Learning & memory in 22q11.2 deletion syndrome

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Learning & memory

Ability to acquire, store and recall information over time
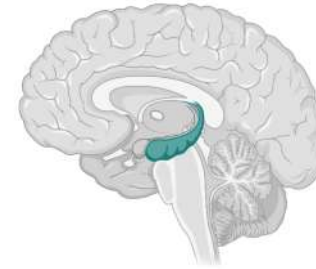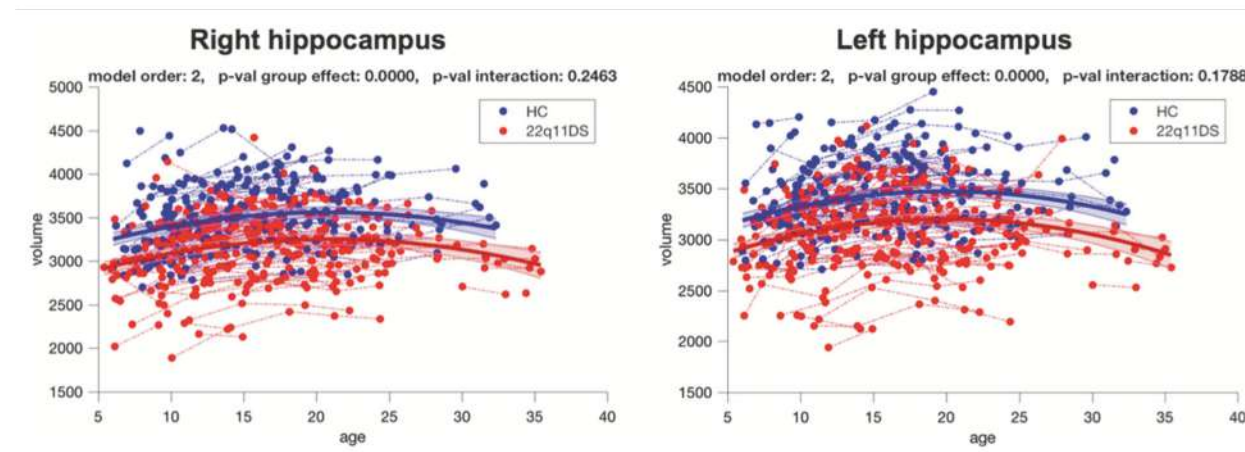
Event *Word meaning* *Skills*

Hippocampus is a key structure in the brain

Hippocampus

Reduction of the volume have been consistently demonstrated in 22q11.2DS

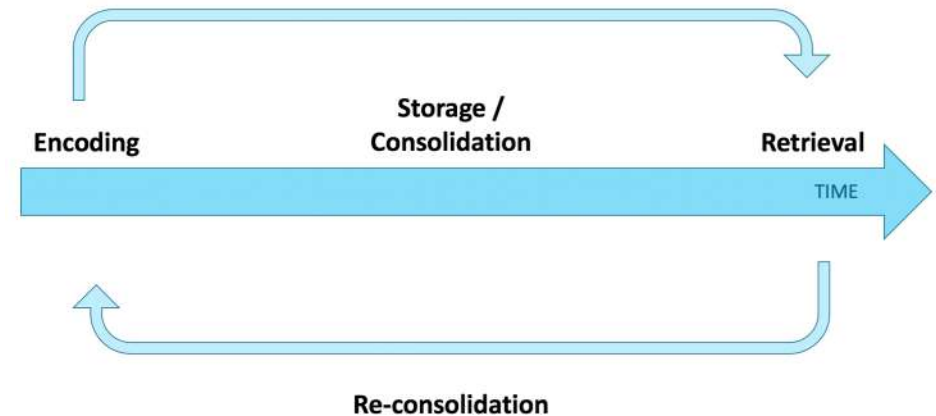From Mancini et al. 2019, Mol. Psych.

Learning & memory in 22q11.2DS

Numerous previous studies on memory have shown verbal > non verbal

> Few have focused on the different steps leading to memory impairments

Acquisition? Storage? Recall?

Memory is tested with paradigms including immediate and differed recalls (30 minutes)

> Consolidation of memory happens over longer delays (days, weeks, months)
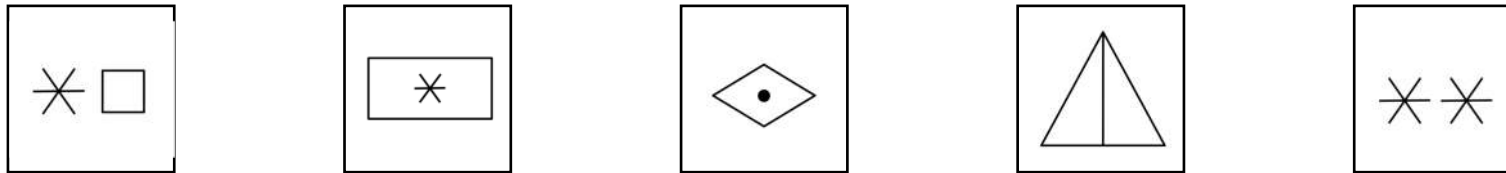
What happens after 30 minutes?

Bostelmann et al., 2017;Campbell et al., 2010; Debbané et al., 2008; Lajiness-O'Neill et al., 2005

Task design

Inspired by Rey's Auditory Verbal Learning Test (RAVLT, 1958)

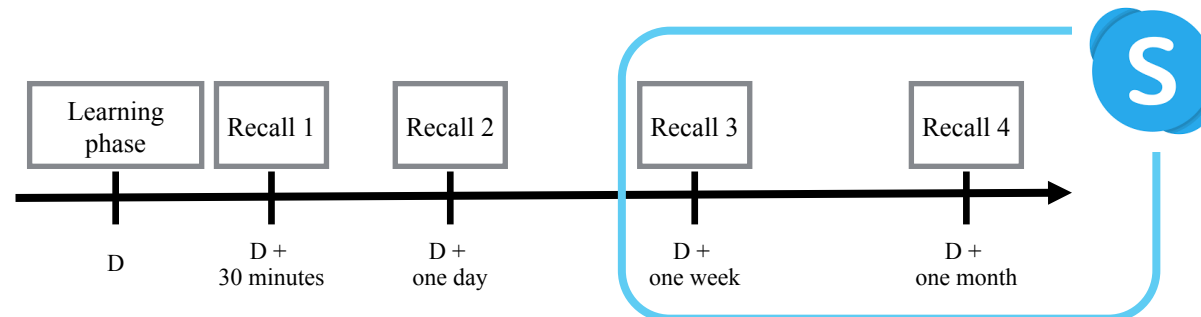**Verbal information** = 15 common French words

Table, cat, moon, car, …

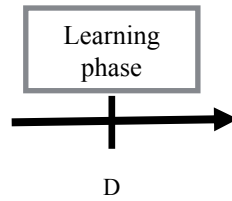**Non-verbal information** = 15 drawings made out of 1 or 2 basic geometrical forms

Learning criterion: 80% (12 items) or max. 6 presentations

Adapted recall design:
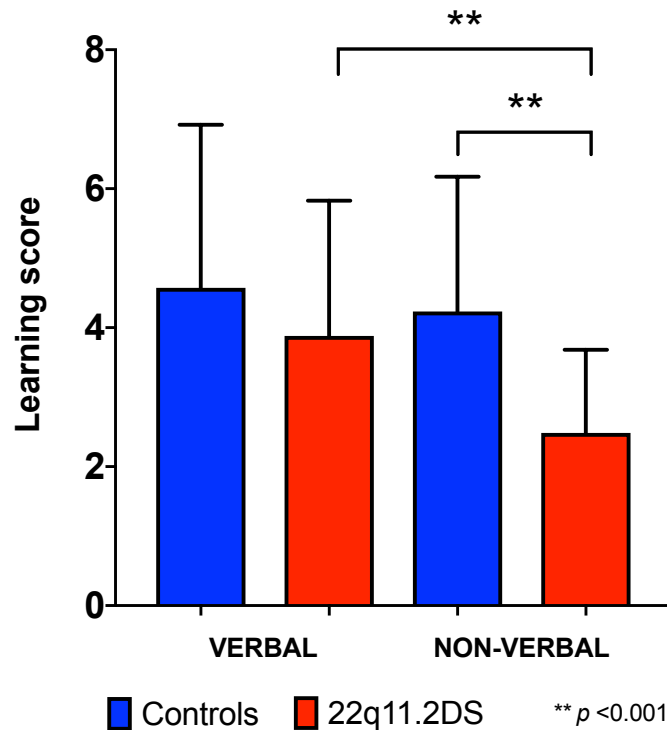
Results on learning

Learning phase

D

$$\text{Learning Score} = \frac{\text{Highest. Nb. Items recalled}}{\text{Nb. Trials necessary to reach criterion}}$$
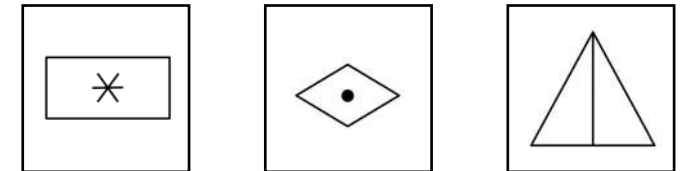
Information acquisition

VERBAL

Table, cat, moon, car, …

Comparable trajectories of learning over time
Similar performances from trial 1
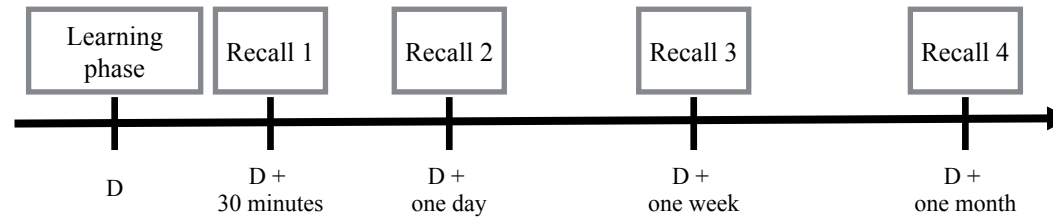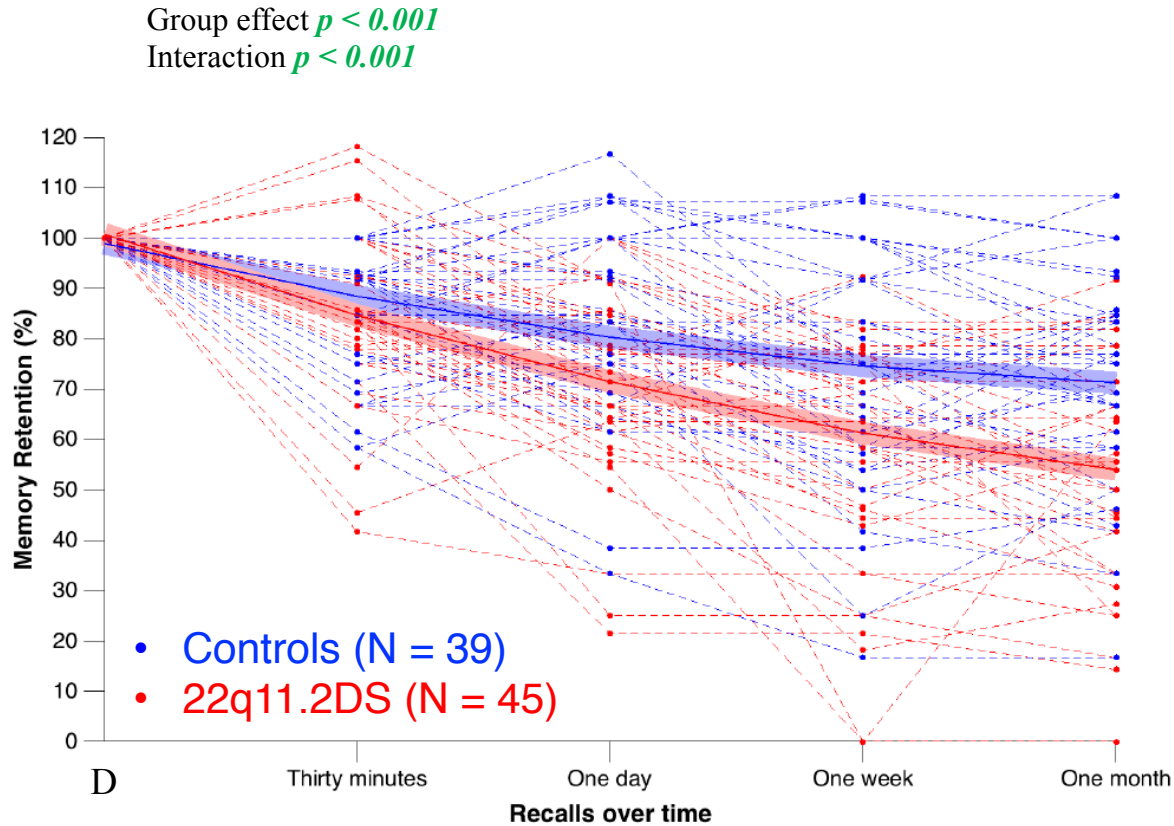Same amount of trials necessary to reach criterion

NON-VERBAL

Lower performances from trial 1 in 22q11.2DS
Slower increase over time in 22q11.2DS
More trials needed to reach criterion in 22q11DS

Controls   22q11.2DS   ** p <0.001

Results on verbal memory

Table, cat, moon, car, …

N= 84
Age range: 8-25

Group effect *p < 0.001*
Interaction *p < 0.001*
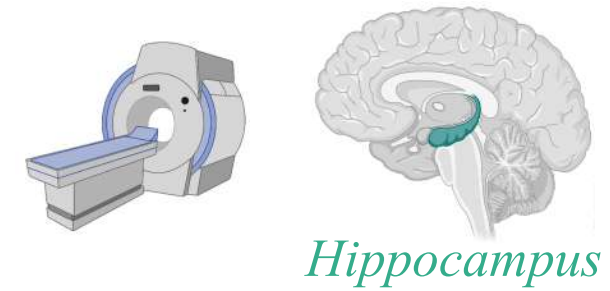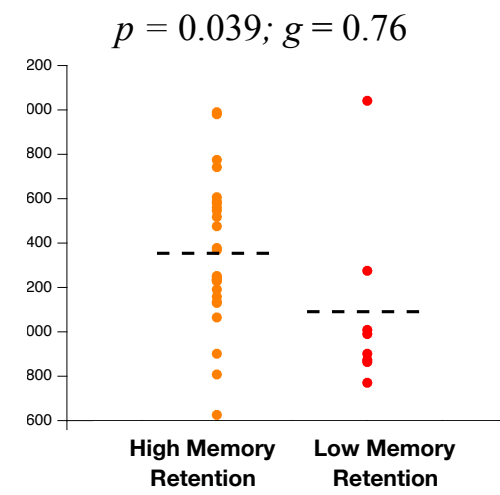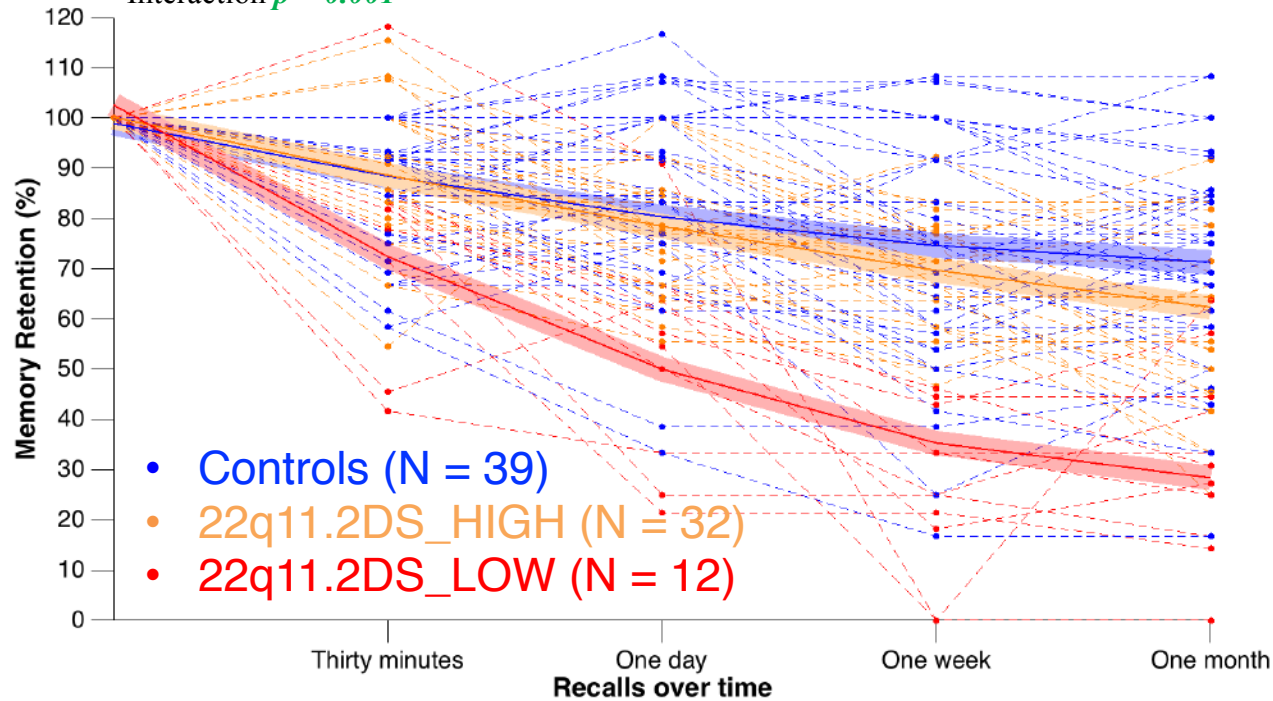

Significant difference in shape between groups

Significantly lower performance after delays of 30 minutes

Evidence for accelerated long-term forgetting (ALF)

(Shape with IQ as a covariate: *p* <0.001)

From Maeder et al. 2019, Child Neuropsychol.

Subgroups in 22q11.2DS

Within 22q11.2DS
Group effect *p < 0.001*
Interaction *p < 0.001*

Hippocampus

Controls (N = 39)
22q11.2DS_HIGH (N = 32)
22q11.2DS_LOW (N = 12)

p = 0.039; *g* = 0.76

p = 0.021; *g* = 0.95
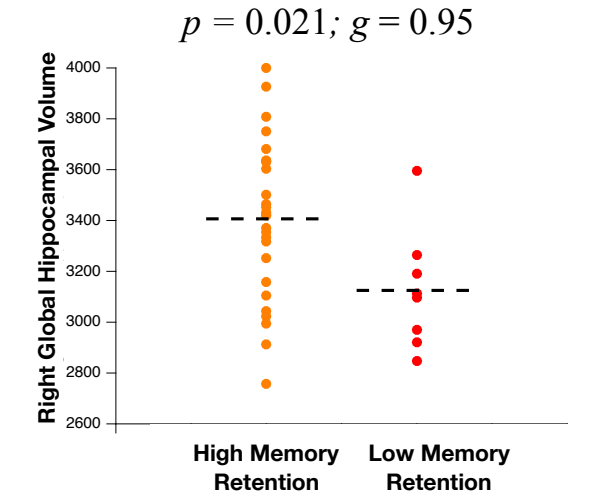
2q11.2DS_HIGH (N = 32)   • 22q11.2DS_LOW (N = 12)

Characteristics of the 22q11.2DS LOW memory group
Lower IQ
Higher rates of psychotic symptoms
Reduction of hippocampal volume

From Maeder et al. 2019, Child Neuropsychol.

Conclusions

Non-verbal encoding is selectively affected in the 22q11.2DS group

> ❯ Start lower and less improvement with repetition

After 30 minutes, verbal memory performance are similar between both groups BUT

after longer delay, a steeper loss of information is observed

> ❯ Evidence for long-term accelerated forgetting (ALF)

Sub-group of patients with lower verbal memory consolidation

Tips to improve learning & memory

Use the verbal channel

- ✓ Give verbal instruction

- ✓ Repeat the information out loud when you learn

Spilt the information in small parts

- ✓ Learn in small chunks

- ✓ Distribute it on different days

Repetitions

- ✓ Repeat the information several times

- ✓ Go back to information previously learned

How does attention contribute to learning & memory?

Clinical trial in Geneva (CH)

In 22q11.2DS, attention deficit disorder (ADD) is very frequent (40%)

Inattentive manifestation predominant (70%) => not always recognized

How does ADD influence learning and memory?

Does ADD medication (methylphenidate) improve learning and memory?

Clinical trial in Geneva:

For people with 22q11.2DS

Age range 8-25 years old

Niarchou et al., 2015, 2018; Schneider et al., 2014

Clinical trial in Geneva (CH)

In 22q11.2D

Inattentive

Do   y?

Clinical tr

Fo

Ag

NO CONFLICT OF INTEREST

RESEARCH IS FUNDED BY THE SWISS
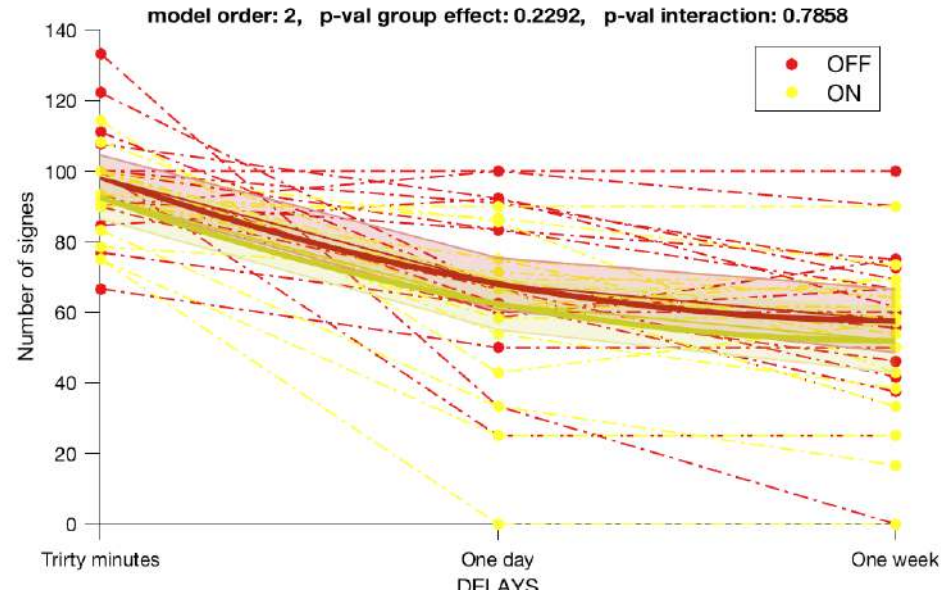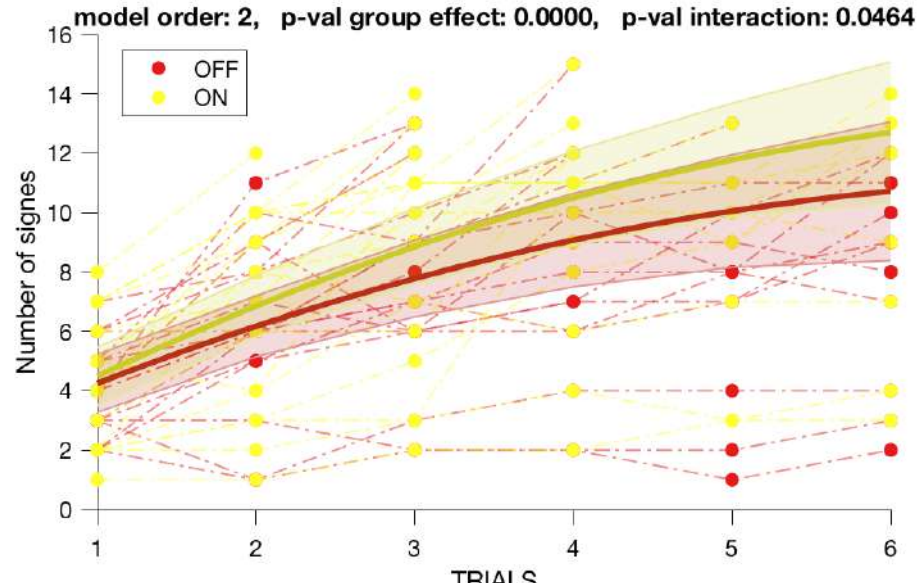
NATIONNAL FUND

WE DO RESEARCH FOR PATIENTS

AND THEIR FAMILIES

Niarchou et al., 2015, 2018; Schneider et al., 2014

Preliminary results on learning & memory

Learning

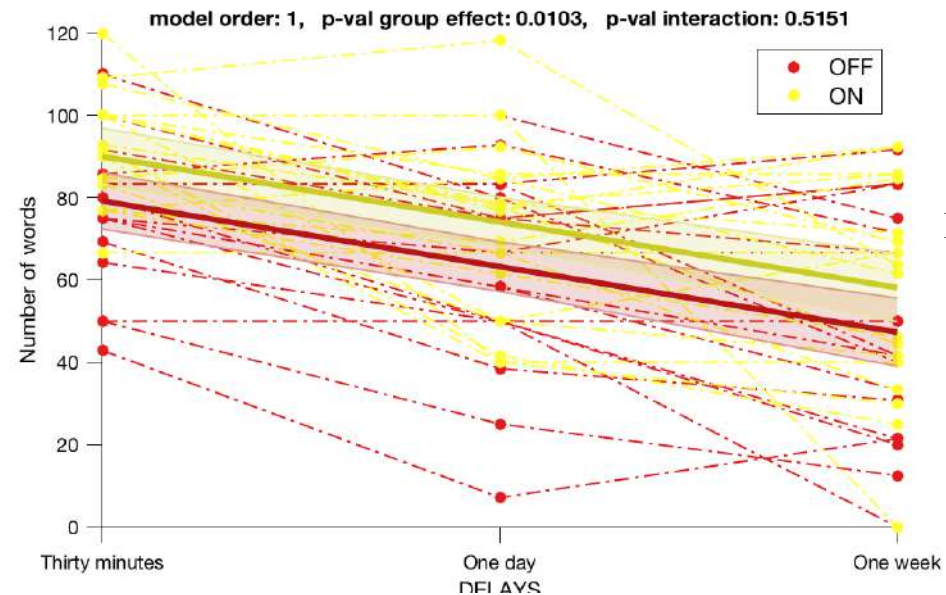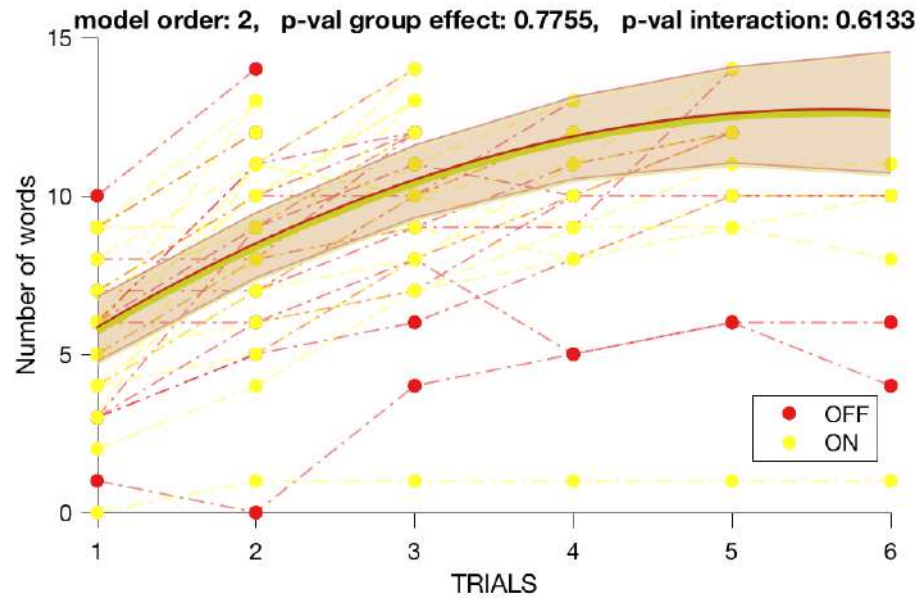**Memory retention over time**

More efficient learning of **visual stimuli** with medication, but similar decline over time

For **verbal stimuli**, similar learning with medication, but remember more information over time

From Maeder et al. In prep

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