# Comparison of temporal grouping effects in musical and verbal short-term memory: Is serial order representation domain-general?


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# Background

## Representing order in short-term memory

Dissociation between item and order information (Henson, 1998; Lee & Estes, 1981; Majerus, 2013)

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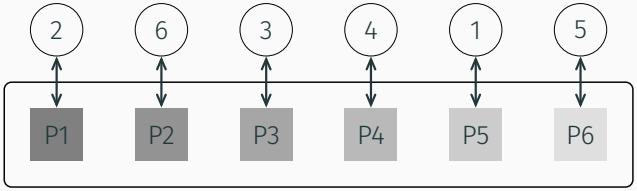
Several models suggest that serial order is represented via positional markers (Brown et al., 2000; Burgess & Hitch, 1999; Hartley et al., 2016; Henson, 1998)



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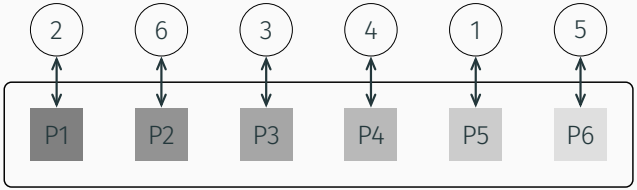
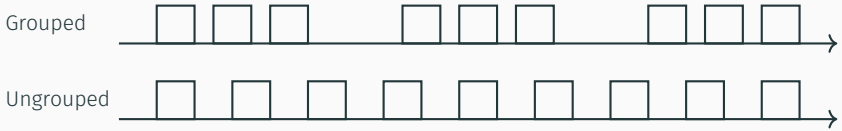



*Serial order* $\Rightarrow$ associations between items and markers representing positions in the list

## Temporal grouping

Positional markers are powerful to explain temporal grouping effects (e.g., Brown et al., 2000; Burgess & Hitch, 1999; Hartley et al., 2016; Henson, 1998)



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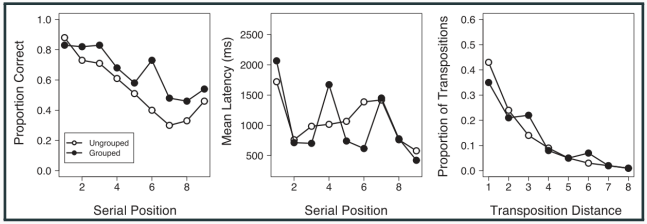


Reproduced from Hurlstone et al. (2014)

- Recall advantage
- Scalloped serial position curve
- Latency peak at groups beginning
- Interpositions ↗

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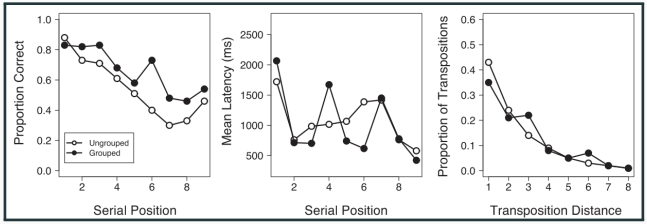


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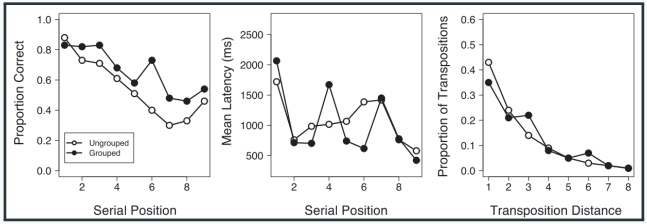


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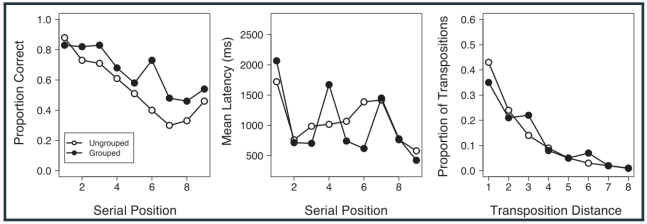


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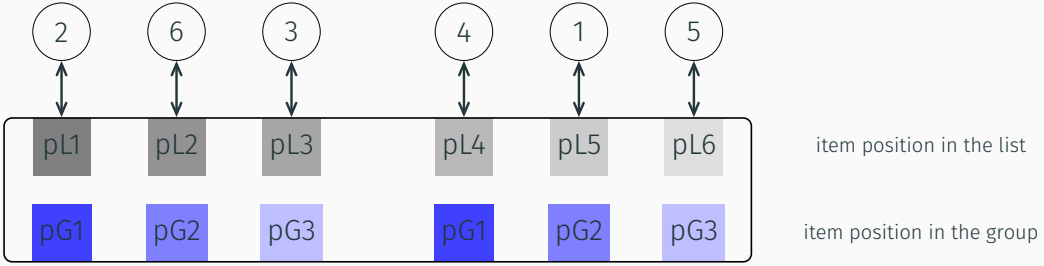
## Temporal grouping

Temporal grouping effects are accounted for by using two-dimensional position markers

- Items at group boundaries are more distinctive
- Items at similar within-group positions are more confusable



Is this way of representing serial order general or specific to verbal material?

## Domain-generality of ordering processes

Recent evidence support the existence of similar ordering effects in verbal and musical STM (e.g., Gorin et al., 2016, 2018a, 2018b)

If positional information is represented similarly in the two domains, we should observed with musical material the same grouping effects as observed in the verbal domain

# Experiment 1

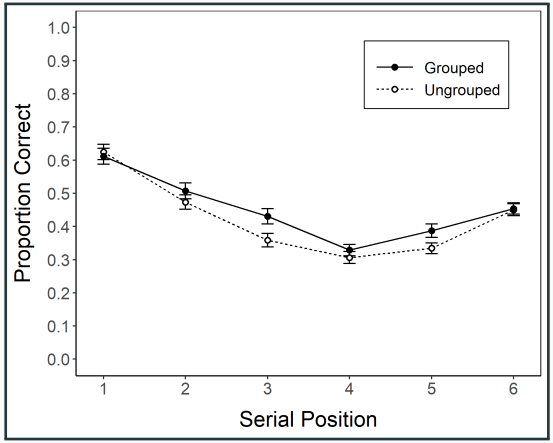
# Experiment 1

## Method

- 50 non-musician participants
- Forward reconstruction-of-order of 6-tone lists
  - 30 ungrouped
  - 30 grouped (2 groups of 3 tones – longer pause between items 3 and 4)
- Stimuli $\Rightarrow$ all the diatonic steps of the C major scale (ranging from $C_4$ to $B_5$)

# Experiment 1

## Results




*Serial position curve*

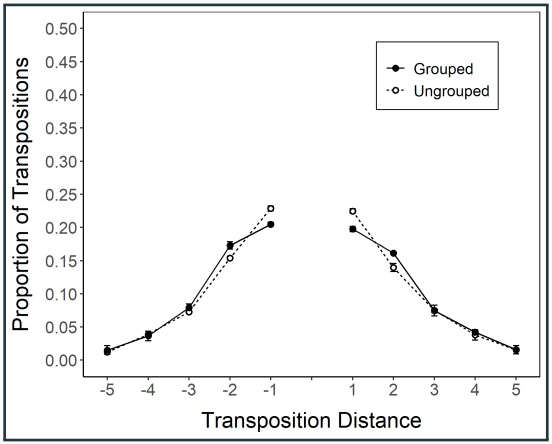
- Position: $BF_{10}$ = $+\infty$
- Grouping: $BF_{10}$ = 21.23
- Position × Grouping: $BF_{10}$ = 2.15

# Experiment 1

## Results

*Transposition errors*

- Distance: $BF_{10}$ = 2.47E+13
- Distance × Grouping: $BF_{10}$ = 648.68
- Distance -1: $BF_{10}$ = 5.59
- Distance 1: $BF_{10}$ = 10.87



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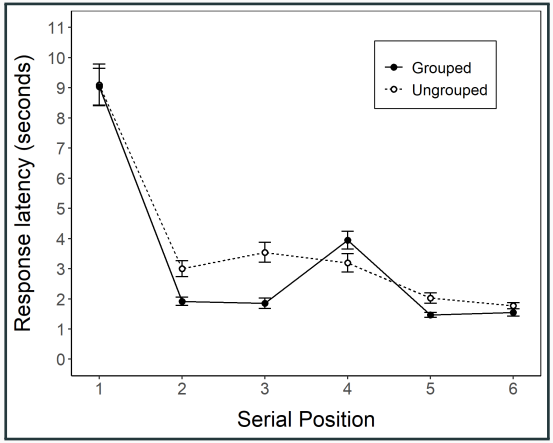



*Response latency*

- Position: $BF_{10}$ = 2.14E+14
- Grouping: $BF_{10}$ = 2.30
- Position × Grouping: $BF_{10}$ = 5.34

# Experiment 1

## Conclusions

- ✅ Recall advantage
- ❓ Scalloped SPC (small)
- ✅ Response latencies (peaks at groups beginning)
- ❌ Interpositions ↗

Is this pattern specific to music or to the $2 \times 3$ grouping structure?

# Experiment 2

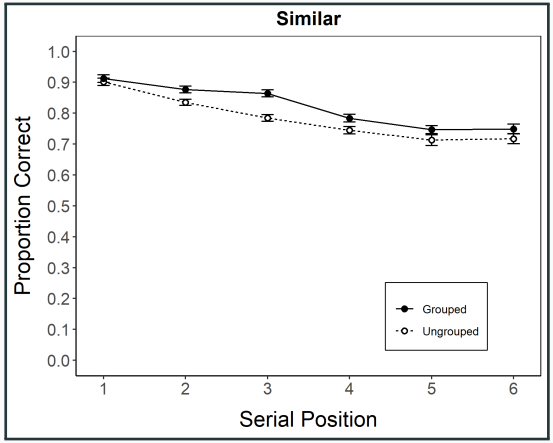
# Experiment 2

## Method

- Online study
- 86 participants
- Serial recall of 40 ungrouped and 40 grouped consonant lists
  - Recall via keyboard (no correction)
  - Phonologically similar letters
  - Visual presentation
  - Grouped sequences $\Rightarrow$ 2 groups of 3 items (longer pause between items 3 and 4)

# Experiment 2

## Results




*Serial position curve*

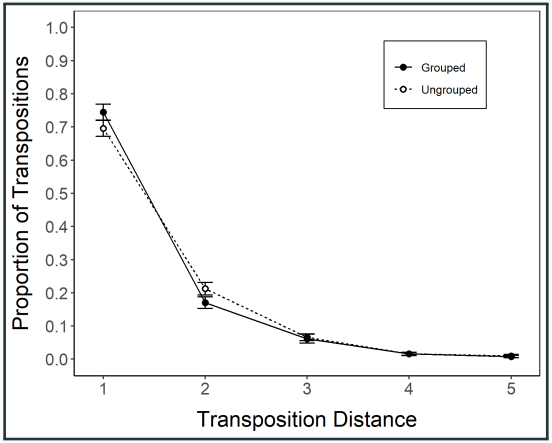
- Position: $BF_{10}$ = $+\infty$
- Grouping: $BF_{10}$ = 2.79E+11
- Position × Grouping: $BF_{10}$ = 6.70

# Experiment 2

## Results

*Transposition errors*

- Distance: $BF_{10}$ = 2.94E+13
- Distance × Grouping: $BF_{10}$ = 60.08
- Distance 1: $BF_{10}$ = 4.61
- Distance 2: $BF_{10}$ = 19.58



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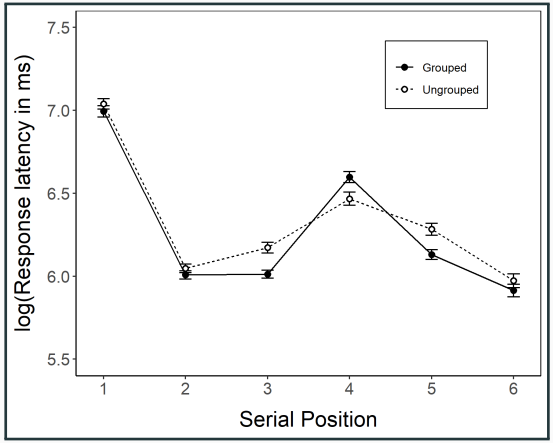


*Response latency*

- Position: $BF_{10}$ = 1.56E+13
- Grouping: $BF_{10}$ = 2.82E+4
- Position × Grouping: $BF_{10}$ = 4.15E+4

## Conclusions

- ✅ Recall advantage
- ❓ Scalloped SPC (small)
- ✅ Response latencies (peaks at groups beginning)
- ❌ Interpositions ↗

But interpretation is limited by ceiling effect...

# Experiment 3

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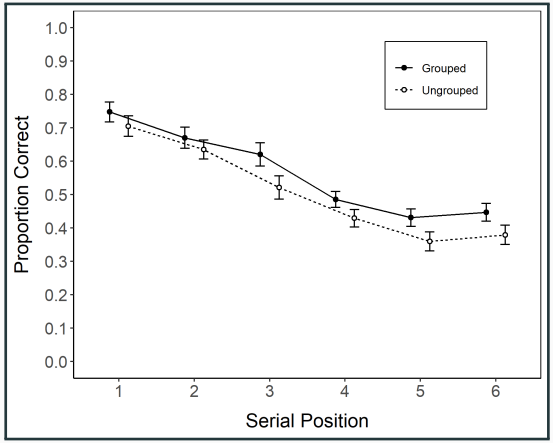
## Method

- Online study
- 58 participants
- Serial recall of 26 ungrouped and 26 grouped consonant lists
  - Recall via keyboard (no correction)
  - Phonologically similar letters
  - Visual presentation
  - Post-list distractor $\Rightarrow$ **parity judgment (8 digits)**
- Inclusion criterion
  - At least 60% acccuracy in the parity judgment task

# Experiment 3

## Results




*Serial position curve*

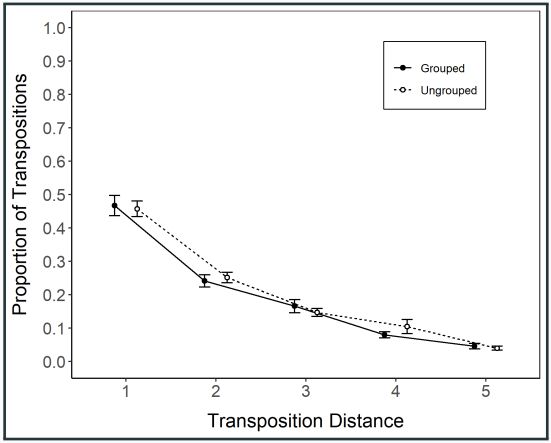
- Position: $BF_{10}$ = 1.02E+6
- Grouping: $BF_{10}$ = 7.32E+13
- Position × Grouping: $BF_{01}$ = 14.42

# Experiment 3

## Results

*Transposition errors*

- Distance: $BF_{10}$ = 3.14E+13
- Distance × Grouping: $BF_{01}$ = 60.77



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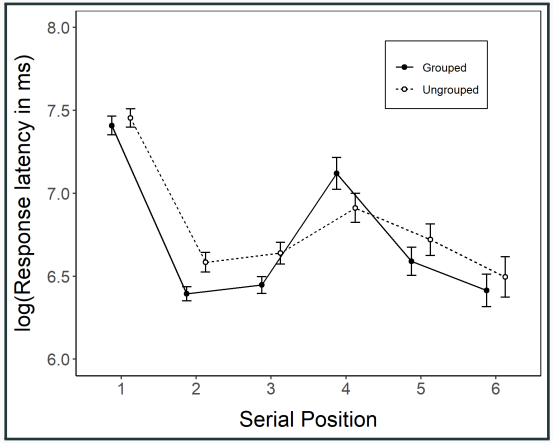


*Response latency*

- Position: $BF_{10}$ = 3.54
- Grouping: $BF_{10}$ = 5.05E+13
- Position × Grouping: $BF_{10}$ = 9.32

## Conclusions

- Recall advantage
- Scalloped SPC (small)
- Response latencies (peaks at groups beginning)
- Interpositions ↗

# General conclusions

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Grouping effects in 6-item verbal and musical lists

- **Recall advantage** ⇒ Verbal and musical domains
- **Small scalloping of serial position curve** ⇒ Verbal and musical domains
- **Latency peak at groups beginning** ⇒ Verbal and musical domains
- **No interpositions** ⇒ Verbal and musical domains

Strong similarity of temporal grouping effects in musical and verbal STM tasks for serial order

# General conclusions

- Supports the view that order information is represented similarly across verbal and musical domains
- Inconsistent with grouping effects observed with 3×3 grouped verbal sequences
  - ⇒ Smaller scalloping
  - ⇒ No increase of interpositions
- Suggests the existence of boundary conditions to observe an increase of interposition errors in grouped sequences
  - ⇒ Overall list length?
  - ⇒ Number of groups in the list?

Thank you for your attention



GorinSimon

Slides: https://osf.io/gfuvd

Pre-print: https://psyarxiv.com/mfynu

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