

How different motions affect lexical access and linguistic structure in a spontaneous speech task

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Background

Multitasking, on the one hand:

- reduces performance (attention and reaction times) due to limited cognitive resources
- **Capacity Sharing:** split resources in parallel tasks (Kahnemann, 1973)
- **Bottleneck Theory:** sequential processing (Broadbent, 1959)

... on the other hand:

- **moderate sport** can enhance cognitive abilities
- lower picture naming latencies on moving belt (Meyer, 2016)
- improved vocabulary acquisition on treadmill (Schmidt-Kassow et al., 2014)

→ **motion enhances lexical storage and access**

Goals:

- **influence of motion on linguistic performance**
- **motion parameters:** applied effort, modality (arm vs. leg), (right vs. left hand)
- **linguistic levels:** phonetics, lexicon, syntax

Methods

Tasks

Physical



Measurements



Physiology

- motion frequency (motion capture)
- respiration rate (plethysmography)

Phonetics:

- speech proportion
- speaking rate

Lexicon and syntax:

- vocabulary size
- complexity

Cognitive

If you were to be stranded on a desert island, what five out of ten things would you take with you? Rank them and motivate why you would take these and not the others.

Experiment 1:

- leg motion on ergometer with low vs. high effort

Experiment 2:

- arm vs. leg motion on mini treadmill

Conditions	Experiment 1	Experiment 2
(1) neither motion nor speaking	[Q]	
(2) speaking only 1	[S]	
(3) motion only	low [B] or high [Be] effort	arm [H] or leg [L]
(4) speaking and motion	[SB] or [SBe]	[HS] or [LS]
(5) motion only	complementary to (3)	
(6) speaking and motion	complementary to (4)	

Results

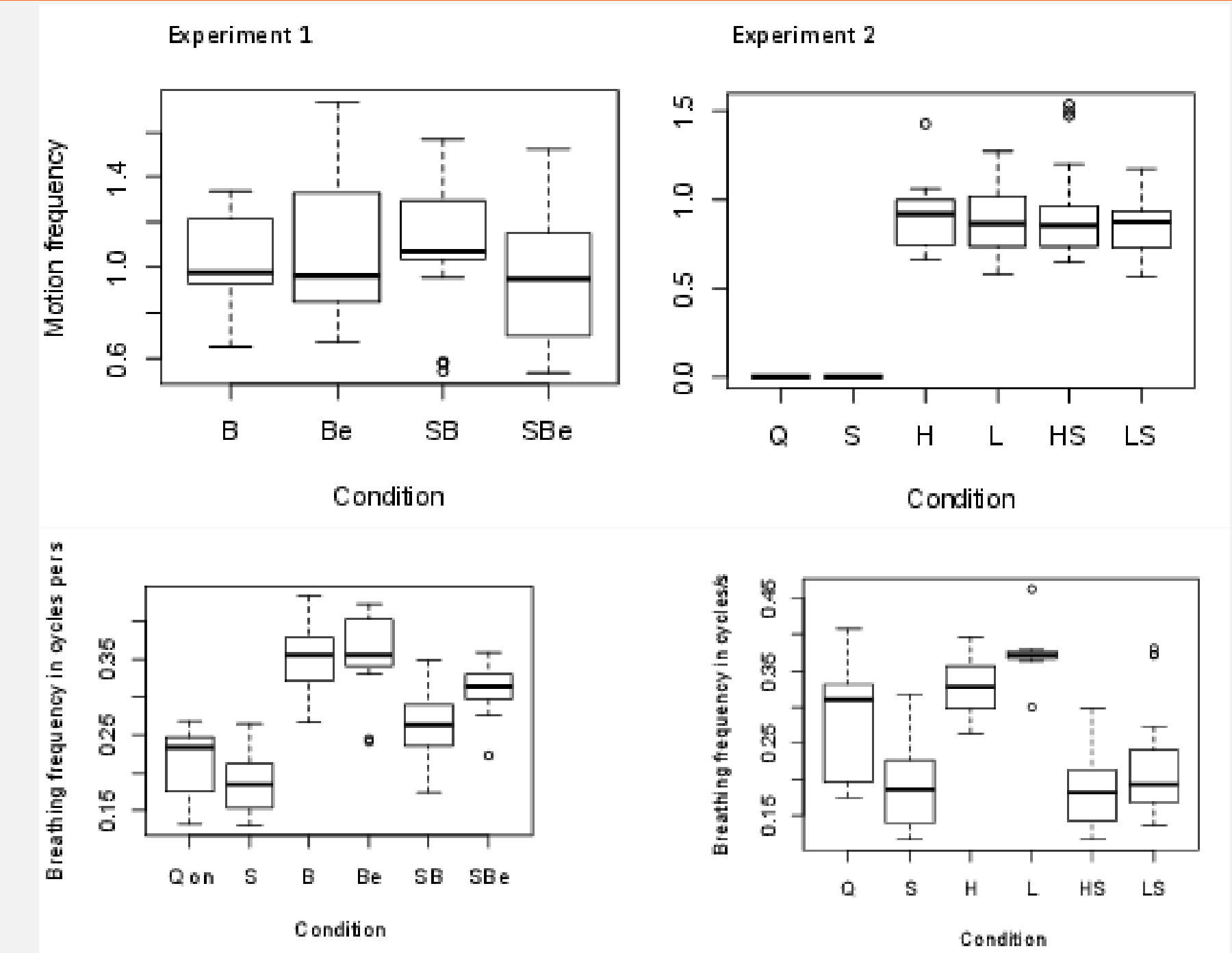
Physiology

Motion frequency:

- more or less constant

Respiratory rate:

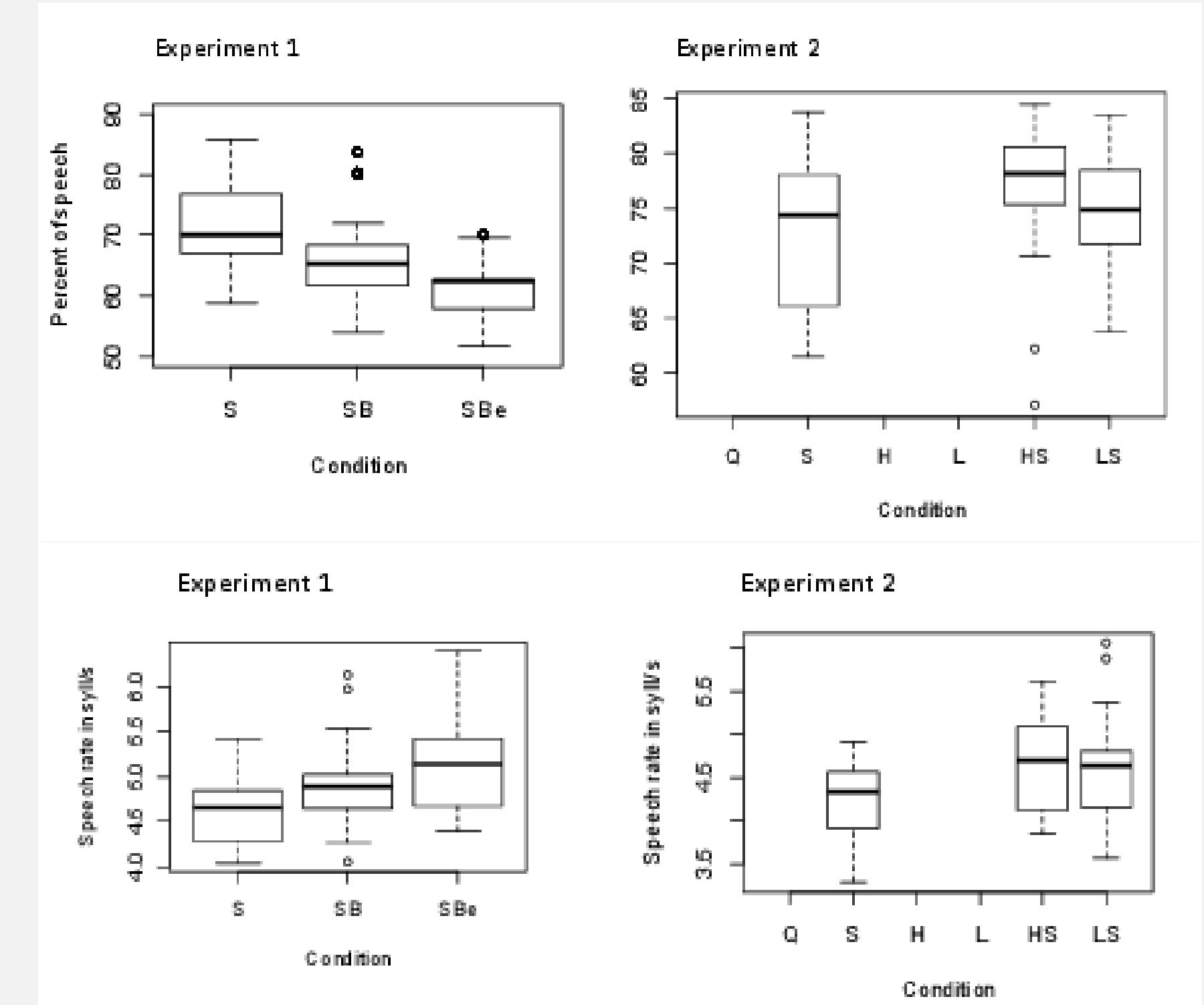
- exp1: higher for effort conditions
- exp2: higher for legs; at low effort determined by speech



Phonetics

Proportion of Speech

- exp1: decreasing (i.e. more pauses) with dual task and effort
- exp2: higher for arm movements

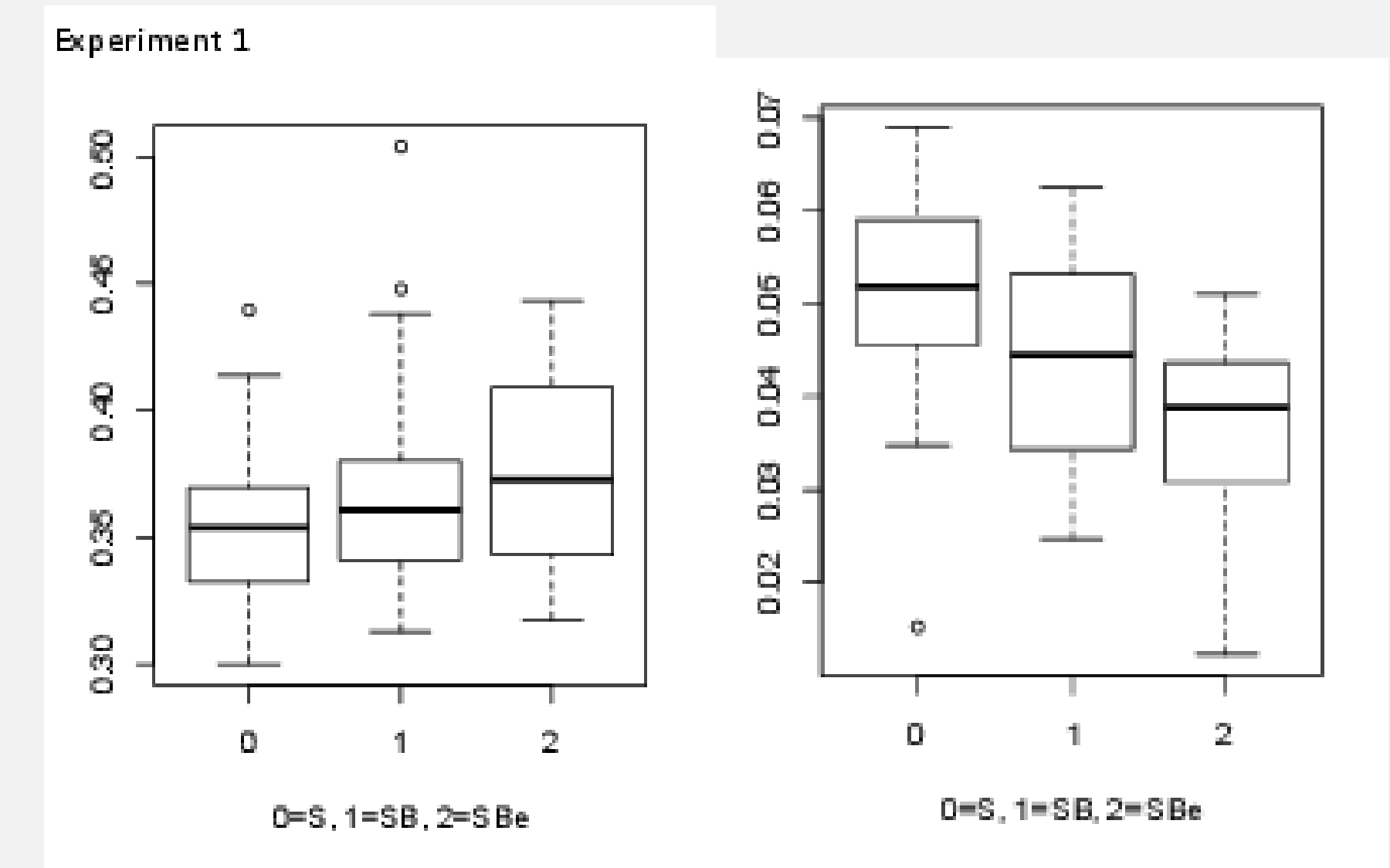


Speaking rate

- exp1,2: higher in dual tasks

Lexicon and Syntax

- exp1: cumulative impact of dual task and effort
- higher proportion of content words
- lower proportion of subordinate constructions



Discussion

Arms vs. legs

- higher proportion of speech with arm than with leg motion
- arm motion is more strongly linked to speech

Impact of dual tasks on cognition

- increased speaking rate might indicate cognitive ease
- effect depends on linguistic level: increased lexical creativity but decreased syntactic complexity

Effort constraints on cognition

- high effort leg motion:
 - increases respiratory rate
 - decreases the proportion of speech
- this might require:
 - a higher speaking rate
 - shorter syntactic units fitting into shorter breathing cycles
 - a higher amount of content words to increase information density