INDIVIDUAL DIFFERENCES IN HEMISPHERICITY: ASSESSMENT OF "THE HEMISPHERIC MODE INDICATOR"

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INTRODUCTION

The *"Hemispheric Mode Indicator" (HMI)* (Lieberman, 1986; McCarthy, 1993) is a self-report measure designed to assess hemisphericity. Hemisphericity refers to the idea that people tend to rely, at least sometimes and in some situations, upon a preferred mode of cognitive processing, which is linked to differential involvement of the cerebral hemispheres (Bogen & Bogen, 1983).

The HMI is comprised of 32 pairs of words or phrases, one of each pair reflecting right-brain functions and the other left-brain functions. Subjects are instructed to choose "a lot" or "somewhat" with respect to one or other pole of the pairs. Scores can range from -64 to +64, with lower values indicating relative left-hemispheric preference and higher values indicating relative right-hemispheric preference. Information of both reliability and validity indices of the HMI is limited. Only two studies, developed by Lieberman (1986) and Hartman & Hylton (1997), have reported indices of internal consistency, test-retest reliability and concurrent validity. The correlation coeficients resulting of such analyses show a very acceptable psychometric properties of the Hemispheric Mode Indicator.

PURPOSE

- To analyse the psychometric properties (internal consistency, temporal reliability and validity indices) of a Spanish version of the *Hemispheric Mode Indicator*.
- To verify the existence of individual differences in lateralized cognitive strategies of information processing by sex and handedness.

METHOD & PSYCHOMETRIC ANALYSIS

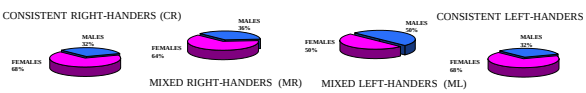
SUBJECTS

The sample consisted of 325 Spanish undergraduate students (215 females and 110 males) recruited from the campus of the U*niversity of Barcelona (UB)* and the *Politechnics University of Catalonia (UPC)*. Their ages ranged from 18 to 46 years, with a mean of 21.19 years (Std. Dev.=3.34) for females, and a mean of 22.16 years (Std. Dev.=4.62) for males.

To verify differences in cognitive strategies of information processing, associated by some researches (e.g. Coren, 1995) to the hemispheric asymmetry as a function of handedness and sex, subjects were subdivided by sex into four categories of manual lateralization (*Consistent Right-Hander* (CR), *Mixed Right-Hander* (MR), *Mixed Left-Hander* (ML) and *Consistent Left-Hander* (CL). The indices of manual lateralization was computed as suggested by Coren (1993). Ambilateral subjects were included into mixed left-hander category (ML).

DISTRIBUTION OF THE SAMPLE BY SEX AND HANDEDNESS

SEX/HAND.	CR	MR	ML	CL	N	RATIO
FEMALES	141	49	8	17	215	66%
MALES	67	27	8	8	110	34%
N	208	76	16	25	325	100%
RATIO	64%	23%	5%	8%	100%	



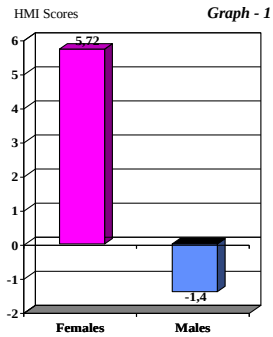
DESCRIPTIVES OF HMI SCORES BY SEX AND HANDEDNESS

SEX/HAND.	CR	MR	ML	CL	TOTAL
FEMALES	Mean=4.11 Std. Dev.=17.92	8.18 16.00	8.87 14.54	10.47 18.89	5.72 17.50
MALES	-1.21 18.71	-0.23 13.87	-12.12 19.55	3.87 22.47	-1.40 17.73
TOTAL	2.41 18.12	5.26 15.73	-1.62 19.86	8.36 19.87	3.33 17.87

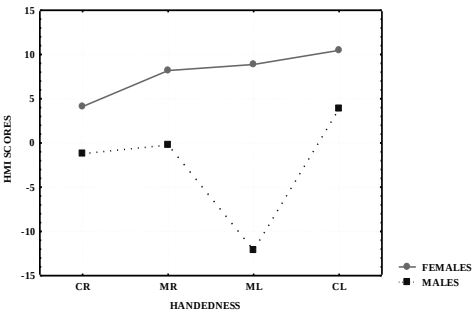
The HMI scores are normally distributed (Kolmogorov-Smirnov d=0.02280, p= n.s.).

To test if the HMI scores are different between males and females an *ANOVA Between Groups* was performed with HMI scores as dependent variable and sex and handedness as independent variables. All variables comply with Homocedasticity Test (p>0.05). Significant differences were found between sexes in HMI scores. As we can see in the *Graph 1*, women score higher than men in right hemispheric preference ($F_{(7,315)}$ =2.76 p=0.008).

Graph - 1



HMI SCORES BY SEX AND HANDEDNESS



The analysis of the interaction "sex by handedness" in relation to preferred lateralized cognitive strategies yields significant differences among the several groups, such as is shown in the above graph.

There are significant differences between sexes in each one of the several groups of handedness: CR (p=0.042), MR (p=0.048), ML (p=0.017), with the exception of CL. Moreover of differences shown, it is worth noting differences among mixed left-handed (ML) males and the other groups of females: ML-CR (p=0.011), ML-MR (p=0.002), ML-ML (p=0.017), ML-CL (p=0.002). According to the tendency shown in *Graph-1*, females of all groups of manual lateralization always score significantly greater than males in HMI. Likewise, significant differences were found between consistent left-handed (CL) females and consistent right-handed (CR) males (p=0.014), and between mixed right-handed (MR) females and consistent right-handed males (p=0.004). This general tendency of women to score higher than men in a right mode of cognitive processing confirms results of a previous work in which hemisphericity was assessed through the *Human Information Processing Survey* (Ruiz et al, 1998).

RELIABILITY INDICES

INTERNAL CONSISTENCY OF H M I

N=325	Reliability Results
Nº ITEMS	32
Mean	3.17
Std. Dev.	17.77
Cronbach's α	0.81
Estandardized α	0.81

Hartman & Hylton (1997) report Alpha coefficients of 0.78 and 0.84 for different samples.

SPLIT-HALF RELIABILITY INDICES OF THE *"HEMISPHERIC MODE INDICATOR"*

N=325	FIRST HALF	SECOND HALF
Items Half 1-2	Odds	Evens
Nº Items	16	16
Mean	2.64	0.54
Std. Dev.	9.80	9.38
Cronbach's α	0.70	0.66

r_{xy} half 1-2 = 0.72
Spearman-Brown Reliability Index = 0.83
Guttman Reliability Index = 0.83

Average Inter-Item Correlation = 0.12

TESTS - RETEST RELIABILITY

TEMPORAL STABILITY OF *H M I*

Comparative Study	Lieberman (1986)	Hartman & Hylton (1997)	Present data
N	47	70	140
Retest Interval	2 months	6 months	3 months
$r_{Test\text{-}Retest}$	0.90	0.74	0.89

FACTOR ANALYSIS

As the HMI returns a single score for each subject, Hartman & Hylton (1997) consider that hemisphericity should be treated as unidimensional. So, in spite of preliminary exploratory principal components analyses indicate that the factor structure of this instrument's items actually is multidimensional, they focus on correlations of all items with the underlying first component (structure coefficients). Their hypothesis is: "if structure coefficients associated whit a principal component are relatively high and interitem correlations relatively low, low item redundancy and strong, multi-item support for the underlying construct are suggested" To verify this point we have examined the factor structure of the Spanish version of HMI.

FACTOR ANALYSIS OF HMI *(N=313)*

FEATURES OF THE CORRELATION MATRIX	RESULTS
Determinant	0.0004437
KMO	0.83
Bartlett Test of Sphericity	2319.9791 (Sign=.00000)
% OFF-Diagonal elem.>0.09	10.3% (102)
FACTOR EXTRACTION	Principal Components
ROTATION METHOD	Varimax
Fact. with Eigenvalues > 1	9
Cum Pct of Var	55.3%
Residuals > 0.05	226 (45%)
Criteria Factors (*Scree Test*)	4
Cum Pct of Var	(36.2%)

See correlations of each item of HMI with first principal component in the attached table. Structure coefficients and item/overall score correlations are ranked by absolute value of structure coefficients. To compute item-overall score correlations, item of interest was excluded.

Correlation of each item of H M I with fist principal component and with over-all score

Hartman & Hylton (1997) (N=525)			*Present data (N=313)*		
Item	Principal Comp.	Over-all Score	Item	Principal Comp.	Over-all Score
11	.62	.45	30	.68	.59
3	.60	.48	19	.65	.53
18	-.60	**-.51**	5	.63	.56
25	.58	.48	24	.63	.53
15	.57	.41	20	.60	.52
30	.56	.48	21	.60	.48
2	.55	.43	3	.58	.47
5	.54	.43	11	.58	.49
22	.53	.42	1	.57	.45
23	.51	.40	23	.57	.48
1	.50	.47	15	.56	.43
21	.49	.42	10	.52	.42
24	.47	.42	6	.51	.44
8	.47	.36	25	.48	.38
16	.47	.40	22	.45	.38
10	.45	.32	8	.42	.36
19	.41	.39	2	.41	.35
6	.40	.34	18	-.39	**-.34**
17	.39	.31	32	.37	.32
13	.39	.37	13	.36	.34
28	.38	.34	14	.34	.27
14	.36	.30	7	.32	.27
32	.28	.23	4	.27	.25
7	.25	.22	26	.27	.27
31	.22	.19	17	.17	.20
26	.22	.18	28	.17	.13
12	.21	.21	16	.17	.13
9	-.19	**-.17**	12	.13	.14
20	.14	**.11**	27	.08	.12
4	.13	.14	31	-.07	**-.06**
29	.09	**.08**	9	-.04	**-.04**
27	-.06	**-.05**	29	-.001	**.009**
Average % Var.	.34 18.2	.28	*Average % Var.*	.36 19.6	0.31

Correlations in bold type are either negative or not statistically significant at p<0.05 level.

VALIDITY INDICES

Convergent validity was calculated by the product-moment correlation between the HMI and other much better known measures of hemisphericity: HIPS (Taggart, et al., 1984), SOLAT (Torrance, et al., 1980) and HPT (Merckelbach, et al., 1996).

CONVERGENT VALIDITY

CRITERIA	r_{xy}
SOLAT *(N=230)*	0.64*
HIPS *(N=319)*	0.61*
HPT *(N=319)*	0.61*

* Significant at p<0.001

To verify if HMI discriminate the cognitive strategies of information processing identified with left (Analytic) and right (Holistic) hemispheres, we have analyzed the HMI scores of two groups of subjects (N=136) classified like very analytic (N=47) or very holistic (N=87) through the Hemisphere Preference Test (HPT)

(t = -9.392 p=0.00000)

These results reveal very acceptable indices of validity.

CONCLUSIONS

Psychometric analysis of the Spanish version of the HMI results in very good indices of reliability, and in acceptable convergent validity indices. This results are agree with Lierberman and Hartman & Hylton's findings.

Factor analysis suggests the multidimensional structure of the HMI. According to Hartman & Hylton (1997) the structure coefficients and item/overall score correlations make clear that items 9, 18 and 29 should be reworded or discarded.

With regard to individual differences in lateralized cognitive strategies of information processing assessed by HMI, in relation to sex and handedness, it is worth noting the general tendency of women to score higher than men in an holistic mode in all groups of manual lateralization. The most significant contrast with analytic mode is show with regard to the group of mixed left-handed males.

•Bogen, J.E. & Bogen, G.M. (1983). Hemispheric specialization and cerebral duality. *TheBehavioral and Brain Sciences, 6 (3),* 517-520.

• Coren, S. (1993). The Lateral Preference Inventory for measurement of handedness, footedness, eyedness and earedness. *Bull. Psychon. Soc., 31 (1),* 1-3. Coren, S. (1995). Differences in divergent thinking as a function of handedness and sex. *Am. J. Psychol., 108 (3),* 311-325.

• Hartman,S. & Hylton, J. (1997) Estimates validity and reliability for the Hemispheric Mode Indicator. *Perceptual and Motor Skills, 85,* 1355-1364

• Lieberman, M.G. (1986). *The Hemispheric Mode Indicator (HMI). Technical notes.* Barrintong, IL: Excel, Inc.

• McCarthy, B. (1993). *Hemispheric Mode Indicator (HMI).* Barrintong, IL: Excel, Inc.

• Merckelbach, H. Muris, P., Pool, K., De Jong, P. & Schouten, E. (1996). Reliability and validity of a paper-and-pencil Test Measuring Hemisphere Preference. *European Journal of Personality, 10,* 221-231.

• Ruiz, J., Tous, J.M. & Fusté, A. (1998). Individual differences in lateralized cognitive strategies: "The Human Information Processing Survey". *9th. European Conference on Personality.* University of Surrey. Guilford, United Kingdom.

• Taggart, W. & Torrance, P. (1984). Human Information Processing Survey. *Scholastic Testing Service, Inc.*Bensenville, Illinois.

• Torrance, E. & Reynolds, C. (1980) *Preliminary norms-technical manual for Your Style of Learning and Thinking.* Athens, C.A. Univ. of Georgia

5th EUROPEAN CONFERENCE ON PSYCHOLOGICAL ASSESSMENT . University of Patras, GREECE (1999)