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# Neuropsychological evaluation in patients with eating disorders

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Artículo original


## SUMMARY

Research related to neuropsychological evaluation on eating disorders (ED) has produced diverse results, being more abundant those which study attention, specifically using Stroop Test, both in the standard and the modified versions, using words related to food and body shape. In most of the cases, different clinical groups have not been used in the same research. Studies have not used other tests which evaluate cognitive areas besides those evaluated by Stroop Test; and most of researchers who have measured attention with Stroop Test have focused on measuring latency and not interference.

Some studies have found deficits in attention, executive functions, and memory in patients with ED; however, other studies have not found deficits in attention.

Because of this evidence, the present study proposed that patients with ED would show deficits in selective attention, perseverative thinking, working memory, and executive planning, compared to a control group without ED.

Participants included 26 female patients with bulimia nervosa (BN) and 10 female patients with anorexia nervosa (AN), matched in age and education by the control group (n = 36). All patients met eating disorders criteria, and did not have a history of neuropsychological evaluation.

Four neuropsychological tests were individually administered in two sessions with a counterbalanced approach: 1. Wisconsin Card Sorting Test, 2. Stroop Colors Test (developed in the program E-Prime with words related to food and body shape), 3. Rey-Osterrieth Complex Figure, and 4. Tower of London Test.

There was a significant difference between three groups in the memory test, the execution total time and in the number of perseverative answers. In memory, the AN group had the worst performance, followed by the BN group. As for the executive planning, both AN and BN groups took longer to complete the test compared to the control group. Finally, AN and BN groups showed more perseverative answers than the control group.

There was a statistically significant difference in the number of errors for negative words related to body shape. Post hoc indicated that AN and BN groups produced more errors than the control group, whereas BN group took longer to complete the negative word list related to body shape, in comparison to the control group.

Results demonstrate a deficit in cognitive processing in AN and BN groups. The AN group showed a greater impairment in memory than BN group, in comparison to the control group; additionally, both groups of patients took longer to complete the Tower of London Test. This indicates the existence of problems of executive planning in these patients. What is more, in both groups of patients a greater perseverative thinking was observed; this indicates an impairment in the establishment of an appropriate strategy to solve problems, a characteristic of BN patients.

Anorectic and bulimic patients showed an attentional deficit for words with negative valence related to body shape. In addition, the AN group showed an attentional bias both for words with positive valence and words with negative valence related to food, and the BN group produced more errors in the words with positive valence related to body shape. In this sense, it is proposed that the patients have general units of knowledge or «schemes» that determine what the most important aspects of a situation are and what sort of information will be stored and processed. From this perspective, body image alterations, and attentional, memory, and executive functions biases for stimuli related to food, shape, and weight represent different ways of information processing biases, because there is distortion in the way the patients perceive and interpret their experiences.


**Key words:** Eating disorders, cognitive assessment, working memory, problem solving.


## RESUMEN

Los trabajos relacionados con la evaluación neuropsicológica de sujetos con trastornos alimentarios (TCA) han obtenido resultados diversos, y abundan más aquellos que estudian la atención, específicamente con la Prueba de Stroop, tanto en su versión estándar como en las modificadas, para lo cual emplean palabras relacionadas con la comida y la figura. En la mayoría de los casos, no se han utilizado diferentes grupos clínicos en la misma investigación. No se han utilizado tampoco otras pruebas que evalúen aspectos cognoscitivos, además de aquellos que evalúa la Prueba de Stroop; y la mayoría de las investigaciones que han medido la atención con ésta se han enfocado en medir la latencia y no la interferencia.



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Algunos estudios han encontrado déficits en la atención, funciones ejecutivas y en la memoria en pacientes con TCA, pero otros estudios no encontraron déficits en la atención.

A la luz de estas evidencias, este trabajo hipotetiza que las pacientes con TCA presentan déficits en la atención selectiva, el pensamiento perseverativo, la memoria de trabajo y la planeación ejecutiva en comparación con un grupo de sujetos control sin TCA.

El grupo de 36 pacientes de nuevo ingreso con TCA incluyó 26 mujeres con BN y 10 con AN. La muestra sin trastorno (n = 36) se emparejó por edad y nivel de estudios con la muestra de pacientes. Todas las pacientes cumplieron los criterios de TCA y no tenían historia de evaluación neuropsicológica.

Se aplicaron cuatro pruebas neuropsicológicas de manera individual y contrabalanceada en dos sesiones: 1. Prueba de Ordenamiento de Tarjetas de Wisconsin, 2. Prueba de Colores de Stroop (desarrollada en el programa E-Prime, con palabras relacionadas con la comida y la figura corporal), 3. Prueba de la Figura Compleja de Rey-Osterrieth, y 4. Prueba de la Torre de Londres.

Se observó una diferencia significativa entre los tres grupos en la prueba de memoria, en el tiempo total de ejecución y en el número de respuestas perseverativas. En la prueba de memoria, el grupo con AN tuvo el peor desempeño, seguido por el grupo con BN. Para la planeación ejecutiva, tanto al grupo con AN como el de BN les tomó más tiempo realizar la prueba. Finalmente, los grupos con AN y BN mostraron más respuestas perseverativas que el control.

Se observó una diferencia estadísticamente significativa en el número de errores para palabras negativas relacionadas con la figura corporal. Los grupos con AN y BN cometieron más errores que el control, mientras que al grupo con BN le tomó más tiempo completar la serie de palabras negativas relacionadas con la figura y el peso corporal, en comparación con el control.

Los resultados demuestran un deterioro en el funcionamiento cognoscitivo tanto en los sujetos con AN y BN. Las pacientes con AN presentaron un sesgo mayor en la memoria que el grupo con BN en relación con el grupo control. Adicionalmente, a los dos grupos de pacientes les tomó más tiempo realizar la Prueba de la Torre de Londres. Ello indica la existencia de problemas de planeación ejecutiva en estas pacientes. También en ambos grupos de pacientes se observó un mayor pensamiento perseverativo que señala déficits en el establecimiento de una estrategia adecuada para solucionar problemas, lo cual es característico de las pacientes con BN.

Las pacientes anoréxicas y bulímicas mostraron un sesgo en la atención para palabras con valencia negativa relacionadas con la figura y el peso. Adicionalmente, el grupo con AN presentó un sesgo en la atención tanto para palabras con valencia positiva como con valencia negativa relacionadas con la comida, mientras que el grupo con BN cometió más errores en las palabras con valencia positiva relacionadas con la figura. En este sentido, se ha propuesto que las pacientes tienen unidades generales de conocimientos o «esquemas» que determinan qué aspectos de una situación son más importantes y qué información será almacenada y procesada. Desde esta perspectiva, las alteraciones en la imagen corporal, los sesgos en la atención, en la memoria y en las funciones ejecutivas para estímulos relacionados con la comida, la figura y el peso corporal representan distintas formas de sesgos en el procesamiento de información, debido a que existe una distorsión en la manera en que los individuos perciben e interpretan sus experiencias.

**Palabras clave:** Trastornos alimentarios, evaluación cognoscitiva, memoria de trabajo, solución de problemas.

## INTRODUCTION

Neuropsychological research on eating disorders (ED) has been carried out based on the assumption that ED are associated with alterations in cognitive processing,[1] specially in the processes of attention,[2] memory,[3] reasoning,[4] and recently, executive functions.[5] A review of the literature suggests that research related to neuropsychological evaluation in ED: a) has produced diverse results, being more abundant those which study attention, specifically with the Stroop Test, both with the standard version and the modified one, using words related to food and body shape; b) in most of the cases, other tests have not been used to evaluate cognitive functions, apart from Stroop test; c) different clinical groups in the same research have not been used, and d) most of researchers who have measured attention by means of the Stroop Test have focused on measuring latency and not interference.

There have been indications that patients with ED might be impaired in several neuropsychological domains.[6-13] Despite some studies having found that ED are associated with neuropsychological deficits, the function that is deteriorated varies among the studies, possibly due to variations in methodology.[14] Some neuropsychological studies failed to find cognitive biases in patients with ED.[15-17] It is possible that other studies with similar findings have not been referred due to the tendency to publish only significant results.[10] Moreover, some studies have evaluated isolated functions.

Some studies have found attentional deficits in patients with ED;[7-9,12,16,18-20] nonetheless, other studies[4,15,21,22] did not find deficits in attention.

Neuropsychological studies on ED have indicated deficits in executive functions.[2,8,9,12,14,23-27] On the other hand, Fowler et al.[28] did not find deficits in executive functions in patients with anorexia nervosa (AN) in comparison to normal controls.

In AN patients, studies found deficits in memory, reaction times, and motor speed.[7,8,25] In patients with AN, Sherman et al.[29] found deficits in non-verbal memory in comparison to controls, using the test of Complex Figure by Rey; however, other studies have failed to find cognitive impairments. Fowler et al.[28] did not find biases on working memory in patients with AN in comparison with their controls. We did not find studies on neuropsychological evaluation with ED patients in Hispanic or Mexican samples.

This study proposed that patients with ED would show deficits in selective attention, perseverative thinking, working memory, and executive planning, compared to the control group without ED.

## MATERIAL AND METHOD

### Participants

This study was carried out with a sample of 26 female patients with bulimia nervosa (BN) and 10 female patients (AN) at an in-patient eating disorder clinic in Mexico City. Participants' ages ranged from 15 to 25 years of age ($A$ = 23.8, $SD$ = 3.81). ED sample was matched in age and education by a control group (n = 36) recruited from different schools in the same city. All patients met eating disorders criteria, outlined in the 4th ed. of the *Diagnostic and Statistical Manual of Mental Disorders*,[30] by means of the Interview for the Diagnosis of Eating Disorders-IV[31] and did not have a history of neuropsychological evaluation. The criterion of exclusion for the control group was the presence of current or previous psychiatric disorders or familiarity with tests. An expert psychologist carried out the interview with each participant. Patients who took part in the study were in the initial phase of their treatments in order to avoid any interference caused by the therapy. The participants' written informed consent or that from their parents (in the case of being underage) was required to participate in the research. This study was approved by the Ethics Committee of Hospital 1° de Octubre from the ISSSTE.

### Measures

The Wisconsin Card Sorting Test (WCST) measures the ability to shift cognitive strategies and the ability to develop and maintain an appropriate strategy for problem solving.[32] This test has a reliability of 0.52 for the number of perseverative errors, 0.71 for the number of errors, and 0.72 for the number of non-perseverative errors.[33] Perseverative thinking was measured using the total number of answers where the participant persisted on responding incorrectly to the stimulus, which is a cognitive flexibility measure made by the dorsal-lateral prefrontal cortex.

In order to measure latency and interference on selective attention, a computerized version of the Stroop Colors Test was used,[34] developed by the first author in the E-Prime program[35] with words related to food and body shape. Reliability with the Cronbach's alpha coefficient was of 0.92 for the eight-word lists. Latency was measured using average times (in milliseconds) obtained by the participants when indicating the color of the words. Interference was evaluated using the total number of errors obtained by the participants when indicating the color of stimulus words.

The Rey-Osterrieth Complex Figure[36] measures organization capacity, planning of strategies for problem solving, memory, and visoconstructive capacity. In Mexico, this test showed a good reliability ($\alpha$ = 0.83 and 0.78) for copy and memory respectively.[37] In the present work, it was used to evaluate working memory. The quantitative system more commonly used for this test includes 18 elements, each one scored with a maximum of two points. Working memory was measured using the scores obtained in the memory section.

The Tower of London-Drexel ($TOL^{DX}$) is a test that measures planning and problem solution, behavioral inhibition, control of impulses, location of attention, cognitive flexibility, abstract reasoning, and behaviors based on rules.[38] Test-retest reliability in an interval of 20 days is acceptable for the number of movements and violations of time.[38] In this study it was used to evaluate executive planning, using the execution's total time and movements' total number.

### Procedure

In order to create the modified Spanish version of Stroop Test, l20 interviews previously made to patients were reviewed in the Eating Disorders Laboratory of the FES-Iztacala. The 40 words with the highest frequency related to food, body shape and weight were used. Later, a group of 60 college students without ED was asked to evaluate the valence (positive or negative) of these words. This gave out a word list that at least 80% of the participants evaluated, either positively or negatively. Four stimulus-word lists were extracted, each one with three words presented in the Spanish language: 1. positive words related to food: SALAD, MILK, CEREAL (*ENSALADA*, *LECHE*, *CEREAL*); 2. negative words related to food: SODA, TACO, FAT (*REFRESCO, TACO, GRASA*); 3. positive words related to body shape: SILHOUETTE, THIN, SHAPE (del tipo *SILUETA, DELGADA, FIGURA*); and 4. negative words related to body shape: OBESITY, OVERWEIGHT, BINGE-EATING (*OBESIDAD, GORDA, ATRACÓN*). The lists were ordered by color according to the original Stroop Test, resulting four lists of 100 words each. Additionally, four lists of neutral words of common use (one for each list of stimulus words) were matched according to the number and sort of syllables of each stimulus word i.e. STAIR, CAR, CITY (*ESCALERA, CARRO, CIUDAD*), consulting the Dictionary of the Usual Mexican Spanish.[39] The eight lists (each one with 100 words) were counterbalanced to apply them to each participant and displayed in two groups of 400 words each one.

Neuropsychological tests were individually applied, in a counterbalanced approach in two sessions, in an isolated place free from distractions. Stroop Test was applied with a 14-inch portable computer screen, whereas the other tests were applied in their traditional format.

### Data analysis

The statistical program SPSS version 10 was used to carry out the analysis. Comparisons were made using one-way

**Table 1.** One-way ANOVA for the scores of the groups in memory, planning, and perseverative thinking

| | AN ($n$ = 10) | | BN ($n$ = 26) | | Control ($n$ = 36) | | |
|---|---|---|---|---|---|---|---|
| Test | *M* | (*SD*) | *M* | (*SD*) | *M* | (*SD*) | *F* (2,69) |
| Number of recalled elements (Rey) | $17.22_{a}$ | (3.27) | $21.86_{b}$ | (5.52) | $24.90_{c}$ | (2.50) | 14.01*** |
| Total number of movements (TOL) | 44.33 | (20.81) | 43.86 | (18.13) | 36.87 | (15.57) | 1.28 |
| Execution total time (TOL) | $339.89_{a}$ | (40.43) | $300.14_{a}$ | (102.41) | $234.63_{b}$ | (69.55) | 7.84*** |
| Number of perseverative answers (WCST) | $12.22_{a}$ | (7.33) | $13.24_{a}$ | (9.66) | $6.57_{b}$ | (4.05) | 6.32** |

** $p < .01$, ***$p < .001$.
Means in same line that do not share subscripts, are significantly different.

ANOVA for scores in WCST, Rey-Osterrieth Complex Figure, Stroop Test, and Tower of London Test, between patients and the control group.

## RESULTS

No differences were found on age and education between ED patients and the control group ($p$>0.05).

Results of memory, executive planning, and perseverative thinking are shown in table 1. There were significant differences between the three groups in memory, execution total time (TOL) and in the number of perseverative answers (WCST).

In memory, the AN group had the worst performance, followed by the BN group. For executive planning, both AN group and BN group, took longer to complete the test in comparison to the control group. Finally AN and BN groups showed more perseverative answers than the control group.

The results of error numbers and reaction times in the Stroop Test are shown in table 2. There were statistically significant differences in error numbers for negative words related to body shape. Post hoc indicated that AN and BN groups produced more errors than the control group, whereas BN group took longer to complete the negative word list related to body shape in comparison to the control group.

## DISCUSSION

Results from the current study demonstrate a deficit in cognitive processing in AN and BN groups. The AN group showed a greater impairment than BN group in memory in comparison to the group control. These findings are consistent with those by Tchanturia, Campbell, Morris, and Treasure,[40] who found a poor performance of memory in AN patients. Additionally, both groups of patients took longer to complete the Tower of London Test. It indicates the existence of problems of executive planning in these patients. Also in both groups of patients a greater perseverative thinking was observed which indicates an impairment in the establishment of an appropriate strategy to solve problems, which is characteristic of BN patients.[1] On the other hand, it was observed that the anorectic and bulimic patients

**Table 2.** Means for three groups in interference (number of errors) and latency (in milliseconds) for the Stroop test

| | AN ($n$ = 10) | | BN ($n$ = 26) | | Control ($n$ = 36) | | |
|---|---|---|---|---|---|---|---|
| Word list | *M* | (*SD*) | *M* | (*SD*) | *M* | (*SD*) | *F* (2,69) |
| Interference | | | | | | | |
| Food positive | 1.20 | (1.03) | 2.31 | (1.78) | 2.08 | (1.71) | 1.62 |
| Neutral | 2.50 | (1.65) | 2.08 | (1.67) | 2.08 | (1.63) | 0.28 |
| Food negative | $0.90_{b}$ | (1.29) | 2.35 | (2.00) | $2.83_{a}$ | (2.12) | 3.72* |
| Neutral | 1.00 | (1.15) | 1.88 | (2.21) | 2.25 | (1.70) | 1.81 |
| Shape positive | 2.00 | (1.89) | 3.27 | (2.54) | 2.39 | (1.74) | 1.92 |
| Neutral | 2.00 | (1.49) | 1.88 | (2.18) | 2.31 | (1.53) | 0.44 |
| Shape negative | 2.30 | (1.77) | $2.92_{b}$ | (2.97) | $1.31_{a}$ | (1.49) | 4.28* |
| Neutral | 2.10 | (1.85) | 1.77 | (1.42) | 1.33 | (1.07) | 1.65 |
| Latency | | | | | | | |
| Food positive | $1162.25_{b}$ | (217.24) | 1045.94 | (236.63) | $971.18_{a}$ | (197.06) | 3.30* |
| Neutral | 1069.26 | (204.41) | 1014.12 | (230.09) | 953.40 | (183.65) | 1.51 |
| Food negative | $1233.70_{b}$ | (296.13) | 1079.83 | (246.43) | $989.93_{a}$ | (209.84) | 4.37* |
| Neutral | 1068.15 | (235.52) | 1049.85 | (244.55) | 975.33 | (197.08) | 1.20 |
| Shape positive | $1171.61_{b}$ | (284.78) | $1100.28_{b}$ | (218.63) | $957.24_{a}$ | (161.51) | 6.25** |
| Neutral | 1130.07 | (340.83) | 1038.32 | (183.67) | 984.41 | (183.14) | 1.96 |
| Shape negative | $1182.41_{b}$ | (314.46) | $1143.35_{b}$ | (229.98) | $956.05_{a}$ | (207.90) | 6.65** |
| Neutral | 1107.08 | (334.43) | 1016.81 | (203.67) | 957.21 | (146.35) | 2.32 |

* $p < .05$; ** $p < .01$.
Means in same line that do not share subscripts, are significantly different.

showed attentional deficit for words with negative valence related to body shape. Likewise, the AN group showed an attentional bias for both words with positive valence and words with negative valence related to food, and the BN group produced more errors in the words with positive valence related to body shape. These findings are consistent with the suggestion by Cooper and Fairburn,[22] in which AN patients are more concerned about feeding, whereas BN patients are more concerned about body weight and shape. In this sense, it is proposed that patients have general units of knowledge or «schemes» that determine which aspects of a situation are more important and which information will be stored and processed. Specifically, cognitive biases emerge from information related to the person's concerns.[41]

From this perspective, alterations to body image, and deficits in attention, memory, and in executive functions for stimuli related to food, body weight and shape, represent different forms of deficits in information processing, because there is a distortion in the way the individuals perceive and interpret their experiences.[42] Results could indicate that ED reflect deeper deficits on the nervous system.

Our findings are subject to the limitations shared by cross-sectional studies, particularly in terms of potential cohort effects. Moreover, we only recruited a relatively small sample in this study, thereby limiting the power of analysis. Finally, it would be important to evaluate neuropsychological functioning after patients receive treatment to identify changes in cognitive functions and to identify whether cognitive deficits are related to ED or are the base of psychopathological structure.

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