



Translation, Adaptation and Cross-Cultural Validation of Hearing Handicap Inventory for Adult in Malay Language

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Background and Objectives: Since a self-reported questionnaire for hearing-impaired listeners is not available by Malay language yet, it is important to develop or translate any available existing questionnaires. The aim of this study was to translate, adapt and validate the Hearing Handicap Inventory for Adult (HHIA) to be used by the audiologist among the hearing-impaired population in Malaysia. **Subjects and Methods:** The HHIA was translated to Malay language using forward-backward translation techniques by four-panellists (two for each level). The translated HHIA was then reconciled and harmonized for cultural aspects and content of the questionnaire by the researchers and two expert panels before being pilot-tested among 10 hearing-impaired patients. Questionnaire validation was conducted among 80 adults with a hearing loss to calculate for Cronbach's α (internal reliability), Spearman's correlation (inter-item correlation) and factor analysis. **Results:** None of the translated items were removed from the scale. The overall Cronbach's α was 0.964; 0.927 and 0.934 for both social and emotional subscales, respectively. The factor analysis (force-concept inventory) demonstrated a two-structure with a strong correlation between all items in either component 1 or 2, that resembled the original scale. The Mann-Whitney test revealed significantly higher scores for those adults with a hearing loss than those adults with normal hearing. **Conclusions:** The Malay HHIA has been successfully translated and validated for the purpose of determining the psychosocial aspects of adults with hearing loss in the local population.

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Introduction

A self-reported outcome measurement that quantifies a patient's disability and functioning affected by a hearing loss plays an important role in aural rehabilitation. This is in parallel with the International Classification of Functioning, Disability and Health (ICF) requirement that specific areas of difficulty experienced by the patients must be identified; and clinicians may use this information for direct intervention in the relevant areas of need [1].

Conventionally, outcome measures of hearing aid satisfac-

tion, such as real ear measurements and speech recognition tests, are widely used in Malaysia [2]. While outcome measures of hearing aid satisfaction have their own advantages, these tests only measure the functional improvement in sounds perception resulting from amplification. For that reason, psychosocial tests such as the self-outcome measurement provide more information on a patient's quality of life resulting from the hearing loss [3,4]. It is also a scientifically defensible method for validly measuring the real-life success of a hearing-aid fitting, because true experiences of hearing aid use in everyday listening situations cannot be measured objectively through machines and laboratories [5,6].

There are a few types of self-reported outcome measurement materials that include the Client-oriented Scale Inventory, Hearing Handicap Inventory, Abbreviated Profile of Hearing

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Aid Benefit and the Glasgow Hearing Aid Benefit Profile that is intended to measure amplification satisfaction. However, the Hearing Handicap Inventory for Adults (HHIA) [7] and the Hearing Handicap Inventory for the Elderly (HHIE) [8] were the only self-reported outcome questionnaires, to our knowledge, that measured the impact of the hearing loss on a patients' psychosocial well-being. The HHIA is revised and adapted from the HHIE for the use of younger hearing-impaired adults. While the HHIE was developed specifically for the elderly over 64 years old [8], Newman, et al. [7] have shown that the HHIA is a reliable tool that can also be used to assess hearing handicaps in young adults. Similar to the HHIE, the HHIA consists of 25 items using three-point Likert scales, with 13 items for emotional subscales and 12 items for social subscales. Three items of the HHIE were substituted in the HHIA with workplace-related items more relevant to the target population. The maximum overall score of the HHIA is 100, where a high score indicates a high psychosocial disability described by patients caused by the hearing loss. In addition, the HHIA has been evaluated psychometrically, making it a valid subjective test battery to measure individual reactions to a hearing loss that is usually not reflected by the audiogram [7]. Despite the requirement to use these questionnaires for hearing amplification validation measurements, until now, the HHIA has not been translated and psychometrically evaluated for the Malaysian population, to the authors knowledge.

Because the application of the HHIA is beneficial for determining the future direction of the management of hearing-impaired patients in Malaysia, the language and cultural diversions mark the limitation of its usage. This is because the perception of the ways in which the health problems are expressed vary with the different cultures and lifestyles, making the direct literal translation from the original to the target language to be ineffective [9,10]. Studies have been conducted previously to cross-culturally translate the HHIA into several languages, such as Italian [11], Brazilian [12] and Japanese [13]. These studies revealed a high internal consistency with $\alpha > 0.7$ for the overall and subscales score [2,7,11].

Therefore, this study aims to 1) translate the HHIA into Malay language, the national language, and modify the items to suite the Malaysian culture and 2) evaluate the psychometric properties of this instrument for clinical usage.

Subjects and Methods

The study was conducted in two phases. The first phase was the translation and cultural adaptation of the HHIA questionnaire. Phase 2 is the psychometric properties of the questionnaire involving a reliability analysis and questionnaire vali-

ation undertaken from June 2015 to December 2016 in the Hearing and Speech Clinic, International Islamic University Malaysia, Malaysia. This study protocol received the unconditional approval of the IIUM Research Ethics Committee (Approval ID: IREC 580). All participants consented to involve in this study.

Phase 1: Translation and cultural adaptation

Part I: Translation process

The cross-cultural translation process was conducted using the forward-backward method [14]. First, the forward translation involves two panellists, who had a good English and Malay language command, translating the original HHIA into the target language [15]. Then, two more bilingual translators translated the questionnaire back from the target language into English. The translators were blind to the existence of the original questionnaire to reduce the potential of ambiguous translations [14].

Part II: Expert committee approach

To synthesize the two translated versions, an expert committee that included three researchers and two audiologists discussed the results of both the forward and backward translations. The committee members modified the sentences to suit the cultural values in Malaysia wherever necessary, and offered appropriate suggestions to achieve equivalence between the original and translated versions.

Part III: Pilot study

In the pilot study, the feasibility, readability and completion duration of the questionnaire were assessed. Ten adults with hearing loss participated in this phase. The ten adults with hearing loss assessed the questionnaire's readability and completion duration and all participants agreed that the structure and items in the questionnaire were readable and feasible of completion [16].

Phase 2: Psychometric properties of Malay HHIA

Part I: Participants selection

Eighty adults with hearing loss from two hearing clinics and three hearing-aid centres were invited to complete the Malay HHIA. The participants met the following requirements, 1) adult patients with hearing loss, and 2) able to understand and communicate in Malay. Patients were excluded if they had any neurological history that might interfere with their decision-making. The participants' mean age was 43 years (SD=13 years). Forty percent of the participants were females

and the rest was males. The type of hearing loss among the participants included sensorineural, mixed hearing loss, unilateral and bilateral. Seventy-nine normal hearing adults were also recruited through convenience sampling as a control for discriminant validation. The mean age was 27 years old (SD=6 years). Twenty-five percent of the normal hearing adults recruited were male and the rest were female.

Part II: Statistical analysis

Analyses of the questionnaire validation were conducted using SPSS 20 (IBM Corp., Armonk, NY, USA). Cronbach's Alpha was conducted to assess the internal consistency of the Malay HHIA. The Spearman correlation coefficient test was used to measure the convergent validity (correlation of the context dimension between the overall questionnaire and the subscales) and the Mann-Whitney U was used to evaluate the discriminant validity (comparing the scores between the experimental and control groups). A non-parametric test was used, because the normality assumption was not met, based on the Shapiro-Wilk's W test ($p < 0.05$). Explorative factor analysis (EFA) was performed using a principal axis analysis with a varimax rotation, to validate and determine the underlying construct of the translated questionnaire. In particular, an EFA was performed to test whether the translated items agreed with the original questionnaire constructs.

Results

Internal consistency and inter-item correlation

The overall internal consistency of the Malay HHIA was 0.97; the Alphas for social and emotional subscales were 0.94 and 0.95, respectively, indicating an excellent internal consistency. Cronbach's Alpha varied between 0.968 and 0.970, when each one of the 25 items was deleted implying every item to be equally important in the instrument. The Spearman correlation coefficient statistical analysis was used to measure convergent and divergent validity, as summarized in Table 1.

Every item was significantly correlated with the items in the same subscale (social and emotional), $p < 0.05$ ranging between 0.261 to 0.785, indicating that the items in the Malay HHIA had a substantial association with each other. The inter-item correlation between the items from the different subscales was significantly correlated ($p < 0.05$) with the r-value less than the acceptable limit of 0.85 [17].

Discriminant validation

The Malay HHIA score differed significantly between both groups, with a higher total score being observed in adults

with hearing loss ($n_c = 80$, median=13.00) than for the normal hearing group ($n_c = 79$, median=0.00) ($U = 830.50$, $p < 0.05$).

Factor analysis

The eigenvalues that were greater than one and a scree plot inspection were used to determine the number of factors [18]. Initially, four factors were extracted, but because eigenvalues greater than one may overestimate the number of factors in the solution, a second factor analysis using Principal Component Analysis was undertaken, requiring forced two-factor solution [19]. The overall variance for the two factors each covered a large percentage of the overall variance and all items had a loading score of > 0.40 . The two-factors explained 60.87% of the total item variance. The first ten items and items 12 and 13 loaded strongly on Factor 1, which could be the "social" domain. Apparently, item S-11 and items 14 to 25 loaded moderate to strongly good on factor 2 (emotional) as seen in Table 2. The number of factors in the solution were maintained at two for the following reasons, 1) items loading values were ≥ 0.4 and, 2) the eigenvalues for the remaining factors were ≤ 1.0 .

Discussion

This study confirmed the translation and adaptation process of the HHIA self-reported outcome measures into Malay and described the validation testing. The 'adaptation' instead of 'adoption' was carried out to ensure the contents of the translated material were equivalent to the original version to allow comparability of data, especially when two languages were not idiomatically and semantically relative. Nevertheless, all Malay HHIA items appear to be culturally acceptable and can be used in the Malay-speaking population, maintaining the 25-items of the original questionnaires without any major alterations in the structure.

Previous studies on the HHIA reported a high internal consistency with $\alpha > 0.7$ for the overall and subscales score [2,7,11]. The results from the literature were comparable to the Malay HHIA in which the α for total, social and emotional subscale was more than 0.7 in this study. Additionally, the alpha values were maintained upon the deletion of each item, signifying that the equal importance of all items in the Malay HHIA are similar to the results of the previous translation and adaptation of the English to Brazilian HHIA [2].

Aiello, et al. [2] measured the correlation between items construct in the Brazilian version of the HHIA with the corresponding subscales SF-36 establishing a convergent validity in which the finding revealed high and significant correlations between Brazilian version of the HHIA and SF-36. Similarly,

Table 1. Inter-item correlation for Malay HHIA with 2 domains (n=80)

	S1	S3	S6	S7	S9	S11	S13	S15	S16	S19	S21	S23	E2	E4	E5	E8	E10	E12	E14	E17	E18	E20	E22	E24	E25
S1	1.000	0.470	0.386	0.256	0.497	0.380	0.503	0.279	0.445	0.474	0.429	0.370	0.526	0.520	0.394	0.406	0.388	0.298	0.495	0.437	0.388	0.330	0.427	0.376	0.386
S3		1.000	0.785	0.533	0.675	0.428	0.682	0.499	0.381	0.459	0.577	0.466	0.764	0.553	0.588	0.500	0.611	0.561	0.353	0.643	0.620	0.476	0.500	0.535	0.678
S6			1.000	0.614	0.779	0.395	0.627	0.442	0.295	0.478	0.601	0.509	0.748	0.585	0.645	0.525	0.690	0.690	0.457	0.368	0.532	0.425	0.580	0.401	0.665
S7				1.000	0.610	0.439	0.468	0.558	0.227	0.439	0.600	0.416	0.515	0.445	0.638	0.669	0.832	0.483	0.310	0.561	0.528	0.509	0.427	0.687	0.497
S9					1.000	0.490	0.712	0.511	0.520	0.575	0.692	0.606	0.683	0.542	0.608	0.710	0.481	0.324	0.601	0.526	0.623	0.462	0.607	0.747	
S11						1.000	0.544	0.500	0.341	0.396	0.385	0.499	0.436	0.406	0.220	0.487	0.525	0.363	0.257	0.398	0.397	0.320	0.485	0.300	0.431
S13							1.000	0.500	0.454	0.628	0.586	0.613	0.716	0.612	0.547	0.555	0.613	0.478	0.368	0.667	0.514	0.589	0.564	0.530	0.709
S15								1.000	0.392	0.447	0.619	0.712	0.439	0.417	0.498	0.613	0.568	0.392	0.354	0.559	0.455	0.439	0.583	0.629	0.429
S16									1.000	0.520	0.517	0.582	0.371	0.469	0.445	0.437	0.355	0.298	0.407	0.436	0.533	0.445	0.704	0.368	0.546
S19										1.000	0.540	0.642	0.528	0.445	0.604	0.498	0.513	0.208	0.349	0.674	0.573	0.648	0.511	0.511	0.530
S21											1.000	0.559	0.586	0.491	0.692	0.518	0.682	0.413	0.462	0.616	0.603	0.494	0.581	0.788	0.629
S23												1.000	0.456	0.486	0.492	0.543	0.496	0.324	0.342	0.537	0.544	0.483	0.640	0.541	0.538
E2													1.000	0.614	0.619	0.600	0.634	0.584	0.373	0.596	0.556	0.484	0.471	0.524	0.584
E4														1.000	0.608	0.559	0.547	0.391	0.485	0.499	0.407	0.550	0.626	0.386	0.598
E5															1.000	0.495	0.711	0.406	0.439	0.629	0.443	0.593	0.545	0.716	0.599
E8																1.000	0.681	0.449	0.261	0.575	0.618	0.557	0.512	0.504	0.528
E10																	1.000	0.447	0.368	0.596	0.560	0.560	0.568	0.748	0.627
E12																		1.000	0.225	0.380	0.383	0.205	0.302	0.388	0.397
E14																			1.000	0.436	0.348	0.397	0.541	0.396	0.372
E17																				1.000	0.600	0.708	0.483	0.578	0.600
E18																					1.000	0.480	0.522	0.476	0.630
E20																						1.000	0.468	0.492	0.680
E22																							1.000	0.545	0.586
E24																								1.000	0.521
E25																									1.000

Inter-item correlation for Malay HHIA between the same and the other subscales. The "S" abbreviation represents items from the social subscale and the abbreviation of "E" represents items from the emotional subscale. The number following this abbreviation represents the sequence of the item in the Malay HHIA questionnaire. HHIA: Hearing Handicap Inventory for Adult

Table 2. Rotated component matrix two-factor solutions of the Malay Hearing Handicap Inventory for Adult (n=80)

	Components	
	1	2
S1	0.453	
E2	0.806	
S3	0.792	
E4	0.624	
E5	0.614	0.489
S6	0.848	
S7	0.734	
E8	0.637	0.450
S9	0.722	0.472
E10	0.764	
S11		0.455
E12	0.707	
S13	0.621	0.500
E14		0.615
S15	0.446	0.551
S16		0.853
E17	0.415	0.703
E18		0.637
S19		0.743
E20		0.688
S21	0.526	0.610
E22		0.764
S23		0.716
E24	0.548	0.485
E25	0.561	0.555

The results of the rotated component matrix for two-factor solutions of the Malay Hearing Handicap Inventory for Adult. All factor loadings are well represented within two domains representing the original subscale of social and emotional.

in this study we aimed to confirm both the convergent and divergent validities by measuring the inter-item correlations in the Malay HHIA. While the procedures used were different in both studies, the findings revealed that the convergent validity had been demonstrated and established by the strength of the relationship between the items in the same subscale [20]. Divergent validity was also established between the majority of the items in the different subscales, because it requires most of the items with different domains to be poorly correlated, thus suggesting all items within this questionnaire appeared homogenous [21].

The comparison of the Malay HHIA scores between the adults with hearing loss (experimental) and the normal hearing (control) groups showed a large difference; the adults with the hearing loss group scored significantly higher than the normal hearing group. Similar findings were reported, not only in the previous HHIA translated versions, such as

the Italian [11] and the Brazilian [2], but also in the epidemiological study of the HHIE in Australia [22], and other types of self-reported outcome measures, such as the self-reported outcomes of aural rehabilitation in developing country [23], the self-report assessment of hearing aid outcome [24], and the Kannada (Southern-Indian) version of the Hearing Handicap Questionnaire [25]. The HHIA questionnaire was designed for those adults with hearing loss who may experience social and emotional issues that may not be the case with someone without a hearing loss (normal hearing people may not perceive any difficulties as described in the items in the HHIA) [7]. This could explain the large median differences in the HHIA scores between the control and experimental groups. Nevertheless, the difficulties faced in the situations described by each item in the HHIA appear to be relevant for patients who had hearing loss. Therefore, this situation demonstrates that the HHIA is only applicable for measuring the difficulties resulting from hearing loss.

The findings from the Principal Component Analysis revealed that most items in the Malay HHIA had higher loadings on Factor 1, demonstrating homogenous behaviour [26]. The analysis also revealed some of the items have a similar factor loading between factors 1 and 2. This suggests some of the items from factors 1 and 2 share the same construct. This is possibly because of the social and emotional domains are an implicit behaviour that could not be easily distinguished [27,28]. Overall, these analyses indicate there are two distinct factors underlying the responses to the Malay HHIA and that these factors have a high internal consistency. Consequently, it was decided to maintain the original two domains from the original HHIA questionnaire. The findings of this study show that the Malay version of the HHIA was easy to understand and acceptable to the Malay-speaking population. Other than the short time taken for the target population to answer the questionnaire, the comparability of the Malay versions with a few international versions of the HHIA demonstrate the evidence of the applicability of the questionnaires' in both clinical and research settings [2,11,13].

In conclusion, the present study found that the Malay HHIA has acceptable psychometric properties for its use in the Malaysian population. The Malay HHIA is easily understandable locally and easily administered, taking less than 10 minutes to fill. A clear and simple questionnaire serves as an advantage for the Malay HHIA to be used as a self-reported outcome measure for rehabilitation purposes.

However, limitations include a possible sample bias. Most participants were Malay and the majority of the participants recruited in the study had a higher level of Malay mastery. Thus, further psychometric property evaluations employing

a larger sample size among all the races in Malaysia may be beneficial for following researches and for a future clinical application of the HHIA in the audiology clinic. Overall, the Malay HHIA is expected to be useful in various settings and across the degree of hearing loss.

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Conflicts of interest

The authors have no financial conflicts of interest.

Author Contributions

Conceptualization: All authors. Data curation: Tengku Zulaila Hasma binti Tengku Zam Zam and Ahmad Aidil Arafat Dzulkarnain. Formal analysis: Tengku Zulaila Hasma binti Tengku Zam Zam, Sarah Rahmat and Ahmad Aidil Arafat Dzulkarnain. Funding acquisition: Masnira Jusoh and Ahmad Aidil Arafat Dzulkarnain. Investigation: Tengku Zulaila Hasma binti Tengku Zam Zam and Ahmad Aidil Arafat Dzulkarnain. Methodology: All authors. Project administration: Tengku Zulaila Hasma binti Tengku Zam Zam and Ahmad Aidil Arafat Dzulkarnain. Resources: All authors. Supervision: Ahmad Aidil Arafat Dzulkarnain and Sarah Rahmat. Validation: Tengku Zulaila Hasma binti Tengku Zam Zam, Ahmad Aidil Arafat Dzulkarnain, and Sarah Rahmat. Visualization: All authors. Writing—original draft: Tengku Zulaila Hasma binti Tengku Zam Zam and Ahmad Aidil Arafat Dzulkarnain. Writing—review & editing: All authors.

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REFERENCES

- 1) Lynn MR. Determination and quantification of content validity. *Nurs Res* 1986;35:382-5.
- 2) Aiello CP, Lima II, Ferrari DV. Validity and reliability of the hearing handicap inventory for adults. *Braz J Otorhinolaryngol* 2011;77:432-8.
- 3) Ciorba A, Bianchini C, Pelucchi S, Pastore A. The impact of hearing loss on the quality of life of elderly adults. *Clin Interv Aging* 2012; 7:159-63.
- 4) Dalton DS, Cruickshanks KJ, Klein BE, Klein R, Wiley TL, Nondahl DM. The impact of hearing loss on quality of life in older adults. *Gerontologist* 2003;43:661-8.
- 5) Cox RM, Alexander GC. The International Outcome Inventory for Hearing Aids (IOI-HA): psychometric properties of the English version. *Int J Audiol* 2002;41:30-5.
- 6) Cox RM, Alexander GC, Beyer CM. Norms for the international

- outcome inventory for hearing aids. *J Am Acad Audio* 2003;14:403-13.
- 7) Newman CW, Weinstein BE, Jacobson GP, Hug GA. The hearing handicap inventory for adults: psychometric adequacy and audiometric correlates. *Ear Hear* 1990;11:430-3.
- 8) Ventry IM, Weinstein BE. The hearing handicap inventory for the elderly: a new tool. *Ear Hear* 1982;3:128-34.
- 9) Berkanovic E. The effect of inadequate language translation on Hispanics' responses to health surveys. *Am J Public Health* 1980;70: 1273-6.
- 10) Guillemin F, Bombardier C, Beaton D. Cross-cultural adaptation of health-related quality of life measures: literature review and proposed guidelines. *J Clin Epidemiol* 1993;46:1417-32.
- 11) Monzani D, Genovese E, Palma S, Rovatti V, Borgonzoni M, Martini A. Measuring the psychosocial consequences of hearing loss in a working adult population: focus on validity and reliability of the Italian translation of the hearing handicap inventory. *Acta Otorhinolaryngol Ital* 2007;27:186-91.
- 12) Araújo PG, Mondelli MF, Lauris JR, Richiéri-Costa A, Feniman MR. Assessment of the auditory handicap in adults with unilateral hearing loss. *Braz J Otorhinolaryngol* 2010;76:378-83.
- 13) Sato M, Ogawa K, Inoue Y, Masuda M. Adaptation of Japanese version of the hearing handicap inventory for adults (HHIA). *Nihon Jibiinkoka Gakkai Kaiho* 2004;107:489-93.
- 14) Brislin RW. Research instruments. In: Lonner WJ, Berry JW, editors. *Field Methods in Cross-Cultural Research*. 1st ed. Thousand Oaks, CA: SAGE Publications, Inc.;1986. p.137-64.
- 15) Jones PS, Lee JW, Phillips LR, Zhang XE, Jaceldo KB. An adaptation of Brislin's translation model for cross-cultural research. *Nurs Res* 2001;50:300-4.
- 16) Zam TZ, Dzulkarnain AA, Rahmat S, Jusoh M. Translation and adaptation of hearing handicap inventory for adult (HHIA) into Malay language: a pilot study. *Int J Health Sci* 2017;1:92-100.
- 17) Kline RB, Santor DA. Principles & practice of structural equation modelling. *Can Psychol* 1999;40:381.
- 18) Watson R, Thompson DR. Use of factor analysis in *Journal of Advanced Nursing: literature review*. *J Adv Nurs* 2006;55:330-41.
- 19) Horn JL. A rationale and test for the number of factors in factor analysis. *Psychometrika* 1965;30:179-85.
- 20) Bardid F, Huyben F, Deconinck FJ, De Martelaer K, Seghers J, Lenoir M. Convergent and divergent validity between the KTK and MOT 4-6 motor tests in early childhood. *Adapt Phys Activ Q* 2016;33:33-48.
- 21) Henseler J, Ringle CM, Sarstedt M. A new criterion for assessing discriminant validity in variance-based structural equation modeling. *J Acad Mark Sci* 2015;43:115-35.
- 22) Sindhusake D, Mitchell P, Smith W, Golding M, Newall P, Hartley D, et al. Validation of self-reported hearing loss. *The Blue Mountains Hearing Study*. *Int J Epidemiol* 2001;30:1371-8.
- 23) Olusanya B. Self-reported outcomes of aural rehabilitation in a developing country. *Int J Audiol* 2004;43:563-71.
- 24) Taylor B. Self-report assessment of hearing aid outcome—an overview. *Hearing Aids-Adults 2007* [cited 2017 Jun 20]. Available from: http://www.audiologyonline.com/articles/article_detail.asp?article_id=1888.
- 25) Thammaiah S, Manchaiah V, Easwar V, Krishna R. Translation and adaptation of five English language self-report health measures to South Indian Kannada language. *Audiol Res* 2016;6:153.
- 26) Halai AD, Woollams AM, Lambon Ralph MA. Using principal component analysis to capture individual differences within a unified neuropsychological model of chronic post-stroke aphasia: revealing the unique neural correlates of speech fluency, phonology and semantics. *Cortex* 2017;86:275-89.
- 27) Greenwald AG, Banaji MR. Implicit social cognition: attitudes, self-esteem, and stereotypes. *Psychol Rev* 1995;102:4-27.
- 28) Roux P, Christophe A, Passerieux C. The emotional paradox: dissociation between explicit and implicit processing of emotional prosody in schizophrenia. *Neuropsychologia* 2010;48:3642-9.