

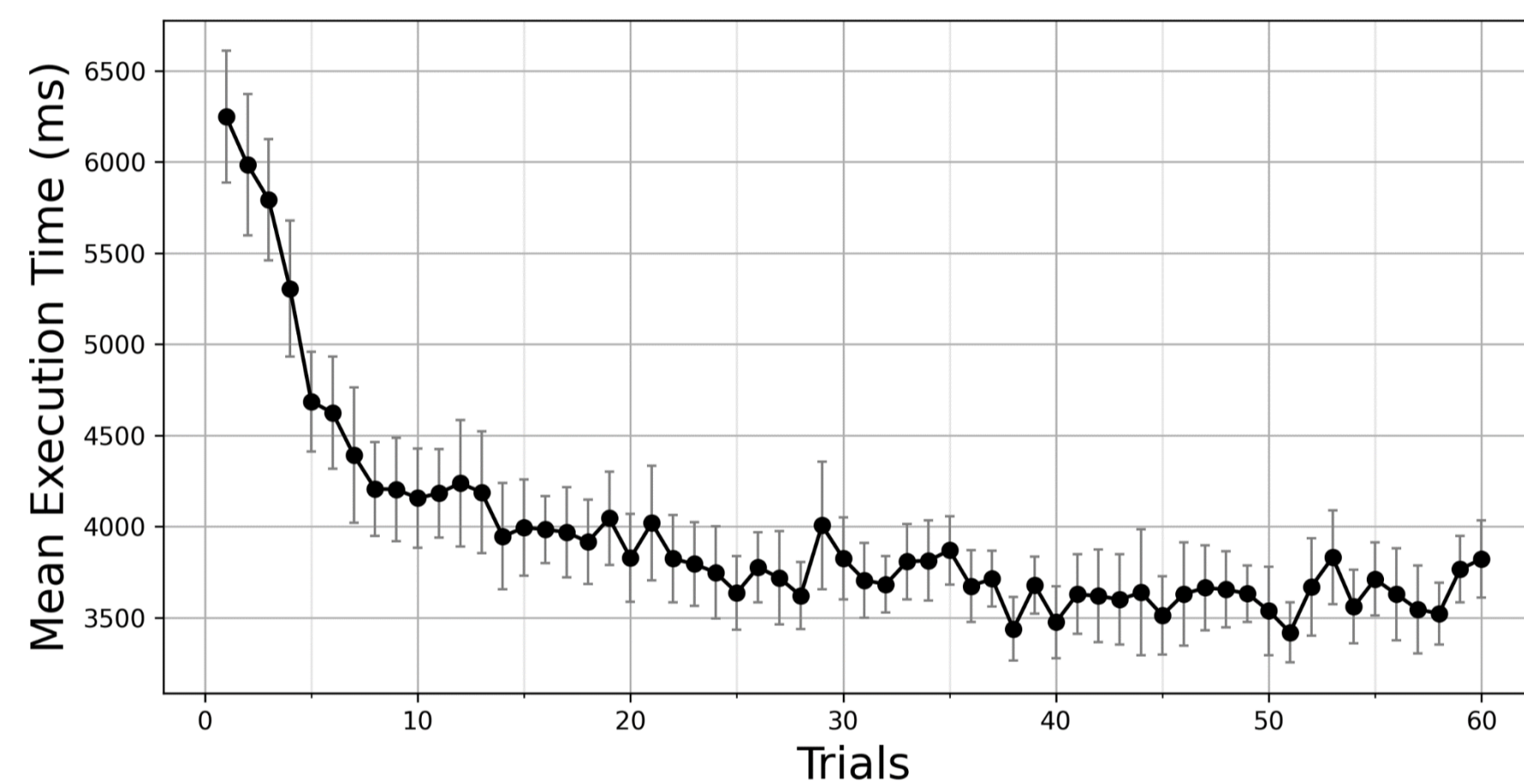


Motor Chunking in Internally-guided Skill Learning

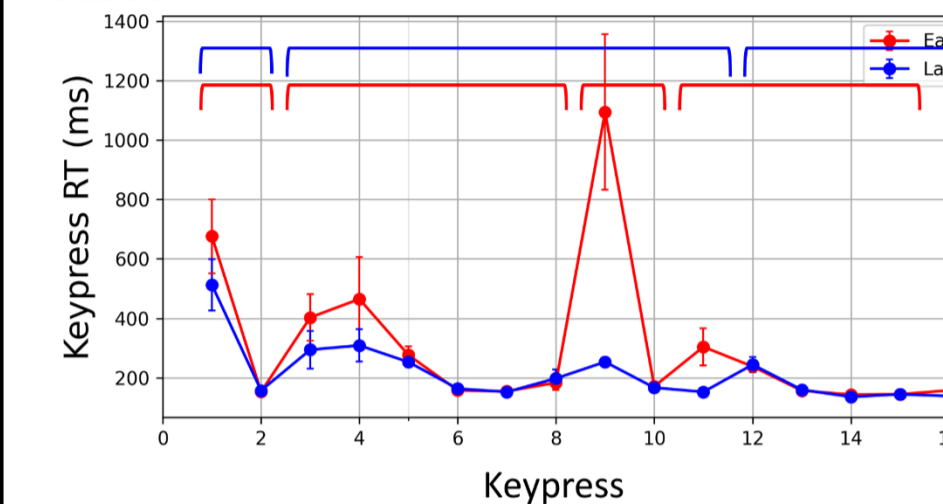
Abstract

- Skill learning is an everyday phenomena (walking, cycling, typing, etc.)
- *Motor chunking* – chaining several elementary actions in sub-sequences to promote efficient sequence execution
- Previous studies have investigated chunking in *externally-specified* tasks (i.e. where the sequence of motor actions is guided by visual stimuli) such as m×n task, SRT task, DSP task
- Using Grid-Sailing Task (GST) as a canonical paradigm, we examine the role of motor chunking in practice-driven performance improvements in *internally-guided* sequencing tasks (i.e. where the sequence of motor actions is volitionally planned)
- We provide empirical evidence for motor chunking in GST by showing the emergence of subject-specific unique temporal patterns in response times. We further show how chunk re-organization occurs with practice
- Our findings confirm spontaneous chunking without pre-specified or externally guided structures while replicating the earlier results with a less constrained, internally guided sequencing paradigm

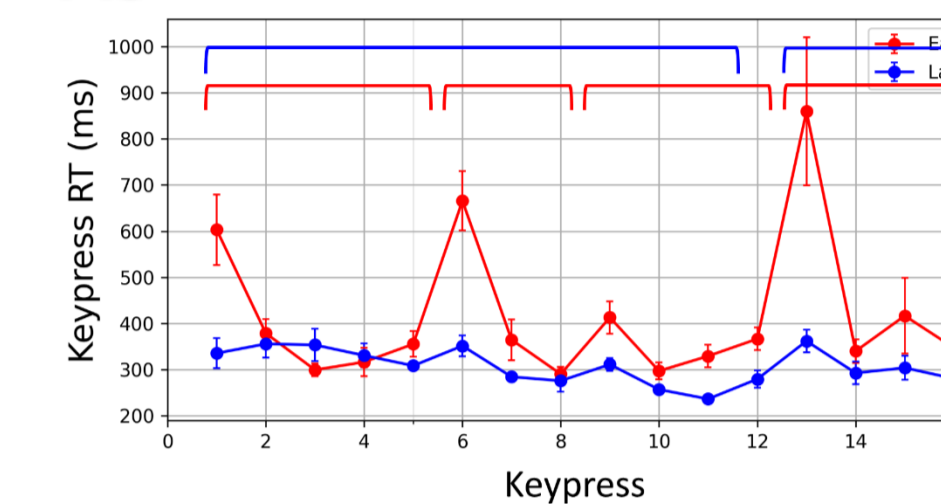
- Behavioral measures: number of moves, execution time ET (total time taken), reaction time RT (interval between stimulus presentation and first key-press)
- To consolidate the motor learning, the reward schema incentivized participants to repeatedly execute the same trajectories.
- Law of practice effect: mean ET decreases with practice. Friedman test (RM within-subject) indicated significant effect of trials on ET [$\chi^2(59) = 291.198, p < 0.001$]



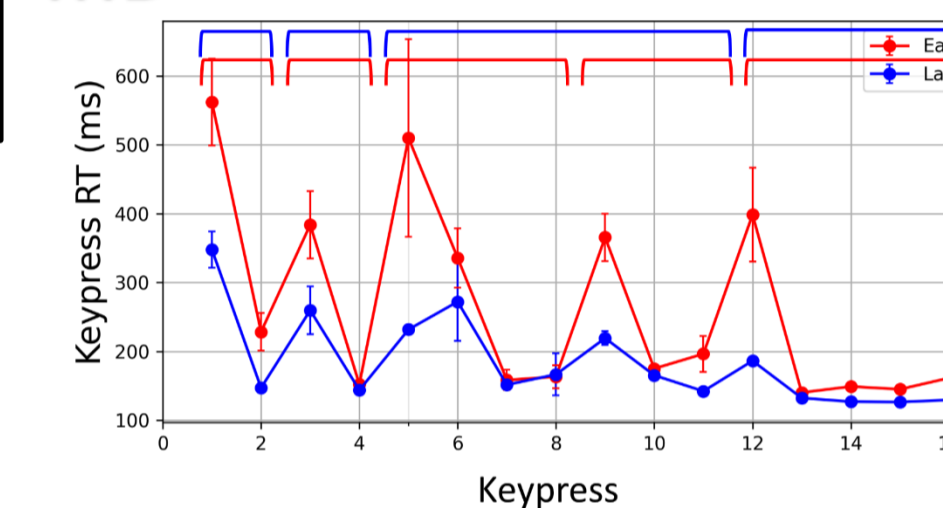
KM



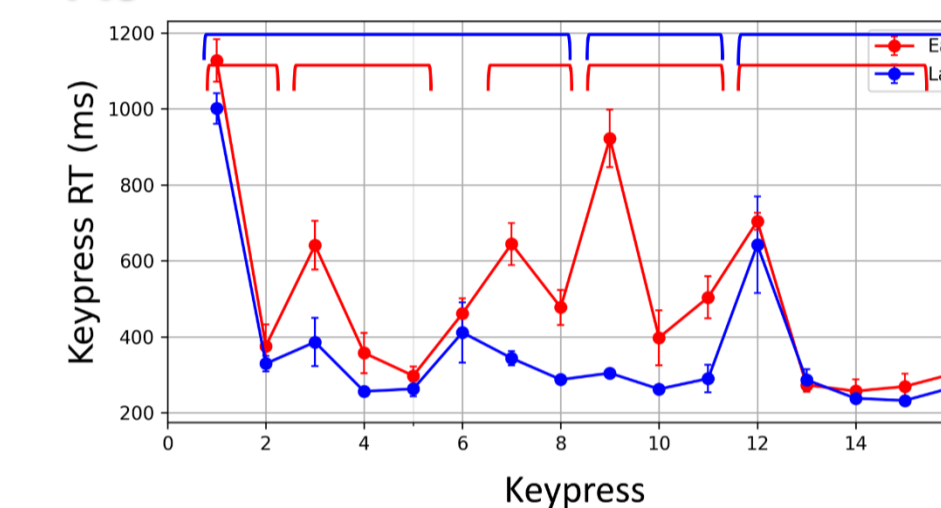
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MD

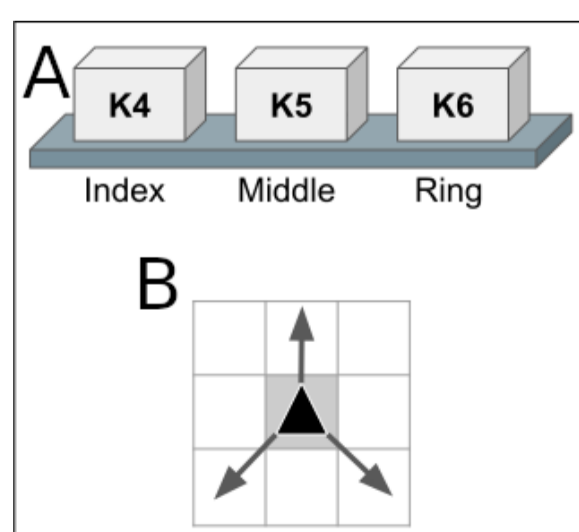
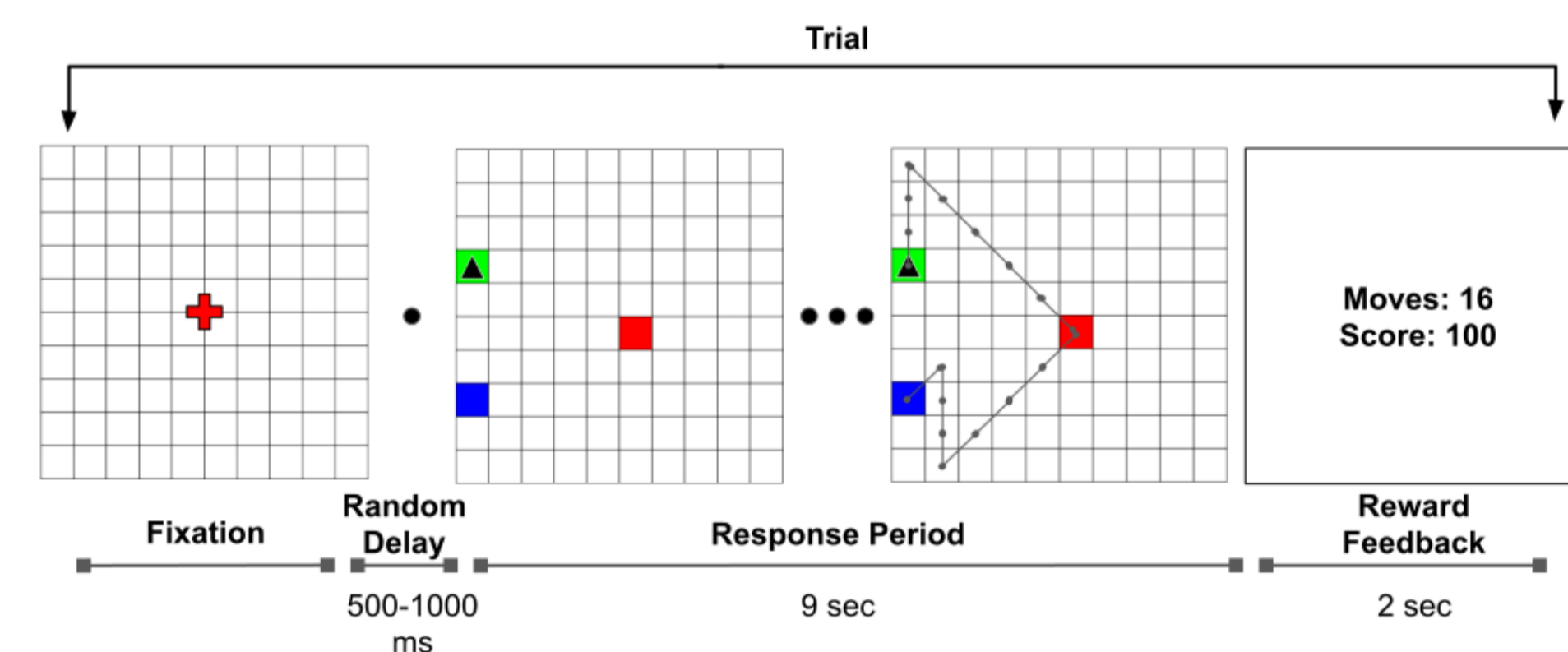


NJ



Re-organization of the chunks with practice: Keypress RTs in four representative subjects during early and late practice phase. The brackets denote chunk segments. The area between the plots clearly indicate performance improvements due to chunk re-organization.

Task Paradigm

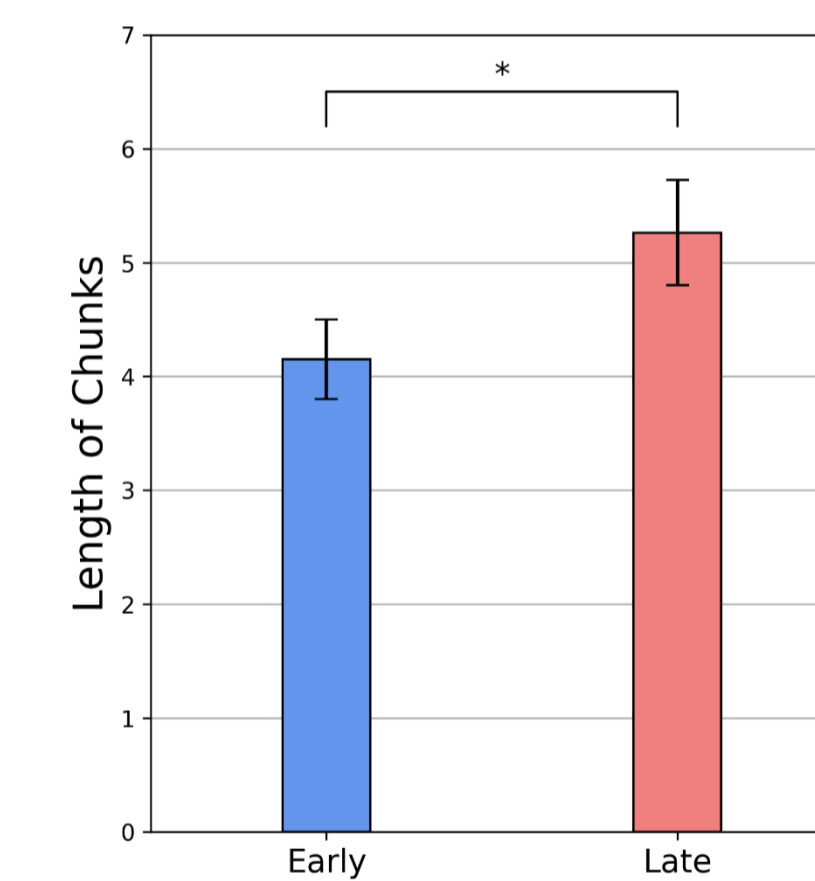
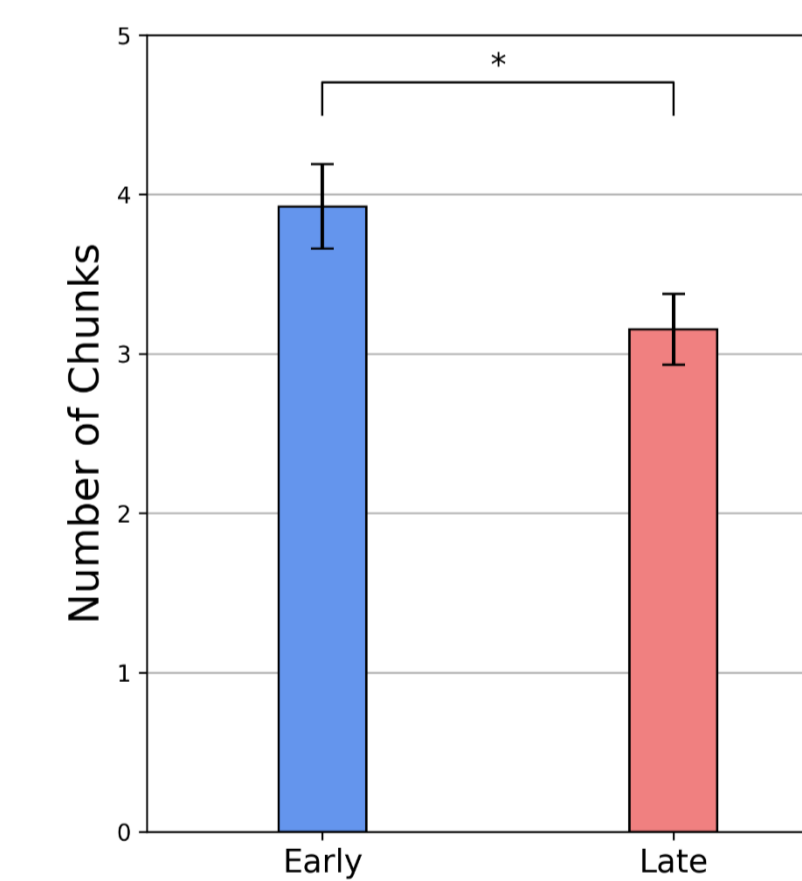
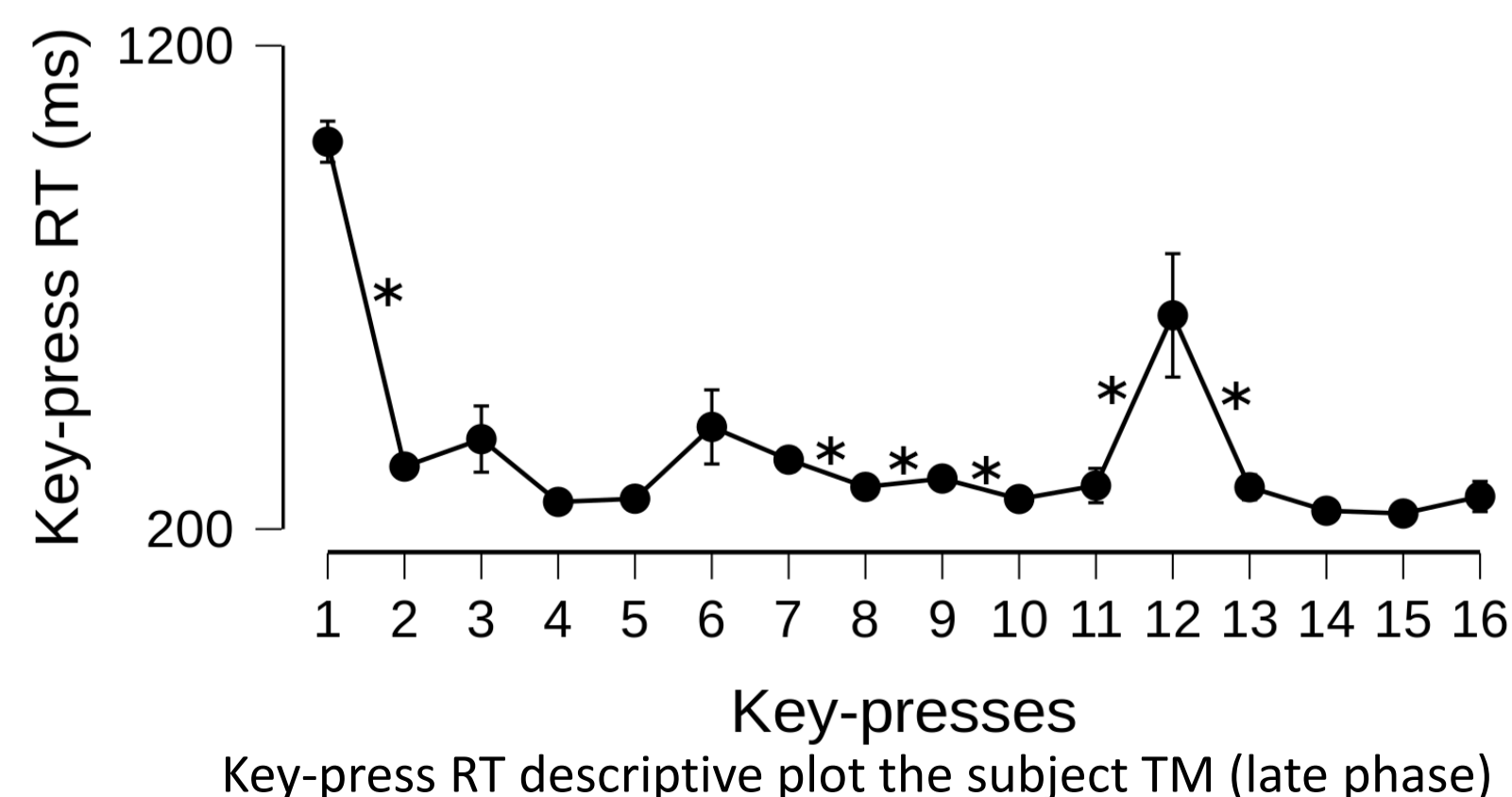


Trial illustration and the key-map (KM)

- Fifteen participants performed the experiment All participants were healthy adults between ages 18 to 27 years (F:M 7:8) with normal or corrected-to-normal vision.
- Then experiment terminated after 60 successful trials. The participants were given a rest block after every 20 trials.

Working rules to identify chunks from key-press (KP) RTs

- The initial element in a chunk is typically characterized by a significantly higher RT than subsequent RTs
- Only successive elements with statistically insignificant difference or monotonically decreasing RTs are appended to the current chunk
- A significant increase in key-press RTs denote beginning of a new chunk



Evolution of the chunking behavior with practice

- KP RTs are different for early phase and late phase trials based on 2x16 within-subject repeated measures ANOVA. The analysis indicated main effect of key-press
- Average chunk length across subjects significantly increased from 4.15 in early phase to 5.26 in late phase. Decrease in number of chunks from 3.92 in early phase to 3.15 in late phase was also significant