

Effects of rhythmic and multisensory stimulations on procedural learning

Lagarrigue Y¹, Cappe C², Tallet J¹

¹ Toulouse NeuroImaging Center, Toulouse University, Inserm, UPS, France
² Cerveau et Cognition, CNRS, Toulouse, France



BACKGROUND

- Procedural motor learning is commonly studied with the serial reaction time task (SRTT) (Nissen, 1987)
- Multisensory stimulations are known to improve speed of motor responses (Diederich, 2004)
- Auditory rhythm activates both auditory and motor areas (Thaut, 2010) and improves sensori-motor synchronization (Repp, 2004)

→ This study investigates the effects of auditory rhythms and multisensory stimulations (audio-visual) on learning of a new motor sequence

METHODS

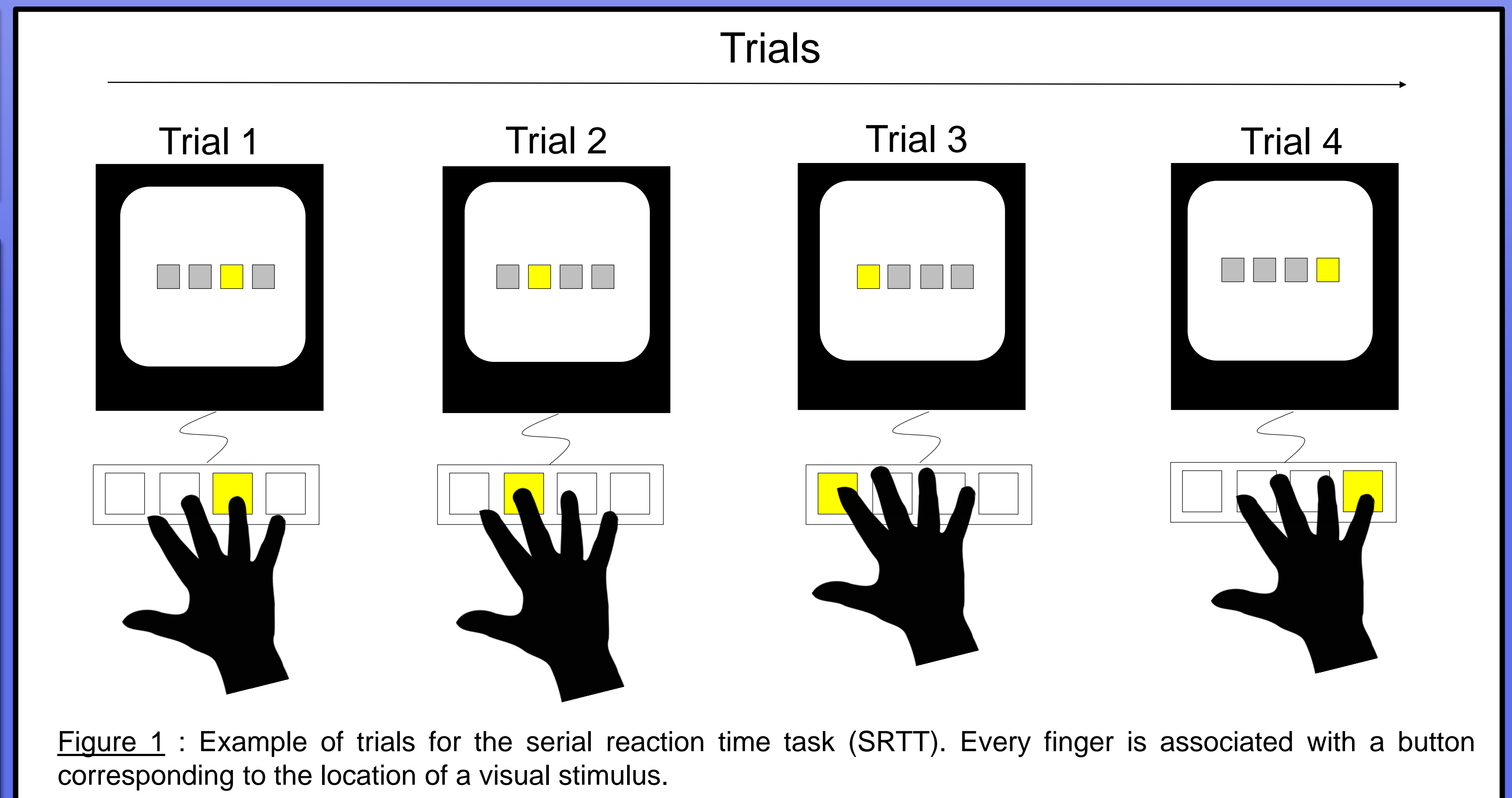
Participants

60 adults (18-30 years old) non-musician and right-handed (LQ=77,59 ± 21,45)

Experimental task (SRTT)

Participants were required to press a button corresponding to the location of a visual stimulus. Unbeknownst to the participant, the positions of visual stimuli were presented with a repeated sequence. Then, a block of random stimuli is presented.

- general learning : ↓ RT and errors
- specific learning : ↑ RT and errors when a random block is introduced



Protocol

Each participant practiced 6 Blocks of 100 trials. For the 5th first Blocks, a sequence of 10 visual stimuli was repeated and for the 6th Block, stimuli were presented randomly. Each participant was randomly assigned to one of the six groups:

Visual only (V), congruent visual and auditory (AV), non-congruent visual and auditory (NCAV), visual and regular auditory metronome (M), visual and irregular auditory metronome (IM), visual and rapid auditory metronome (RM).

ANALYSIS AND RESULTS

- **Learning** : ANOVAs with Group and repeated measures on Blocks (B1-B5 to test general learning and B5-B6 to test specific learning) were performed on the RT and errors. Fischer's test was used as post-hoc comparisons (all p<0.05).
- **Synchronization** : ANOVA Blocks (B1-B5 and B5-B6) were computed for the audio-motor and audio-visual synchronization.

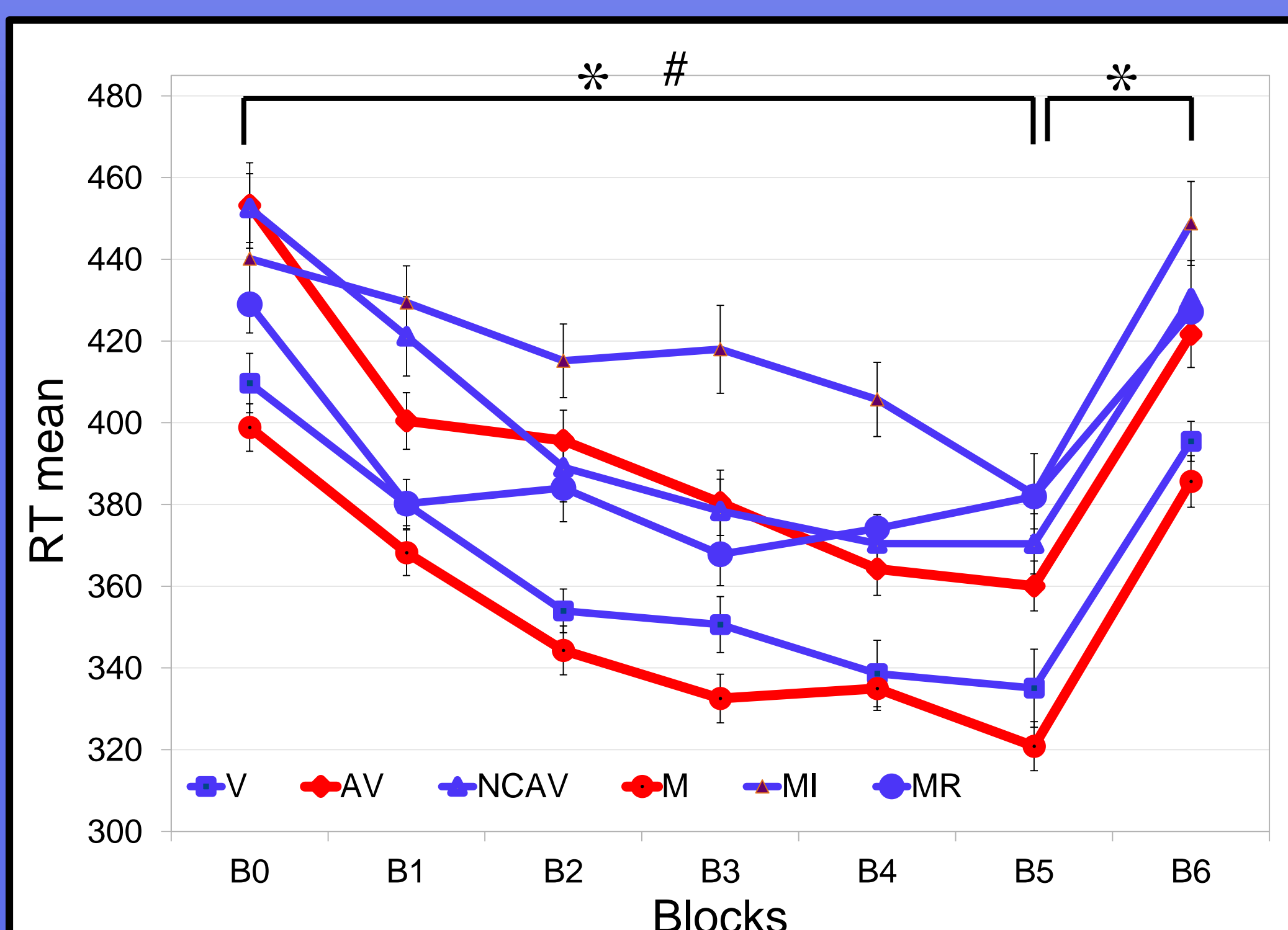


Figure 2 : RT mean from B1 to B6 for all groups.

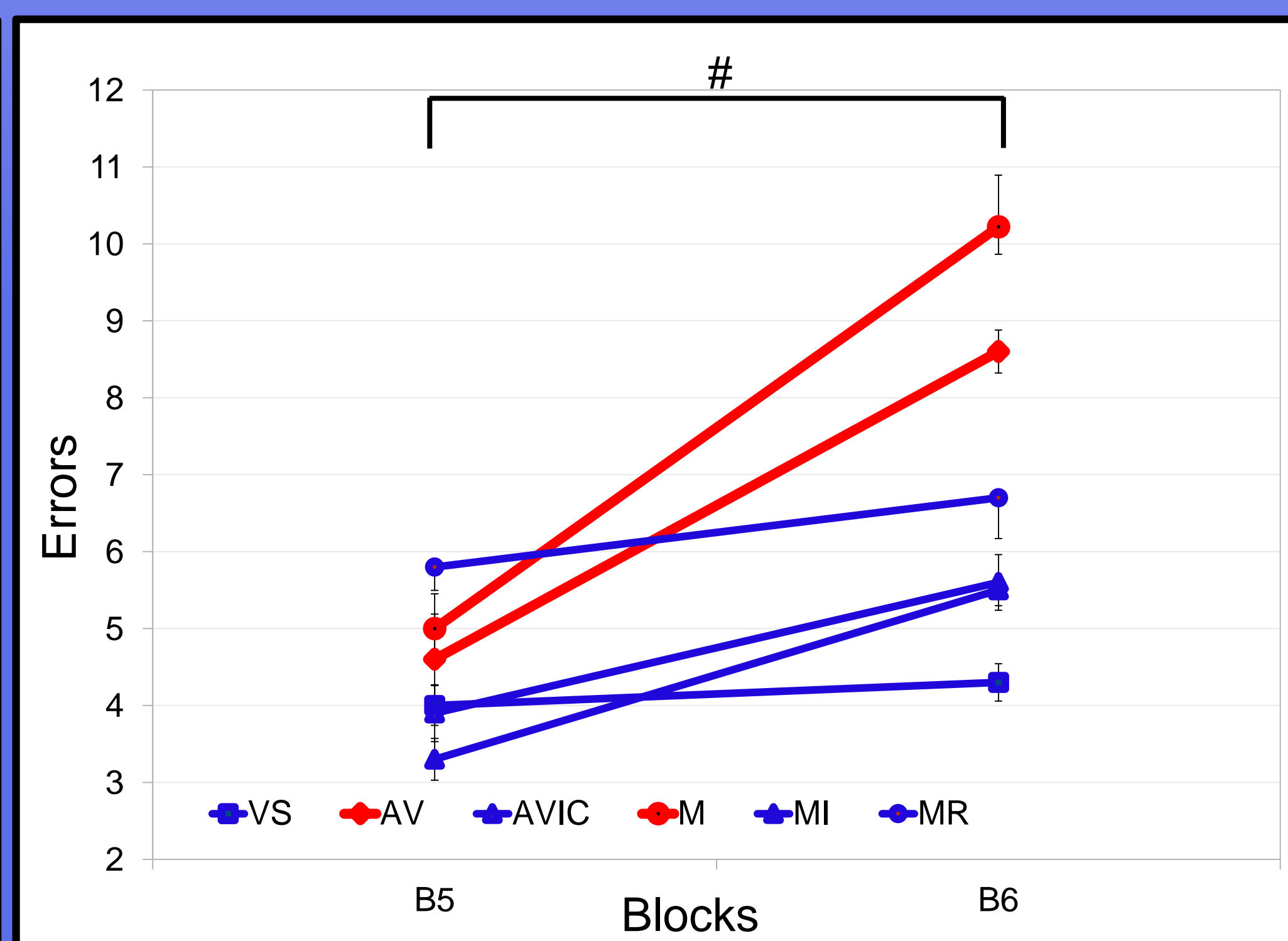


Figure 3: Errors from B1 to B6 for all groups.

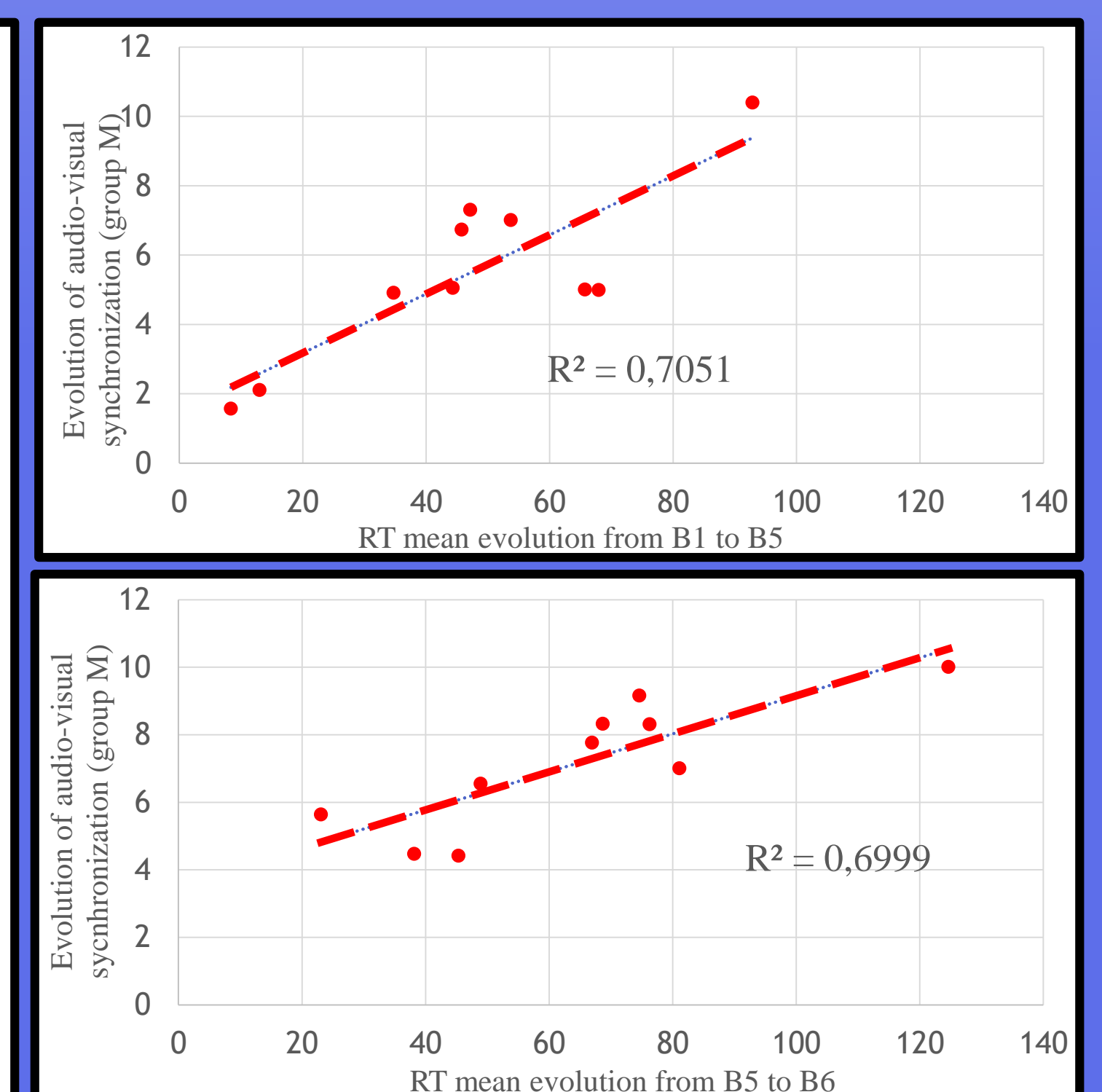


Figure 4: Correlations between RT evolution and audio-visual synchronization from B1 to B5 (a) and from B5 to B6 (b) for Group M.

GENERAL LEARNING: Lower decrease of **RT mean** from B1 to B5 for MR than for the others group

SPECIFIC LEARNING: Higher increase of **errors** from B5 to B6 for AV and M than for the others group

SYNCHRONIZATION : Same evolution for the RT mean than for the audio-visual synchronization

CONCLUSION

Both auditory rhythmic and combined auditory and visual congruent sensory information promote specific procedural learning. General learning is altered with too quick metronome. Learning with a rhythmic metronome was associated with a progressive audio-visio-motor synchronization, hence suggesting that “rhythmic multisensory integration” could optimize procedural learning.