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Referential processing places high demands on hippocampal declarative memory

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INTRODUCTION

• Establishing and maintaining reference is a central component of language processing, as much of what we talk about involves referring to entities

• Referential processing requires maintaining a representation of the unfolding discourse history and potential referents, and integration of information about referential form with rich representations of referential context

• Much of this work has focused on working memory or executive control processes, functions putatively associated with prefrontal cortex mechanisms

• We propose that the rapid relational binding and representational flexibility of the hippocampal declarative memory system affords the informational binding and integration necessary for referential processing

• In a preliminary study of referential processing in patients with bilateral hippocampal damage and severe and selective declarative memory impairment we reported disruptions; these patients produced fewer cohesive ties, the adequacy of their ties were more often judged to be incomplete, and ratings of their local coherence were consistently lower than comparison participants (Kurczek & Duff, 2011)

• Here we extend this line of work by performing a more extensive examination of discourse cohesion and coherence in patients with hippocampal amnesia across a variety of narrative tasks

METHODS

Participants

6 Individuals with hippocampal amnesia: Inclusion criteria included: 1) minimum 3 months post onset, 2) bilateral, focal, non-progressive hippocampus lesion, 3) adult onset lesion, 4) severe and selective declarative memory impairment

6 Healthy Comparison Participants: matched to AM patients on age, sex, education, and handedness

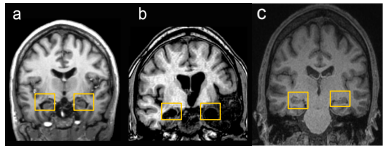
Patient Demographic and Neuropsychological Characteristics

Patient	Sex	Education	Test Age	Chronicity	Etiology	HC Volume
1606	M	12	61	18	Anoxia	-3.99
1846	F	14	45	15	Anoxia	-4.23
1951	M	16	56	18	HSE	-8.10
2308	M	16	52	9	HSE	N/A
2363	M	16	52	10	Anoxia	-2.64
2563	M	16	53	8	Anoxia	N/A
Average (StDev)		15 (1.67)	53.17 (5.27)	13 (4.56)		

Note: Chronicity = amount of time since injury ; HC Volume = reduction in size of hippocampal tissue, Allen et al., 2006

Patient	FSIQ	WMS-3 GMI	MQ Diff >20	Token	Boston Naming	AVLT	AVLT 30M	CF	WAIS Vocab	CF Copy
1606	91	66	25	44	32	7	2	11	11	34
1846	84	57	27	41	43	7	3	6	8	28
1951	106	57	49	44	49	9	2	4	10	32
2308	98	45	53	44	52	5	0	0	11	26
2363	98	73	25	44	58	8	0	5	12	26
2563	94	63	31	44	52	10	4	7	9	36
Average (StDev)	95.17 (7.44)	60.17 (9.56)	35.00 (12.65)	43.50 (1.22)	47.67 (9.09)	7.67 (1.75)	1.83 (1.60)	5.50 (3.62)	10.17 (1.47)	30.33 (4.27)

Note: FSIQ = WAIS-III Full Scale IQ, WMS-3 GMI = Weschler Memory Score- III General Memory Index; MQ Diff > 20 = Difference between FSIQ and WMS-3 GMI; Token = Token Test; AVLT = Auditory Verbal Learning Test; AVLT 30M = 30 minute recall; CF = Rey Complex Figure 30 minute recall; CF Copy = Complex Figure copy



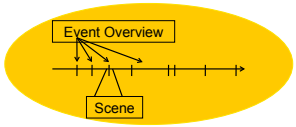
T1 MRI demonstrating hippocampal damage (hippocampus highlighted by boxes) in two representative patients with a) anoxic damage b) herpes simplex encephalitis infection. A healthy comparison brain is represented in c.

METHODS CONTINUED

Procedure

• Gathered different types of narrative:

1. ***Dynamic event construction elicitation protocol***: Adapted from Levine et al. (2002) participants elaborated on a mental representation in response to a neutral cue word (e.g., tree) in two ways (Event Overview and Scene) in four conditions for a total of 12 descriptions (3 per condition):
   - ***Past***: occurred before age 25; happened only once; autobiographical
   - ***Imagined Past:*** occurred before age 25; plausible event that has never happened, autobiographical
   - ***Imagined Present***: could take place right now; plausible event that has never happened, autobiographical
   - ***Future***: take place in the future, a plausible event that has never happened, autobiographical



2. Narrative Generation - Norman Rockwell – *The Runaway, Breaking Home Ties*

3. Cue-Word Narrative - Frightening story, Family story (Hengst & Duff, 2007)

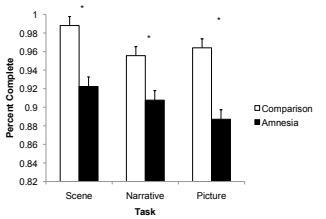
Analysis

1. All discourse samples are transcribed using a consensus procedure (see Duff et al., 2008).
2. All transcripts are divided into T-units (Hunt, 1970).
3. Following Liles (1985), transcripts are coded for cohesive markers across three categories: reference, lexical and conjunctive. Decisions regarding adequacy of each cohesive tie are made.
4. Following Glosser and Deser (1990) each transcript is rated for global and local coherence.

Variables Investigated:

COHESION

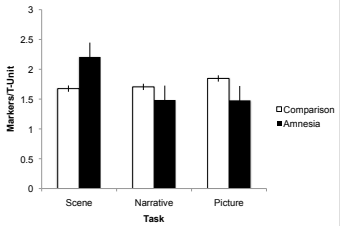
Percentage of Total Ties and Number Per T-unit:
1. Percentage of complete ties
2. Markers per T-unit



There was a main effect of group, $F(1,30) = 5.7880$, $p < 0.05$, where amnesic patients produced less complete ties across tasks compared to comparison participants.

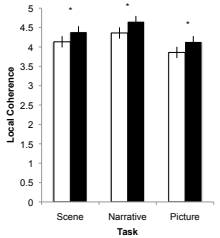
COHERENCE

1. Global
2. Local



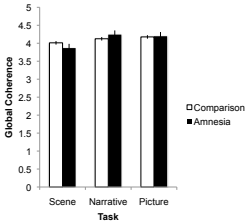
There was no main effect of group in the production of markers per T-unit, $F(1,30) = 0.017$, $p = 0.90$.

RESULTS



There was a main effect of group on ratings of local coherence, $F(1,30) = 9.0505$, $p < 0.05$, where comparison subjects were rated lower across tasks. Additionally a main effect of task, $F(2,30) = 10.8369$, $p < 0.01$, and post-hoc test revealed that personal narratives were rated higher on local coherence than picture narratives ($p < 0.001$)

There was no main effect of group on the ratings of global coherence, $F(1,30) = 0.002$, $p = 0.96$



CONCLUSION AND DISCUSSION

• Consistent with our previous work (Kurczek & Duff, 2011), these results provide additional evidence for disruptions in referential processing, specifically in discourse cohesion and coherence, in patients with hippocampal damage and severe and selective declarative memory impairment

• The findings point to a role for hippocampus in language use and is consistent with our proposal that the rapid relational binding and representational flexibility afforded by the hippocampal declarative memory system is important for informational binding and integration necessary for a range of language functions including referential processing (Duff & Brown-Schmidt, 2012)

• Results challenge the notion that the frontal lobes uniquely support discourse cohesion and coherence. We (Kurczek & Duff, in press) and others (Coelho et al., in press) and reported intact discourse cohesion in patients with focal vmPFC and dlpfc damage.

FUTURE DIRECTIONS

We are continuing to examine referential processing in patients with hippocampal damage by extending our work to :

- Comprehension
- Eye-tracking methods to assess on-line processing
- Longer and more complex stretches of discourse (across time, speakers, interactional resources)

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