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Semantic memory on verbal fluency test in patients with anorexia nervosa

Memoria semántica en prueba de fluidez verbal en pacientes con anorexia nerviosa

Ignacio Jauregui-Lobera¹, Jesús M. Culebras²

¹Instituto de Ciencias de la Conducta y Universidad Pablo de Olavide. Sevilla. España.

²De la Real Academia de Medicina de Valladolid y del IBIOMED, Universidad de León. Académico Asociado al Instituto de España. AcProfesor Titular de Cirugía. Director, Journal of Negative & No Positive Results. Director Emérito de NUTRICION HOSPITALARIA. España

* Autor para correspondencia.

Correo electrónico: ijl@tcasevilla.com (Ignacio Jauregui-Lobera).

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Abstract

Introduction. The aim of this study was to analyse the performance and the semantic organization of patients with anorexia nervosa (AN) and of healthy controls by means of a “Human Body Parts” type of (Semantic Verbal Fluency) SVF task.

Method. A total of 58 participants took part in this study (23 suffered from anorexia nervosa, with a mean age of 21.32 ± 2.53 , and 35 healthy participants, with a mean age of 22.41 ± 1.67). The Verbal Fluency Test “Human Body Parts” (a word naming task) was applied. In this task, participants were asked to say as many “Human Body Parts” as possible in a period of 1 minute. Participants were given the instruction not to repeat body parts already said. Responses were recorded and transcribed in order to be analysed.

Results. The mean number of words for the control group was 15.94 ± 7.79 and in case of anorectic patients it was 17.52 ± 5.23 . With respect to intrusions and perseverance there were not any significant differences, having obtained 0.10 (control group) and 0.11 (anorectic patients), and 0.42 (control group) and 0,46 (anorectic patients) respectively. With respect to correspondence analysis, a two-dimensional



representation yielded 90.01% of the total inertia, thus accepting two-dimensional map as valid. “Perceptible parts of human body” and “Internal parts” would be representative of one category and “Small parts” would be representative of the other. In the anorectic patients group some parts such as waist, ass, thighs and calf muscle were the most remembered words. In the control group, internal parts such as brain, heart and liver, along with tongue, are the most remembered words in the semantic memory organization.

Discussion. Semantic maps obtained in both groups of participants appear to be very different. Specifically, the semantic category “body parts” seems to be very influenced by the presence of anorexia nervosa. It is possible to conclude that studies on AN have reported controversial results in this field of study.

Keywords

Anorexia nervosa; human body parts; semantic memory; verbal fluency task

Resumen

Introducción. El objetivo de este estudio fue analizar el rendimiento y organización semántica de pacientes con anorexia nerviosa (AN) y un grupo de participantes de control mediante una Tarea de Fluidez Verbal semántica del tipo “Partes del Cuerpo Humano”.

Método. Participaron un total de 58 individuos (23 con anorexia nerviosa, con una media de edad de 21.32 ± 2.53 ; y 35 controles, con una media de edad de 22.41 ± 1.67). Se aplicó el Test de Fluidez Verbal “Partes del Cuerpo Humano (tarea de decir palabras). En esta tarea se solicitó que dijeran tantas Partes del Cuerpo Humano como pudieran en 1 minuto. Se les dio la instrucción de no repetir partes del cuerpo ya mencionadas. Las respuestas se grabaron y transcribieron para el análisis posterior.

Resultados. La media de palabras en el grupo de control fue 15.94 ± 7.79 ; en el caso del grupo de anorexia nerviosa la media fue 17.52 ± 5.23 . Con respecto a la presencia de intrusiones y perseverancia no hubo diferencias significativas, habiendo obtenido 0,10 (grupo de control) y 0,11 (grupo de anorexia), y 0,42 (grupo de control) y 0,46 (grupo de anorexia) respectivamente. Con respecto al análisis de correspondencia, la representación bidimensional arrojó el 90,01% de la inercia total, por lo que el mapa bidimensional se consideró adecuado. “Partes perceptibles del cuerpo humano” y “Partes internas” serían representativas de una categoría, y “Pequeñas partes” lo sería de la otra. En el grupo de pacientes con anorexia nerviosa algunas partes como la cintura, el culo, muslos y pantorrillas fueron las palabras más recordadas. En el grupo de control las partes internas como cerebro, corazón, hígado o lengua fueron las más recordadas en su organización semántica.

Discusión. Los mapas semánticos obtenidos en ambos grupos parecen muy diferentes. Específicamente, la categoría semántica “partes del cuerpo” parece muy influenciada por la presencia de anorexia nerviosa. No obstante, puede concluirse que los estudios sobre anorexia nerviosa han venido dando lugar a resultados controvertidos en este campo de estudio.

Palabras clave

Anorexia nerviosa; partes del cuerpo humano; memoria semántica; test de fluidez verbal



Introduction

Anorexia nervosa (AN) is characterised by different physiological and psychological symptoms, cognitive factors being a core element in this disorder with the presence of specific thoughts related to food, weight and body shape. Some attentional and memory biases have been described in these patients. With respect to attentional bias, it has been reported in case of body shape and weight stimuli but it seems not to be generalizable to food stimuli. Regarding memory bias, it seems to be present in different mental disorders. In AN, different studies have shown several disturbances in memory tasks⁽¹⁾. In a pioneer study on memory bias in eating disorders, authors reported that eating disordered individuals showed a memory bias for weight- and food-related information. They found that obese and eating disorder patients recalled more weight- and food-related information than other items, implying the existence of a memory bias⁽²⁾. In fact, there is ample evidence of a selective memory bias in patients with AN, mainly reflected in an enhanced explicit recall for AN-related stimuli. Selective processing of eating disorder-related stimuli in patients with AN has been interpreted as an “activation of self-schemata”⁽³⁻⁵⁾.

Verbal fluency performance is commonly evaluated for assessment of executive functioning. Fluency is usually explored by the person’s ability to produce as many words as possible from a given cue within a specific timeframe. The cues are typically phonemic, e.g. words beginning with a specific letter, or semantic, e.g. words within a given category⁽⁶⁾. Regarding neuropsychological functioning in AN, several studies have employed verbal fluency tests⁽⁷⁻¹²⁾. As result, verbal fluency does not seem to be disturbed in patients with AN. In fact, a meta-analysis⁽¹³⁾ has shown that patients with AN perform significantly better than healthy controls on the phonemic fluency test. One of the methods designed to access semantic systems is a Verbal Fluency (VF) task which consists in asking the participants to say out loud as many words as they can in a set period of time (usually 1 minute) and according to a given criterion (e.g. words belonging to a specific semantic category -Semantic Verbal Fluency, SVF- or words beginning in a particular letter -Phonological Verbal Fluency, PVF-). These two types of VF are associated to differential activation of brain regions (PVF-prefrontal regions, SVF-temporal regions)⁽¹⁴⁾.

Qualitative approaches on word-profiles generated in VF tasks show two observable results: switching and grouping. Grouping would be related to semantic memory (activation of temporal regions), while switching would depend on activation of prefrontal cortex. By means of other analyses (multidimensional escalation and correspondence analysis) it is possible to obtain semantic maps based on the closeness or distance between concepts retrieved in VF tasks. With these types of analyses semantic organization has been studied in different mental/neurological disorders (schizophrenia, Alzheimer and Parkinson diseases, etc.), for



example by means of a Human Body Parts type of SVF task⁽¹⁴⁾. Distances between words in a semantic map would represent the proximity from which they have been retrieved and semantic organization.

The aim of this study was to analyse the performance and the semantic organization of patients with AN and of healthy controls by means of a “Human Body Parts” type of SVF task.

Method

Participants

A total of 58 participants took part in this study. Of these, 23 suffered from AN and they were receiving treatment in an Eating Disorders Unit as outpatients. The mean age of this group (EDG) was 21.32 ± 2.53 (range 16-27), 20 being females (86.95%). At the moment of the study patients had recovered a normal Body Mass Index. With respect to the healthy group (Control group; CG), it comprised 35 participants who were volunteers from Pablo de Olavide University (mean age 22.41 ± 1.67 ; range 18-24).

Neuropsychological measures

The Verbal Fluency Test “Human Body Parts” (a word naming task) was applied. In this task, participants were asked to say as many “Human Body Parts” as possible in a period of 1 minute. Participants were given the instruction not to repeat body parts already said. Responses were recorded and transcribed in order to be analysed.

Statistical analyses

Correspondence analysis was performed in order to build a semantic map. A list of the most frequent words was ranked and considering the two groups (ED and Control) a double-entry table was obtained (by means of “0” = absence of the word; “1” = occurrence of the word). This is a way to obtain distances between words and their level of connexion. Inertia (average distance between the words and their centre of gravity) determines the distribution in the dimensional space. Total inertia in the dot cloud, which is a measure of dispersal of the cloud, represents the distances between the dots in a column (words) and the centre of gravity in the cloud. Words, participants, distances between words and how they relate to one another are represented in graphs so if two participants yield similar word profiles, those profiles will be close to each other in the semantic map.

All analyses were performed using R software, version 3.2.2.



Results

Number of words in the two groups

The mean number of words for the CG was 15.94 ± 7.79 and in case of EDG it was 17.52 ± 5.23 . With respect to intrusions and perseverance there were not any significant differences, having obtained 0.10 (CG) and 0.11 (EDG), and 0.42 (CG) and 0,46 (EDG) respectively.

Frequency of words

Table 1 shows the percentages for the 24 words with the highest occurrence in the SVF task.

Table 1. Percentage of occurrence of parts on the SVF task

BODY PART	EDG (%)	CG (%)
HEAD	37,21	62,79
HAIR	42,1	57,9
EARS	40,54	59,46
FACE	72,73	27,27
EYES	38,64	61,36
NOSE	39,02	60,98
MOUTH	38,46	61,54
TONGUE	9,09	90,91
NECK	58,85	41,15
BREAST	62,5	37,5
SHOULDERS	42,86	57,14
ELBOW	61,54	38,46
HANDS	38,09	61,91
FINGERS	40,54	59,46
BELLY	58,33	41,67
WAIST	77,78	22,22
ASS	90	10
CALF MUSCLE	100	0
KNEES	45,83	54,17
THIGHS	100	0
FEET	40,48	59,52
HEART	16,67	83,33
BRAIN	17,65	82,35
LIVER	21,43	78,57

EDG = Eating Disorders Group; CG = Control Group



Correspondence analysis

A two-dimensional representation yielded 90.01% of the total inertia, thus accepting that two-dimensional map as valid. “Perceptible parts of human body” and “Internal parts” would be representative of one category and “Small parts” would be representative of the other. The most frequent words are those represented in the middle of the map, such as neck, hair and shoulders.

Figure 1 represents the two-dimensional semantic map for both, control and eating disorders group.

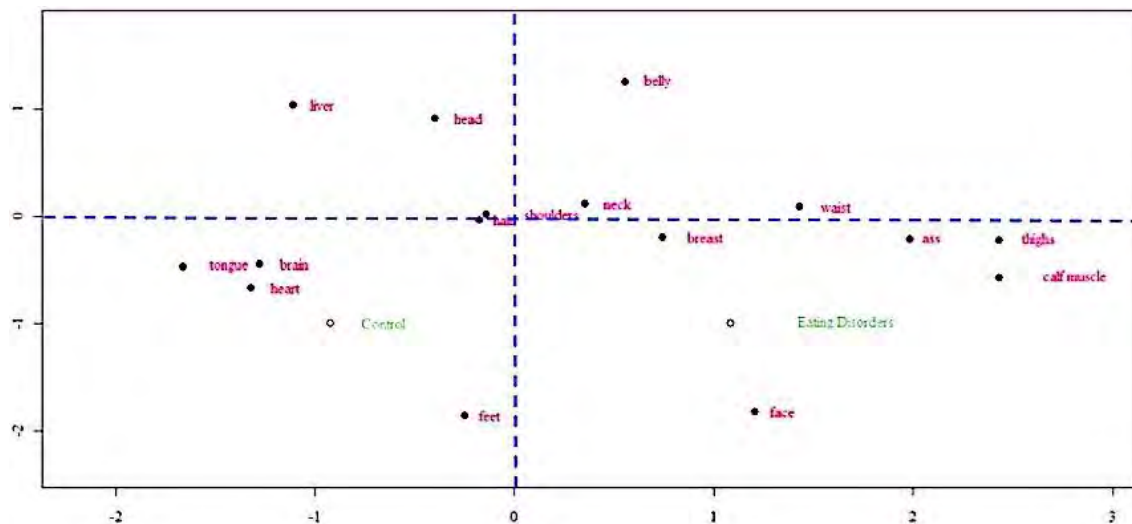
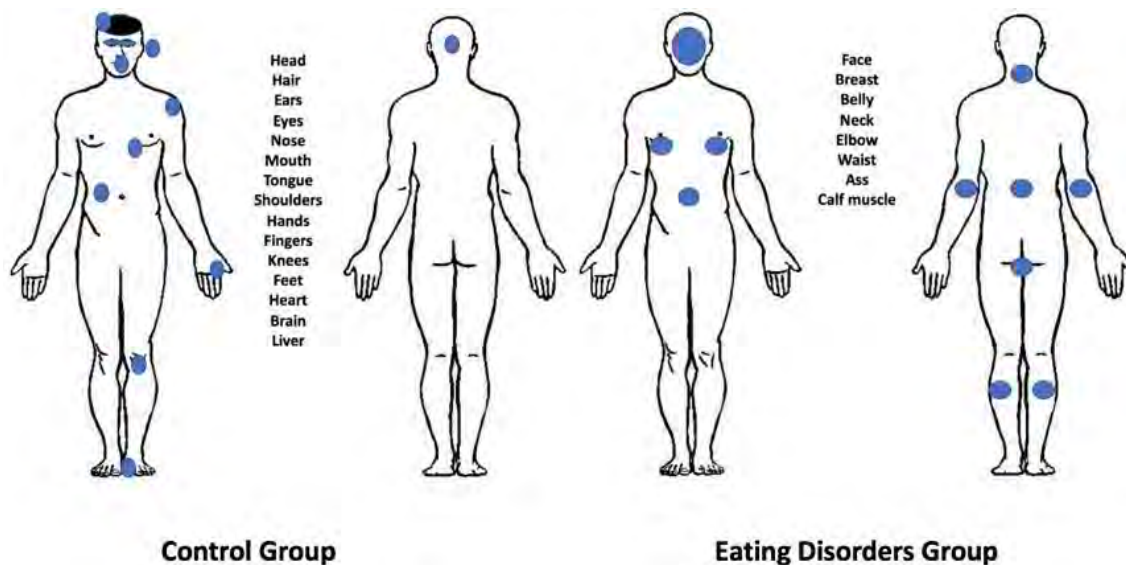


Figure 1. Semantic map for Eating Disorder and Control groups

As it is shown in Figure 1, in the EDG group some parts such as waist, ass, thighs and calf muscle were the most remembered words. In the CG, internal parts such as brain, heart and liver, along with tongue, are the most remembered words in the semantic memory organization.

Considering the percentages obtained for the 24 body parts showed in Table 1, Figure 2 represents those parts in the human silhouette. For each silhouette, the predominant percentages in EDG and CG have been marked.



Control Group **Eating Disorders Group**
Figure 2. Body parts most remembered and represented by groups

Discussion

Phonological and semantic associations obtained by means of VF tasks are useful to explore the organization of semantic memory because concepts are represented as semantic nodes. In addition, the concepts properties may be represented as links between nodes. Each link has a weight associated to the relevance of the meaning of the concept. When two nodes have more properties in common their proximity will be closer in the network. When a concept is remembered activation spreading occurs between associated nodes with an intensity that decreases as the distance between the links joining them increases^(14,15).

Several studies on AN have reported controversial results on this field of study. Thus, some authors indicate that almost 50% of AN-patients are verbally strong and neuropsychologically average to high average while others have found verbal fluency impairment (not associated with BMI and years of education but with depression)^(16,17). Considering the number of words produced, both CG (15.94) and EDG (17.52) had similar results, not significant but a bit better in the EDG. In a recent similar study (by means of the Human Body Parts SVF), the mean number of words for a CG was 22.81 while it was 15.05 in a schizophrenia group⁽¹⁴⁾. By means of other verbal fluency tests, it has been reported some difference between patients with AN and a control group with better results in the AN group considering the total number of words⁽⁶⁾.

Human Body Parts SVF test represents an easier access to the semantic store⁽¹⁸⁾, one reason being that body provides the key to the recovery of words. It has been proposed a circuit for the processing of information referring to body parts. This circuit would involve the left interparietal fissure, the left precentral fissure and the medial frontal gyrus⁽¹⁹⁾. On the basis of



this theoretical specificity, differences might be obtained in both the number of produced words and the organization of these words. As it was mentioned above there were not significant differences with respect to the total number of words. What about the organization of these words?

As it is shown in Figure 1, “internal organs” (liver, brain, heart) as well a small organs (e.g. tongue) were organised around the healthy group whilst external parts of human body (more relevant from an aesthetical point of view) were predominant in the ED group (Figures 1 and 2). Despite the number of spontaneously produced words is similar between the two groups and it is also similar to the number of words reported in other studies and pathologies, the semantic maps obtained through this Human Body Parts SVF in both groups of participants appears to be very different. In this case, the semantic category “body parts” seems to be very influenced by the presence of an eating disorder. It must be noted that body parts are special concepts since they are not only perceived by sensory means (such as sight) but are also introceptively experimented through nociception (Kemmerer) and via emotional states⁽²⁰⁾.

Verbal fluency has been explored by means of phonemic (e.g. words beginning with a specific letter) or semantic (e.g. words within a given category, in this case body parts) cues⁽²¹⁾. Generally, patients with AN have shown good performance in these verbal fluency tasks, these tasks being a way of assessing executive functions. An efficient verbal fluency performance requires access to a semantic store and an affective search process to find and use that information. Verbal fluency does not seem to be altered in AN (in fact some studies have reported that AN patients perform better than healthy controls on phonemic fluency tests)⁽⁶⁾. Nevertheless, AN patients have shown difficulties on set shifting and cognitive flexibility⁽⁷⁾. There are less studies based on semantic categories but phonemic and semantic fluency tasks scores usually correlate only modestly with each other. In addition, switching accounts for more of the variance in phonemic than in semantic tasks. The most relevant aspect in semantic tasks is the organization of categories^(22,23).

Semantic distances between some words is a way to explore the strengths of the links between words generated in these types of tasks⁽¹⁴⁾. Among AN patients some body parts seem to be very closed (e.g. waist, ass, thighs, calf muscle or shoulders, neck, belly, breast), these parts being clearly related with an aesthetic aspect of human body. It is not the case in the control group, in which other internal organs are more closely related. Relevance for health vs relevance for aesthetic factors might be a way to organize differently the semantic maps in healthy individuals or AN patients. Is it possible that the semantic organization is progressively changed under treatment? In order to respond that question longitudinal studies are required.

Studies in primates have reported that brain regions that process body parts concepts are interconnected in a complex circuitry specialized for a sensory-motor transformation which allows the perceptual localization of body parts. Apart from some disorders which affect motor



abilities (with the corresponding disorganization in storing which might be hindering the localization of one's own body in the world)⁽²⁴⁻²⁷⁾, negative emotional states (e.g. those related with body image in AN) could affect that storing process resulting in a reorganization of semantic maps related to body parts.

It is possible to conclude that studies on AN have reported controversial results in this field of study. A circuit for the processing of information referring to body parts would involve the left interparietal fissure, the left precentral fissure and the medial frontal gyrus. In this regard, some differences might be obtained in both the number of produced words and the organization of these words. Nevertheless, there were not significant differences with respect to the total number of words. Regarding the organization of words, "internal organs" (liver, brain, heart) as well a small organs (e.g. tongue) were organised around the healthy group whilst external parts of human body (more relevant from an aesthetical point of view) were predominant in the ED group. Summarizing this result, semantic maps obtained in both groups of participants appear to be very different. Specifically, the semantic category "body parts" seems to be very influenced by the presence of AN.

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