Eating Behaviors 16 (2015) 47–53

Contents lists available at ScienceDirect

Eating Behaviors

Impaired executive functioning influences verbal memory in anorexia nervosa

J. Oltra-Cucarella [a,*], L. Rojo Moreno [b], P. Arribas Sáiz [c], C. Sanguesa García [c], P. Latorre Paniagua [c], E. Hidalgo Muñoz [c], L. Rojo Bofill [d]

[a] Complejo Hospitalario Universitario de Cartagena, Murcia, Spain
[b] Unit of Infant/Juvenile Psychiatry and Eating Disorders, Hospital Universitari i Politècnic La Fe, 46026 Valencia, Spain, CIBERESP
[c] Unit of Infant/Juvenile Psychiatry and Eating Disorders, Hospital Universitari i Politècnic La Fe, 46026 Valencia, Spain
[d] Psychiatry Service, Hospital Universitari i Politècnic La Fe, 46026 Valencia, Spain

ARTICLE INFO

Article history:
Received 29 July 2014
Accepted 19 October 2014
Available online 1 November 2014

Keywords:
Anorexia nervosa
Cognition
Executive functioning
Verbal memory
Speed of information processing

ABSTRACT

Background: How executive functioning affects delayed verbal recall in AN has never been tested. We investigated the influence of speed of information processing (SIP) and inhibition on delayed verbal recall in females with AN.
Methods: Measures of SIP and inhibition from 35 females with AN were analyzed using hierarchical multiple regression after controlling for age, depressive symptomatology and body mass index. Each predictor was evaluated using structure coefficients, common variance and dominance weights.
Results: The combination of measures of SIP and inhibition accounted for almost 80% of the variance on the delayed recall of the story recall task. When the rest of the variables were partialled out, SIP and inhibition accounted for more than 50% of the variance.
Conclusions: As it occurs with visuospatial abilities in AN, basic cognitive abilities such as speed of information processing and cognitive inhibition may affect other cognitive functions such as delayed verbal memory regardless of immediate recall. These findings may help interpret performance on cognitive tests in future research.

1. Introduction

Previous research focusing on neuropsychological impairments in AN found impaired executive (Cavedini et al., 2004; Galimberti et al., 2012; Kemps, Tiggemann, Wade, Ben-Tovim, & Breyer, 2006; Steinglass, Walsh, & Stern, 2006; Tchanturia et al., 2004; Tchanturia et al., 2007; Tchanturia et al., 2011; Tchanturia et al., 2012) as well as verbal memory functioning (Bayless et al., 2002; Chui et al., 2008; Kingston, Szmukler, Andrewes, Tress, & Desmond, 1996; Weider, Indredavik, Lydersen, & Hestad, 2014). For example, Chui et al. (2008) found significant differences in delayed verbal recall between weight-recovered participants and healthy females, but no such differences between low-weight participants and healthy controls. After finding immediate verbal memory impairments in their AN sample, Kingston et al. (1996) concluded that delayed recall was influenced by short-term recall as long term memory scores were related to information initially encoded. Weider et al. (2014) found impaired verbal learning and memory in their sample of patients with AN even after controlling for IQ, psychotropic medication, BMI, depressive symptoms, age, sex, and years of education. However, none of these studies investigated how impaired EF influenced performance on memory tasks, even when impairments in cognitive abilities such as speed of information processing (SIP) that were related to depressive symptoms were found in patients with AN (Weider et al., 2014).

The influence of executive functioning on verbal memory has been reported previously in neurological or psychiatric populations with contradictory results. Tremont, Halpert, Javorsky, & Stern (2000) found that performance on the Logical Memory (LM) subtest did not differentiate between patients with significant executive dysfunction and those without, whereas patients with significant executive dysfunction were significantly worse on measures of the California Verbal Learning Test (CVLT) such as learning and recall. Conversely, Bush et al. (2005) found no influence of executive functioning in performance on memory tasks when injury severity was controlled for in a sample of patients with traumatic brain injury. Hill, Alosco, Bauer, & Tremont (2012) found that executive functioning accounted for minimal variance in some CVLT-II measures and for substantial variance in measures such as immediate recall, delayed recall and discriminability in a sample of patients with different neurological conditions. Brooks, Weaver, & Scialfa (2006) studied older adults with mild cognitive impairment and older adults without dementia, and found that the group with executive dysfunction was worse on the total learning and short free recall trials of the CVLT-II with no differences in delayed recall or in the LM

* Corresponding author at: Complejo Hospitalario Universitario de Cartagena, Paseo Alfonso XIII, 61. 30203 Cartagena, Spain. Tel.: +34 968 32 50 00.

http://dx.doi.org/10.1016/j.eatbeh.2014.10.013
1471-0153/

task. However, to our knowledge no work to date has studied the effects of EF on verbal learning and memory in AN, though it is an area that warrants further research.

Oltra-Cucarella et al. (2014) found significant differences in both immediate and delayed recall between patients with AN and a healthy control group unrelated to the variations on the Body Mass Index (BMI). Contrary to the findings reported by others (Kingston et al., 1996), delayed recall impairments were not due to short-term recall impairments as they were found in different tasks with no significant correlations with one another. While differences in short term recall were found in the TAVEC test (the Spanish adaptation of the CVLT (Benedet & Alejandre, 1998)), differences in delayed recall were found in the Logical Memory subtest (Wechsler, 1997). However, no short-term differences were found in the LM test. Impaired SIP and EF such as inhibition were also found in the AN sample. One plausible explanation for the differences in delayed but not in immediate verbal memory using the LM test is the effect of EF on verbal recall. Duff, Schoenberg, Scott, & Adams (2005) found that verbal memory and EF shared 55% of the variance in a sample of participants with suspected neurological or psychiatric conditions. Leeson et al., (2010) found that SIP significantly correlated with verbal memory in a sample of first-episode psychosis patients, and that it was a significant predictor of cognitive impairment at one year follow-up. Fossati, Amar, Raoux, Ergis, & Allaire (1999), assessing a sample of unipolar and bipolar depressed patients, found that both executive functioning and age independently affected memory performance both in young and old participants, with no interaction between those variables.

Two factors suggest that lower LM delayed recall scores reflected executive functioning and not memory deficits per se in the study by Oltra-Cucarella et al. (2014). First, both the delayed free and cued recall and the recognition tasks were within normal ranges in the TAVEC test, so it could be concluded that verbal learning and memory were unimpaired. Second, both SIP and inhibition were impaired in the AN sample. It was hypothesized that, on the one hand, slow information processing could hinder delayed retrieval as target material was not rapidly available when recall was requested. On the other hand, disinhibited behavior could have caused that AN participants finished delayed recall before all the stored information had been successfully retrieved. Thus, a combination of slow processing speed and impulsivity could causes a behavior which mimics delayed verbal memory impairments when, in fact, no such deficits are present.

This work is aimed at providing objective data of the influence of EF on verbal memory in AN, because previous research has found both executive and verbal memory impairments in AN but none studied their mutual relations. Our hypothesis was that if LM delayed recall is partly accounted for by SIP and inhibition, then performance on tasks measuring SIP and inhibition would predict performance on the LM test. Moreover, we expected that SIP and inhibition accounted for a larger part of the variance of delayed recall compared to encoding (immediate recall).

2. Methods

2.1. Sample

Forty-two females with AN from the Unit of Eating Disorder at La Fe Hospital, Valencia (Spain) were assessed as potential participants in the study. Candidates were assessed if they had a diagnosis of AN for more than 12 months, were on specialized treatment and had no diagnosis of mental retardation. All the potential participants had been diagnosed by an experienced psychiatrist (L.R.) using the Diagnostic and Statistical Manual of Mental Disorders-4th Edition-Text Revised (American Psychological Association, 2002), laboratory analyses and a personal interview at hospital admission. Laboratory analyses included measures of uric acid levels; liver transaminases (ALT/GPT and AST/GOT); albumin and prealbumin; liver enzyme levels (GGT and bilirubin); creatine kinase; calcium; iron; copper; cholesterol (HDC and LDC); complementary C3 and C4 levels; creatinine; red blood cell folate. Inorganic phosphate; alkaline phosphatase; glucose; electrolytes (sodium; potassium and chloride); hemogram; magnesium; leptin; total plasma protein; transferrin; thyroid stimulating hormone (T3; free T4 and total T4); vitamins A; B; E and D; zinc and erythrocyte sedimentation. Seven participants were discarded because of missing data, so the final sample included 35 females with AN. Twenty-five participants (71.4%) had restrictive AN-subtype, and 6 (17.1%) took anxiolytic medication. We did not exclude participants taking antidepressant and/or anxiolytic medication so as to reflect common clinical situations given that anxiety symptoms are highly prevalent in AN (Kaye, Bulik, Thornton, Barbarich, & Masters, 2004). None of the participants in the final sample had abnormal serum levels.

2.2. Measures

Demographic variables included age, time since onset, weight, body mass index (kg/m^2) and the Eating Attitudes Test-40. All the participants had at least 7 years of formal education. The EAT-40 is a self-report measure of eating attitudes and symptoms related to eating disorders (Garner & Garfinkel, 1979). This questionnaire helps diagnosis, but is not a criterion needed to be diagnosed with an eating disorder. It includes 40 questions regarding attitudes, behavior and traits present in eating disorders. Scores >30 indicate the presence of an eating disorder. Scoring above the cut-off point was not one of the inclusion criteria since diagnosis of AN was based on both clinical and DSM-IV-TR criteria.

The cognitive tests used to assess SIP, inhibition and depressive symptomatology were the Stroop Test (Golden, 2005), the Symbol Digit Modalities Test (SDMT) (Strauss, Sherman, & Spreen, 2006), the Logical Memory subtest (Wechsler, 1997) and the Beck Depression Inventory (BDI-II)(Sanz, Perdigón, & Vázquez, 2003). The Stroop Words (Stroop-W), the Stroop Colors (Stroop-C) and the SDMT were used as a measure of SIP, whereas the Stroop Color/Word (Stroop-CW) was used as a measure of inhibition. The oral version of the SDMT was used to measure SIP without a motor component.

Regarding verbal memory, only Story A was included because we wished to observe the performance of participants in a task similar to real life situations. The normative application of the Logical Memory subscale includes two stories, and scaled scores are obtained using a combination of scores from the two tasks. Memory functioning in real life situations is not based on the combination of information items, but on the ability to retain information encoded at any time-point. Thus, as it has been previously studied using memory tasks in neurological populations (Arnett, 2004; De Anna et al., 2008; Higginson, Arnett, & Voss, 2000), only one story was included and the primary measure of delayed memory was the total number of ideas recalled.

2.3. Procedure

All the participants gave informed consent prior to participating in the study, which was approved by the hospital's Ethical Committee.

Statistics from the healthy control group from Oltra-Cucarella et al. (2014) were used to compare demographical and neuropsychological scores and to convert participant's raw scores to z-scores. Executive dysfunction (ED) was assumed when z-scores ≤ -1.64 in at least one measure, which corresponds to the 5th percentile and 90% confidence interval (Strauss et al., 2006), a cut-off point frequently used in neuropsychological research (Duff, 2012).

The influence of inhibition and SIP was analyzed with a cross-validation approach after running a hierarchical multiple linear regression (Tabachnick & Fidell, 2007). The sample was randomly split into two sets of equal size. The Estimation Sample (ES) was used to run the regression, whereas the Validation Sample (VS) was used to cross-validate the model. The cross-validation set was 50% of the total sample in order to analyze two halves of the available sample and reduce