higher scores among females than among males for the ability to notice interoceptive input and the awareness of the relationship between bodily sensations and emotional states.

Conclusions: Results suggested that women could be more inclined to notice and focus on internal cues. Also, the gender differences could be related to physical and hormonal changes that women experience during development. Future research on the relationship between gender and physiological responses (e.g., heartbeat, skin conductance) for a specific ethnographic sample is recommended.

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1. Introduction

From an evolutionary point of view, bodily self-recognition is the simplest and oldest form of self-consciousness (Gallup, 1970). It requires of an individual a reflexive representation, that is, a schema or an image of one's own body. Although the body schema and image are often engaged simultaneously, body schema primarily refers to the unconscious motor and postural control of one's own body, while body image is the conscious appraisal of one's own physical appearance (Cuzzolaro, 2018; de Vignemont, 2010; Gallagher, 1986). Recognizing one's image in a picture or a mirror is the most typical kind of self-recognition; other forms of recognition include the voice, smell, or smoothness of skin. The body represents the most basic level of the self (Damasio, 2000; Gallagher, 2005), and bodily self-consciousness arises from the integration of different bodily signals (Metzinger et al., 2007). Sensory inputs are integrated in the brain to create an internal body representation (Ehrsson et al., 2004), which is constantly updated to perceive our bodily position in the environment (Re et al., 2023). Previous research supported the development of body representations across the lifespan (Myles, 2022). For example, Raimo et al. (2021) investigated the role of interoceptive information in body representations. They showed that the young performed better than children and older adults in action and non action-oriented body representation. Bodily self-awareness involves several dimensions, such as the sense of body ownership, the sense of agency, and the perception of internal signals from one's own body (Braun et al., 2018; Berlucchi & Aglioti, 2010; Blanke et al., 2015; Kalckert & Erhsson, 2012).

The exteroceptive and proprioceptive information involved in bodily self-awareness was investigated using the rubber hand illusion (Botvinick & Cohen, 1998). This experimental behavioural paradigm showed that it is possible to perceive an artificial hand as part of the individual's body if the former is placed in a congruent position with the latter (Botvinick & Cohen, 1998; Ehrsson et al., 2004). It has been demonstrated that it is possible to perceive an artificial hand as part of the individual's body if the former is placed in a congruent position with the latter (Botvinick & Cohen, 1998; Ehrsson et al., 2004). More specifically, the ownership illusion can be induced by illusory visual-tactile integration, whereas asynchronous stimulations do not induce a sense of ownership over the rubber hand. Furthermore, an illusory feeling of ownership may develop differently among subjects highlighting some individual differences. Sensory suggestibility might increase the feeling of ownership, as indicated by Marotta et al. (2016). In addition, the sense of body ownership also depends on interoceptive sources that provide information on the body's physiological state. The feeling that my body belongs to me

arises not only from processes related to exteroceptive sources but also from those related to internal processes. When a subject experiences a sense of ownership towards the artificial hand, this experience is often followed by physiological changes in the real hand, which could be expressed in skin temperature reduction (Moseley et al., 2008).

Crucianelli et al. (2018) investigated the idea of body ownership by focusing on the interplay between interoception and exteroception: while the former refers to the perception of environmental stimuli originating outside the body, the latter refers to the ability to recognise and integrate signals from within the body. More precisely, their research explored how the RHI (that is, exteroception through affective touch) could be affected by cardiac interoceptive sensitivity (Tsakiris et al., 2011). The results did not show cardiac interoceptive sensitivity to have a modulating effect on the RHI. Also, a more relevant form of interoceptive sensitivity was revealed in ambiguous situations (e.g., synchronous versus asynchronous touch), suggesting that an individual's sense of body ownership could result from a balancing of interoception and exteroception. Interoceptive awareness (i.e., the ability to perceive one's body from the inside) is related to bodily sensations, thus forming the basis of our emotional state (Craig, 2002; Craig, 2015). The ability to perceive sensations inside the body along with the related emotional state seems to be associated with better emotional regulation (Kever et al., 2015; Pollatos et al., 2008). In fact, physiological changes in response to specific emotions allow us to recognize these emotions in our daily life experiences. Feldman et al. (2001) argued that individuals with a greater range of emotional experiences are more able to regulate their emotions. Stress can have a negative impact by altering the ability to regulate emotional responses to bodily states (Schulz & Vögele, 2015). In addition, an association has been reported between a maladaptive response to stress and disorders such as depression and anger management (Briere & Jordan, 2009; Hooven et al., 1995). In line with heartbeat awareness as a measure of interoception, it has been demonstrated that there could be a difference according to gender in the performance of heart-focused tasks, with men proving to be more accurate in performing such tasks than women (Prentice & Murphy, 2022). Accordingly, women seem to be more vulnerable to mental illness due to a lower degree of interoceptive accuracy (Murphy et al., 2019). There is empirical evidence of the connection between interoceptive awareness and regulation of emotions (Craig, 2015). Accordingly, previous research has investigated interoceptive awareness using the 32-item Multidimensional Assessment of Interoceptive Awareness (MAIA), which assesses eight different factors related to interoceptive awareness (Mehling et al., 2012). The MAIA appears to be the most widely-used self-report questionnaire for assessing interoceptive awareness (Mehling et al., 2018). It has been used to assess interoceptive awareness in the cases of

interoceptive training (Bornemann et al., 2015), post-traumatic stress disorders (Mehling et al., 2017) and clinical eating disorders (Brown et al., 2017).

1.1 The present study

Different adaptations of the MAIA have been applied to specific ethnographic samples (e.g. Bornemann et al., 2015; Brytek-Matera & Koziel, 2015; Todd et al., 2020; Valenzuela-Moguillansky & Reyes-Reyes, 2015; Willem et al., 2021), and analyses of similarities and differences across cultures have also been investigated (Freedman et al., 2020). However, there has been little research aimed at investigating the relationship between interoceptive awareness and gender: the study of Grabauskaitė et al. (2017) is one example. The study of Calì et al. (2015) constituted the first attempt to assess the validity of the Italian-language translation of the MAIA. Although the factorial design of the study confirmed the reliability and dimensionality of the Italian translation (when compared with the original version), the authors declared that such a preliminary validation could be biased by a sample comprising 91% female individuals. Accordingly, it was the aim of our pilot study to investigate the gender differences in the interoceptive awareness among Italian people. Previous research on gender differences reported (Barrett et al., 2000; Thompson & Voyer, 2014., Prentice & Murphy, 2022). So, we expected women to exhibit an advantage over men in processing and recognising their own emotions, whereas poor interoceptive accuracy in women compared to men was also reported (Montoya et al., 1993., Grabauskaitė et al., 2017).

2. Materials and Methods

2.1 Participants

114 volunteers (57 females, 57 males; M = 27.93, SD = 4.70, 47.37% students) were recruited via opportunity sampling and using social networks. The inclusion criteria required that participants were healthy and aged 18-35. All the participants provided an implied consent. The study was conducted in accordance with the Declaration of Helsinki and the Italian Psychological Society code of ethics.

2.2 The Multidimensional Assessment of Interoceptive Awareness (MAIA) questionnaire

We used the Italian version (Calì et al., 2015; translation coordinated by Committeri, Department of Neuroscience, Imaging and Clinical Science, University G. d'Annunzio, Italy) of the original Multidimensional Assessment of Interoceptive Awareness (MAIA), whose internal consistency reliability of the subscales as well as construct validity were confirmed by Mehling

et al. (2012). MAIA allows to measure the multiple dimensions of interoceptive awareness, additionally investigating gender differences. The questionnaire (see Appendix) consists of 32 items divided into 8 factors corresponding to the scales listed below:

- Scale 1: Noticing – awareness of unpleasant, pleasant and neutral bodily sensations.
- Scale 2: Not-distracting – difficulty ignoring or distracting oneself from feelings of pain or discomfort.
- Scale 3: Not-worrying – tendency not to worry about sensations of pain or discomfort.
- Scale 4: Attention regulation – ability to sustain and control attention to bodily sensations.
- Scale 5: Emotional awareness – awareness of the connection between bodily sensations and emotional states.
- Scale 6: Self-regulation – ability to regulate distress by paying attention to bodily sensations.
- Scale 7: Body listening – active listening to the body for insight.
- Scale 8: Trusting – experiencing one's body as safe and reliable.

2.3 Procedure

Participants were invited to complete an online questionnaire hosted on Google Forms. Before starting the questionnaire, the information sheet was displayed, and participants were asked to provide implied consent if they wished to take part in the study. Then, they were asked to give their demographic information (i.e., age, gender, occupation) and fill in the MAIA questionnaire. The questionnaire involved participants giving ratings for all 32 items; a 6-point Likert scale was used, ranging from 0 = 'Never' to 5 = 'Always'. Finally, they were debriefed.

2.4 Data Handling

The Shapiro-Wilk test was firstly conducted to assess the data distribution, with the critical value being fixed at $p = .05$. Since the data were not all normally distributed ($p < .05$), non-parametric statistics was applied. Cronbach's alpha was calculated to assess the internal consistency of the MAIA's eight scales. Furthermore, correlations among the scales were investigated using Spearman's index. The Mann-Whitney test was carried out to compare the mean ages of males' (M = 27.05, SD = 5.09) and females' (M = 28.81, SD = 4.14) subsamples and to analyse the differences in the MAIA scores according to gender. Also, no outliers were detected. The scores of each MAIA scale were obtained by calculating the average score for each item. G*Power 3.1.9.4 (Faul et al., 2007) was used to conduct a post-hoc power analysis: setting parameters for

a Mann-Whitney test (two groups, two tails), to detect a moderate effect size (d = .50), alpha level of .05 and 57 as sample size of both groups, the power level was .73, corresponding to having a 27% probability of making a type II error.

The data are openly available in OSF at https://osf.io/u7tqf.

3. Results

Unstandardized Cronbach's alpha applied to the MAIA ranged from .71 to .86 for all scales except scale 2 (Table 1), the Not-distracting scale; for this scale, the reported alpha was .28, so the value could not be considered acceptable. In order to investigate this result, we carried out a correlation analysis among the items of the Not-distracting scale, which only revealed a weak positive correlation (r = .25, p = .01) between the second ("I distract myself from sensations of discomfort") and third ("When I feel pain or discomfort, I try to power through it") items. Overall, a high percentage of correlations (18 out of 28 possible pairs: 64.29%) among the eight scales was reported, but scales 2 (Not-distracting) and 3 (Not-worrying) were shown to be relatively independent from the other ones. There was no significant difference between the mean ages of males and females (Z = -1.79, p = .07), thus allowing the gender differences to be investigated. The comparison between genders revealed higher scores in females' samples for scales 1 (Noticing: Z = -2.58, p = .01) and 5 (Emotional awareness: Z = -3.00, p = .003; see Table 2 and Figure 1). By analysing the correlation matrices, we observed a positive correlation between Noticing and Emotional awareness in both males' (r = .61, p < .001; see Table 3) and females' (r = .47, p < .001; see Table 4) groups.

Table 1. Descriptive statistics (i.e., mean and standard error), internal-consistency reliability, and correlations among the eight MAIA scales calculated on the total sample

Scale	M	SE	Cronbach's alpha	1	2	3	4	5	6	7
1. Noticing	3.24	.09	.73							
2. Not-distracting	2.22	.08	.28	-.03						
3. Not-worrying	2.47	.10	.71	-.08	-.23*					
4. Attention regulation	2.92	.09	.85	.43**	-.07	.24*				
5. Emotional awareness	3.47	.10	.87	.59**	.13	-.13	.41**			
6. Self-regulation	2.70	.09	.77	.43**	-.05	.12	.47**	.43**		
7. Body listening	2.70	.11	.86	.54**	.09	-.09	.49**	.53**	.54**	
8. Trusting	3.37	.10	.86	.35**	.03	.21*	.43**	.22*	.46**	.51**

Notes: * p < .05, ** p < .001

Table 2. Descriptive statistics (i.e., mean and standard error) and the Mann-Whitney test applied to males' and females' samples, for each MAIA scale

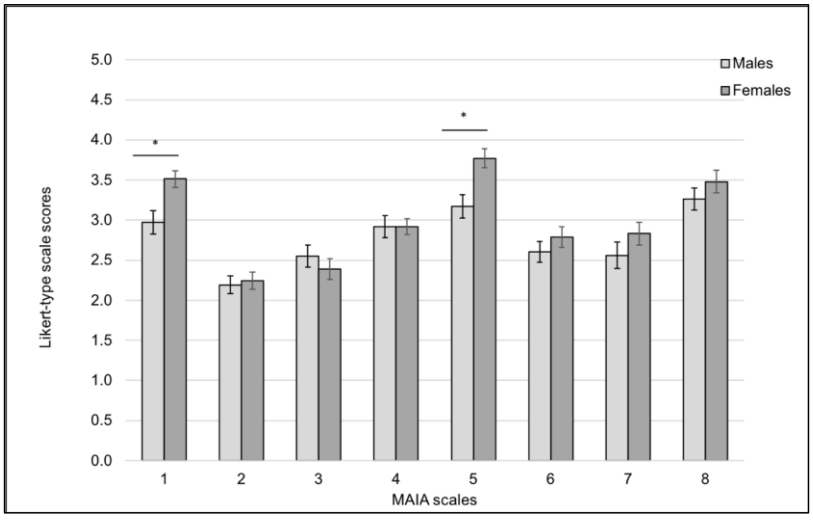
Scale	Males (N = 57)		Females (N = 57)		Z	*p*
	M	SE	M	SE		
1. Noticing	**2.97**	**.15**	**3.51**	**.11**	**-2.58**	**.01**
2. Not-distracting	2.19	.11	2.25	.11	-.45	.65
3. Not-worrying	2.55	.14	2.39	.13	-.64	.52
4. Attention regulation	2.92	.14	2.92	.10	-.38	.71
5. Emotional awareness	**3.17**	**.15**	**3.77**	**.12**	**-3.00**	**.003**
6. Self-regulation	2.60	.13	2.79	.13	-.75	.45
7. Body listening	2.56	.16	2.83	.14	-1.18	.24
8. Trusting	3.26	.14	3.48	.14	-.86	.39

Notes: Significant differences are marked in bold

Table 3. Correlations among the eight MAIA scales calculated on the males' sample

Scale	1	2	3	4	5	6	7
1. Noticing							
2. Not-distracting	-.05						
3. Not-worrying	.05	-.29*					
4. Attention regulation	.58**	-.01	.19				
5. Emotional awareness	.61**	.28*	-.17	.57**			
6. Self-regulation	.51**	.20	.001	.48**	.47**		
7. Body listening	.60**	.20	-.13	.58**	.68**	.61**	
8. Trusting	.40*	.10	.21	.53**	.32*	.53**	.53**

Notes: * $p < .05$, ** $p < .001$



Note: *$p < .05$

Figure 1. Comparison of the MAIA scales' mean scores across gender. Error bars indicate standard error

Table 4. Correlations among the eight MAIA scales calculated on the females' sample

Scale	1	2	3	4	5	6	7
1. Noticing							
2. Not-distracting	-.02						
3. Not-worrying	-.21	-.18					
4. Attention regulation	.29*	-.11	.31*				
5. Emotional awareness	.47**	.002	-.05	.25			
6. Self-regulation	.37*	-.30*	.25	.46**	.39*		
7. Body listening	.40*	-.02	-.02	.41*	.31*	.47**	
8. Trusting	.29*	-.04	.22	.32*	.06	.38*	.50**

4. Discussion

Bodily self-awareness arises from both exteroceptive and interoceptive information. Different experimental procedures enable the dynamic integration of information coming from the inside and the outside of the body to be investigated, thus allowing us to understand how multiple body-related signals contribute to self-awareness. The present pilot study aimed to investigate differences in interoceptive awareness based on gender by using the Italian version of the MAIA. Internal consistency was confirmed in all but one of the eight scales; only the Not-distracting scale was found to have an unacceptable Cronbach's alpha value. This result seems to be consistent with a number of previous studies reported by the authors of the MAIA, who added five new items to a second, improved version of the questionnaire (Mehling et al., 2018) in order to overcome the internal consistency issue. Moreover, the correlation analyses showed the Not-distracting and Not-worrying scales to be relatively independent from the other scales, revealing a pattern consistent with the results of Calì et al. (2015). The gender comparison showed higher scores among females than males for scales 1 (Noticing) and 5 (Emotional awareness), which are related to the ability to notice interoceptive input and the awareness of the relationship between bodily sensations and emotional states, respectively. This result could confirm that women are more inclined to notice and focus on internal cues, whereas men perhaps pay more attention to external cues (Moriguchi et al., 2014). Our findings also could support the view of Meyers-Levy and Loken (2015) that better emotional awareness in females corresponds to the empirical evidence on gender differences in psychology. Furthermore, interoceptive accuracy in men is positively related to specific emotional regulation strategies (Lischke et al., 2020), suggesting that gender may contribute towards differences in how men and women perceive and regulate their emotions. Also, our findings could be related to the empirical evidence that women are more vulnerable to negative stimuli (Meyers-Levy & Loken, 2015) and mental illness (Murphy et al., 2019). Accordingly, Meyers-Levy and Loken (2015)

claimed that women are more inclined to ruminate, increasing the likelihood of developing psychological conditions such as anxiety and depression. Moreover, gender differences were also reported in terms of heartbeat awareness, with men showing a higher level of interoceptive accuracy than women (Grabauskaitė et al., 2017). Myles and Merlo (2021) investigated the relationships between alexithymia and physical outcomes, also concerning gender differences in men and women in physical functioning, whereas Shah et al. (2016) suggest that alexithymia could be associated with atypical interoceptive awareness. Despite can be argued that gender differences are a product of the physical changes that women experience during development (Murphy et al., 2019) and some mental conditions are more prevalent among women (Whiteford et al., 2015) there is no causal evidence that attribute being a woman as a predisposing factor for mental health difficulties.

5. Limitations of the study

As a pilot study, this research has several limitations. Firstly, the achieved power is slightly below the minimum threshold value of .80. This could be related to the sample size, so a further investigation with a larger number of participants is strongly recommended. Also, exploratory factor analysis should be applied to the MAIA in order to assess the factor structure; however, in line with recommendations on the sample size (Tabachnick et al., 2007), this pilot study was conducted on a small number of participants, so factor analysis was not carried out. Secondly, it should be recognised that previous research on interoception awareness has highlighted the need to also investigate interoceptive accuracy. In fact, the study of Calì et al. (2015) on Italian people suggested that people could use the perception of their own heartbeat to control their interoceptive accuracy, although there has been some debate over the validity of this claim (Ring et al., 2018; Parkin et al., 2013). Furthermore, it should be considered that our data collection was carried out during the COVID-19 state of emergency in Italy; this could have affected the MAIA results since interoceptive sensibility could be influenced by pandemics (Suzuki et al., 2021).

6. Conclusions

Previous research investigated empirical evidence of the connection between interoceptive awareness and emotion regulation as well as interception's role in different mental health conditions. Although the processing of these bodily signals does not involve conscious awareness, the ability to focus attention on these signals presents some individual differences among people. Finally, our future research aims to deepen the results of the present pilot study by using a new, 37-item validated Italian version of the MAIA, and by associating the

questionnaire with interoceptive accuracy along with other paradigms related to bodily self-awareness, such as the moving rubber hand illusion (Re et al., 2023).

Ethical approval

The study was approved by the Ethical Committee of the Department of Cognitive Sciences, Psychology, Education and Cultural Studied (approval n. COSPECS_01_2022, date: 16/02/2022) of University of Messina.

Informed Consent Statement

Informed consent was obtained from all subjects involved in the study.

Data Availability Statement

The data are openly available in OSF at https://osf.io/u7tqf.

Conflict of interest statement

There are no conflicts of interest to disclose.

Author Contributions

AR: Conceptualization, Methodology, Investigation, Writing (original draft), Writing-review and editing. SM: Data analysis, Writing (original draft), Writing-review and editing. CL: Conceptualization, Methodology, Investigation, Data curation, Writing (original draft). PP: Conceptualization, Investigation, Writing-review and editing. DM: Conceptualization, Methodology, Investigation, Supervision, Writing-review and editing.

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Appendix A

32-item MAIA scale (Mehling et al., 2012). Italian translation coordinated by Prof. G. Committeri, in collaboration with Dr. M. Costantini, Dr. E. Ambrosini, and Dr. G. Finotti (Laboratory of Neuropsychology and Cognitive Neuroscience, Department of Neuroscience, Imaging and Clinical Sciences, University G. d'Annunzio, Italy)

English version	Italian version
Noticing	
1. When I am tense I notice where the tension is located in my body.	1. Quando sono teso noto in che punti del mio corpo è localizzata la tensione.
2. I notice when I am uncomfortable in my body.	2. Noto quando sono a disagio nel mio corpo.
3. I notice where in my body I am comfortable.	3. Noto i punti del mio corpo in cui mi sento a mio agio.
4. I notice changes in my breathing, such as whether it slows down or speeds up.	4. Noto i cambiamenti nel mio respiro, per esempio se rallenta o accelera.
Not-distracting	
5. I do not notice (I ignore) physical tension or discomfort until they become more severe.	5. Non noto la tensione fisica o il disagio fino a quando questi non diventano più seri.
6. I distract myself from sensations of discomfort.	6. Mi distolgo dalle sensazioni di disagio.
7. When I feel pain or discomfort, I try to power through it.	7. Quando provo dolore o disagio, cerco comunque di andare avanti con quello che stavo facendo nonostante ciò.
Not-worrying	
8. When I feel physical pain, I become upset.	8. Quando sento un dolore fisico, mi agito.
9. I start to worry that something is wrong if I feel any discomfort.	9. Inizio a preoccuparmi che ci sia qualcosa che non va, se percepisco un disagio.
10. I can notice an unpleasant body sensation without worrying about it.	10. Posso notare una sensazione corporea spiacevole senza preoccuparmene.

Attention regulation

11. I can pay attention to my breath without being distracted by things happening around me.	11. Posso prestare attenzione sul mio respiro senza farmi distrarre dalle cose che succedono attorno a me.
12. I can maintain awareness of my inner bodily sensations even when there is a lot going on around me.	12. Posso mantenere la consapevolezza delle mie sensazioni fisiche interiori anche se attorno a me avvengono molte cose.
13. When I am in conversation with someone, I can pay attention to my posture.	13. Quando sto conversando con qualcuno, riesco a prestare attenzione alla mia postura.
14. I can return awareness to my body if I am distracted.	14. Posso ritrovare la consapevolezza del mio corpo se sono distratto.
15. I can refocus my attention from thinking to sensing my body.	15. Riesco a ridirezionare l'attenzione dall'atto di pensare all'atto di percepire il mio corpo.
16. I can maintain awareness of my whole body even when a part of me is in pain or discomfort.	16. Riesco a mantenere la consapevolezza del mio corpo nella sua interezza anche quando una parte di me è dolorante o a disagio.
17. I am able to consciously focus on my body as a whole.	17. Sono capace di focalizzarmi intenzionalmente sul mio corpo nella sua interezza.

Emotional awareness

18. I notice how my body changes when I am angry.	18. Noto in che modo il mio corpo cambia quando sono arrabbiato.
19. When something is wrong in my life I can feel it in my body.	19. Quando qualcosa va storto nella mia vita, riesco a percepirlo nel mio corpo.
20. I notice that my body feels different after a peaceful experience.	20. Noto di sentire il mio corpo diverso dopo un'esperienza serena.
21. I notice that my breathing becomes free and easy when I feel comfortable.	21. Noto che il mio respiro diventa libero e agevole quando mi sento a mio agio.
22. I notice how my body changes when I feel happy/joyful.	22. Noto come il mio corpo cambia quando mi sento felice/gioioso.

Self-regulation

23. When I feel overwhelmed I can find a calm place inside.	23. Quando mi sento sopraffatto, riesco a trovare dentro di me un posto tranquillo.
24. When I bring awareness to my body I feel a sense of calm.	24. Quando rivolgo la consapevolezza sul mio corpo, provo un senso di calma.
25. I can use my breath to reduce tension.	25. Riesco ad utilizzare il mio respiro per ridurre la tensione.
26. When I am caught up in thoughts, I can calm my mind by focusing on my body/breathing.	26. Quando mi assalgono i pensieri, posso calmare la mente concentrandomi sul mio corpo/respiro.
Body listening	
27. I listen for information from my body about my emotional state.	27. Ascolto le informazioni provenienti dal mio corpo riguardanti i miei stati emotivi.
28. When I am upset, I take time to explore how my body feels.	28. Quando sono agitato, prendo il tempo necessario per indagare come sta il mio corpo.
29. I listen to my body to inform me about what to do.	29. Ascolto il mio corpo per sapere cosa fare.
Trusting	
30. I am at home in my body.	30. Nel mio corpo mi sento a casa.
31. I feel my body is a safe place.	31. Sento che il mio corpo è un posto sicuro.
32. I trust my body sensations.	32. Mi fido delle sensazioni del mio corpo.