

Linguistic and cultural adaptation and psychometric validation of the Multidimensional Assessment of Interoceptive Awareness in Greek individuals

Eleni Vinni^{1*}, Katerina Karaivazoglou^{2*}, Evanthia Tourkochristou¹, Philippos Gourzis², Konstantinos Thomopoulos¹, Eleni Jelastopoulou³, Christos Triantos¹

Abstract

Background: Interoception refers to the processing of stimuli from within the body and has been linked to several mental and physical health conditions. The Multidimensional Assessment of Interoceptive Awareness (MAIA) is a 32-item self-report instrument, used to assess several dimensions of bodily awareness. The current study's aim was to present the process of linguistic and cultural adaptation and psychometric validation of the MAIA in a Greek-speaking setting.

Methods: The forward-backward translation methodology was employed including cognitive debriefing interviews with 6 Greek-speaking adults to assess content validity. The final form of the translation was subsequently administered to a larger group of participants to determine the translated questionnaire's factorial structure and its internal consistency.

Results: Following the translated version's pilot testing, the revised version was administered to 107 Greek-speaking adults, 54.2% males with a mean age of 39.4 (12.3) years old. Exploratory factor analysis (EFA) revealed the existence of 8 factors similar to the original version, accounting for 70.6% of the total variance. 31 items presented with satisfying factor loadings (0.396-0.987) to the same factors as the original version, while only 1 item had a lower loading of 0.255 to its theoretical subscale. All MAIA subscales exhibited satisfactory or high internal consistency (Cronbach's alpha ranging between 0.64 and 0.88). In addition, most MAIA subscales exhibited moderately high subscale-subscale correlations.

Conclusion: The Greek version of the MAIA exhibited satisfying content validity, a factorial structure similar to the original version and high reliability and may be useful in assessing interoceptive sensibility in Greek-speaking individuals.

Key words: *Interoception; MAIA; linguistic adaptation; psychometric validation*

¹Division of Gastroenterology, Department of Internal Medicine, University Hospital of Patras, Rio, Greece

²Department of Psychiatry, University Hospital of Patras, Rio, Greece

³Department of Public Health, School of Medicine, Patras, Greece

*these authors contributed equally to this work

Received: 09 May 2021; Accepted: 17 Aug 2021

INTRODUCTION

Interoception is defined as the sensing of internal bodily states and is considered crucial for physiological homeostasis [1]. It reflects the brain's capacity to focus inwards, on stimuli derived mainly from the gastrointestinal, respiratory and cardiovascular system and is clearly differentiated from the other senses (vision, audition,

taste, smell, touch and proprioception) which process external information or use bodily stimuli to describe the body's relation to the external environment [2]. Research has linked impairments in interoceptive processing with mental and physical health disturbances including sickness behavior, fatigue, obesity, diabetes, depression, autism spectrum, anxiety and eating disorders and for this reason there is an emerging interest in studying interoception in several chronic disease populations [1,3].

Interoception constitutes a multidimensional concept encompassing neurophysiological mechanisms, emotional and behavioral correlates, and metacognitive processing. Interoceptive ability consists of interoceptive accuracy which refers to the objective perception of interoceptive sensations, interoceptive sensibility which includes the self-report (subjective) sensitivity to interoceptive sensations and interoceptive awareness which refers to the correspondence between a person's interoceptive sensibility and his/her interoceptive accuracy [4-6]. The Multidimensional Assessment of Interoceptive Awareness (MAIA) is a 32-item questionnaire which measures interoceptive sensibility and has been widely used in interoception research in various linguistic and cultural settings exhibiting satisfying psychometric properties [7]. Its multidimensional nature has broadened interoceptive assessment and has contributed to the discrimination between maladaptive and adaptive aspects of body awareness [8]. However, the use of any self-reported questionnaire requires its translation and adaptation to the socio-cultural characteristics of the research population [9]. This process is fundamental to ensure the instrument's suitability to be used in a cultural setting different from the setting of its original development and validation, in order to exhibit its optimal psychometric properties. In this context, the present study's aim is to perform the linguistic and cultural adaptation and psychometric validation of MAIA in a Greek-speaking setting. We strongly believe that our findings will reveal valuable information regarding Greek people's interoceptive abilities and will provide researchers with a promising and highly reliable psychometric instrument that might further advance research on interoception and its correlates.

PARTICIPANTS AND METHODS

The current study was conducted at the Division of Gastroenterology of the Internal Medicine Department of the University Hospital of Patras with the collabora-

tion of the Department of Psychiatry and the Department of Public Health. Study participants were treated in accordance with the Declaration of Helsinki and the study protocol and all relevant procedures were approved by the University Hospital's Ethical Committee. All participants provided written consent prior to study entry, after being thoroughly informed about the study's aim and methods.

Adult individuals recruited from outpatients, hospital personnel and a community convenience sample were invited to participate. Individuals with major psychopathology, severe cognitive or neurological deficits, malignancies, or severe chronic diseases, as well as individuals who were not fluent in the Greek language were excluded. All collected data were sealed in envelopes and the names of participants were assigned to numbers, insuring blinding of participants and personnel. Data procession was performed by an independent researcher, who had exclusive access to the specially designed storage space of envelopes.

Interoception questionnaire

The original MAIA is a 32-item self-reported questionnaire used to assess multiple dimensions of interoceptive sensibility. It consists of 8 sub-scales, namely the (1) Noticing subscale which reflects awareness of uncomfortable, comfortable, and neutral body sensations, the (2) Not-Distracting subscale which reflects the tendency not to ignore or distract oneself from sensations of pain or discomfort, the (3) Not-Worrying subscale which reflects the tendency not to worry or experience emotional distress with sensations of pain or discomfort, the (4) Attention Regulation subscale which represents the ability to sustain and control attention to body sensations, the (5) Emotional Awareness subscale which refers to awareness of the connection between body sensations and emotional states, the (6) Self-Regulation subscale which reflects the ability to regulate distress by attention to body sensations, the (7) Body-Listening subscale which refers to the active listening to the body for insight, and the (8) Trusting subscale which refers to the experience of one's body as safe and trustworthy. MAIA items are rated on a 6-point Likert Scale (0-5) and higher scores are suggestive of greater interoceptive sensibility [7].

Translation process and linguistic validation

We followed a forward-backward translation process. Two independent translators, who were native-speaking

Greek language, translated separately the original MAIA subscales from English into Greek (forward translation). A prior detailed analysis of the original questionnaires was conducted by translators to clarify their context and they were informed about the questionnaires' targets and their use in research. A third independent translator and Greek native-speaking reconciled the two forward translations to one single target language translation, creating a revised version of the questionnaire. A native-speaking English language translator, who speaks Greek language fluently and had never read the original version of the questionnaire translated independently and separately the reconciled version of the questionnaire from Greek into English (backward translation). A review of the back-translated and reconciled version of the questionnaire was performed by an evaluation committee comprised of three native Greek-speaking experts in mixed fields [a healthcare professional (psychiatrist), specialized in the context of the questionnaires, a scientist specializing in the methodology of questionnaire's validation and an independent translator of the questionnaire scientist, specialized in biomedical sciences] who examined independently all the translation process steps, selecting the most appropriate terms or suggesting new terms of translation for each questionnaire item.

Cognitive debriefing

A pilot-testing of the first consensus of the questionnaire was performed, including cognitive debriefing interviews with 6 native Greek-speaking adults, who were given the questionnaire and were asked about the understanding of questions, whether or not there were any clarity issues, inappropriate context, irrelative terms or unpleasant feelings caused by the questions. Participants were also asked to suggest alternative wording regarding some translated terms. The evaluation committee analyzed all participants' comments and suggestions to ensure the comprehension of terms by the target language population and revised the translated version leading to the final version.

Statistical analysis

Content validity was assessed based on the participants' answers to the cognitive debriefing interviews regarding the content of each question. A descriptive statistical analysis was performed to describe the sample's background characteristics. In order to detect the underlying factor structure of the Greek MAIA we

conducted an exploratory factor analysis (EFA) of the 32 items. Initially, we computed the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy and the Bartlett's test of sphericity to assess whether our data were factorable. Estimation of the factors was performed by factoring the Pearson correlation matrix by the maximum likelihood (ML) method. The number of extracted factors was based upon eigenvalues > 1.0 . Internal consistency was estimated with the calculation of Cronbach's alpha for each MAIA subscale. Scales means and range of item-total correlations were also elicited and Pearson correlations were conducted to determine subscale-subscale associations. Statistical analyses were performed with the SPSS version 20.0 software for Windows.

RESULTS

During the MAIA pilot-testing, 6 adults (3 females) were initially administered the questionnaires and were interviewed regarding their content and the administration process. Based on the analysis of the cognitive debriefing interviews, all 6 participants reported that the questionnaire was administered in a visually satisfying form, item scoring was easy, and they found no question disturbing or embarrassing. However, 5 individuals reported that items 12, 13 and 16 were hard to comprehend and asked for clarifications. Based on these comments, the evaluation committee properly rephrased items 12, 13 and 16 and suggested that the MAIA should be administered in the presence of a mental health professional familiar with its content and scope in order to provide appropriate clarification if needed.

Subsequently, we proceeded with the next part of the study which included 107 adults, 58 (54.2%) males with a mean age of 39.4 (SD: 12.3 years). Participants' demographic characteristics are depicted in Table 1.

Exploratory factor analysis

The Bartlett's test of sphericity was significant, $\chi^2(496) = 2041.89$, $p < 0.001$, and the Kaiser-Meyer-Olkin (KMO) sampling adequacy was 0.78, which together indicate that the MAIA items had sufficient common variance for factor analysis. Exploratory Factor Analysis revealed the existence of 8 factors with an eigenvalue exceeding 1.0, and the extracted factors explained 70.6% of the total variance. Supplementary Table 1 includes the factor loadings of all 32 items, with items 10 ("I can notice an unpleasant body sensation without worrying about it") and 16 ("I can maintain awareness of my whole body even when a part of me is in pain or

Table 1. Socio-demographic characteristics of the study population.

| | |
|---------------------------------|-------------|
| Total participants | 107 |
| Gender, male, N (%) | 58 (54.2) |
| Age, mean (SD) | 39.4 (12.3) |
| Education, mean (SD) | 14.3 (2.6) |
| Family status, N (%) | |
| Single | 40 (37.4) |
| Married without children | 6 (5.6) |
| Married with children | 50 (46.7) |
| Divorced, widow/-er | 7 (6.5) |
| Occupation status, N (%) | |
| Unemployed | 8 (7.5) |
| Private sector | 24 (22.4) |
| Public sector | 29 (27.1) |
| Free lancer | 10 (9.3) |
| Student | 10 (9.3) |
| Retired | 7 (6.5) |

discomfort") presenting with the lowest loadings (0.255 and 0.396, respectively), while all the remaining items presented with significantly higher loadings ranging between 0.444 and 0.987.

Internal consistency

The Noticing, Attention Regulation, Emotional Awareness, Self-regulation and Body Listening subscales exhibited high internal consistency with Cronbach's alpha ranging between 0.80 and 0.88. The Not distracting, Not worrying and Trusting subscales exhibited satisfying internal consistency (Cronbach's alpha 0.66, 0.64 and

0.65, respectively). Table 2 includes Cronbach alphas, mean scale scores and ranges of item-total correlations for each Greek translated MAIA subscale.

Correlations among the 8 subscales ranged between 0.002 and 0.688 indicating independence (Table 3). The strongest correlations were observed between Body Listening and Self-Regulation (0.688) and Emotional Awareness (0.654) and between Self-Regulation and Emotional Awareness (0.610). In contrast, the weakest correlations were observed between Not Distracting and Not Worrying (-0.031), Attention Regulation (-0.012), Emotional Awareness (-0.015) and Body Listening (-0.002) and between Not Worrying and Attention Regulation (-0.024), Self-Regulation (0.005) and Body Listening (-0.034).

DISCUSSION

The present study's findings confirm that the Greek version of the MAIA is a well-accepted and valid instrument and can be reliably used to assess interoceptive sensibility in a Greek-speaking setting. All subscales exhibited high (5 scales) or satisfying (3 scales) internal consistency and for 7 of them, namely the Noticing, Not Distracting, Not Worrying, Attention Regulation, Emotional Awareness, Self-regulation and Body Listening, the Cronbach's alpha indices were equal or even higher to those of the original version.

Exploratory factor analysis confirmed the factorial structure of 8 subscales which in general loaded the same items as the original version. For items 4, 16, 17, 18, 19, and 24 factor analysis revealed slightly higher loadings to a different factor compared to the original version; however, this difference was rather small and factor loadings to their theoretical subscales were quite

Table 2. Scale means, range of item-total correlations and Cronbach's alphas for the MAIA subscales.

| | # of items | Items numbers | Scale means (SD) | Range of item-total correlations | Alpha original MAIA | Alpha Greek validation |
|----------------------|------------|---------------|------------------|----------------------------------|---------------------|------------------------|
| Noticing | 4 | 1-4 | 3.11 (1.28) | 0.45-0.73 | 0.69 | 0.80 |
| Not-distracting | 3 | 5-7 | 1.77 (1.09) | 0.36-0.56 | 0.66 | 0.66 |
| Not-worrying | 3 | 8-10 | 2.50 (1.14) | 0.20-0.65 | 0.67 | 0.64 |
| Attention regulation | 7 | 11-17 | 2.92 (1.08) | 0.48-0.75 | 0.87 | 0.85 |
| Emotional awareness | 5 | 18-22 | 3.28 (1.37) | 0.59-0.80 | 0.82 | 0.88 |
| Self-regulation | 4 | 23-26 | 2.52 (1.32) | 0.51-0.79 | 0.83 | 0.84 |
| Body listening | 3 | 27-29 | 2.34 (1.29) | 0.65-0.69 | 0.82 | 0.82 |
| Trusting | 3 | 30-32 | 3.79 (0.97) | 0.44-0.53 | 0.79 | 0.65 |

MAIA: Multidimensional Assessment of Interoceptive Awareness

Supplementary Table 1. Exploratory factor analysis (EFA) loadings of the Greek MAIA (all 32 items).

| | Factor | | | | | | | |
|-----------------------------|-------------|-------------|-------------|-------------|-------------|-------------|--------------|-------------|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| Noticing | | | | | | | | |
| Item1 | ,220 | -,103 | ,723 | ,230 | ,347 | ,415 | ,309 | -,128 |
| Item2 | ,231 | -,208 | ,986 | ,232 | ,132 | ,306 | ,138 | ,022 |
| Item3 | ,371 | -,047 | ,623 | ,340 | ,260 | ,252 | ,349 | ,248 |
| Item4 | ,505 | -,362 | ,466 | ,438 | ,191 | ,480 | ,142 | ,038 |
| Not distracting | | | | | | | | |
| Item5 | ,105 | ,161 | -,233 | -,042 | -,189 | -,094 | -,481 | ,250 |
| Item6 | ,110 | ,100 | -,216 | ,051 | -,035 | ,029 | -,519 | ,105 |
| Item7 | -,029 | ,018 | -,125 | -,069 | ,031 | ,046 | -,552 | -,124 |
| Not worrying | | | | | | | | |
| Item8 | -,137 | ,750 | -,167 | -,196 | -,076 | -,110 | ,004 | ,289 |
| Item9 | -,178 | ,987 | -,180 | -,112 | ,041 | -,188 | -,018 | ,145 |
| Item10 | ,087 | ,255 | ,048 | ,056 | ,189 | ,033 | ,516 | ,071 |
| Attention regulation | | | | | | | | |
| Item11 | ,276 | -,126 | ,114 | ,637 | ,402 | ,361 | ,157 | ,071 |
| Item12 | ,268 | -,051 | ,228 | ,629 | ,246 | ,312 | ,217 | ,001 |
| Item13 | ,394 | -,081 | ,164 | ,730 | ,082 | ,383 | -,034 | ,179 |
| Item14 | ,399 | -,194 | ,284 | ,920 | ,076 | ,243 | -,141 | ,233 |
| Item15 | ,406 | -,143 | ,280 | ,752 | ,187 | ,361 | ,084 | ,365 |
| Item16 | ,363 | ,073 | ,204 | ,396 | ,219 | ,139 | ,318 | ,533 |
| Item17 | ,451 | ,103 | ,205 | ,496 | ,326 | ,423 | ,254 | ,555 |
| Emotional awareness | | | | | | | | |
| Item18 | ,452 | -,223 | ,412 | ,488 | ,322 | ,634 | ,165 | ,171 |
| Item19 | ,509 | -,384 | ,404 | ,361 | ,123 | ,706 | -,003 | -,138 |
| Item20 | ,733 | -,306 | ,341 | ,488 | ,177 | ,663 | ,002 | ,104 |
| Item21 | ,985 | -,181 | ,329 | ,416 | ,305 | ,432 | ,016 | ,190 |
| Item22 | ,801 | -,219 | ,295 | ,492 | ,298 | ,651 | -,009 | ,127 |
| Self regulation | | | | | | | | |
| Item23 | ,301 | ,089 | ,148 | ,336 | ,444 | ,367 | ,325 | ,353 |
| Item24 | ,483 | -,011 | ,145 | ,410 | ,605 | ,654 | ,238 | ,335 |
| Item25 | ,451 | -,090 | ,352 | ,391 | ,822 | ,496 | -,019 | ,211 |
| Item26 | ,424 | -,077 | ,357 | ,403 | ,866 | ,590 | ,086 | ,223 |
| Body listening | | | | | | | | |
| Item27 | ,378 | -,115 | ,334 | ,378 | ,397 | ,767 | ,012 | ,094 |
| Item28 | ,383 | ,090 | ,213 | ,318 | ,533 | ,652 | ,109 | ,330 |
| Item29 | ,417 | -,049 | ,348 | ,468 | ,295 | ,677 | -,140 | ,319 |
| Trusting | | | | | | | | |
| Item30 | -,016 | ,213 | -,011 | -,007 | ,298 | ,028 | ,120 | ,533 |
| Item31 | ,308 | ,270 | -,057 | ,169 | ,180 | ,173 | -,038 | ,545 |
| Item32 | ,209 | ,175 | ,021 | ,225 | ,034 | ,166 | -,101 | ,631 |

MAIA: Multidimensional Assessment of Interoceptive Awareness

Table 3. Pearson product-moment correlations among the eight MAIA subscales.

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|----------------------|----------|--------|----------|---------|---------|---------|---------|---|
| Noticing | | | | | | | | |
| Not-distracting | -0.268** | | | | | | | |
| Not-worrying | -0.196* | -0.031 | | | | | | |
| Attention Regulation | 0.423** | -0.012 | -0.024 | | | | | |
| Emotional Awareness | 0.578** | -0.015 | -0.282** | 0.566** | | | | |
| Self-regulation | 0.452** | -0.065 | 0.005 | 0.555** | 0.610** | | | |
| Body Listening | 0.467** | -0.002 | -0.034 | 0.517** | 0.654** | 0.688** | | |
| Trusting | 0.055 | 0.088 | 0.290** | 0.294** | 0.096 | 0.339** | 0.275** | |

MAIA: Multidimensional Assessment of Interoceptive Awareness

* $p < 0.05$, ** $p < 0.001$ (bilateral)

satisfactory (equal or exceeding 0.40) and for this reason, these items were grouped to the initial subscale in accordance with the original version. Item 10 loaded significantly higher to the Not Distracting compared to its original Not Worrying subscale (0.516 vs 0.255), which suggests that item 10 might be more suitable to be added to the Not Distracting subscale. However, removing this item from the Not Worrying subscale would leave only 2 items in that scale, an alteration that would significantly weaken the subscale's internal consistency. It should be noted that, the vast majority of the translated items presented high factor loadings ranging between 0.444 and 0.987, suggesting that the MAIA translation provides a valid and reliable instrument to assess the 8 dimensions of interoceptive sensibility described by Mehling et al (2012) in the original validation study [7].

Subscale-subscale correlations analysis revealed moderately high correlations among the MAIA subscales, except for the Not Distracting subscale which negatively correlated only with the Noticing subscale and the Not Worrying subscale which correlated only with the Emotional Awareness and the Trusting subscale. These moderately high correlations confirm the anticipated associations among the subscales as subdimensions of the same construct (interoceptive sensibility) and the fact that these correlation coefficients did not exceed 0.80 confirm the validity of each subscale as a measure of a distinct aspect of interoception. Our findings corroborate earlier studies [10,11] which have shown that the Not Distracting and the Not Worrying subscales are not significantly associated with the remaining MAIA subscales.

In conclusion, the Greek version of the MAIA was well accepted by Greek-speaking adults and exhibited satisfying psychometric properties, providing a reliable and useful instrument in the field of interoception research. Clinicians and researchers are encouraged to use this linguistically and culturally adapted version in a variety of clinical settings to improve its qualities and expand its usefulness.

Conflict of interest disclosure: None to declare.

Declaration of funding sources: None to declare

Author contributions: EV, ET, KK and EJ conducted the research; KK wrote the manuscript; EJ, PG, KT and CT provided expert opinion and approved the manuscript's final version.

REFERENCES

1. Quadt L, Critchley HD, Garfinkel SN. The neurobiology of interoception in health and disease. *Ann N Y Acad Sci.* 2018;1428(1):112-28.
2. Barrett LF, Simmons WK. Interoceptive predictions in the brain. *Nat Rev Neurosci.* 2015;16(7):419-29.
3. Van den Bergh O, Witthöft M, Petersen S, Brown RJ. Symptoms and the body: taking the inferential leap. *Neurosci Biobehav Rev.* 2017;74(Pt A):185-203.
4. Reinhardt KM, Zerubavel N, Young AS, Gallo M, Ramakrishnan N, Henry A, et al. A multi-method assessment of interoception among sexual trauma survivors. *Physiol Behav.* 2020;226:113108.
5. Murphy J, Brewer R, Catmur C, Bird G. Interoception and psychopathology: A developmental neuroscience perspective. *Dev Cogn Neurosci.* 2017;23:45-56.
6. Garfinkel SN, Seth AK, Barrett AB, Suzuki K, Critchley HD. Knowing your own heart: distinguishing interoceptive

- accuracy from interoceptive awareness. *Biol Psychol.* 2015;104:65-74.
7. Mehling WE, Price C, Daubenmier JJ, Acree M, Bartmess E, Stewart A. The Multidimensional Assessment of Interoceptive Awareness (MAIA). *PLoS One.* 2012;7(11):e48230.
 8. Pearson A, Pfeifer G. Two Measures of Interoceptive Sensibility and the Relationship With Introversion and Neuroticism in an Adult Population. *Psychol Rep.* 2020:33294120965461.
 9. Tsang S, Royse CF, Terkawi AS. Guidelines for developing, translating, and validating a questionnaire in perioperative and pain medicine. *Saudi J Anaesth.* 2017;11(Suppl 1):S80.
 10. Mehling WE, Daubenmier J, Price CJ, Acree M, Bartmess E, Stewart AL. Self-reported interoceptive awareness in primary care patients with past or current low back pain. *J Pain Res.* 2013;6:403-18.
 11. Valenzuela-Moguillansky C, Reyes-Reyes A. Psychometric properties of the multidimensional assessment of interoceptive awareness (MAIA) in a Chilean population. *Front Psychol.* 2015;6:120.

Corresponding author:

Katerina Karaivazoglou
Kentrou 9, Agrinio, Greece, 30100
E-mail: karaivaz@hotmail.com