



Vi Comunico
Che Penso

Assessment of linguistic and numerical ability via EMG, movement tracking and eye tracking in FC users.

An experimental study.

FC: the problem of intellectual disability

Absence of language  absence of thought

Many FC users received the diagnosis of intellectual disability.

Standardized tests

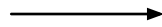
Interference of many variables occurs in tests that aim to assess intellectual ability:

- Executive functions (working memory, attention...)
- Motor planning of the movement (integration of somatosensory and visual information, movement coordination toward a target).

«Even the simplest and most automatic task might be influenced by the co-occurring of a different activity.» (Mitra 2008)

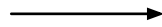
Aims of the study

1. Portray a faithful profile of the participants' competences



Quantitative and **QUALITATIVE** analysis of linguistic and numerical ability

2. Does the participant benefit from facilitation and/or physical contact?



Differences' analysis among different experimental conditions

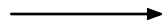
Material and methods



- ▶ 13 FC users and 6 facilitators took part in the experiment
- ▶ Standardized tests (BADA; BDE; MT)
- ▶ Different experimental conditions (autonomy, facilitation, touch, physical containment)
- ▶ Eye tracking glasses
- ▶ EMG sensors
- ▶ Movement active markers

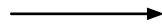
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Differences' analysis among different experimental conditions

Results	Facilitation	Autonomy	Physical containment	Touch
P1	100	83,72	75	85,71
P2	93,55	52,63	91,67	100
P3	100	100	85,42	96
P4	93,51	57,14		91,53
P5	93,51		89,83	90,91
P6	95,54		88,00	100
P7	87,23	75		80,85
P8	85,92	56,34		81,69
P9	83,87			82,22
P11	90,63	85,11		100
P12	91,18	62,71		89,71
P13	92,31		88,57	90,59

Aim 1:results (a)

Table 1: percentage of correct answer among different conditions for each participant

	Facilitation	Autonomy	Touch
Mean	92,75	71,58	90,69

Table 2: Average percentage of correct answer among different conditions (8 participants: P1,P2,P3,P4,P7,P8,P11,P12)

- Statistically significant difference in terms of correctness between the facilitation and the autonomous condition ($t(7)=4,0194$; $p<0,05$)
- Statistically significant difference in terms of correctness between the touch and the autonomous condition ($t(7)=3,0341$; $p<0,05$)

Aim 1: results (b)

Aim 2: Differences among the conditions-movement markers and EMG data

- Statistical significant differences in terms of rapidness of the pointing movement (P2-P3)
 - P2-P3: slower movement in the autonomy-condition vs facilitated condition.
- Detection of facilitator's deltoid peaks and their relation to the participant movement (P2-P4-P6)

Differences in times(P2-P3)

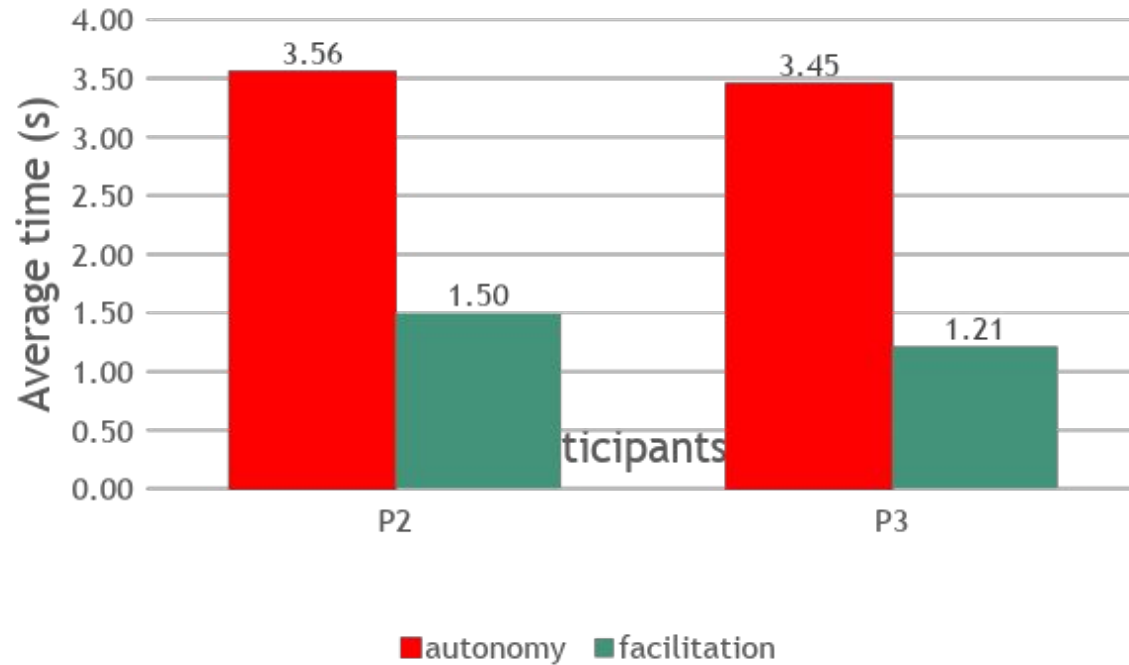


Figure 1: Pointing movement's mean time among different conditions

P2: $t(10)=3,7499$, $p \text{ value}<0,05$

P3: $t(7)= 5,7024$, $p \text{ value}<0,05$

Differences in times(P2-P3)

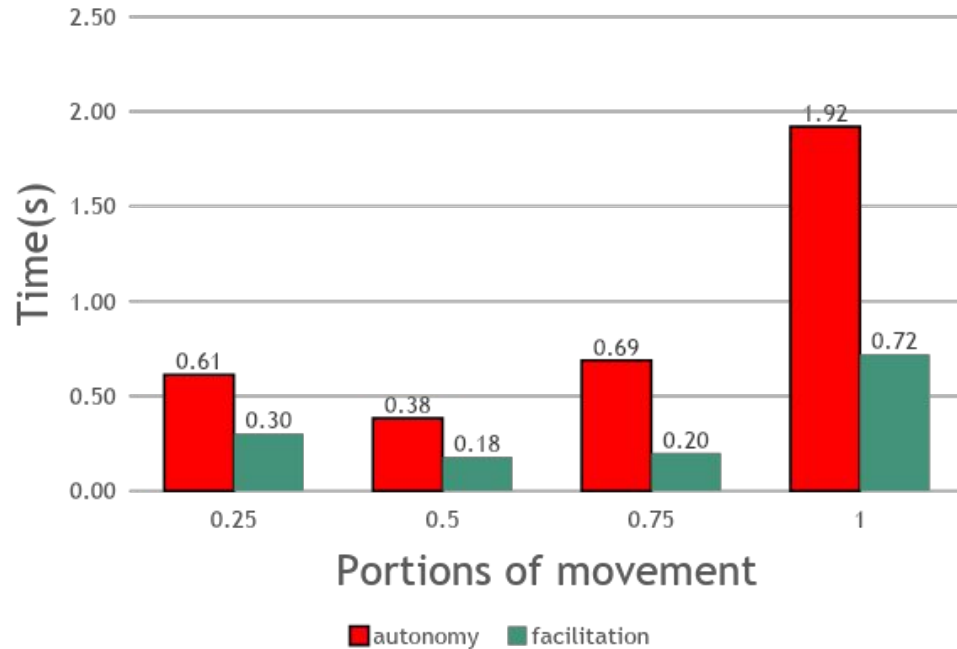


Figure 2: differences in time for each portion of movement among different condition- *number inserction task- P2*

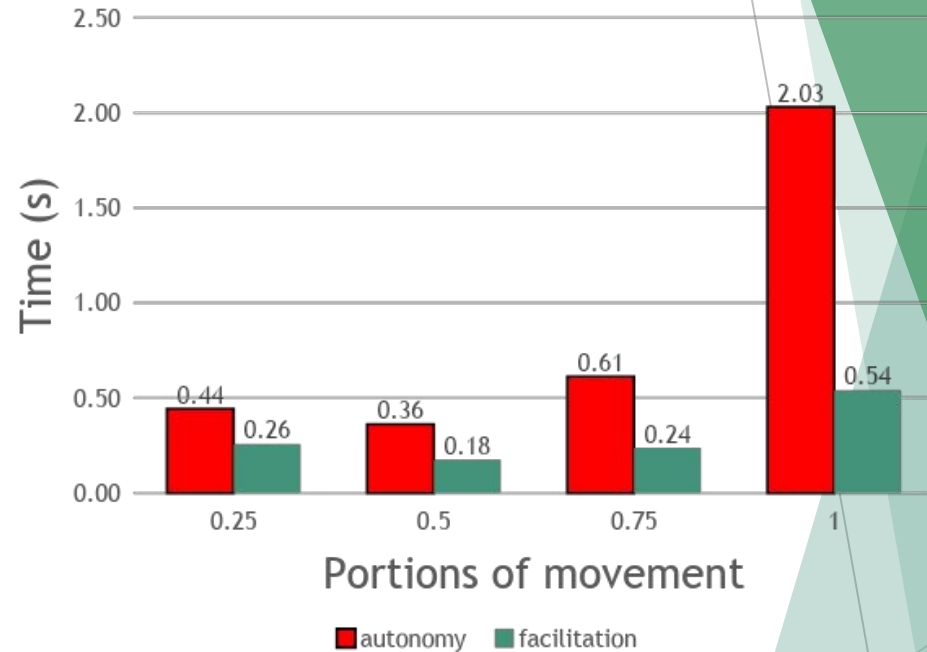
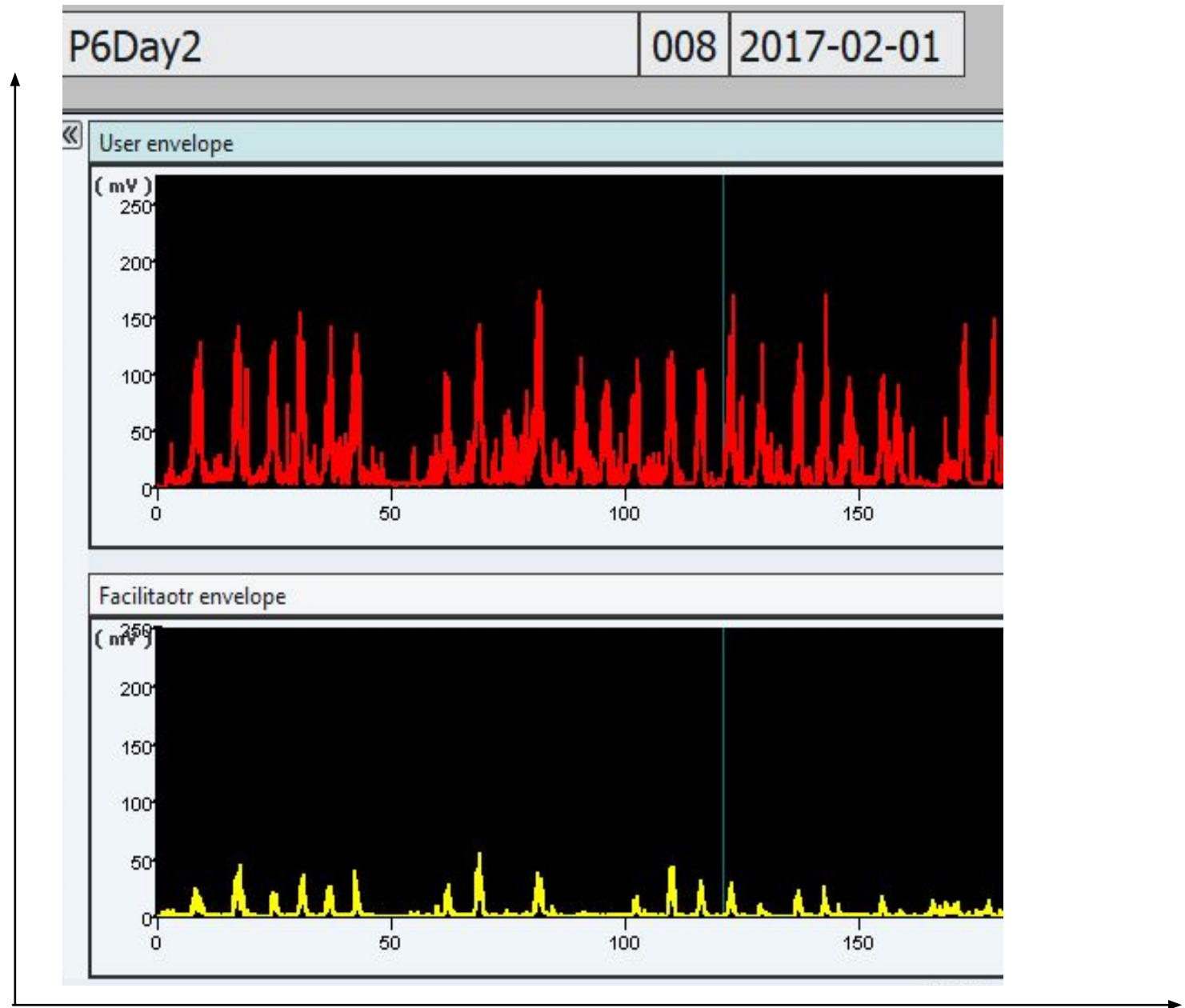


Figure 3: differences in time for each portion of movement among different condition- *visual grammaticality judgements task- P3*

Facilitator's deltoid activation

Among all the participant the user's deltoid activation is $\frac{3}{4}$ times higher than the one of the facilitator.

- ▶ Figure 4: Odin codamotion layout: participant deltoid activation (red) vs facilitator deltoid (yellow).
- ▶ X axis: time (s)
- ▶ Y axis: millivolt (mV)



Facilitator's deltoid activation

Among all the participant the user's deltoid activation is $\frac{3}{4}$ times higher than the one of the facilitator.



This could be just the results of a different type of action; the participant points at the screen while the facilitator is holding the participant's arm.

Means facilitator's times of peaks (a)

- Detection of the 2 highest peaks of the facilitator:

	Beginning of the movement	Facilitator's Peak1	Facilitator's Peak 2	End of the movement
P2	0	0,41	0,66	1
P4	0	0,25		1
P6	0	0,34	0,57	1

Facilitator's peaks of activation (b)

- Does the occurrence of the facilitator activation modify the direction of the pointing movement of the participant?



Analysis of the participant lateral movement (x axis)

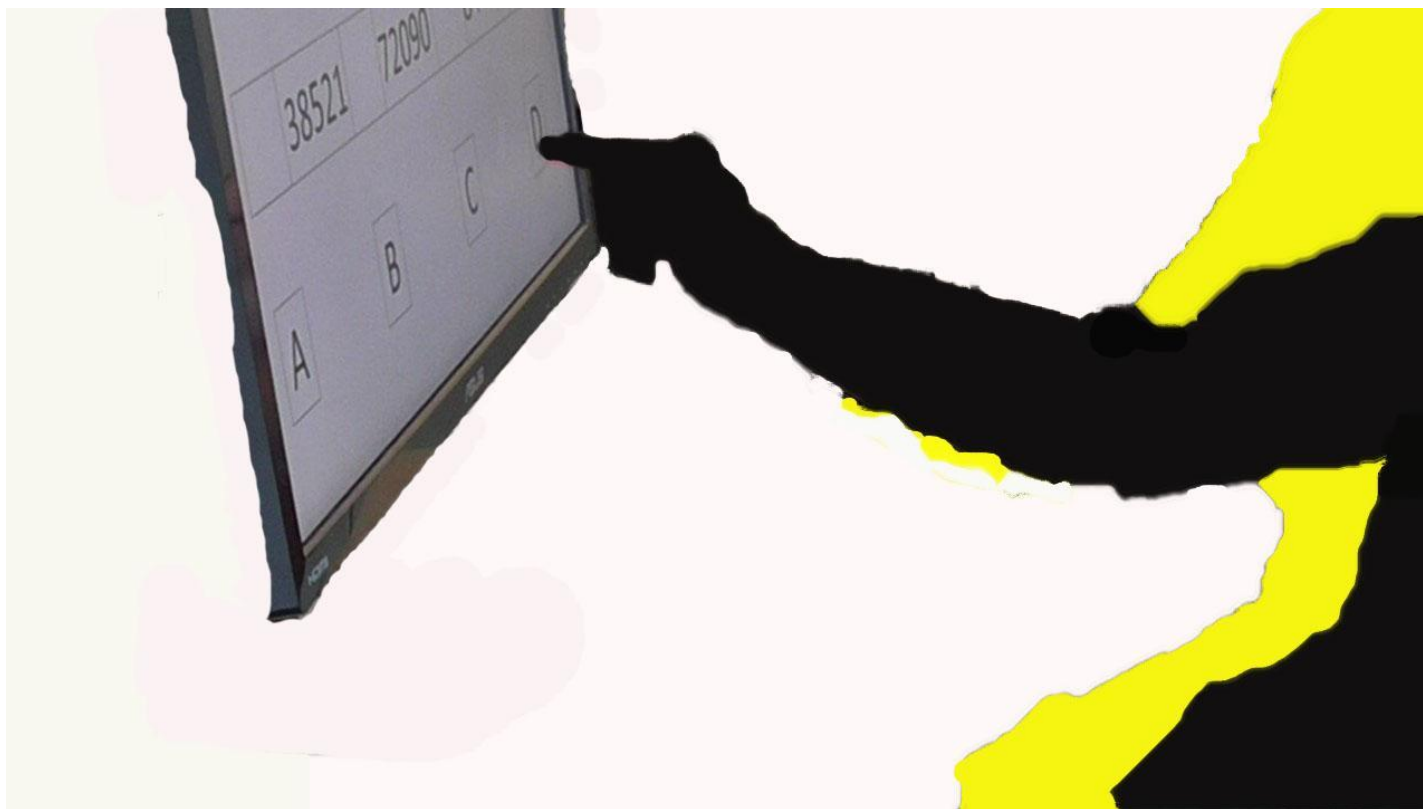


Figure 5: X, Y, Z
dimension in relation
with the participant
pointing movement

Analysis of movement on the x axis (a)

The X axis is directly related to the possible options shown on the screen.

The active marker detect the position of the participant arm in the X dimension. That portrays the shifting of the arm in the X dimension.



Pointing at the answer on the left or pointing at the answer on the right require different patterns of movement.

Therefore, it was possible to pinpoint a precise time after which the movement's direction was predictable with certainty (right vs left/answer A or B or C or D).

Analysis of movement on the x axis (b)

	Time	Answer A	Answer B	Answer C	Answer D
P2	0,4 s	16,54 mm	33,41 mm	119,366 mm	152,94 mm

	Time	Left answer	Right answer
P4	0,2s	10 mm	31 mm

	Time	Left answer	Right answer
P6	0,2s	-0,530 mm	41,55 mm

Figure 6: Time after which is possible to predict correctly the direction of the answer

	Beginning of the movement	Facilitator's Peak1	Facilitator's Peak 2	End of the movement	Clear direction point
P2	0	0,41	0,66	1	0,29
P4	0	0,25		1	0,17
P6	0	0,34	0,57	1	0,17

Figure 7: the facilitator's peaks occur after the direction is decided

Discussion

- ▶ The activation of the facilitator does NOT influence nor determine the direction of the movement.
- ▶ The movement direction is planned at the beginning of the movement.
- ▶ The participant knows the direction s/he is going to point at when s/he moves towards the keyboard.
- ▶ Any influence from the facilitator must be very clear and precise and this hypothetical cue must happen before the movement starts.

Thank you for the attention



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