# Facial mimicry impairment impacts the quality of visual working memory representations

## Visual Working Memory Precision for Emotional Faces in Moebius Patients


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## Introduction

**Moebius syndrome** is a rare neurological condition that primarly affect *facial muscles control and eye movements* (VII and VI cranial nerves). Models of **Sensorimotor Simulation** remark the importance of **Facial Mimicry** (i.e. the subtle movements of facial muscles in response to other people facial expressions) in facial expression processing and emotion recognition **(Goldman & Sripada, 2005; Sato, Fujimura, Kochiyama, & Suzuki, 2013; Wood et al., 2016b)**. **Facial mimicry compromission** seems to have an impact on facial expression recognition **(Korb et al., 2016; Oberman, Winkielman, & Ramachandran, 2007; Wood et al., 2016a)**.

Literature about **emotion processing and social functioning in Moebius patients** is very sparse and mainly related to the verbal component (i.e. facial expressions labelling and rating) **(Bogart & Matsumoto, 2010; Calder, Keane, Cole, Campbell, & Young, 2000)**. The moedel by Wood and colleagues **(2016b)** proposed a lower level impact of sensorimotor simulation and facial mimicry on emotional processing, where visual representation quality (i.e. the emotional face) can be modulated by the sensorimotor activity.

Visual representations have been widely studied in cognitive neuroscience literature especially related to visual working memory activity (VWM). VWM can be defined as a limited-space cognitive system where visual information is temporarily stored and manipulated for further processing **(Liesefeld & Müller, 2019; Luck, 2008)**.

VWM seems to be important in social cognition **(Gambarota & Sessa, 2019)** and facial mimicry manipulation seems to change the precision of emotional face representations **(Sessa, Lomoriello, & Luria, 2018)**. In this study we investigate if a congenital impairment in facial mimicry can impact the **precision** of VWM representations.

## Methods

We used a **Delayed Estimation Task (Zhang & Luck, 2008)** Figure 1. with emotional pictures (8 pictures) extracted from a facial expression video. Images ranged from neutral (0) to full facial expression (7) of **Anger**, **Fear** and **Happiness**. Subjects have to compare a brefly presented face (Memory Array) with a continous array made by the entire pool of images of the same emotion (Test Display). Our dependant variable (**Test-Memory**):

$$abs(Pressed\ Level - Memory\ Level)$$

Where:

- 0 = Correct
- 1-7 = Increasing Error

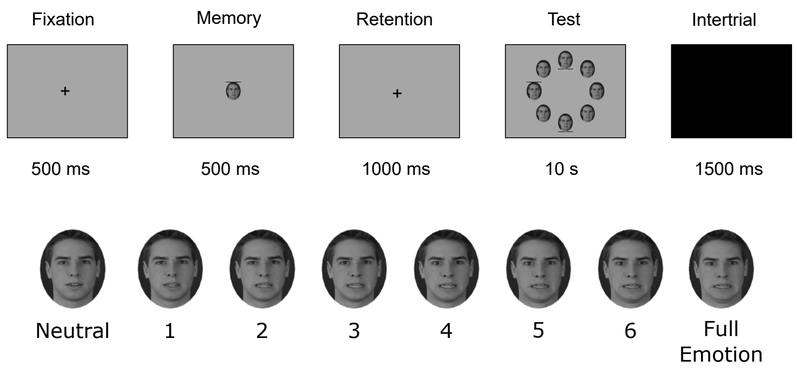



*Figure 1: Delayed Estimation Task with Faces*

### Sample

We collected **7 Moebius patients** (3 females, mean age of 34 years, SD=10.5) and **30 healthy volunteers** (15 females, mean age of 24.2, SD=4.6).

## Analysis

We use a `Linear Mixed-Effect Model` for modeling the absolute error distribution (Figure 2) in the task as a function of **Emotion**, **Memory Level** and **Group**. We use a *model selection* approach to select the best predictors combination to explain our data. For dealing with difference in variability we include in the model that `Moebius` and `Controls` have difference in variance.

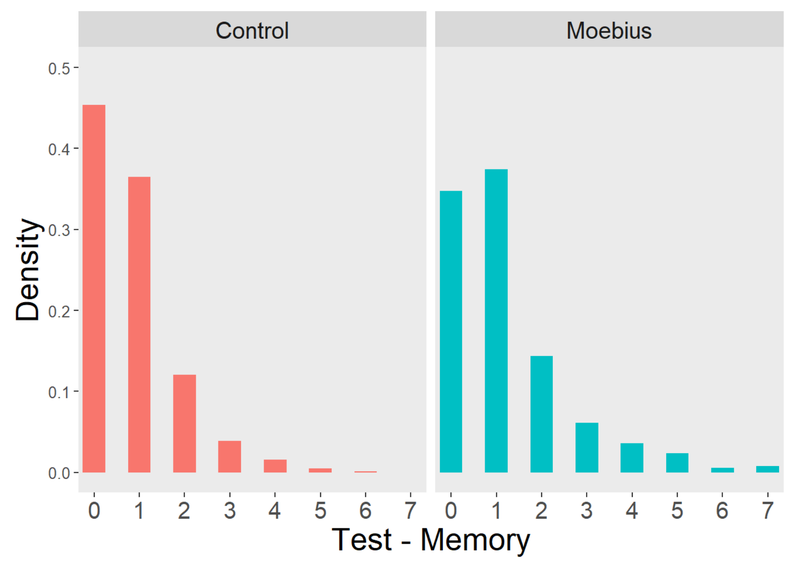
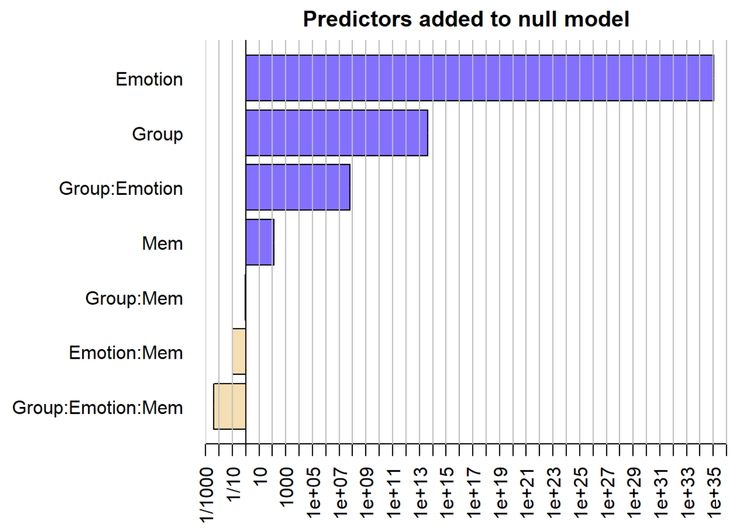



*Figure 2: Test - Memory Distribution*

## Results

We select the best factor combinations according to **Akaike Information Criteria (AIC)**, **Bayesian Information Criteria (BIC)** and **Bayes Factor (BF)**. The most important factors are **Emotion** and **Group**:




### The statistical model:

$$Test - Memory = Group + Emotion$$

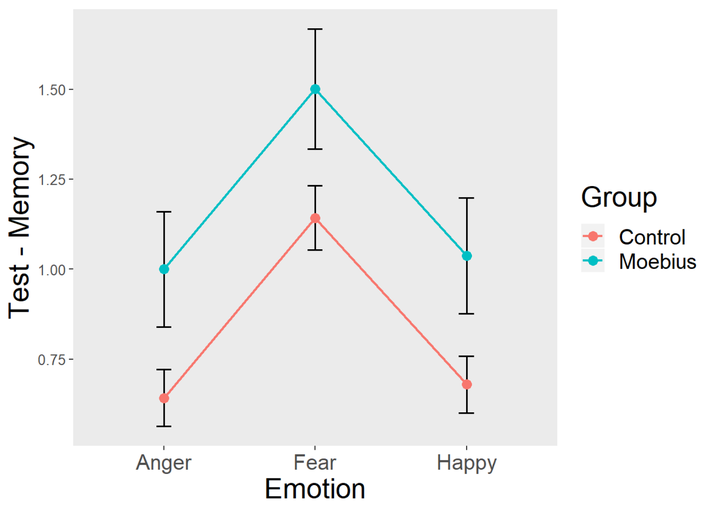



*Figure 3: Model Effects for Group and Emotion*

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