Institut universitaire en santé mentale de Québec



DE LA PAROLE ET DE L'AUDITI

SPEECH AND HEARING IEUROSCIENCE LABORATORY

Using electromyography to study the implication of the motor system in language processing Courson Melody^(1,2), Macoir Joël^(1,2), & Tremblay Pascale^(1,2)

Introduction

Functional neuroimaging [1,2], EEG [3] and TMS [4] studies have shown an implication of the motor system during action language processing such as action verbs (e.g. «to nail») and tool names (e.g. «hammer»). Peripheral motor activity modulations have also been recorded during action language processing through a force sensor [5].

Recent evidence suggests that the motor implication is modulated by linguistic [6] as well as conceptual [7,8] parameters.



There is, however, debate regarding whether or not the motor system is necessary to comprehend action language, and whether it plays a part in early linguistic processes or in later conceptual processes [9].

This research aims to determine whether :

- (1) EMG can capture modulations of peripheral motor activity in relation to language processing
- (2) peripheral motor activity is modulated by specific linguistic parameters: sentence type, linguistic context, prosody
- (3) this implication is observed at an early or late stage of language processing

Methods

Participants: 23 (12 women) healthy adults, aged 20 to 50 years, right-handed, native speakers of French Canadian, with no prior history of neurological, psychiatric or language disorders.

Pre-testing: audition, cognitive abilities (MoCA), prosody discrimination

Task: passive auditory language processing while performing a distractor task (visual detection). Participants were instructed to indicate, by a left foot movement, any change in the visual pattern.

Stimuli:

180 manual action sentences : «Dans le jardin, Sarah découpe le journal»

Variable			
Sentence type	Affirmative	Type 1 negative	Type 2 negative
	Sarah découpe le journal	Sarah ne découpe pas le journal	
Preceding	Neutral	Positive	Negative
context	Dans le jardin,	Avec ses ciseaux,	Sans ses ciseaux,
Prosody	Falling	Rising	

	Tool names	Actio	on verbs	associated
associated	ciseaux	découpe		manual ac
to manual	cuillère			
	crayon			
action	couteau	épluche		controlled
	guenille	essuie		
	mouchoi	r frotte		number
	pinceau	peint		
	marteau	u cloue		of syllables
	raquette			1
bisyllabic	stylo	signe		
DISYNADIC				 controlled frequ
				of occurrer
				or occurrer



Dans le jardin, Sarah	décou	pe le jou	rnal.
	0	300	600

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Aujourd'hui Québec, demain le monde

The motor response in FDI increases 300ms after action verb onset, suggesting that the peripheral motor system is implicated during action language processing, starting immediately after the action verb perception.

Time x Context interaction effect (Figure 2)

The motor response in FDI follows different patterns across time according to the context preceding the action verb. In neutral and affirmative context sentences, the motor response in FDI increases over time, while in negative context sentences, it decreases over time.

This suggests that the motor system is implicated in semantic processing of the action word. In addition, these results show that EMG can capture modulations of peripheral motor activity in relation to language processing.

Contrary to previous research, no effect of sentence type on the EMG response was observed. There was also no effect of prosody on the EMG signal, despite the fact that it was accurately interpreted by the participants, as shown by our

Conc usion

These preliminary results support the notion of an implication of the motor system during action language processing, immediately after an action verb that is embedded in a two-clause sentence. Here we show for the first time that EMG can capture modulations of peripheral motor activity in relation to language processing, and that the semantic context modulates the peripheral motor response during action verb processing. Additional analyses are underway, including the analysis of the EMG response to the tool nouns.

Further research aiming to determine which linguistic and conceptual parameters may influence motor activity, such as adverbs modulating the action verb (e.g. strongly, softly) or attentional focus, is needed to continue uncover the neurobehavioral and neurophysiological mechanisms underlying

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