Journal of Child & Adolescent Behavior

Tchanturia and Lang, J Child Adolesc Behav 2014, 2:3
DOI: 10.4172/2375-4494.1000140

Research Article OMICS International

A Systematic Review of Central Coherence in Young People with Anorexia Nervosa

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Received date: May 09, 2014, **Accepted date: June** 06, 2014**, Published date:** June 13, 2014

Abstract

Objectives: It is hypothesised that Weak Central Coherence (superior attention to detail with poorer bigger picture thinking) is a possible endophenotype for Anorexia Nervosa (AN). Currently the neuropsychological profile of children and adolescents with AN in unclear. The present review aimed to summarise the available literature with regards to the central coherence abilities of children and adolescents with AN, and clarify their neuropsychological profile.

Method: The search found seven eligible studies. Meta-analyses were not possible due the variation in tasks used.

Results: Evidence of less efficient global processing in children with AN was observed in a number of studies. The strongest evidence was observed from studies using the Rey Osterrieth Complex Figures Test (ROCFT). A visual comparison of ROCFT from child and adult AN studies highlighted similarities in global processing profiles.

Conclusions: Evidence of inefficient global processing was observed across a number of studies. However methodological flaws in the current literature were highlighted and made interpretation difficult. These are discussed and recommendations for future research are made.

Keywords: Anorexia nervosa; Central coherence; Global processing; Children; Adolescents; Systematic review.

Introduction

Anorexia Nervosa (AN) is an eating disorder characterised by persistent restriction of calorie intake, a fear of gaining weight and a disturbance in body perception [1]. With limited effective treatment options for AN, research interests within the eating disorders field have recently turned to examining possible underlying factors and traits such as cognitive processing styles. This work has highlighted that adults with AN exhibit a specific neuropsychological profile with certain areas of weakness (relative to their IQ), that may help to maintain the disorder, namely that of inefficient set-shifting [2-4] and weak central coherence [5]. Weak central coherence refers to a cognitive processing style whereby there is a relative lack of gistful 'bigger picture' thinking alongside superior attention to detail [6]. This evidence along with observations of similar profiles in those recovered from AN and also in unaffected relatives [7,8] has led to the postulation that rather than being a consequence of long-term starvation, they are in fact representative of endophenotypes for AN. An endophenotype is a measurable component in between a genotype and a phenotype for a disorder. It must be heritable and persist regardless of illness status [9]. What is lacking from the literature, and needed to provide further support for the endophenotype hypothesis, is clarity regarding the neuropsychological profile of children with AN. Studying neuropsychological processing in younger populations with AN is beneficial as we would expect any neurological scars as a consequence of starvation to be minimal, and therefore any underlying premorbid traits should be more prominent.

A recent systematic review and meta-analysis aimed to clarify set shifting abilities of children and adolescents with AN [10]. Overall this review found no significant differences between children with and without AN. It is important to note that this work is in its early stages and data is limited, therefore these results should be interpreted with caution. To our knowledge there are no published systematic reviews of the literature with regards to central coherence abilities in children and adolescents with AN, and such information would be beneficial to the field both in a research and clinical sense. Therefore the aim of the present study is to review the available literature examining central coherence abilities in children and adolescents with AN, in order to help clarify the neuropsychological profile of this group.

Method

The systematic review was conducted according to the 'PRISMA' statement (preferred reporting items for systematic review and meta-analysis, [11]. Figure one shows the consort diagram for the study selection.

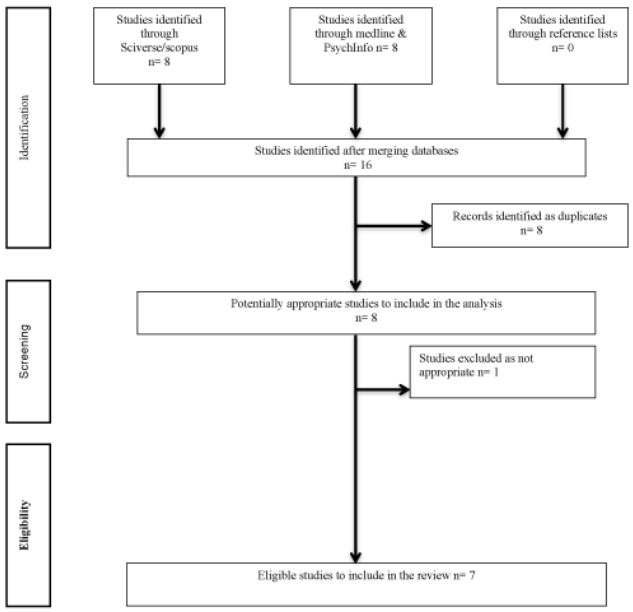

Figure 1: Flow diagram of study according to 'PRISMA'

Eligibility criteria

Both authors conducted the search and studies were selected based on the following criteria:

1. Studies contained adolescents with a diagnosis of AN.
2. Studies employed the use of a neuropsychological measure of central coherence.
3. Means and standard deviations were reported.

Information sources and search

Electronic databases were used to identify relevant articles. The databases used were Medline, Embase, PsychINFO, ISI Web of Science and Scopus. Searches were conducted up until May 2014.

Selection

Articles sourced from the initial search were then screened by the content of their abstracts, and any relevant manuscripts were retrieved. Full text articles were then assessed further for suitability.

Summary of measures

The following neuropsychological measures were used to measure central coherence:

Rey-Osterrieth Complex Figure Test (ROFT, [12]).

The ROCFT is a pencil and paper task used to assess a number of executive functions such as memory, planning, organisation, as well as central coherence. When using the ROCFT to assess central coherence, performance is benefited by a global approach. Previously, this task was scored according to accuracy scores [13], whereby the participant is ask to copy directly from the picture and then again from memory after a delay. The delayed recall accuracy score has been used as an indirect measure of central coherence, as it was believed that the way the object is processed in the direct copy phase (either globally or fragmented) will have an effect on the ability to recall it later, with global strategy in the copy phase benefiting later recall.

More recently, when exploring cognitive profiles in Autism, Booth and colleagues developed a scoring system which is thought to tap into the concept of central coherence more accurately. A Central Coherence Index (CCI) is generated from calculating both an order and style index [14]. A higher CCI is indicative of more efficient global processing. This scoring system was effectively applied and explored within the eating disorder literature [3,8,15,16]. Six studies employing samples of adults with AN demonstrated that adults with AN performed significantly less globally than those without AN (d=-0.56 (95% C.I. -0.76, 0.35), p<0.001 [5].

Object Assembly (OA, [17]).

Participants are required to complete 5 jigsaw puzzles depicting familiar objects. The main outcome measure is the time taken to complete each puzzle. Time is scaled whereby higher scores (shorter times) indicate better global integration.

Overlapping Figures Test (OFT,[18])

Participants are presented with a line drawing of a number of entangled objects. They must discriminate as many objects as they can in 4 minutes. Detecting a smaller number of objects indicates that the participant is more susceptible to distraction by the background details and therefore is a marker of local processing.

Groton Maze Learning task (sub-test of the Cogstate Computerised test battery [19]).

Participants are required to navigate through a computerised maze. Navigation is aided by adopting a more global approach (e.g. thinking about the overall 'bigger picture' rather than focussing on small details such as the next move).

Synthesis of data

Means and standard deviations from the AN groups were collated along with the means and standard deviations of healthy control groups where available.

Results

Study selection

A total of eight studies were found from using the search terms. However one study was excluded from the review [20] as means and standard deviations were not reported. There was also one study [21] that had employed the use of block design, but since this was not recognised as a valid measure in the adult AN literature, the decision to exclude this study was made [15]. One study [22] that had used the Group Embedded Figures test [23], but as this study did not use a HC comparison group and there were no other child AN studies to informally compare the data to, the decision was taken to exclude this data from the review.

Study Characteristics

A summary of all study characteristics can be found in Table 1. Five of these studies employed an AN and HC group. However two studies did not include HC groups [22,24]. All participants in the AN groups met the DSM-IV criteria for Anorexia Nervosa, with the exception of [25] whose sample also included Bulimia Nervosa and Eating Disorders Not Otherwise Specified.

Author/ date	Group	N	Age (years)	Age range (years)	BMI	IQ
Tenconi et al., (2010)	AN	60	26.2 (6.9)	14-47	16.2 (1.5)	N.R
	HC	120	27.4 (4.5)	N.R	21.8 (3.0)	N.R
Andres-Perpina et al., (2011)	AN	37	15.4 (1.5)	N.R	Below 17.5	N.R
	HC	41	15.4 (1.5)	N.R	NR	N.R
Rose et al., (2011)	AN	9	14.9 (1.39)	12.4-16.08	16.41 (1.38)	N.R
Allen et al., (2012)	AN	58	17.5 (0.26)	15-18	24.78 (8.10)*	N.R
	HC	542	16.98 (0.24)	N.R	22.55 (5.09)	N.R
Frampton et al., (2012)	AN	15	19 (1.95)	9.7-21.2	88.13 % w4h (12.19)	113.27 (10.15)
	HC	15	18.3 (2.20)	13.11-21.7	106.39 % w4h (9.79)	114.37 (13.80)
Stedal et al., (2012)	AN	114	17.1 (3.2)	9.5-27.1	16.3 (2.0)	N.R
	HC	66	N.R	N.R		N.R
Dahlgren et al., (2013)	AN	20	15.9 (1.6)	13-18	16.81 (1.63)	N.R
						N.R

Notes: N=Number of participants, BMI=Body mass index (BMI; Kg/M2), N.R=Not reported

*This sample is inclusive of AN, BN and EDNOS participants** This study is separated into two cohorts in the meta-analysis based on brain function

Table 1: Study demographics

Synthesis of results

Rey-Osterrieth Complex Figure Test (ROFT; [12]). The ROCFT was used in 6 studies [21,22,24,26-28]. The methods for scoring the ROCFT varied between studies with the most consistently used method of scoring was Booth's (2006) where by the order and style indices are calculated and contribute to a central coherence index (CCI). This method was adopted by four studies [21,22,24,27,28], is presented as two separate studies, as the AN sample was divided into two subgroups. The subgroups (hypo-perfusion and normal-perfusion) were based on neurobiological status reflecting results from a brain scan that measured regional cerebral blood flow (rCBF). Two of these studies did not have a HC comparison group, therefore to utilise this data the means for all studies have been plotted in figure 2, to enable visual comparison between all studies.

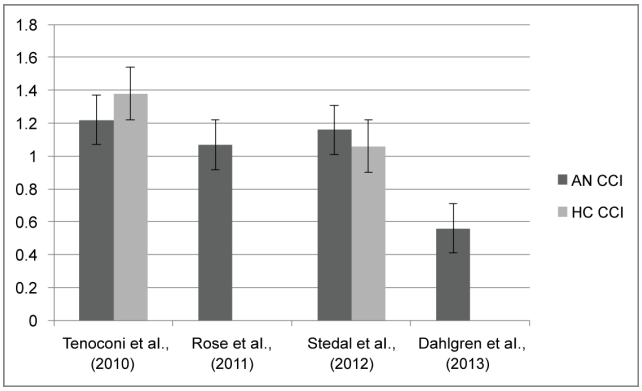

Figure 2: Means (standard errors) of studies reporting the CCI in children and adolescents with AN.

Stedal et al., (2012) found no significant differences on the ROCFT, with their reported raw means and standard deviations suggesting that the AN group performed more globally than the HCs (d=0.25, small effect). Tenconi et al., (2010) reported lower CCIs in the AN group compared to the HCs, suggesting less efficient global processing in the AN group (d=0.46). These results should be interpreted with caution as this sample was inclusive of children and adults (age range 14-47 years). Rose et al., [22] and Dahlgren et al., [23] did not utilise HC groups. Figure 2 compares their ED group performance with the HC data from the other studies, and suggests that both of the AN groups demonstrated lower CCIs and therefore less efficient global processing than the other studies HC groups. Four studies did not use Booth's [14], method to score the ROCFT, but instead reported the accuracy score for the delayed recall. Frampton et al., [28] reported significant differences between the hypoperfusion AN groups and the HC group in delayed visual recall of the ROCFT with AN group performing worse (p=0.001, d=2.35, huge effect). There were no differences in performance between the normal perfusion AN group and the HC group. Andres-Perpina et al., reported no significant differences in ROCFT recall score between AN and HCs (p=0.058, d=0.47, medium effect). Tenconi et al., also reported no significant differences in delayed recall scores between AN and HC (d=0.38).

Object Assembly (OA, [15]).

One study employed OA [21] and reported lower scores in the AN group, suggesting poorer global integration. However, these scores are inclusive of adult data as well as child.

Overlapping Figures Test (OFT [16]).

One study used the OFT, and reported that those with AN detected fewer shapes, suggesting that they were showing superior local processing. These results are inclusive of adult data.

Groton Maze Learning task (sub-test of the Cogstate Computerised test battery[17]).

One study (Allen et al.,) used the GMLT to assess global processing and found worse performance in the ED group compared to the HC group (p=<0.05).

The ROCFT: Comparison with the adult Anorexia Nervosa literature.

Figure 3 compares the CCI means from the child and adolescent AN literature with that of the adult AN literature.

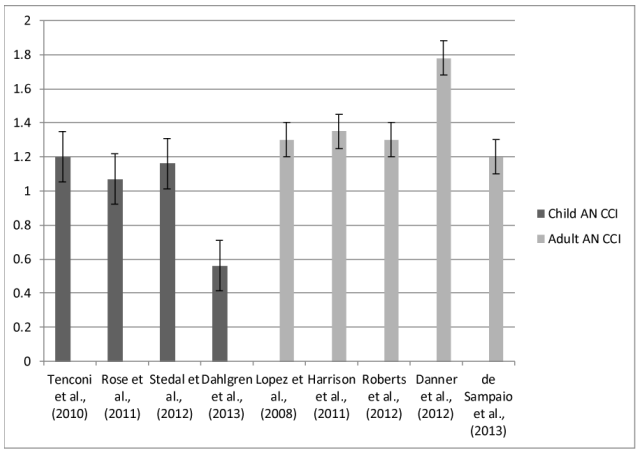

Figure 3: Mean (standard errors) CCI scores of child and adolescent AN studies and adult AN studies.

This visual comparison suggests that children and with AN are performing in a similar way to adults with AN with regards to the CCI, and demonstrating inefficient global processing on this task.

Discussion

This study aimed to systematically review the available literature assessing central coherence abilities in children and adolescents with anorexia nervosa. The review found a number of studies utilising neuropsychological measures of central coherence with children and adolescents with AN. A meta-analysis was not possible due to the large variation in tasks used between the studies.

The most popular neuropsychological measure was the ROCFT, with 'six' studies utilising it. There was some variation in the administration and scoring methods for this task, with four studies using Booth's [14], method to obtain a CCI. Overall the findings from these studies suggested that children and adolescents with AN had a lower CCI score, therefore indicating a less globally-orientated processing style then the HC groups. Several studies used the ROCFT delayed recall accuracy scores to assess central coherence. Overall these studies did not find any differences in accuracy scores between AN and HC groups, which led a majority of the authors to suggest that there were no differences in central coherence abilities. The validity of using this method a measure of central coherence will be discussed. There were a number of other measures used to assess central coherence with children. Overall, these studies showed poorer performance by the AN group on tasks that were benefited by a more global approach (the Overlapping figures task, and the Groton Maze Learning task). However, it is important to note that two of these studies also included data from adults with AN, and therefore such poor performance cannot be attributed to the younger AN population alone. This manuscript attempted to informally compare the ROCFT CCI scores from the child AN literature with those from the adult literature. When presented in a bar chart (Figure 3) the results suggested that the CCI scores of children with AN are similar to that found in adults with AN, suggesting an inefficient global processing style. However, such comparisons are very preliminary and further well powered, planned comparison studies are needed in order to confirm any differences and similarities in profiles. The present review highlighted a number of methodological limitations that made interpretation of the available data challenging. The large variation in the number of tasks used to assess central coherence meant that it was not possible to conduct a meta-analysis of the available data. As previously mentioned there was also variation found in the scoring methods of the same tasks, namely the ROCFT, whereby either studies had calculated a CCI or had used the delayed recall accuracy scores. Historically the accuracy scores from the delayed recall phase have been used as an indirect measure of detail focussed processing, as it was believed the way in which the shape is processed in the copy phase had a knock on effect on the ability to accurately recall the shape at a later stage. As differences were found between AN and HC groups when using the CCI but not with accuracy scores, this may suggest that delayed recall performance may not be a sensitive enough measure of central coherence abilities, as the accuracy in which the figure is drawn may not be a precise representation of global versus detail focussed processing. In comparison, the central coherence, style and order indices can give us more insight into the processing style, as they directly examine the order and style in which the participant attends to each feature, therefore providing a more sensitive measure of whether the participant is focussing on smaller featural details or larger global elements.

The CCI is therefore a more accurate and direct measure of central coherence abilities, and for this reason it would prove beneficial to use it more consistently. It is also the most widely used scoring method within the adult AN literature, and therefore using the CCI more consistently with children would also prove valuable in terms of being able to compare the data we collect with children from what we gather in adults. Therefore helping us to elucidate any differences in neuropsychological profile between children and adults with AN. This review is the first to our knowledge to summarise the current state of the literature in young age group with AN. Clarifying the literature in this way will be beneficial not only for future research (in terms of methodological recommendations), but it will also aid the development of future treatments. For example Cognitive Remediation Therapy was introduced as intervention within the adult AN population [29] and it is now starting to attract more attention from clinicians working with adolescents [30].

However, it is clear from both the present review and an earlier review of set-shifting abilities in children [10], that a lack of data in this area currently limits us from drawing firm conclusions about the profile of children and adolescents with AN. Further research is therefore needed to firstly confirm the neurocognitive profile of young group with AN, and then secondly to determine whether remedial treatments are required in this population. In conclusion, the present review aimed to provide some clarity in regards to weak central coherence in children and adolescents with AN, and ultimately provide support for the endophenotype hypothesis. The review found a number of studies examining central coherence in children and

adolescents with AN, however it also found a number of methodological constraints that made interpretation difficult. The available data hints that children and adolescents with AN may show inefficient global processing, however it is clear that this is an important area in need of further research, employing robust methodology, in order to confirm this and provide evidence for the endophenotype hypothesis.

Acknowledgments

Both authors would like to thank the National Institute for Health Research (NIHR) [Mental Health Biomedical Research Centre Dementia Biomedical Research Unit] at South London and Maudsley NHS Foundation Trust and King's College for funding. Kate Tchanturia would like to thank Maudsley Charity Health in Mind for funding

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