Semantic Fluency in Aphasia: Word Production, Typicality and Frequency over Time

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Background

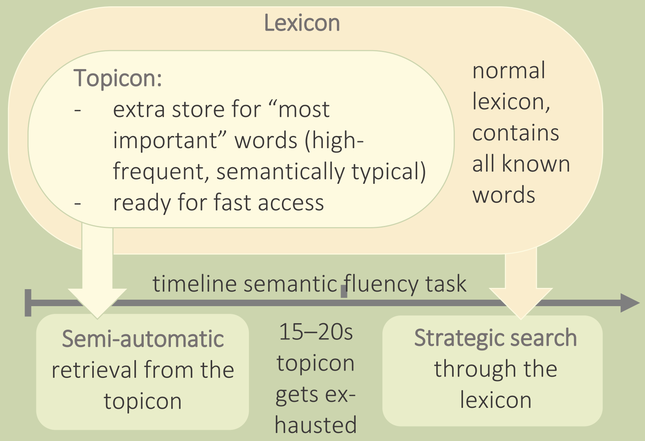
Introduction

Semantic fluency tasks are easy to apply and highly sensible to neurological disorders such as aphasia[1]. Therefore, they are widely used in neurological assessment. However, it is still unclear which neuropsychological aspects of the task cause difficulties for individuals with aphasia (IWAs)[2]. This work compares temporal performance patterns between IWA and linguistically healthy controls (HC) to shed light on the neuropsychological processes involved.

Typical Performance Pattern over Time in HC

- score effect: rate of production of correct words decreases over time; most are typically produced within the first 15–20s[3]
- frequency effect: as time proceeds, frequency of produced words decreases[3, 4]
- semantic typicality effect: as time proceeds, semantic typicality of produced words decreases[4]

Smith & Claxton's Lexical Organization Model[5]



Individuals with mild cognitive impairments (MCI) have specific difficulties with the early, semi-automatic retrieval process.[6] For IWA, no study focused on the involved subprocesses within the lexical organization framework yet.

Research Question

Do IWAs have specific difficulties with one of the search processes?

If yes: Performance pattern of IWA and HC should differ within the semi-automatic retrieval phase or the strategic search phase.
If no: Performance pattern of HC and IWA should be similar over the time-course of the task.

Methods

Participants

Data collection is currently ongoing. This poster presents preliminary results for:

n= 40 linguistically healthy controls (HC) across the age span

age (years)	*n*=
18 - 29	5
30 - 39	6
40 - 49	5
50 - 59	10
60 - 69	9
> 70	5

n= 4 individuals with aphasia (IWA)

IWA	A	B	C	D
age (years)	46	70	51	51
post onset (years)	14	21	25	11
aphasia syndrome and severity[7]	mild anomic	mild–moderate Broca's	mild Broca's	mild anomic
picture naming[7] (percentile)	87	55	94	97
further information (all IWA)	intact semantic system (unimpaired nonverbal semantic sorting[8] and word-picture-matching auditory and visual[9])			
	no severe apraxia of speech or dysarthria[10]			

Task

„Please name as many animals *(/clothes)* as you can within 60 seconds."

„cat, dog, tiger, giraffe…"

Six semantic categories were tested in a balanced order.
This poster presents preliminary results for *animals* and *clothes.*

Test language: German (native for all participants)

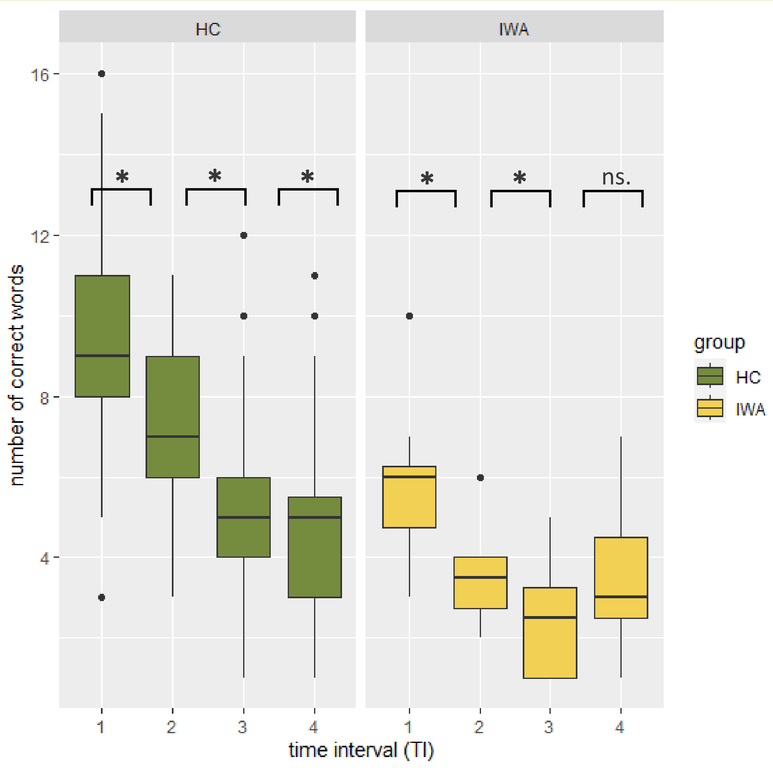
Analysis

1. all answers were standardized
   - Correction of:
     - minor phonological errors
     - morphological variants (e.g., plural, diminutive)
     - adjective noun combinations: kept as individual answers if different semantic concepts (e.g., short pants ≠ long pants)
2. all answers were assigned to their:
   - time interval (TI) of voice onset: TI 1: *0–14s*, TI 2: *15–29s*, TI 3: *30–44s*, TI 4: *45–60s*
   - word position: *first word, second word…*
   - semantic typicality: rated on 7-point Likert Scale: *1 = very typical, 7 = atypical*[11]
   - word frequency: based on WebXL corpus, DWDS
   - word accuracy: based on standardized answers; incorrect, if repetition or not from the semantic category, else correct
3. statistical modelling
   - Number of Correct: General linear mixed models (poisson family) with TI as predictor and random intercept for participants
   - Semantic Typicality and Word Frequency: Linear mixed models with TI as predictor and random intercept for participants and semantic category on log-transformed values

Results

! Semantic typicality data was only available for 60% of the responses.

Number of Correct Words

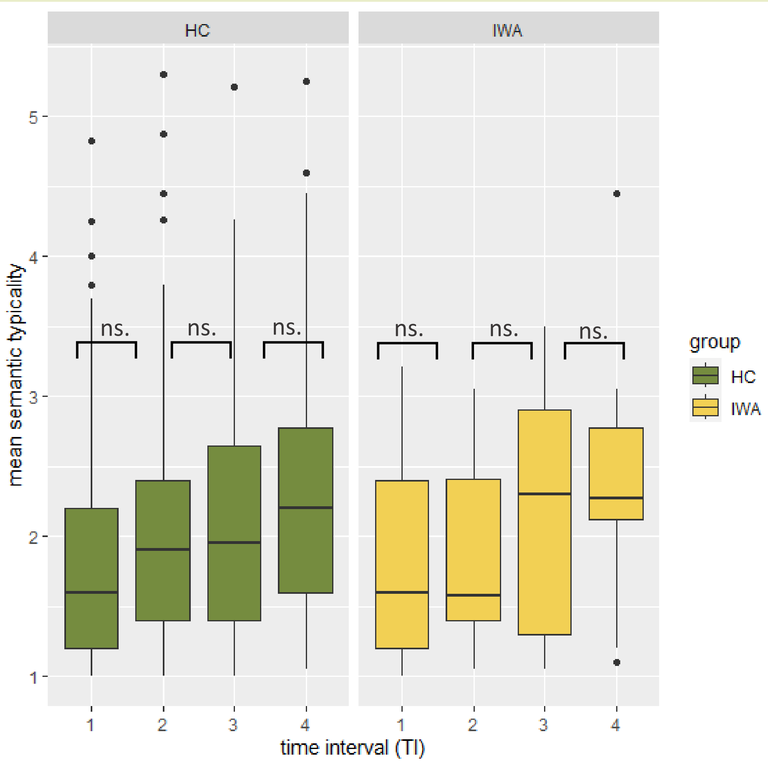


Number of correct words produced in a 1min semantic fluency task, divided in four time intervals of 15 seconds (TI 1: *0–14s*, TI 2: *15–29s*, TI 3: *30–44s*, TI 4: *45–60s*) across the categories *animals* and *clothes*. HC = linguistically healthy controls, IWA = individuals with aphasia

HC: sign. decrease in number of correct between all time intervals (all *p*-values < .001)

IWA: sign. decrease in number of correct for the first three time intervals (TI 1–2: *p*< .001; TI 2–3: *p*< .050)
Non-significant increase between the last two time intervals (TI 3–4: *p*= .812)

Semantic Typicality



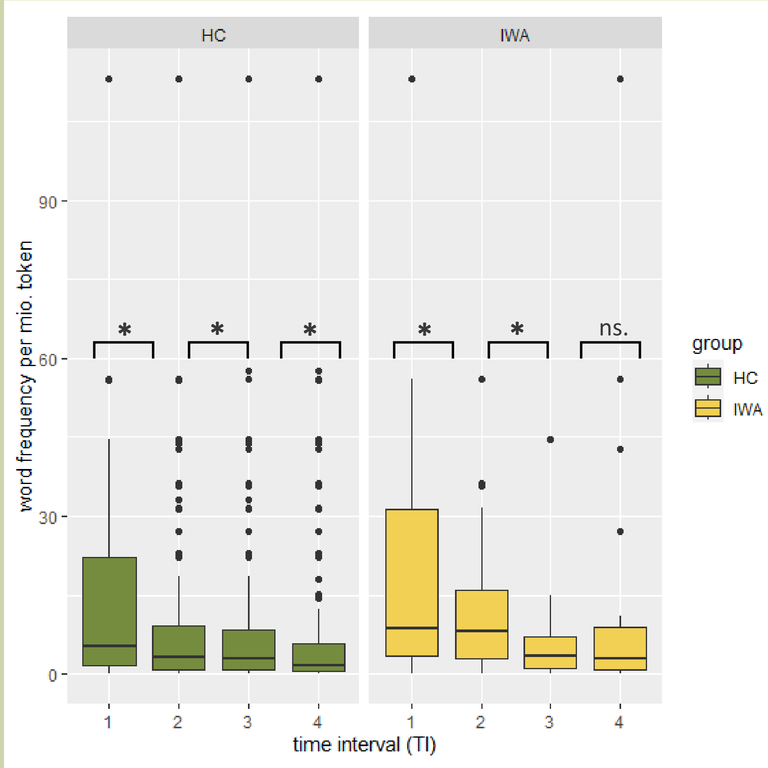
Mean semantic typicality of words produced in a 1min semantic fluency task for four time intervals of 15 seconds (TI 1: *0–14s*, TI 2: *15–29s*, TI 3: *30–44s*, TI 4: *45–60s*) across the categories *animals* and *clothes*. HC = linguistically healthy controls, IWA = individuals with aphasia

HC: no sign. change in sem. typicality between any time intervals (TI 1–2: *p*= .137; TI 2–3: *p*= .052; TI 3–4: *p*= .155)

IWA: no sign. change in sem. typicality between any time intervals (TI 1–2: *p*= .745; TI 2–3: *p*= .527; TI 3–4: *p*= .260)

BUT: Analysis of semantic typicality over word position: both groups show a significant decrease of semantic typicality (HC: *p*< .001; IWA: *p*< .001).

Word Frequency



Mean semantic typicality of words produced in a 1min semantic fluency task for four time intervals of 15 seconds (TI 1: *0–14s*, TI 2: *15–29s*, TI 3: *30–44s*, TI 4: *45–60s*) across the categories *animals* and *clothes*. HC = linguistically healthy controls, IWA = individuals with aphasia

HC: sign. decrease in word frequency between all time intervals (all *p*-values < .001)

IWA: sign. decrease in word frequency for the first three time intervals (TI 1–2: *p*< .010; TI 2–3: *p*< .010)
No sign. changes between the last two time intervals (TI 3–4: *p*= .234)

Summary

Semantic typicality effect	**Both groups:** Significant decrease in semantic typicality over word position. This trend was not significant for adjacent time intervals.
Score & frequency effect	**HC:** Significant decrease over all TIs in number of correct words and word frequency **IWA:** TI 1–2–3: Sign. decrease in number of correct words and word frequency as in HC. TI 3–4: No sign. changes.

Conclusion

The strongest difference between performance patterns of IWA and HC is in the last 30 – 60s of the semantic fluency task (➞ within the strategic phase).

IWA may have specific difficulties with the late, strategic search process

IWA may enter the strategic search phase later than HC (at approx. 30s). Possible Reasons:
- slower word retrieval
- IWA need more time for switching strategies

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