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Lexical Access of Verbs in Parkinson's Disease: Does Agency Matter?

Maura Panozzo Chiomento, Maria Vender, Denis Delfitto

University of Verona (Dept. of Foreign Languages and Literatures and Dept. of Cultures and Civilizations)

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Outline



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Introduction

- Background on Parkinson's Disease (PD)
- Problem Stating: Diagnostic Delay
- Research Question

Materials and Methods

- Participants (demographic and clinical characteristics)
- Stimuli
- Procedure

Preliminary Results

- Accuracy
- Reaction Times

Discussion

Parkinson's Statistics: Facts and Figures

Second-most common neurodegenerative disease after Alzheimer's disease

PD incidence estimates increase with age in the **65+ range**

The primary risk factor for PD is **age**

PD incidence estimates are **higher in men compared to women** at all ages

Prevalence data:

10 million people worldwide are living with PD

The increase in the incidence of PD aligns with the growth of an **aging population**

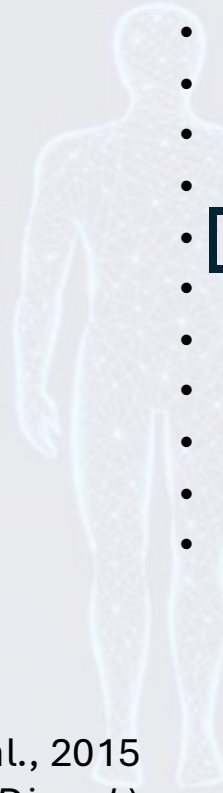
Data Source: The Parkinson's Foundation

A Systemic Disease

Movement Disorder Society (MDS)
Clinical Diagnostic Criteria for PD:

- Bradykinesia
- Tremors
- Rigidity
- Postural imbalance
- Walking difficulties
- Freezing of gait

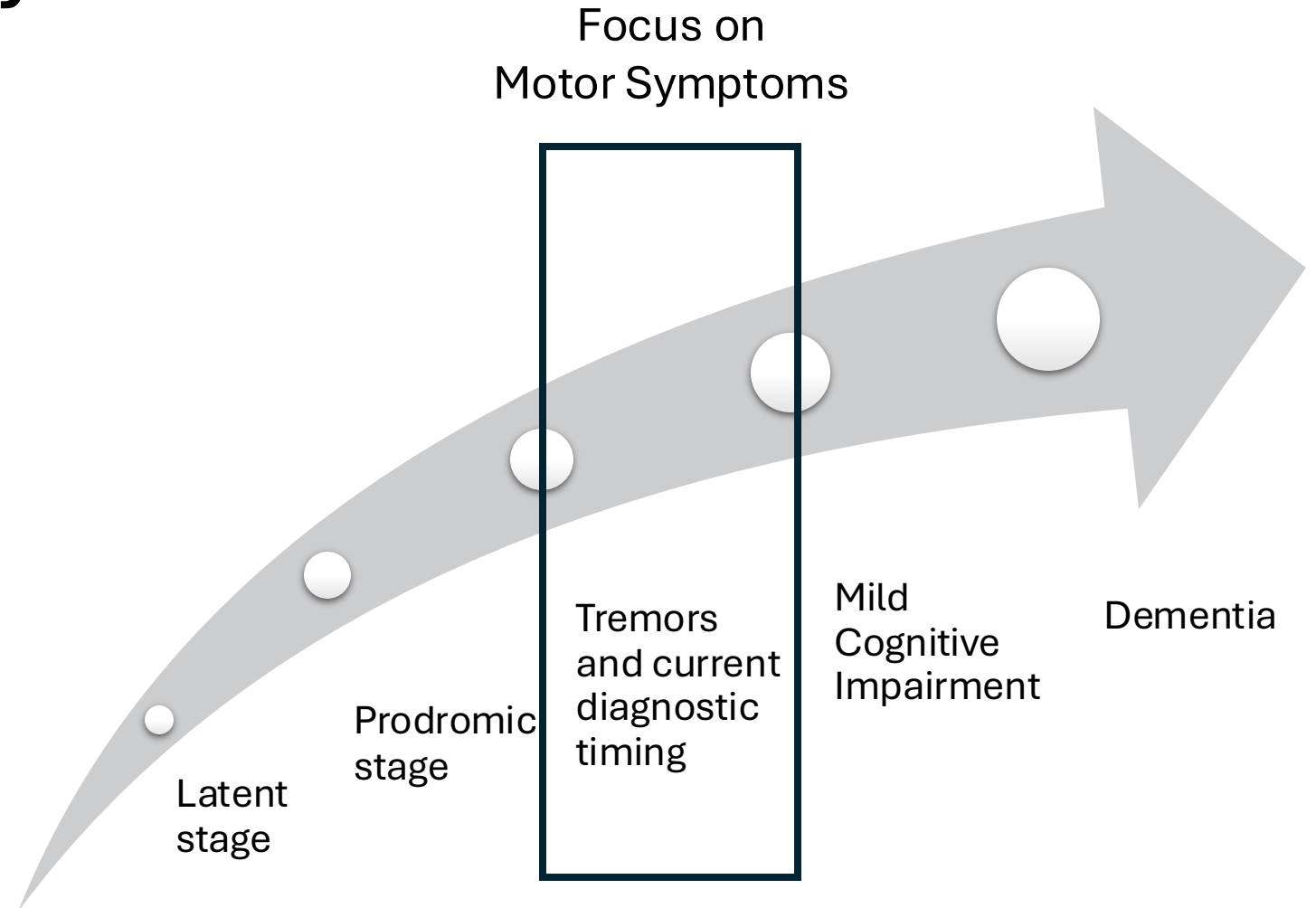
For a complete list see Postuma et al., 2015
(*Mov. Disord.*)



- Depression
- Anxiety
- Apathy
- Psychosis
- Impulse Control and related disorders
- Cognition
- Orthostatic hypotension
- Urinary
- Sexual
- Gastrointestinal
- Sleep and wakefulness
- Pain

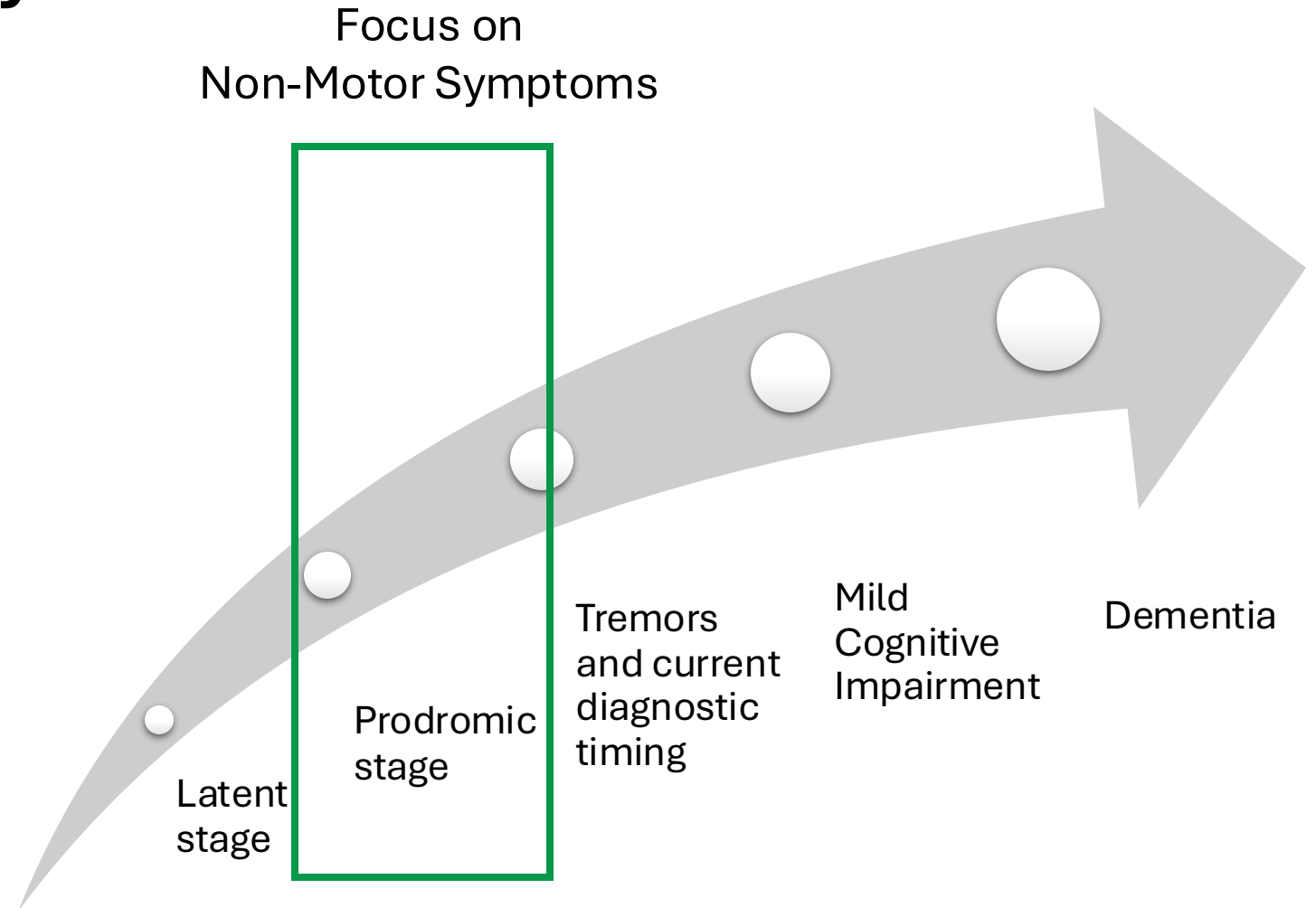
Rodriguez-Blazquez et al., 2020 (*Mov. Disord. Clin. Pract.*)

Diagnostic Delay



Graph on disease progression based on Emre, 2015

Diagnostic Delay



Graph on disease progression based on Emre, 2015

Relevance of Non-Motor Predictors

Can we identify **non-motor predictors** of Parkinson's disease
and contribute to a **timely diagnosis**?

Linguistic Background on PD

Individuals with PD exhibit **altered “awareness of the authorship of action”** (Saito et al., 2017)

Heterogeneous language impairment attested in PD spanning across multiple domains (morphology, syntactic processing, pragmatics, ToM)

One of such domains is semantic knowledge and **lexical access**. People with PD encounter difficulties in naming pictures depicting:

action verbs

(Herrera et al., 2012; Bocanegra et al., 2015; 2017)

manipulable nouns

(Johari et al., 2019; Bocanegra et al., 2017)

Linguistic Background on PD

Do people with PD exhibit lexical access difficulties
in retrieving verbs as a function of the **agentivity component**?

Prediction: The presence of an agent may pose greater difficulty

Materials and Methods: Participants

- Sex
- Age
- Education
- Handedness
- Linguistic profile (PD: 22 Veneto, 2 Trentino, 1 Emilia-Romagna, 2 Tuscany, 1 Apulia, 1 Sicily)

	PD <i>N</i> = 31	Controls <i>N</i> = 31	PD vs. Controls <i>p</i> value
Age (years)	65.03 (6.66)	64.18 (8.31)	.65 ^a
Education (years)	11.87 (3.30)	13.42 (3.68)	.08 ^a
Sex (F:M)	7:24	9:22	.59 ^b

^a Welch T

^b Chi Squared

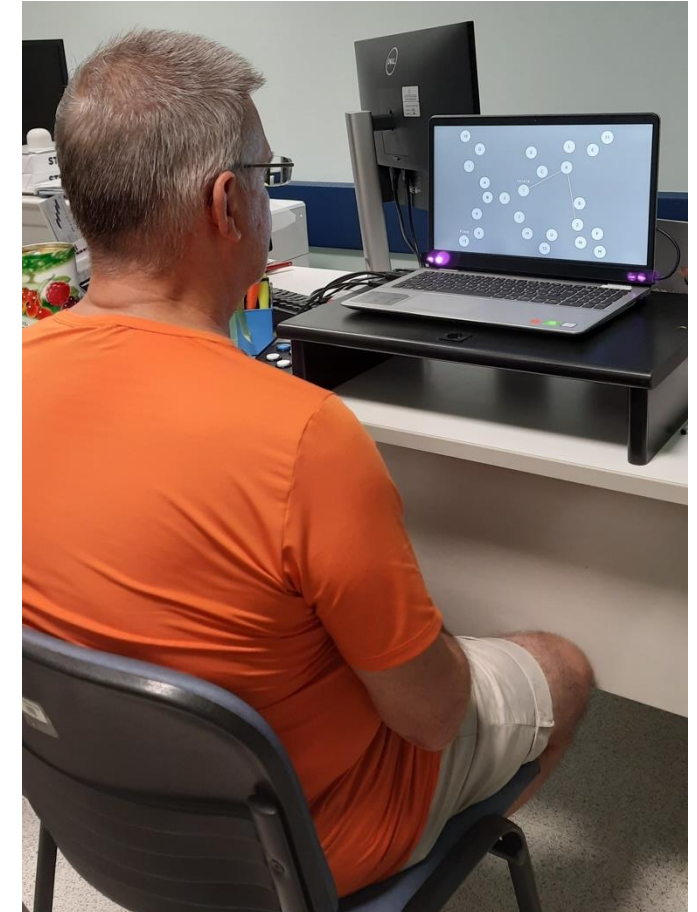
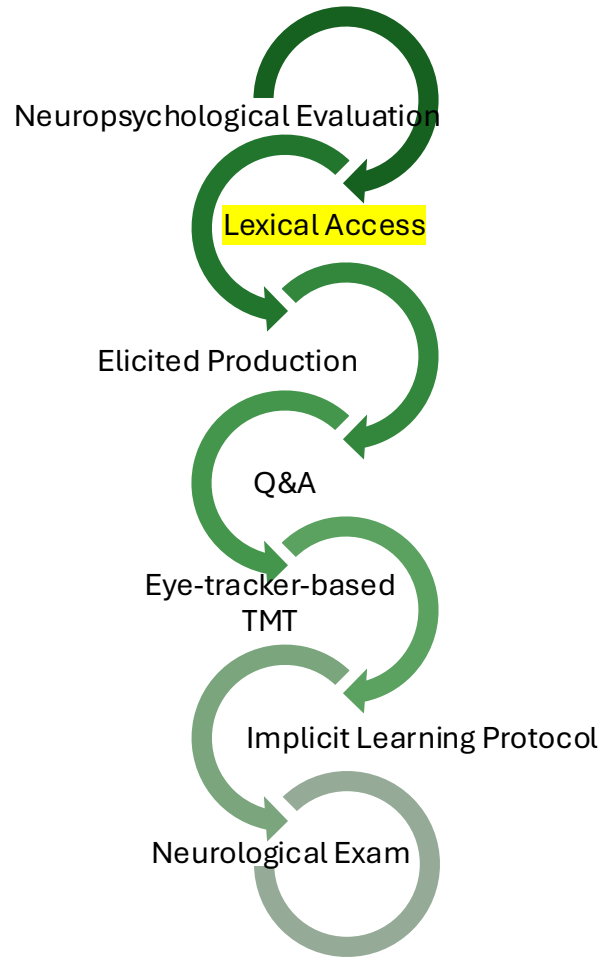
Materials and Methods: Clinical Characteristics

Information on Patients	
Age at onset (years)	61.2 (7.03)
Disease duration (years)	3.57 (2.14)
Most affected side	16 right; 15 left
Phenotype	23 tremor-dominant; 8 akinetic-rigid

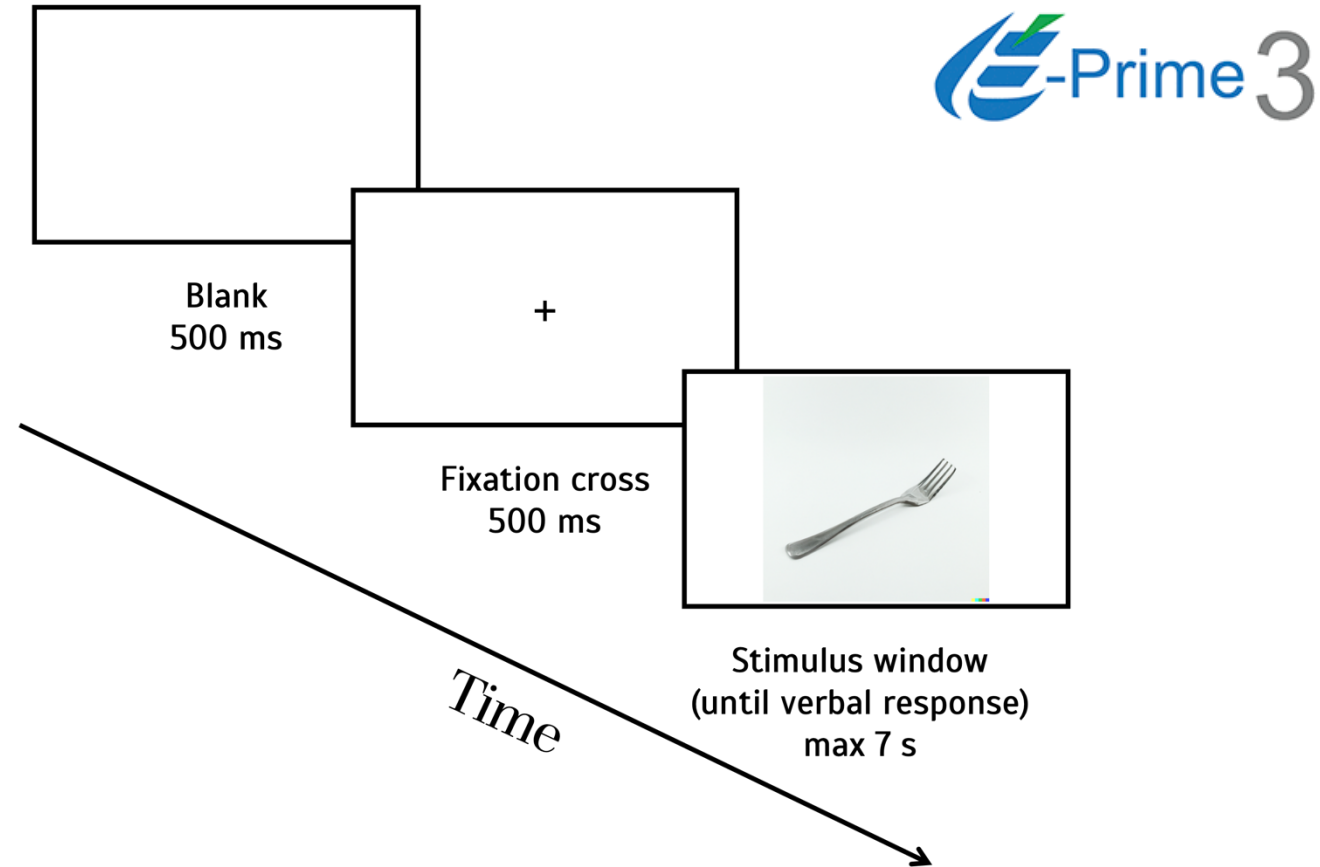
Evaluation Scales	
UPDRS-I (Non-motor aspects of daily life experiences)	9.70 (5.14)
UPDRS-II (Motor aspects of daily life experiences)	6.47 (4.61)
UPDRS-III (Motor evaluation)	21.6 (8.63)
UPDRS-IV (Motor complications)	0
Hoehn & Yahr	1.77 (0.41)

Goetz et al., 2008. *J. Mov. Disord.*

Materials and Methods: Tasks Overview

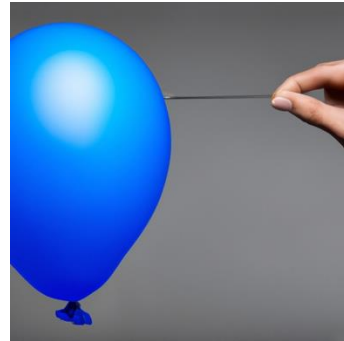


Materials and Methods: Procedure



Materials and Methods: Stimuli

1/5 Transitive Achievements



arresta
(to arrest)

vince
(to win)

buca
(to pop)

trova
(to find)

imbuca
(to post)

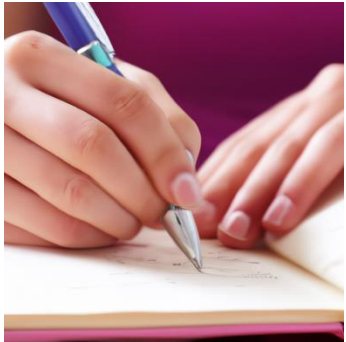
scopre
(to discover)

para
(to save)

All the target answers in Italian are in the third person singular form, as the verbs were elicited by asking the participant: “Cosa fa questa persona?” (*What does this person do?*).

Materials and Methods: Stimuli

2/5 Transitive Accomplishments



scrive
(to write)



gonfia
(to blow)



disegna
(to draw)



cucina
(to cook)



costruisce
(to build)



attraversa
(to cross)



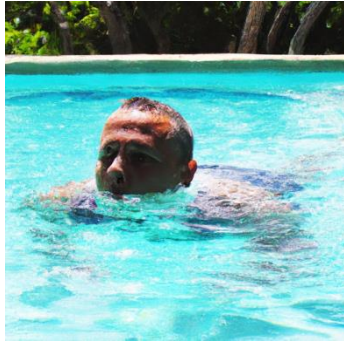
taglia
(to cut)

Materials and Methods: Stimuli

3/5 Unergatives



pattina
(to skate)



nuota
(to swim)



prega
(to pray)



brinda
(to toast)



cammina
(to walk)



bussa
(to knock)



scia
(to ski)

Materials and Methods: Stimuli

4/5 Unergatives (internal)



dorme
(to sleep)



tossisce
(to cough)



vomita
(to vomit)



trema
(to tremble)



sbadiglia
(to yawn)



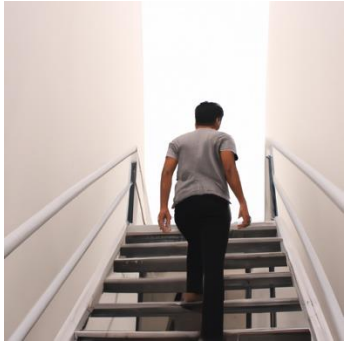
ride
(to laugh)



piange
(to cry)

Materials and Methods: Stimuli

5/5 Unaccusatives (Control, Agent-less)



sale

(to go up)



scende

(to go down)



sviene

(to faint)



scivola

(to slip)



esce

(to exit)



entra

(to enter)



cade

(to fall)

Accuracy (Group Comparison)

The HCM group has a higher accuracy rate (80.3%) than the PD group (75.6%).

Is this difference statistically significant?

Logistic regression model to test whether Group (PD vs. HCM) predicts Accuracy.

It does! Group is a main effect ($p = 0.00759$).



Accuracy (Group * Category)

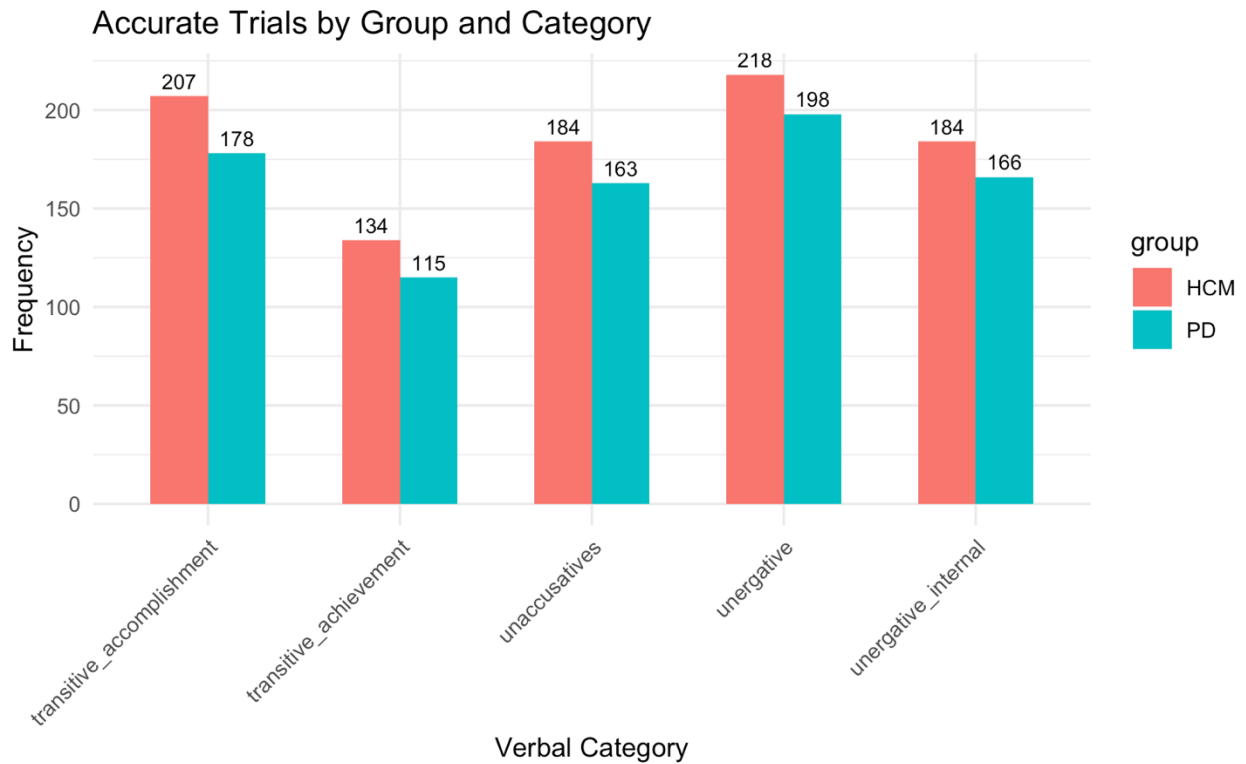
Does the difference in Accuracy between Groups vary across verbal Categories?

Updated logistic regression model to test whether the interaction between Group and Category predicts Accuracy.

The interaction is not significant, indicating that the difference in Accuracy between PD and HCM does not vary significantly across Categories.

There are independent main effects:

- **Group effect** is significant;
- **Category effect** is significant



Accuracy (Group + Category)

Updated logistic regression model including Group and Category as additive predictors (**independent main effects**):

PD Group performs significantly worse than HCM overall ($p = 0.0051$), independent of the verbal category;

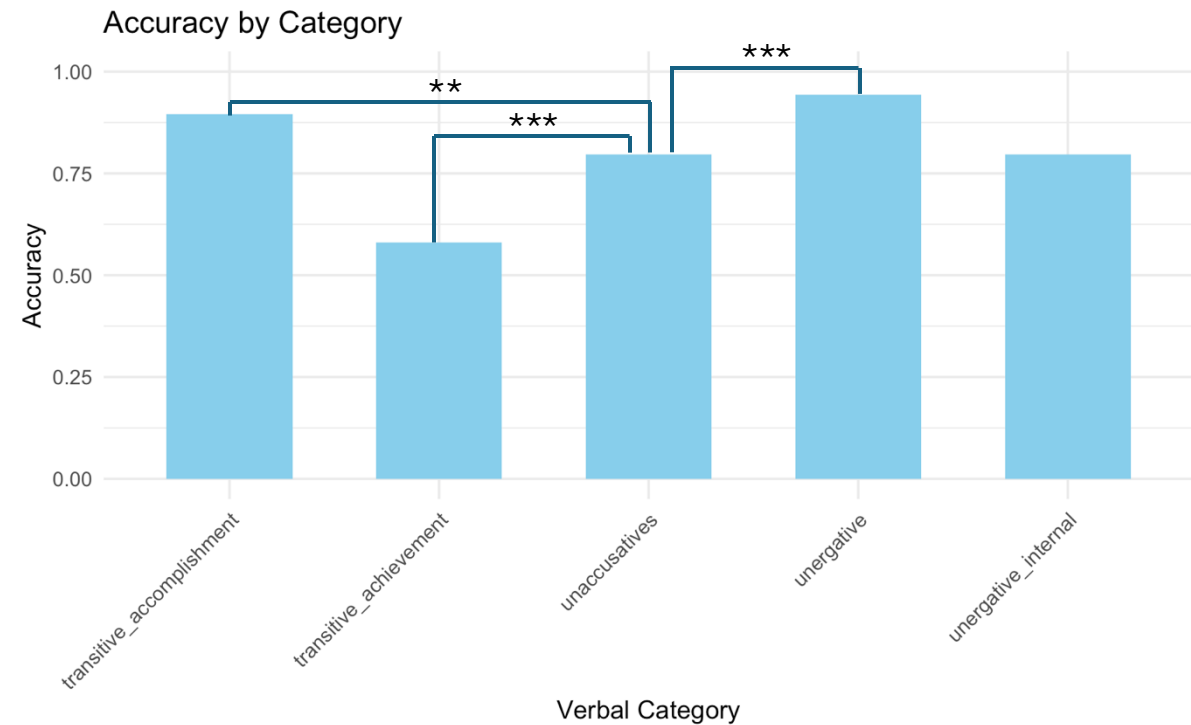
Category effects (against control Category)

Tran_accomp: Higher Accuracy than Unacc ($p = 0.0011$)

Tran_achiev: Lower Accuracy than Unacc ($p < 0.001$)

Unerg: Higher Accuracy than Unacc ($p < 0.001$)

Unerg_int: No significant difference from Unacc ($p = 0.809$)



Accuracy (Error Distribution)

Accuracy Coding

err_type1_omission

err_type2_pos

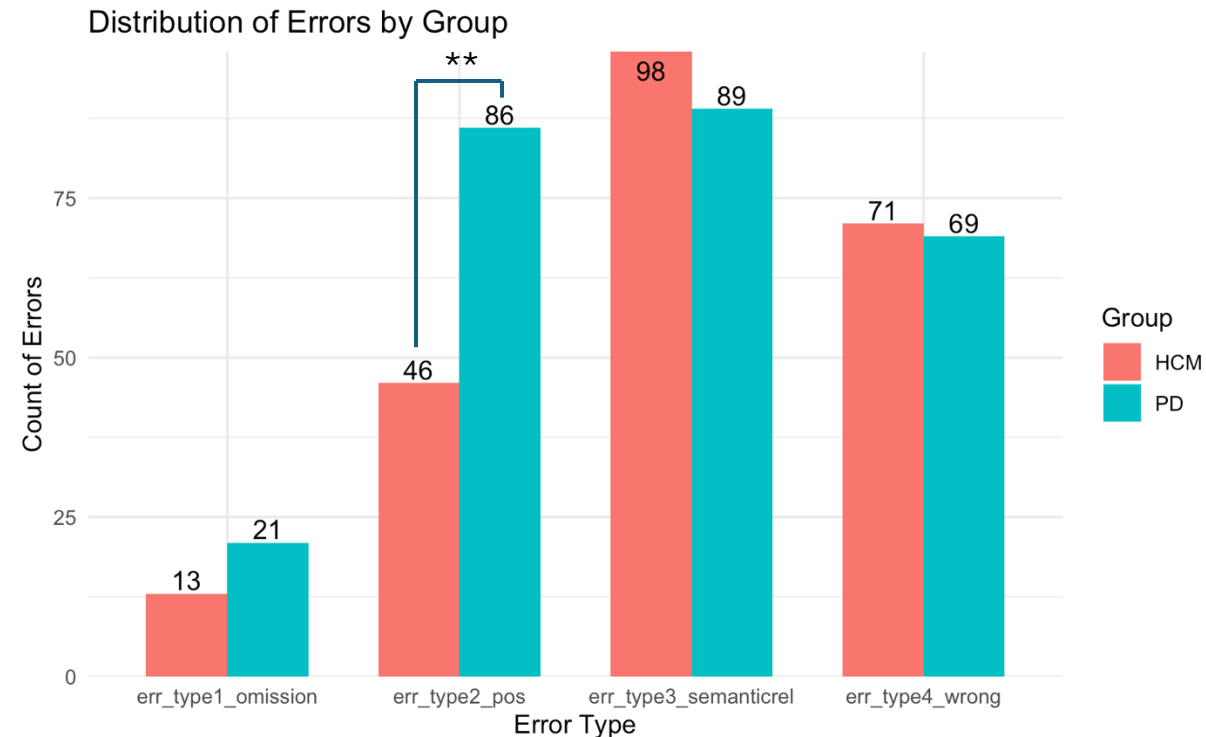
err_type3_semanticrel

err_type4_wrong

err_type2_pos

Participants produce a **non-verbal answer**
(cross-categorical confusion)

PD Group produces significantly more
err_type2_pos than HCM ($p < 0.01$).



Accuracy (Non-Target Tendencies)

Accuracy Coding

rem_type1_addition

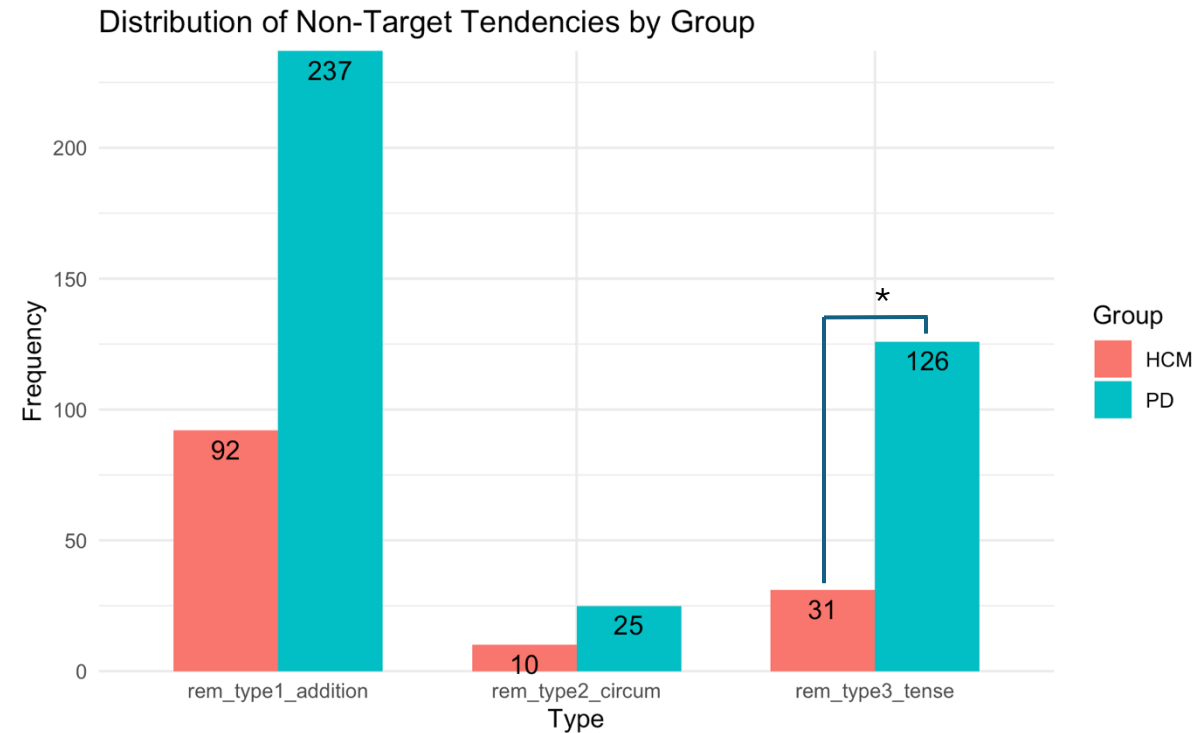
rem_type2_circum

rem_type3_tense

rem_type3_tense

Participants' answer encodes a **non-target value of Tense** (e.g., non-finite, past forms)

PD Group produces significantly more rem_type3_tense than HCM ($p < 0.05$).

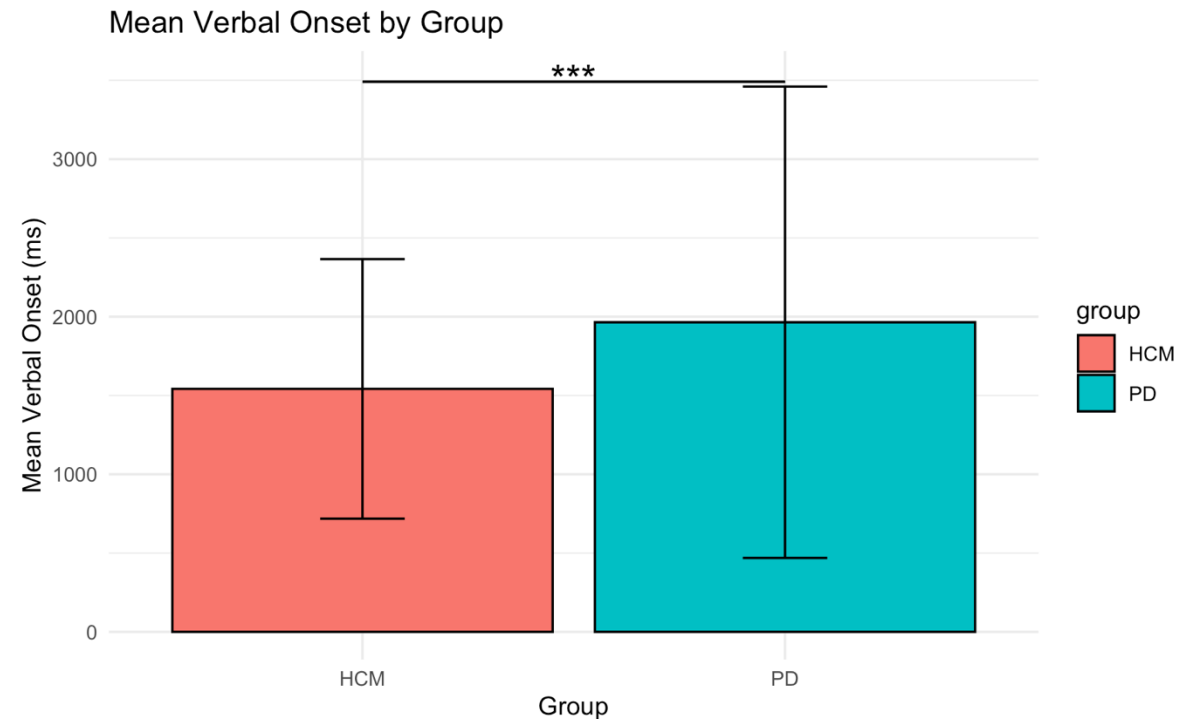


Reaction Times (Group Comparison)

The PD group is slower ($M = 1964.78$ ms; $SD = 1495.95$) than the HCM group ($M = 1541.84$ ms; $SD = 823.71$).

Is this difference statistically significant?

Mann-Whitney U test shows that there is a statistically significant difference in reaction times (ms) between Groups, with PD significantly slower than HCM ($p < 0.001$).



Reaction Times (Group * Category)

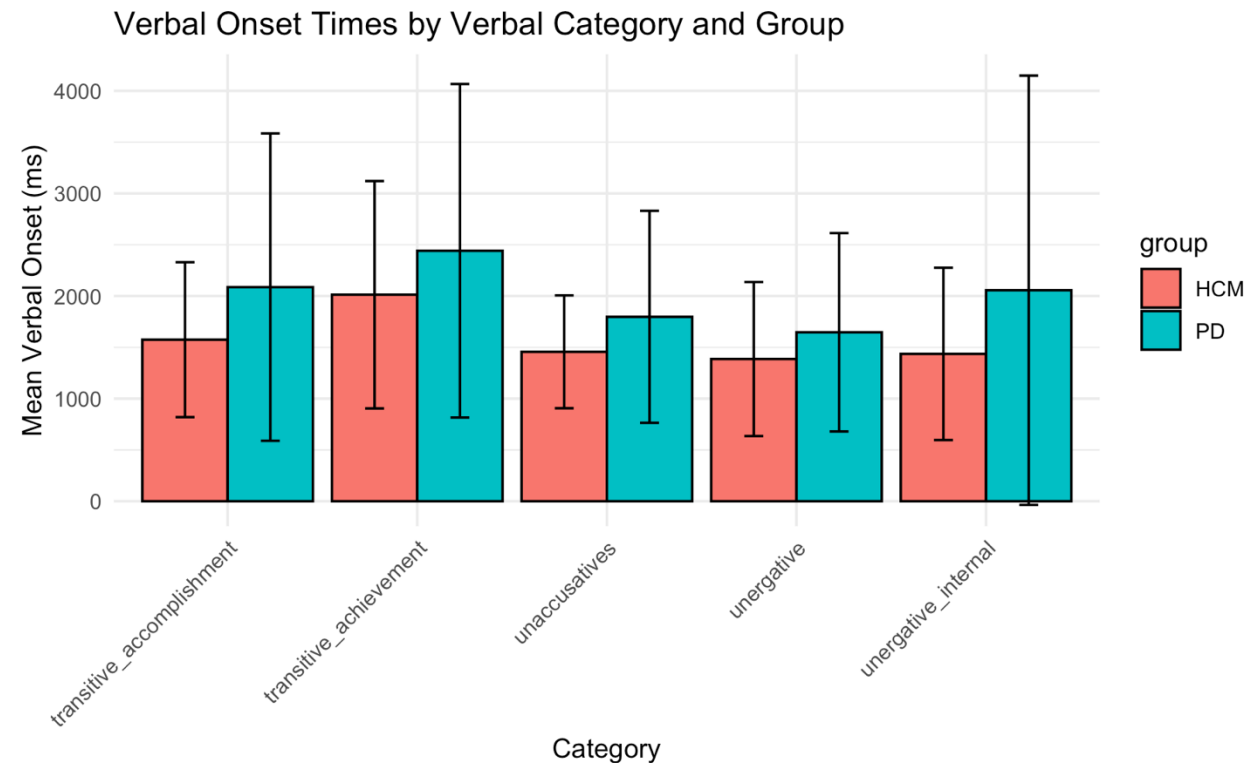
Does the difference in Reaction Times between Groups vary across verbal Categories?

Linear regression model to test whether the interaction between Group and Category predicts Reaction Times.

The interaction is not significant, indicating that the difference in Reaction Times between PD and HCM does not vary significantly across Categories.

There are independent main effects:

- **Group effect** is significant;
- **Category effect** is significant



Discussion (Results in a Nutshell)

Accuracy and Reaction Times (ms) results so far

Group significantly influences both Accuracy and Reaction Times with converging results. The **PD Group** has a **lower Accuracy** ($p < 0.01$) and **higher Reaction Times** ($p < 0.001$) compared to HCM overall, irrespectively of verbal Category.

Similar pattern between PD and HCM across **all verbal categories**, including the agent-less category “unaccusatives”, going beyond the initial, agency-driven prediction.

Discussion (The Road Ahead)

Next steps include more detailed analyses considering:

- lexical frequency
- individual variability, especially within the PD group
- a comparison between Verbs and Nouns to rule out a generalised slowing for all parts of speech

- **Agency** (*unaccusatives*) vs. **Intentionality** (*unergatives_internal*)
- Between-group differences in lexical access of verbs might suggest that this measure can be used as a **marker of PD**
- Tests involving verbal lexical access could complete the clinical picture of PD and inform **diagnostic practices**



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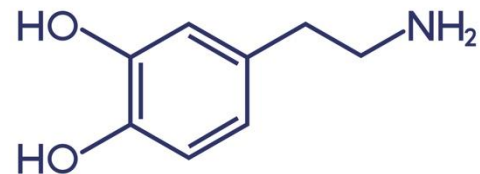
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Thank you!

Acknowledgments

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maura.panozzochiomento@univr.it