Neuropsychologia 51 (2013) 930–937

Contents lists available at SciVerse ScienceDirect

Neuropsychologia

journal homepage: www.elsevier.com/locate/neuropsychologia

Distinct neuroanatomical bases of episodic and semantic memory performance in Alzheimer's disease

Daniela I. Hirni [a,b], Sasa L. Kivisaari [a,b], Andreas U. Monsch [a,b], Kirsten I. Taylor [a,b,c,*]

[a] Memory Clinic, Department of Geriatrics, University Hospital Basel, Schanzenstrasse 55, 4031 Basel, Switzerland
[b] University of Basel, Petersplatz 1, 4003 Basel, Switzerland
[c] Centre for Speech, Language and the Brain, Department of Experimental Psychology, Downing Street, Cambridge CB2 3EB, UK

ARTICLE INFO

Article history:
Received 22 October 2012
Received in revised form
17 January 2013
Accepted 20 January 2013
Available online 29 January 2013

Keywords:
Alzheimer's disease
Episodic memory
Semantic memory
Perirhinal cortex
Entorhinal cortex
Hippocampus

ABSTRACT

Alzheimer's disease (AD) neurofibrillary pathology begins in the medial perirhinal cortex (mPRC) before spreading to the entorhinal cortex (ERC) and hippocampus (HP) in anterior medial temporal lobe (aMTL). While the role of the ERC/HP complex in episodic memory formation is well-established, recent research suggests that the PRC is required to form semantic memories of individual objects. We aimed to test whether commonly used clinical measures of episodic and semantic memory are distinctly associated with ERC/HP and mPRC integrity, respectively, in healthy mature individuals and very early AD patients. One hundred thirty normal controls, 32 amnestic mild cognitive impairment patients, some of whom are in the earliest (i.e., preclinical) stages of AD, and ten early-stage AD patients received neuropsychological testing and high-resolution anatomic and diffusion MRI. Voxel-based regression analyses tested for regions where episodic memory (delayed recall scores on the California Verbal Learning and Rey Osterrieth Complex Figure Tests) and semantic memory (Boston Naming Test, category fluency) performance correlated with gray matter (GM) regions of interest and whole-brain fractional anisotropy (FA) voxel values. When controlling for the opposing memory performance, poorer episodic memory performance was associated with reduced bilateral ERC/HP GM volume and related white matter integrity, but not with mPRC GM volume. Poor semantic memory performance was associated with both reduced left mPRC and ERC/HP GM volume, as well as reduced FA values in white matter tracts leading to the PRC. These results indicate a partial division of labor within the aMTL and suggest that mPRC damage in very early AD may be detectable with common clinical tests of semantic memory if episodic memory performance is controlled.

© 2013 Elsevier Ltd. Open access under CC BY-NC-ND license.

1. Introduction

A major goal in Alzheimer's disease (AD) research is to identify the earliest cognitive changes in the disease which would allow current and future therapies to be initiated when they are expected to be maximally beneficial. Currently, impairments in episodic memory performance are considered the first clinical sign of AD, and are associated with atrophy of the entorhinal cortex (ERC) and hippocampus (HP) (i.e., ERC/HP complex; Killiany et al., 2002; Petersen et al., 2000). Importantly, AD neurofibrillary pathology affects the more medial portion of the perirhinal cortex (PRC) before it spreads to the ERC and HP (Braak & Braak, 1995; Taylor & Probst, 2008). Recent research suggests that the PRC may be involved in a different kind of memory processing, namely, semantic memories for individual objects (Murray & Richmond, 2001; Taylor, Moss, Stamatakis, & Tyler, 2006; Tyler et al., 2004). However, it is unclear whether this functional-anatomical dissociation can be observed with commonly used clinical tests in the context of early AD. Therefore, the aim of this cross-sectional study was to determine whether episodic memory and semantic object memory functioning as measured by common clinical neuropsychological tests are distinctly associated with the ERC/HP and medial PRC (mPRC) integrity, respectively, in healthy control participants (NC) and patients with suspected early AD.

Isolated episodic memory dysfunction as manifested in the amnestic Mild Cognitive Impairment (aMCI) syndrome represents a preclinical stage of AD (Petersen, 2004; Winblad et al., 2004). Indeed, the cognitive measures which decline earliest during the course of AD are typically delayed recall scores from tests of verbal and nonverbal episodic memory (Salmon, 2011; Saxton

* Correspondence at: Memory Clinic, Department of Geriatrics, University Hospital Basel, Schanzenstrasse 55, CH-4031 Basel, Switzerland.
Tel.: +41 61 265 89 42; fax: +41 61 265 37 88.
E-mail addresses: HirniD@uhbs.ch (D.I. Hirni), KivisaariS@uhbs.ch (S.L. Kivisaari), andreas.monsch@unibas.ch (A.U. Monsch), kirsten.taylor@usb.ch (K.I. Taylor).

0028-3932 © 2013 Elsevier Ltd. Open access under CC BY-NC-ND license.
http://dx.doi.org/10.1016/j.neuropsychologia.2013.01.013

et al., 2004), such as the California Verbal Learning Tests (CVLT) (Delis, Kramer, & Ober, 1987), the Buschke Selective Reminding Test (Buschke & Fuld, 1974) and the Rey Osterrieth Complex Figure (ROCF) test (Osterrieth, 1944). Recent models of anterior medial temporal lobe (aMTL) function posit that episodic memory formation is critically underpinned by the HP and ERC (Eichenbaum, Dudchenko, Wood, Shapiro, & Tanila, 1999; Lipton & Eichenbaum, 2008). Consistent with such models, poor episodic memory performance in early-stage AD patients is associated with decreased volume of the ERC and/or HP (Davies, Graham, Xuereb, Williams, & Hodges, 2004; Killiany et al., 2002; Petersen et al., 2000).

AD neurofibrillary pathology starts neither in the ERC nor in the HP, but in the transentorhinal cortex representing the medial aspect of the PRC (Braak & Braak, 1991; Gertz et al., 1998; Taylor & Probst, 2008), suggesting that cognitive functions associated with the PRC may be additionally important for the early detection of AD. The PRC receives dense inputs from the visual object processing stream and also information from unimodal and polymodal sensory areas (Suzuki & Amaral, 1994). Research in primarily non-human primates suggests that the PRC binds this information together to form complex, multimodal object representations (Lavenex & Amaral, 2000; Murray, Malkova, & Goulet, 1998; Parker & Gaffan, 1998) which may correspond to human semantic object memories (Murray et al., 1998; Murray & Richmond, 2001). Recent human cognitive neuroscientific studies support this account. For example, Taylor et al. (2006) observed greater PRC activity when healthy participants performed a crossmodal integration task with features belonging to living things (e.g., a picture of a cat and the sound "meow") compared to features belonging to nonliving things (e.g., a picture of a telephone and a ringing sound), and greater activity for meaningfully unrelated than meaningfully related stimuli. Thus, PRC responses were sensitive to the meaning (semantics) of the multimodal objects. Furthermore, a voxel-based correlational analysis with brain-damaged patients showed that decreased integrity of aMTL regions, including the PRC, was similarly associated with poorer integration of crossmodal features of living compared to nonliving and meaningfully unrelated compared to meaningfully related stimuli (Taylor, Stamatakis, & Tyler, 2009). Finally, atrophy of the aMTL including the PRC in semantic dementia patients correlated with performance on common clinical tests of semantic object memory, including confrontation naming and animal category fluency (Davies et al., 2004). Taken together, these findings suggest that the human PRC binds different object features together to form meaningful multimodal object representations which may correspond to semantic memories of individual objects (Kivisaari, Probst, & Taylor, in press; Taylor et al., 2006; Taylor, Devereux, & Tyler, 2011; see also Wang, Lazzara, Ranganath, Knight, & Yonelinas, 2010).

An outstanding question and aim of the present study was to determine whether commonly used clinical measures of episodic and semantic memory functioning are differentially related to the integrity of the ERC/HP and mPRC, respectively in healthy participants and very early AD patients. We studied patients with early-stage AD as well as patients with aMCI, many of whom progress to AD (Petersen, 2004; Winblad et al., 2004), since both patient groups are presumed to have aMTL pathology. We correlated clinical measures of episodic (i.e., CVLT and ROCF delayed recall) and semantic (i.e., Boston Naming Test (BNT) and category verbal fluency of animals (CVFA) memory performance with measures of gray and white matter (GM and WM, respectively) integrity in NC, aMCI and AD patients. We directly tested whether the mPRC and ERC/HP complex are differentially associated with clinical tests of semantic and episodic memory using GM region of interest (ROI) analyses. In addition we used whole-brain voxel-based FA analyses to determine whether WM tracts associated with the mPRC and ERC/HP complex were likewise associated with semantic and episodic memory performance, respectively. Because these processes are partially interdependent (i.e., episodic memory aids retrieval from semantic memory, and semantic memories enrich episodic memories) and thus engage similar brain regions (Greenberg, Keane, Ryan, & Verfaellie, 2009; Greenberg & Verfaellie, 2010; Ryan, Cox, Hayes, & Nadel, 2008), we also aimed to determine the unique neural correlates of episodic and semantic memory performance by controlling for the contrasting memory performance. We hypothesized that episodic memory performance is related to ERC/HP integrity and semantic memory performance to mPRC integrity. Since neurofibrillary pathology in AD starts in the mPRC before extending into the ERC and HP (Braak & Braak, 1991), confirmation of these hypotheses would indicate that widely used clinical measures of semantic object memory may be useful for the very early detection of AD.

2. Method

2.1. Participants

Data from 130 NCs were included in this study. All participants were members of longitudinal research studies on aging and dementia at the Memory Clinic, Department of Geriatrics at the University Hospital Basel (Monsch et al., 2000). All NC participants were cognitively and neurologically healthy, i.e., none suffered from severe sensory or motor deficits, severe systemic diseases, continuous mild to intense pain, current psychiatric problems, current or past diseases of the central nervous system, or diseases or states which potentially negatively impacted on central nervous system activity including depression according to the Diagnostic and Statistical Manual of Mental Disorders (DSM) IV criteria (American Psychiatric Association, 1994).

Data from 42 members of the same research studies with diagnoses of aMCI ($n=32$) and probable AD ($n=10$) were also included in the analyses. aMCI patients were diagnosed according to Winblad et al. (2004) criteria and probable AD patients according to the criteria outlined by the National Institute for Neurological and Communicative Disorders and Stroke and the Alzheimer's Disease and Related Disorders Association (McKhann et al., 1984) and DSM-IV (American Psychiatric Association, 1994). Medical and psychiatric examinations ruled out concomitant neurologic or psychiatric diseases.

All participants were native German speakers. The three groups did not differ with respect to the demographic characteristics of age, education and gender, but significantly differed, as expected, with respect to their MMSE (Mini-Mental Status Examination) scores (Folstein, Folstein, & McHugh, 1975) (see Table 1). This study was approved by the local Ethics Committee of Both Basel (EKBB) and written informed consent was obtained from all participants.

2.2. Neuropsychological tests

All participants were administered all subtests of the German version of the Consortium to Establish a Registry for Alzheimer's Disease-Neuropsychological Assessment Battery (CERAD-NAB, Morris et al., 1989) with the exception of the figures and word-list subtests. This battery included the short version of BNT (Morris et al., 1989) and 1 min CVFA ("animal fluency"; Lezak, Howieson, Loring, Hannay, & Fischer, 2004; Morris et al., 1989). All participants were additionally administered the German version of the CVLT (Delis et al., 1987) and the ROCF test (Osterrieth, 1944). Four neuropsychological measures reflecting recall from episodic and semantic memory, described below, were selected for the present analyses.

2.2.1. Episodic memory

2.2.1.1. German version of the California Verbal Learning Test (CVLT). The CVLT (Delis et al., 1987) presents a shopping list containing 16 items (List A), which are read aloud to the participant five times. After each trial, participants are instructed to recall as many words as possible. After the last trial, a second word list (List B) is verbally presented, followed by an immediate free recall of List B, then a free recall and afterwards cued (category labels) recall of List A items. After a delay of circa 20 min, participants are instructed to freely recall List A words, followed by a cued recall with category labels (Delis et al., 1987). For the present study, scores on the

دریافت فوری ← متن کامل مقاله

ISIArticles
مرجع مقالات تخصصی ایران

✓ امکان دانلود نسخه تمام متن مقالات انگلیسی
✓ امکان دانلود نسخه ترجمه شده مقالات
✓ پذیرش سفارش ترجمه تخصصی
✓ امکان جستجو در آرشیو جامعی از صدها موضوع و هزاران مقاله
✓ امکان دانلود رایگان ۲ صفحه اول هر مقاله
✓ امکان پرداخت اینترنتی با کلیه کارت های عضو شتاب
✓ دانلود فوری مقاله پس از پرداخت آنلاین
✓ پشتیبانی کامل خرید با بهره مندی از سیستم هوشمند رهگیری سفارشات