# Stability and Consistency of Narrative Production Across Time in Hippocampal Amnesia

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## INTRODUCTION

• The critical role of the hippocampus and related medial temporal lobe regions in the formation of new enduring memories (i.e., long-term memory) and in their subsequent retrieval is well established.

• Hippocampal dependent declarative (relational) memory has two hallmark features; *relational (or associative) memory binding* and the *flexible expression* of memory (Eichenbaum & Cohen, 2001).

• An important aspect of memory is its ability to be flexibly and constructively recalled in novel contexts. Here we measure episodic and semantic memories in two contexts, one in which the same narratives were told and retold over the course of a month and a second in which the same narratives were told from different perspectives.

• Few studies have investigated the role of damage to the hippocampus in telling memories/narratives over time. Evidence from individuals with depression (Semkovska et al., 2012) suggests that individuals with hippocampal damage will be less consistent when retrieving memories and retelling narratives.

• We rarely just tell the same story in the same way. Different contextual demands (e.g., people, setting, purpose) drives telling different versions of memories. Findings here may address how damage to the hippocampus affects integrating both past (i.e., having told the stories previously) and current demands (i.e. updating the story to tell a new perspective) when attempting to re-construct both personal (episodic) and semantic narratives.

## METHODS

### Participants

*5 Individuals with hippocampal amnesia*
*Healthy Matched Comparison Participants*
*Time Manipulation – 10; Perspective Manipulation - 6*

### Patient Demographic and Neuropsychological Characteristics

| Patient | Sex | Education | Test Age | Chronicity | Etiology | HC Volume |
|---|---|---|---|---|---|---|
| 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 | | 15 | 53.17 | 13 | | |
| (StDev) | | (1.67) | (5.27) | (4.56) | | |

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

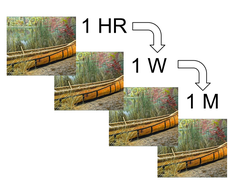
| Patient | FSIQ | WMS-3 MQ Diff GMI | WMS-3 MQ Diff >20 | Token | Boston Naming | AVLT 30M | CF | CF Copy |
|---|---|---|---|---|---|---|---|---|
| 1846 | 84 | 57 | 27 | 41 | 43 | 3 | 6 | 28 |
| 1951 | 106 | 57 | 49 | 44 | 49 | 2 | 4 | 32 |
| 2308 | 98 | 45 | 53 | 44 | 52 | 0 | 0 | 26 |
| 2363 | 98 | 73 | 25 | 44 | 58 | 0 | 5 | 26 |
| 2563 | 94 | 63 | 31 | 44 | 52 | 4 | 7 | 36 |
| Average | 96.0 | 59.0 | 37.0 | 43.4 | 50.8 | 1.8 | 4.4 | 29.6 |
| (StDev) | (8.0) | (10.2) | (13.0) | (1.3) | (5.4) | (1.8) | (2.7) | (4.3) |

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 30M = Auditory Verbal Learning Test 30 minute recall; CF = Rey Complex Figure 30 minute recall; CF Copy = Complex Figure copy

### Procedure

*Time Manipulation*

1. ***Dynamic Event Construction***: Adapted from Levine et al. (2002) participants elaborated on a mental representation in response to event cues (e.g., celebration, winning something) generating 6 past events (Kurczek et al., 2015).
2. ***War of the Ghosts***: Participants were asked to read the Native American legend the War of the Ghosts (WotG) a 330 word narrative.

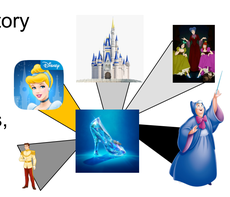




*Perspective Manipulation*

3. ***Personal***: Adapted from Levine et al. (2002) participants elaborated on a mental representation in response to an event cue (e.g., favorite memory). After the original telling, participants were asked to tell the story in different ways (e.g., from other character's perspective, different spatial perspectives, different times in the story).
4. ***Cinderella***: Participants viewed a wordless picture book of Cinderella. They then told the Cinderella narrative. After the original telling, participants told the story of Cinderella from different perspectives: Fairy God Mother, Evil Step Sisters, Cinderella, the Prince, from halfway through, from standing on top of the castle.

**Personal**
My trip to NYC told from other perspectives: people, times, and places

**Cinderella**
Cinderella story told from different character perspectives, times, and places

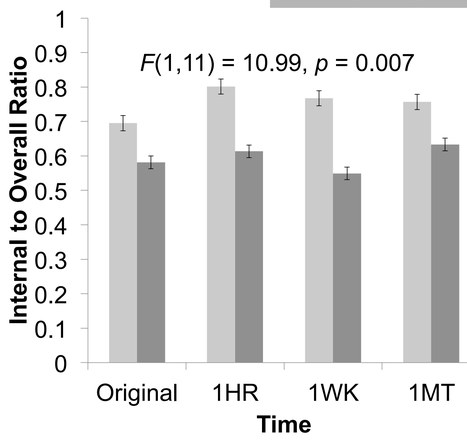


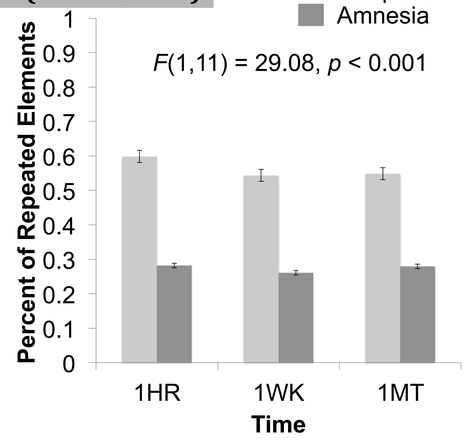
### Analysis

Narratives were analyzed with memory and consistency using an adapted AM scoring

## RESULTS

### Event Construction (Across Time)




**Amnesic Participant – 2363**

**First Telling**
Job interview uh okay which job interview do you want me to tell you about? Um well let's do the Texaco interview. Thy had me over to Houston 'cause I was livin' in Beaumont at the time and the uh they had me over and they had me talk to five different people and one turned out to be my boss and the other four were her members of the team that was developing this probe to use for oil exploration and it was a dielectric energy level and- or dielectric measurement device and it was used to tell the uh dielectric properties of the water in the ground and by telling that you could tell between saltwater and uh freshwater, 'cause freshwater is very- is very uh dielectric- or the dielectric level is- is very high the resistance is very high and the uh saltwater is very low so it makes a good demarcation point when you look for oil in the ground and I built a probe that was- consisted of four circuit boards, you know there were four circuit boards and circuitry on each one of 'em. They were about 'bout two inches wide- I mean two inches wide and uh 'bout four inches long and there were multiples of those 'cause we had to put it in a tube that was about roughly one and a half inches wide- or one and a half- two and a half- it woulda been two and a half inches wide and the uh we had to mount those in a string to make the whole circuitry and the uh mm let's see uh I forgot uh what I was talking about 'bout- oh I made the probe but I forgot what the question was job interview okay that's- that's what the job was that I interviewed for. Twenty- one I guess.

Words = 311
Internal to Overall Ratio = 0.13

**Second Telling**
Okay ya want me to repeat it? Okay the job interview at Texaco was conducted at the facility the uh I got to meet the various people in the lab I'd be working in. The uh they showed me around, took me out to dinner- or lunch I mean and then uh asked me various questions about my training and uh that was about it. I was twenty-one or twenty-two at the time.

Words = 102
Internal to Overall Ratio = 0.7
Repeated = 0.0%

**Matched Comparison Participant**

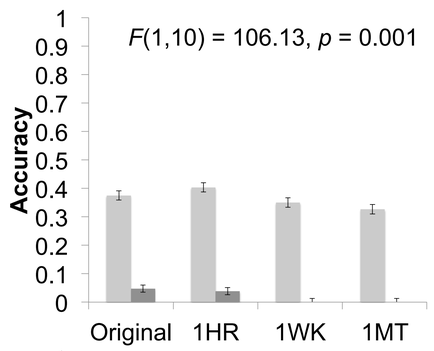
**Third Telling**
Okay um so um my mom went to the hospital and uh my brother was um she was pregnant with Tom so my dad didn't go to the hospital with her and he took me up later um we went to the hospital and there was my mom was on in a wheelchair being pushed and she was holding my brother and um and she came out I just remember seeing her being pushed and her holding my brother wasn't much more to it but uh that's all I remember

Words = 121
Internal to Overall Ratio = 0.82
Repeated = 63.6%

**Fourth Telling**
That was uh September of nineteen sixty-nine um so my recollection of that is my mom my dad taking me into the hospital and um my mom in a wheelchair being pushed out um holding my brother and um you know I think I mentioned before it's fairly vague but I I I just remember her being pushed out in a wheelchair holding my brother that's it

Words = 92
Internal to Overall Ratio = 0.89
Repeated = 66.6%

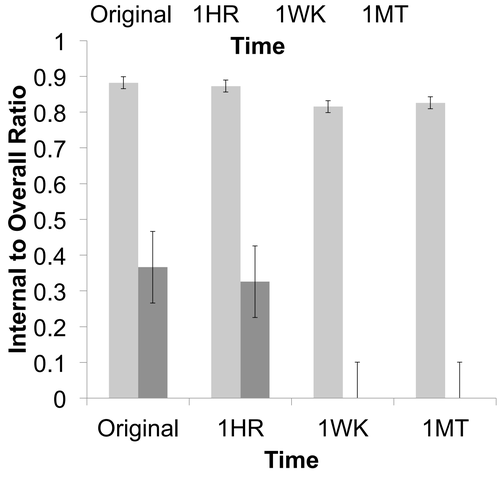
### WotG (Across Time)



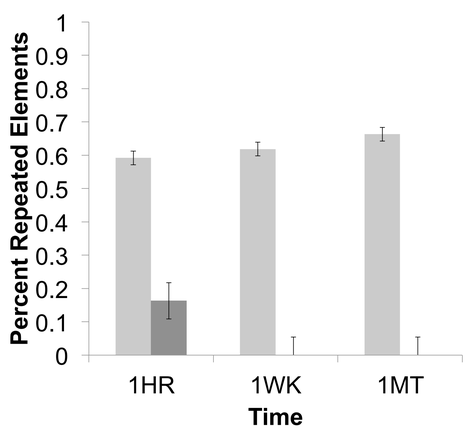

**Amnesic Participant – 2363**

**Second Telling – 1 Hour**
Oh let's see the war of the ghost story oh boy had something to do with uh two Indians and they were expecting an attack from d- from a different tribe or something and they uh one went back to warn the people the people and the other one went ahead to spot them or- or find out their position or where they were that's pretty much all I can remember right now.

Words = 73
Accuracy = 6.0%
Repeated = 33.3%



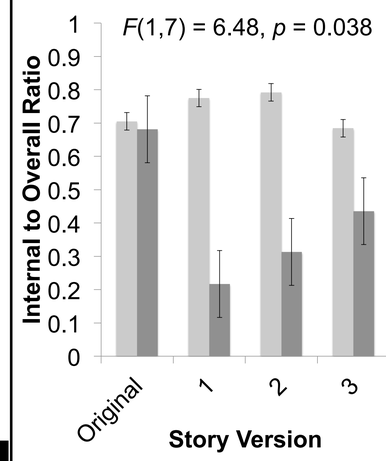

F(1,10) = 76.20, p < 0.001

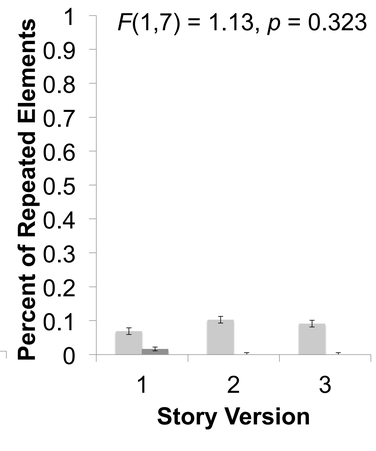



F(1,10) = 200.35, p < 0.001

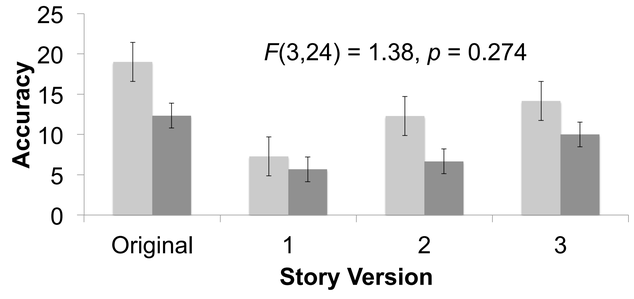
## RESULTS

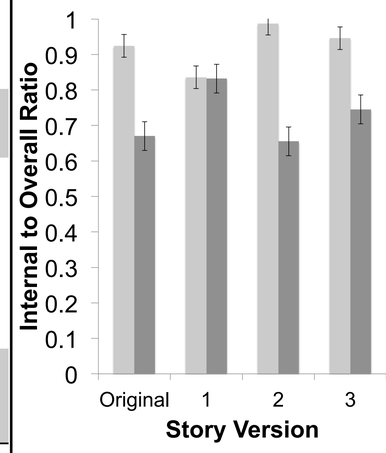
### Personal (Perspective Change)



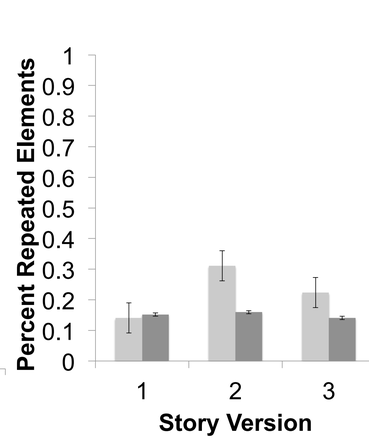




### Cinderella (Perspective Change)




F(1,8) = 03.50, p = 0.098

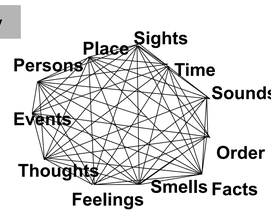



F(1,8) = 0.58, p = 0.467

## THE HIPPOCAMPUS AND NARRATIVE

- Hippocampus binds together elements into some ordered structure (i.e. the plot)
- Hippocampal damage reduces reduces *flexible* and *relational* binding use and number of elements
- Both memories and narratives lose their richness and structure


Healthy






Amnesia

## CONCLUSION AND DISCUSSION

• The hippocampus, in its support of rapid relational binding and representational flexibility, is important for a range of language functions including integration and flexible use of relational information across time and perspectives for narrative production (Duff & Brown-Schmidt, 2012).

• Manipulations of narrative production demands (repeated tellings over time and from multiple perspectives) may inform on-going debates regarding whether the observed deficits in narrative production in amnesia stem from a sole impairment in memory (Race et al., 2011; 2013) or a more basic impairment in cognitive functioning outside of memory (Gasser et al., 2011; Zeman et al., 2012).

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**REFERENCES**

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Zeman et al., 2012

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