

# Subjective Rhythmization

**A replication and a reassessment**

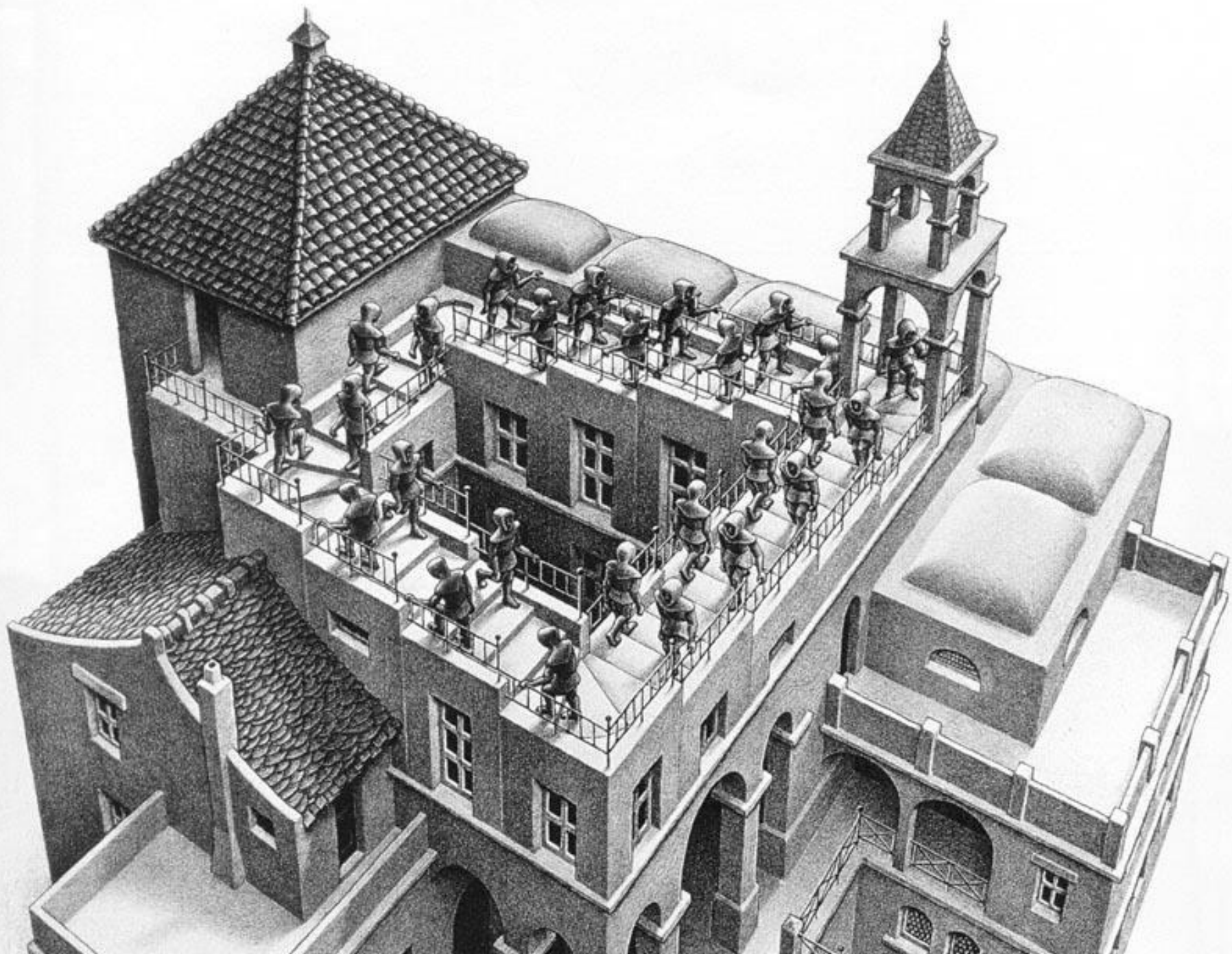
Rasmus Bååth, Kristín Ósk Ingvarsdóttir  
Lund University Cognitive Science  
[rasmus.baath@lucs.lu.se](mailto:rasmus.baath@lucs.lu.se), [kristin.osk\\_ingvarsdottir@lucs.lu.se](mailto:kristin.osk_ingvarsdottir@lucs.lu.se)

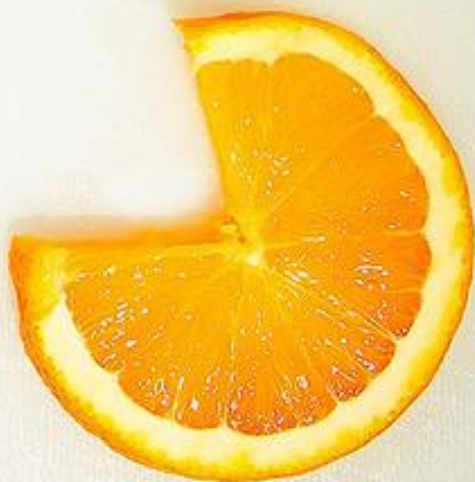
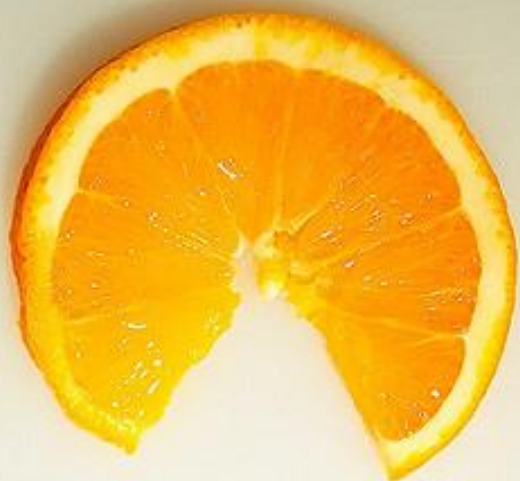


Thinking in Time



Lund University  
Cognitive Science



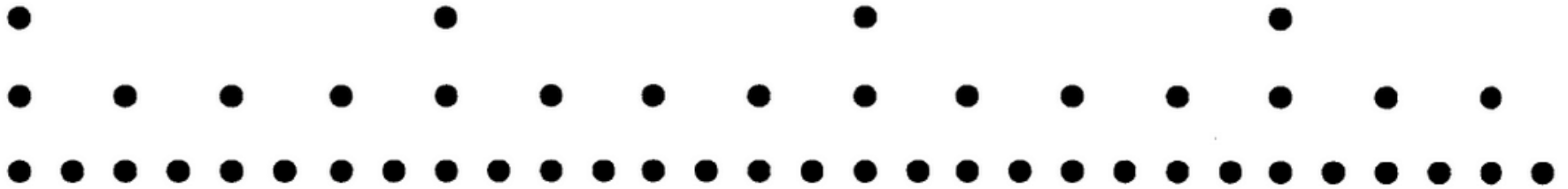


# Subjective Rhythmization

# The next 20 minutes

1. The phenomena of Subjective Rhythmization
2. Prior research on Subjective Rhythmization
3. The current study

# Subjective Rhythmization



subjective meter

subjective accentuation



**Clock illusion**

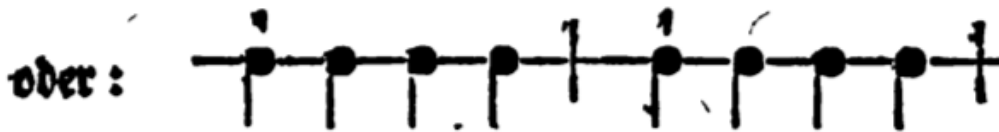
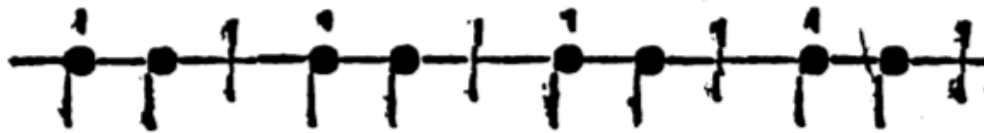
**Tick-Tock effect**

# **Prior Research on Subjective Rhythmization**

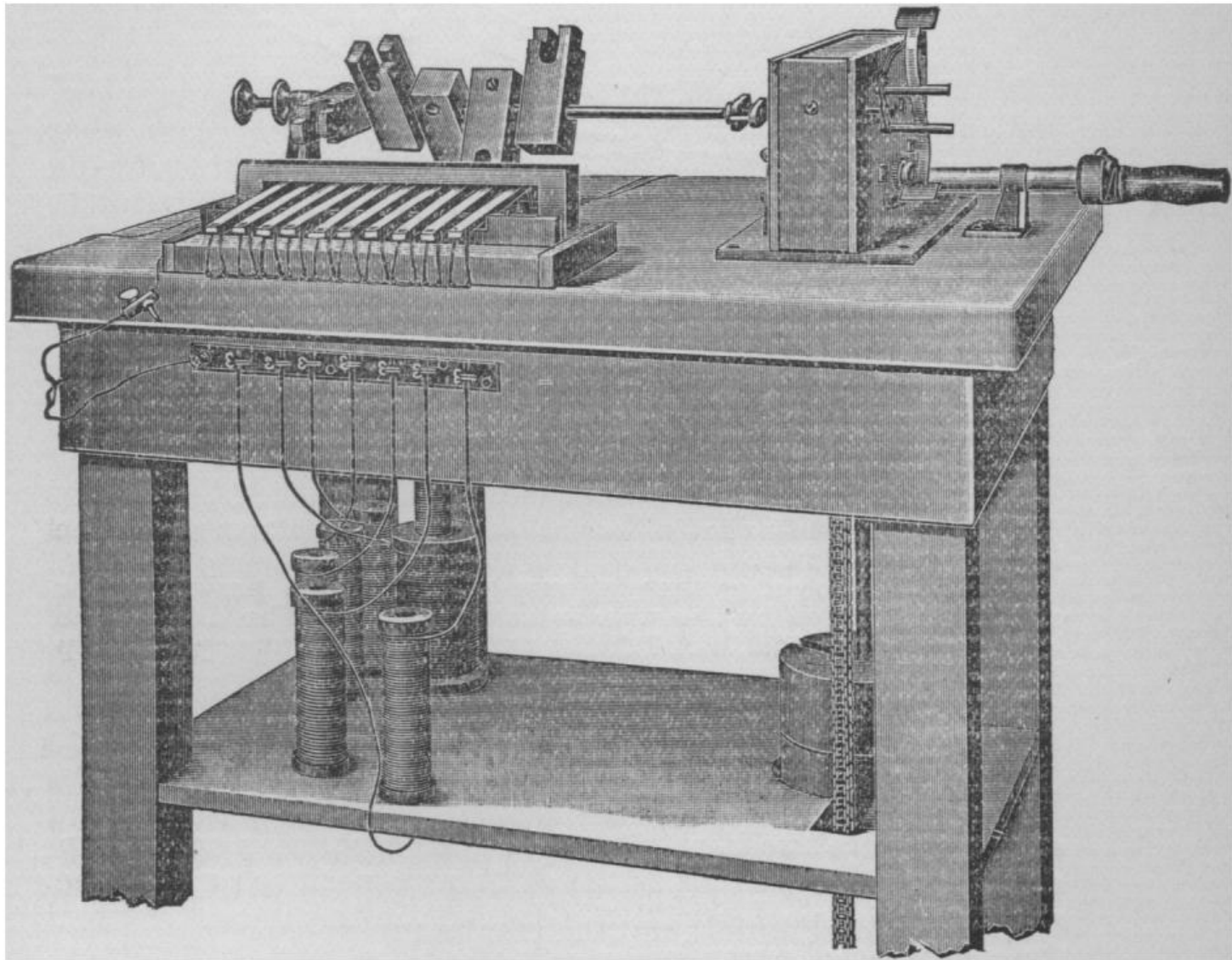




so lehrt die Erfahrung, daß wir in unsern Gedanken alsobald eine tactmäßige Eintheilung dieser Schläge machen, indem wir sie in Glieder ordnen, die eine gleiche Anzahl Schläge in sich fassen, und zwar so, daß wir auf den ersten Schlag eines jeden Gliedes einen Accent legen, oder ihn stärker als die übrigen Schläge zu vernehmen glauben. Diese Eintheilung kann auf dreyerley Art geschehen, entweder also:



nemlich, wir theilen die Schläge in Glieder von zwey, oder drey, oder vier Schlägen ein.



*Rhythm*, T. Bolton (1894)

# Characteristics of Subjective Rhythmization

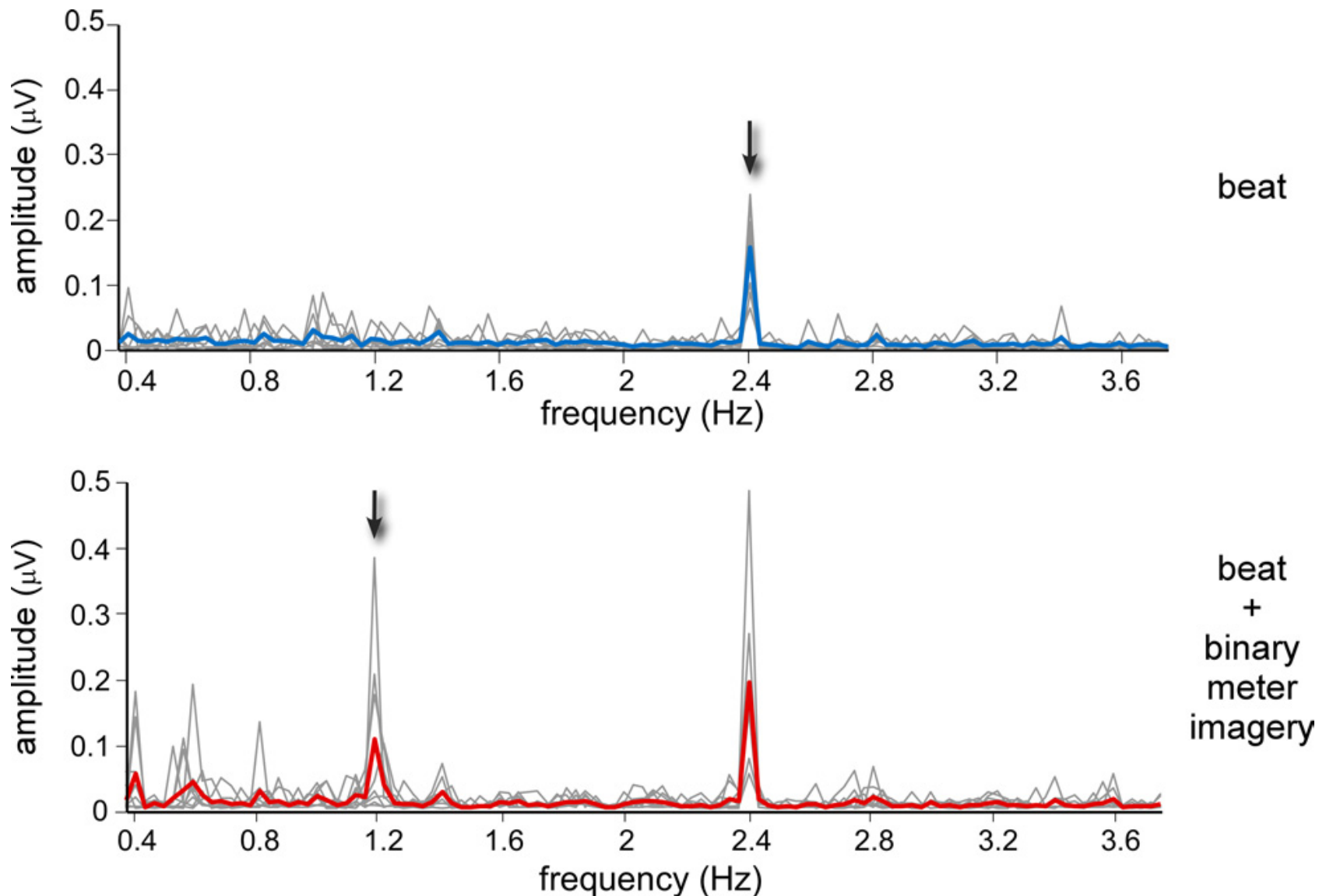
- The most common groupings are 2, 3, 4 and 8.
- What group size is that is experienced depends on the tempo.
- Subjective rhythmization has a slower limit around an ISI of 2 seconds.

# WAARNEMING VAN METRISCHE TOONREEKSEN

## PROEFSCHRIFT

TER VERKRIJGING VAN DE GRAAD VAN DOCTOR IN DE  
SOCIALE WETENSCHAPPEN AAN DE KATHOLIEKE UNI-  
VERSITEIT TE NIJMEGEN, OP GEZAG VAN DE RECTOR  
MAGNIFICUS PROF. MR. F.J.F.M. DUYNSTEE VOLGENS  
BESLUIT VAN HET COLLEGE VAN DECANEN IN HET  
OPENBAAR TE VERDEDIGEN OP VRIJDAG 30 NOVEMBER  
1973, DES NAMIDDAGS TE 14.00 UUR PRECIES

***Waarneming van metrische toonreeksen. Vos, P.  
(1973). Reanalyzed by Noorden and Moelants (1999)***



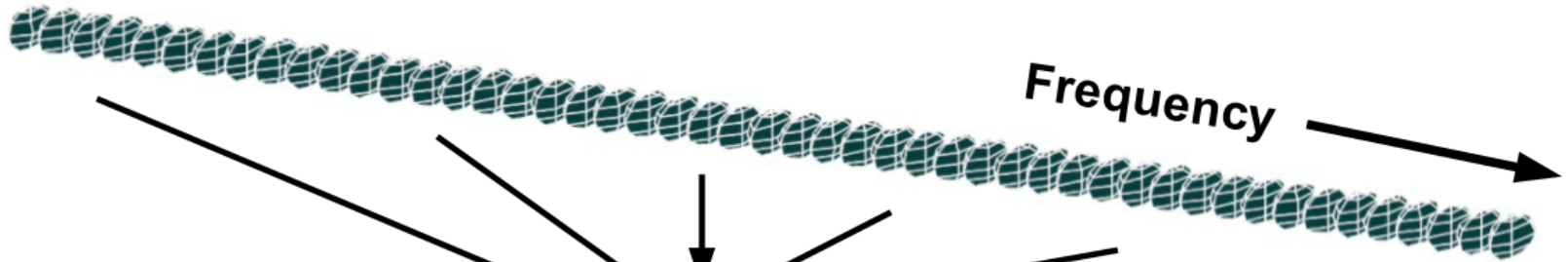
***Tagging the neuronal entrainment to beat and meter.***  
**Nozaradan et al. (2011)**

**Sound**



**Time** 

**Neural  
Oscillators**

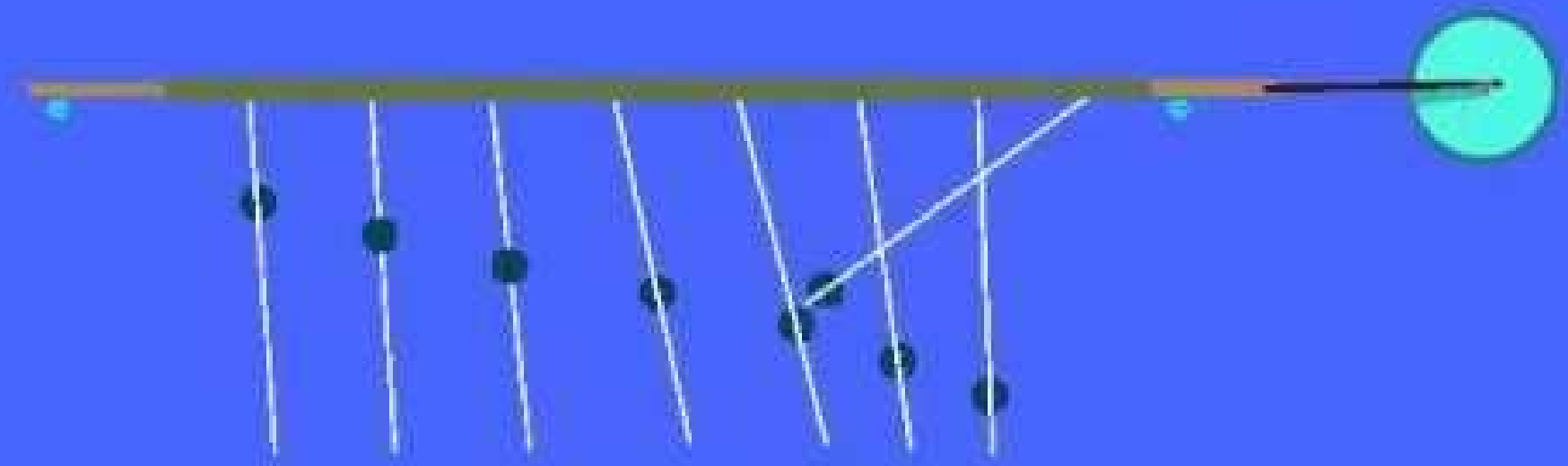


**Frequency** 

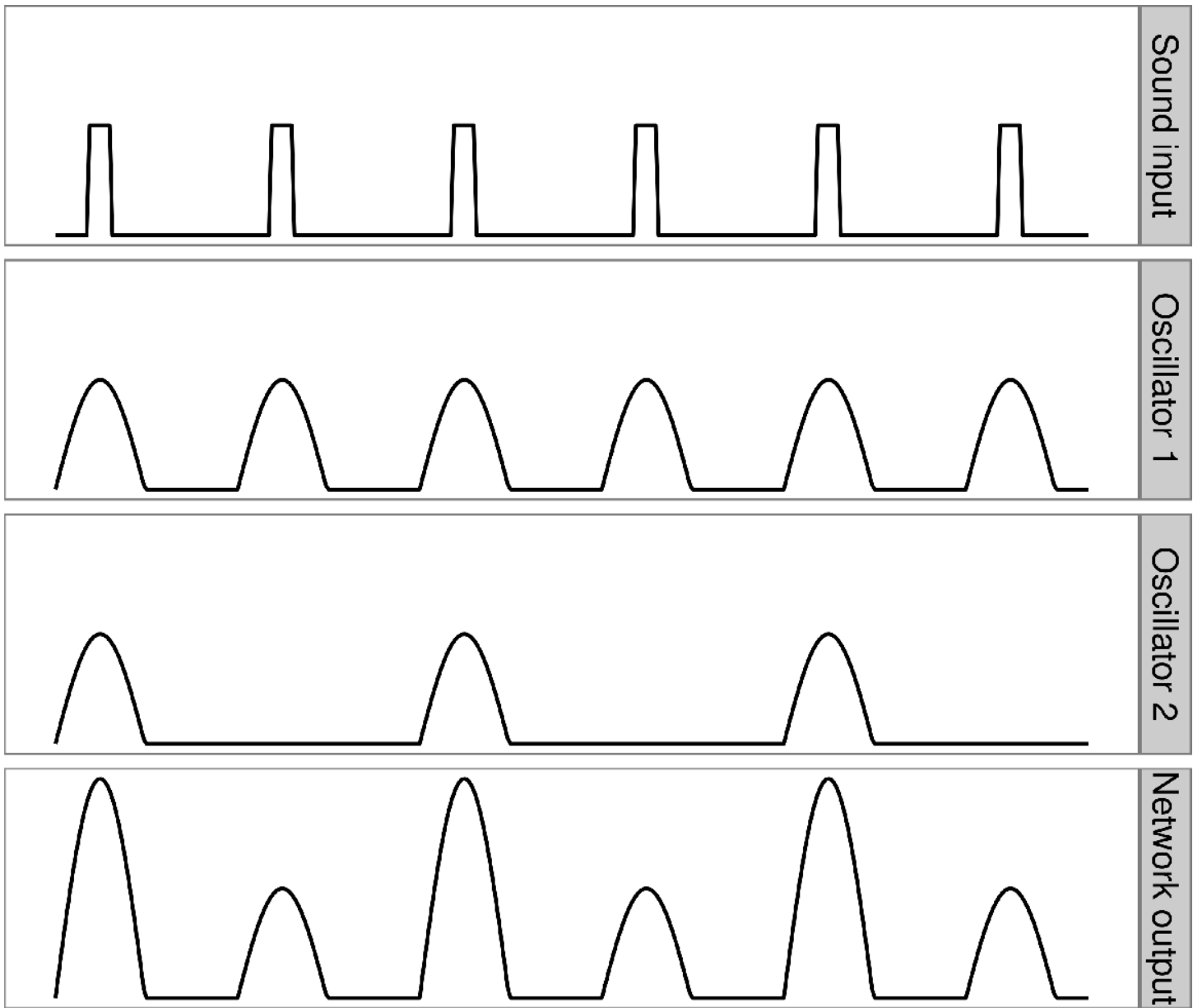
$\Sigma$

**Pulse**

***Neurodynamics of Music. Large (2008)***

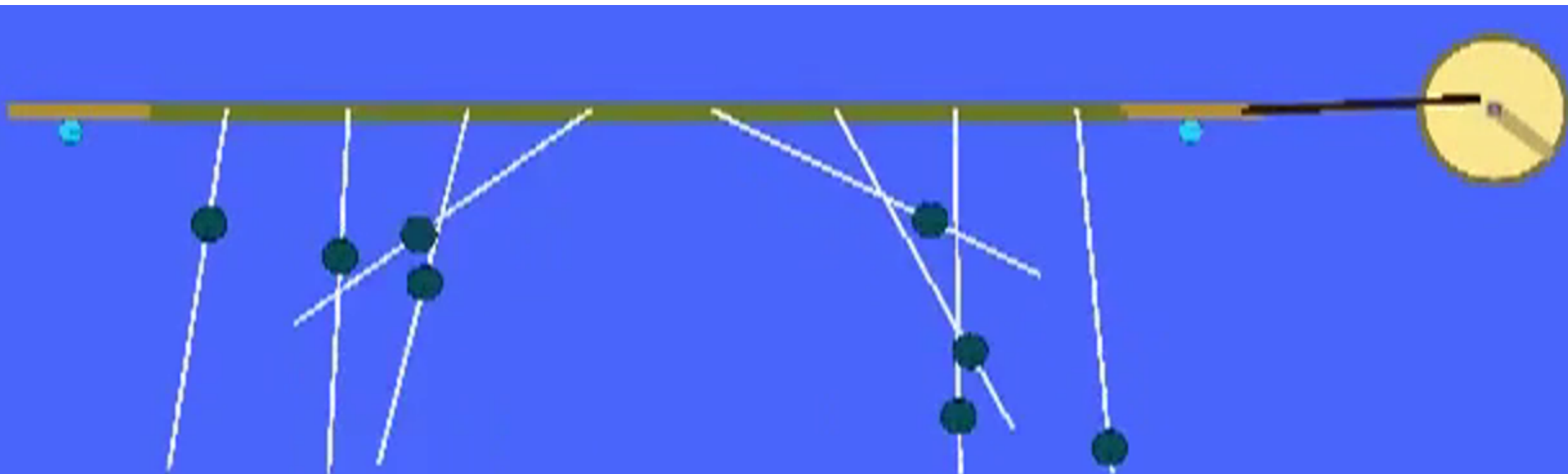
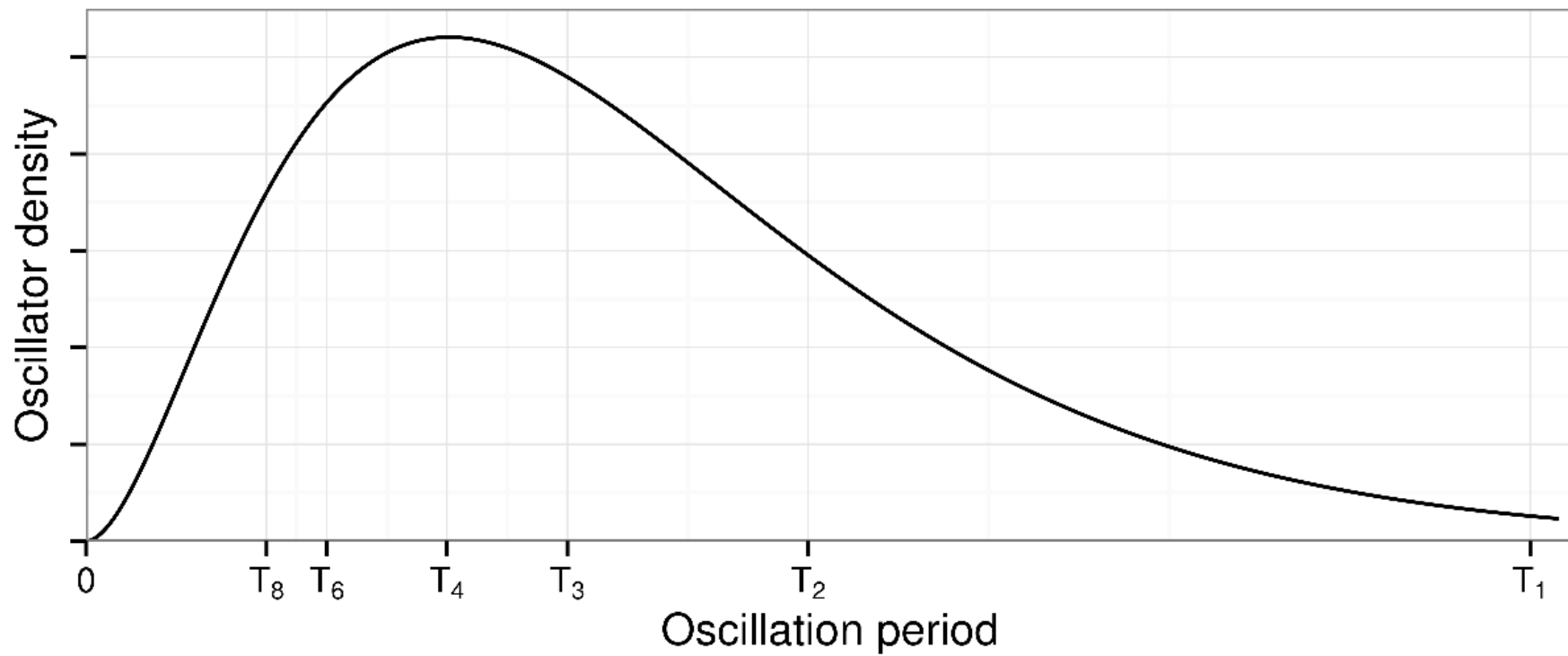


Amplitude



Time





# The Current Study

- A replication of Bolton and Vos.
  - But with an experiment protocol and with a decent number of participants (30).
- An extension
  - Wider range of tempi, ISI from 150 ms to 2000 ms
  - Additional task
    - Finger tapping at slow tempi, ISI from 600 ms to 3000 ms

Mozilla Firefox

File Edit View History Bookmarks Tools Help

file:///home/rasmus/Documents/akademia/scripts/sr\_and\_resonance/sr/sr... Google

file:///home/ras...\_experiment.html

# Bedömning av ljudsekvenser.

**Sekvens 1**

Spela sekvens Jag känner Grupper om tre.

**Sekvens 2**

Spela sekvens Jag känner

- Ingen gruppering / Grupper om en.
- Grupper om två.
- Grupper om tre.
- Grupper om fyra.
- Grupper om fem.
- Grupper om sex.
- Grupper om sju.
- Grupper om åtta.

**Sekvens 3**

Spela sekvens Jag känner

**Sekvens 4**

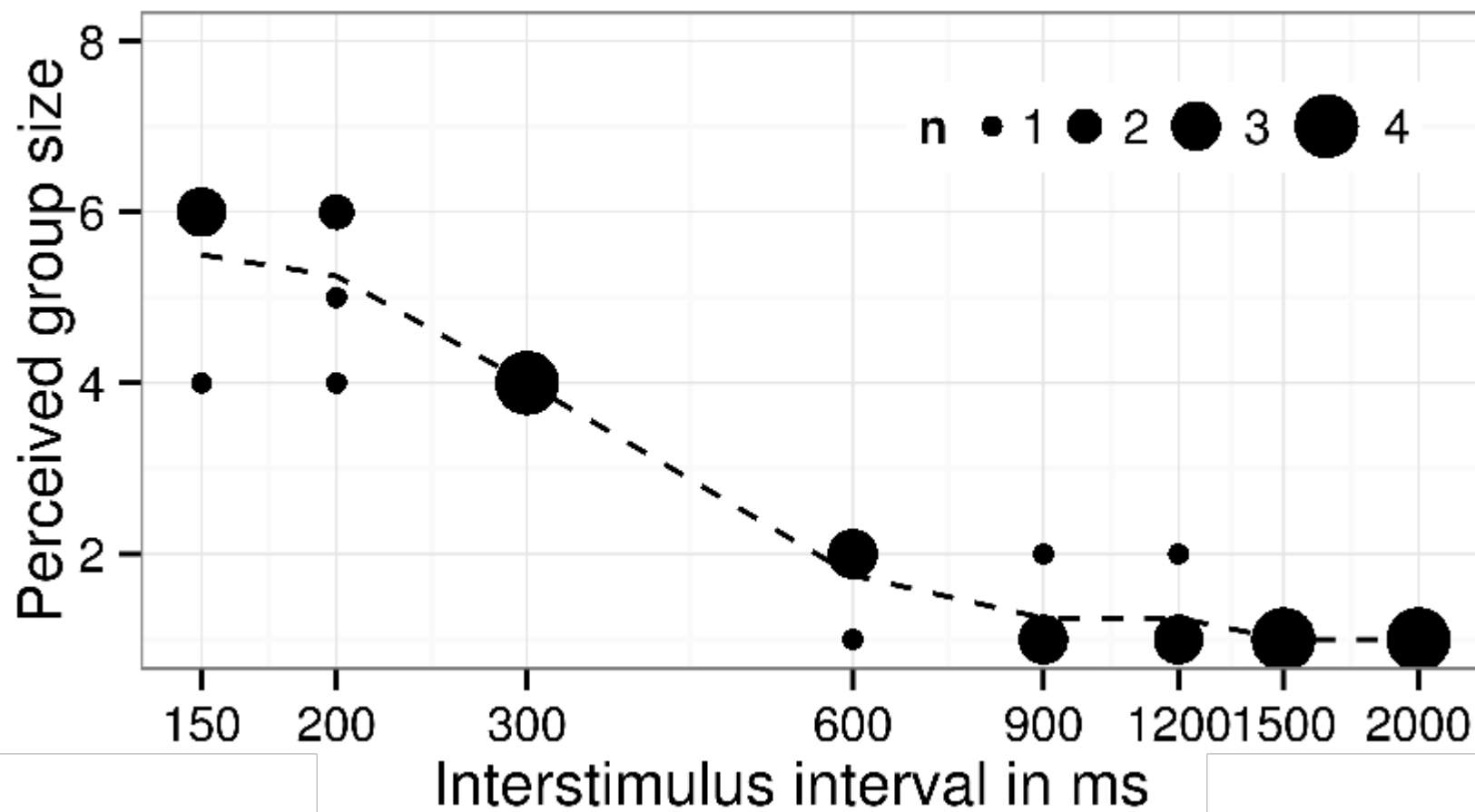
Spela sekvens Jag känner

Try it out at: [http://sumsar.net/files/sr\\_task/public\\_sr\\_task.html](http://sumsar.net/files/sr_task/public_sr_task.html)

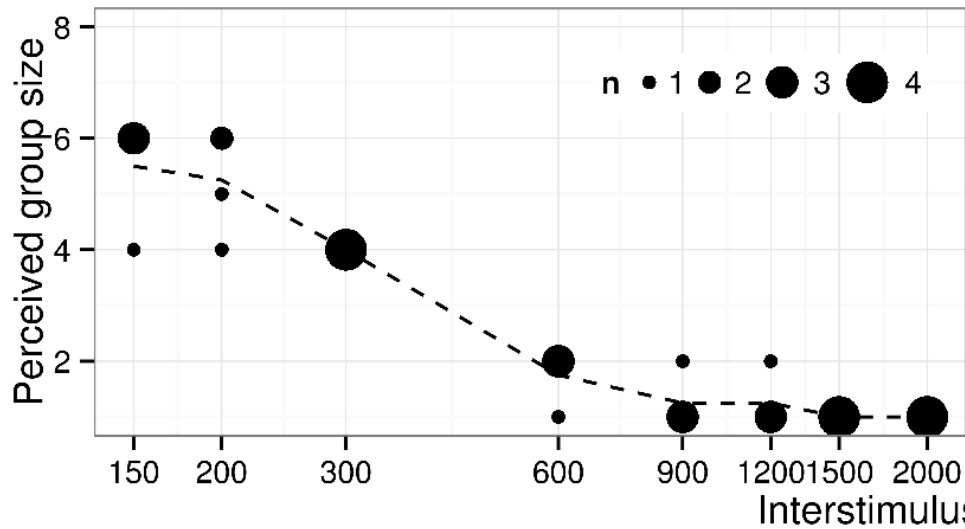
# Predictions

- There should be a negative correlation between interstimulus interval and perceived grouping.

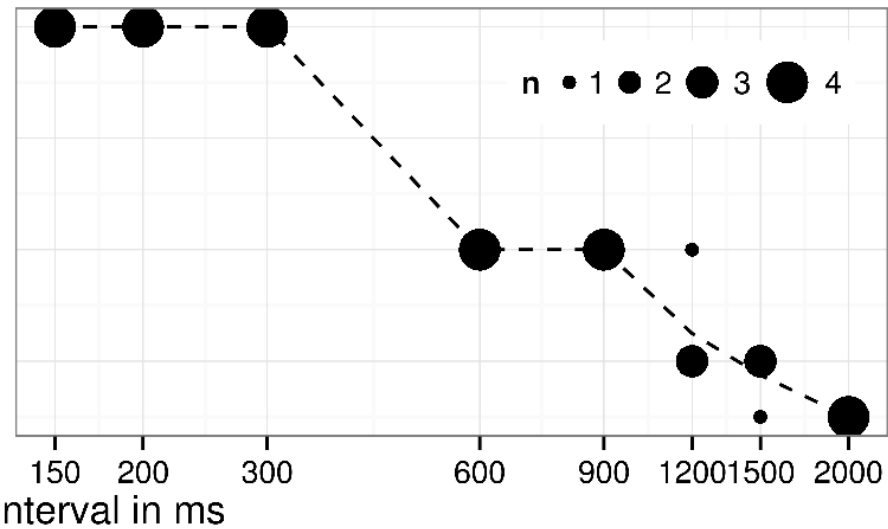
# Participant A



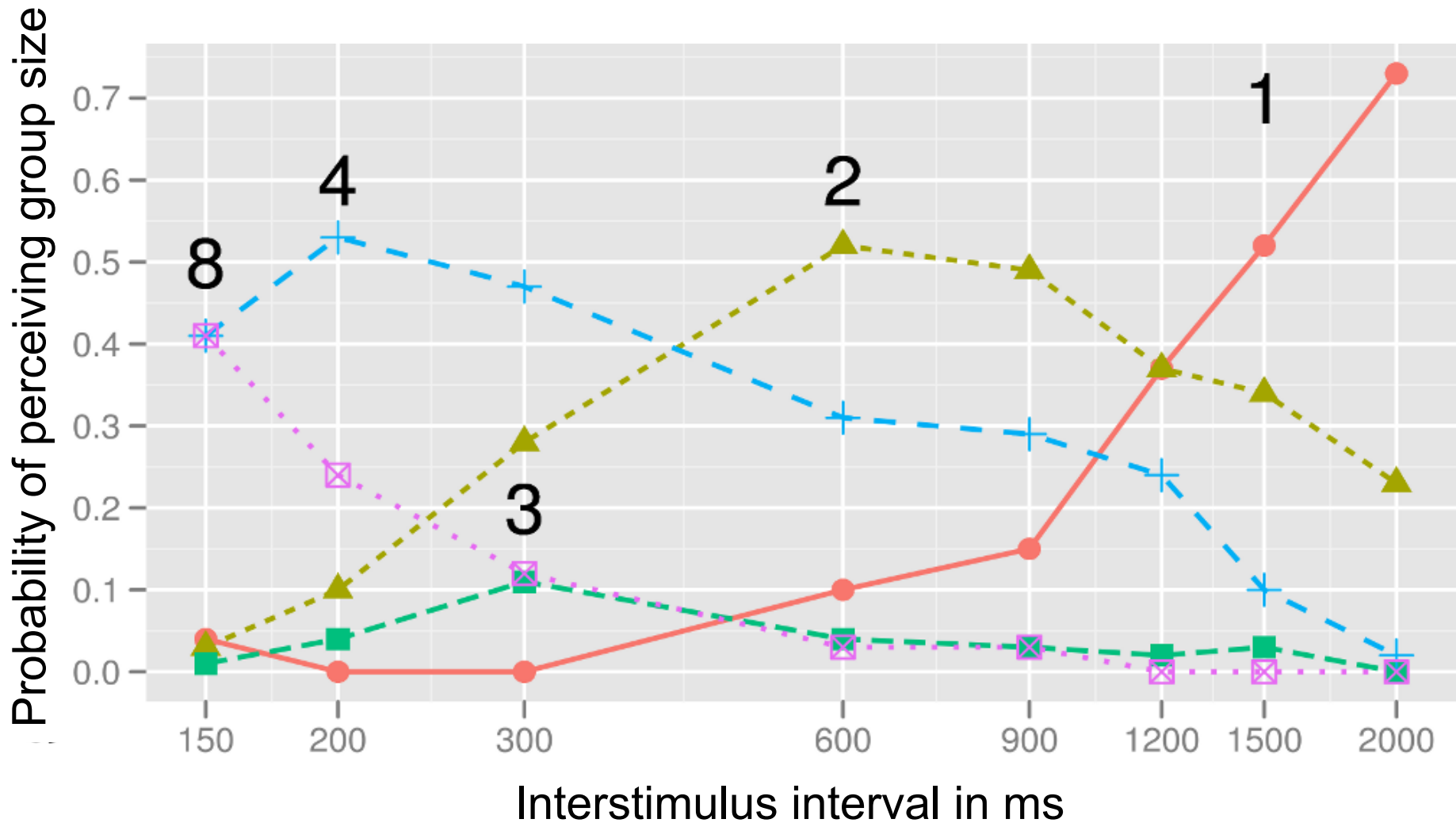
Participant A



Participant B



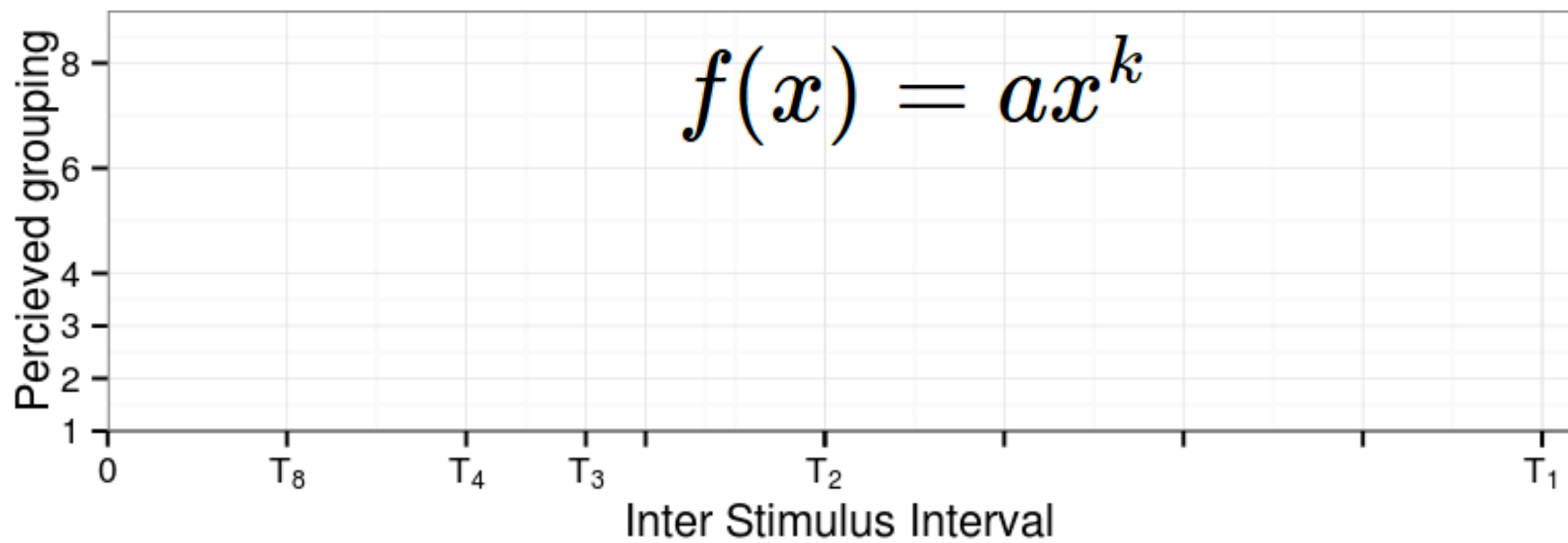
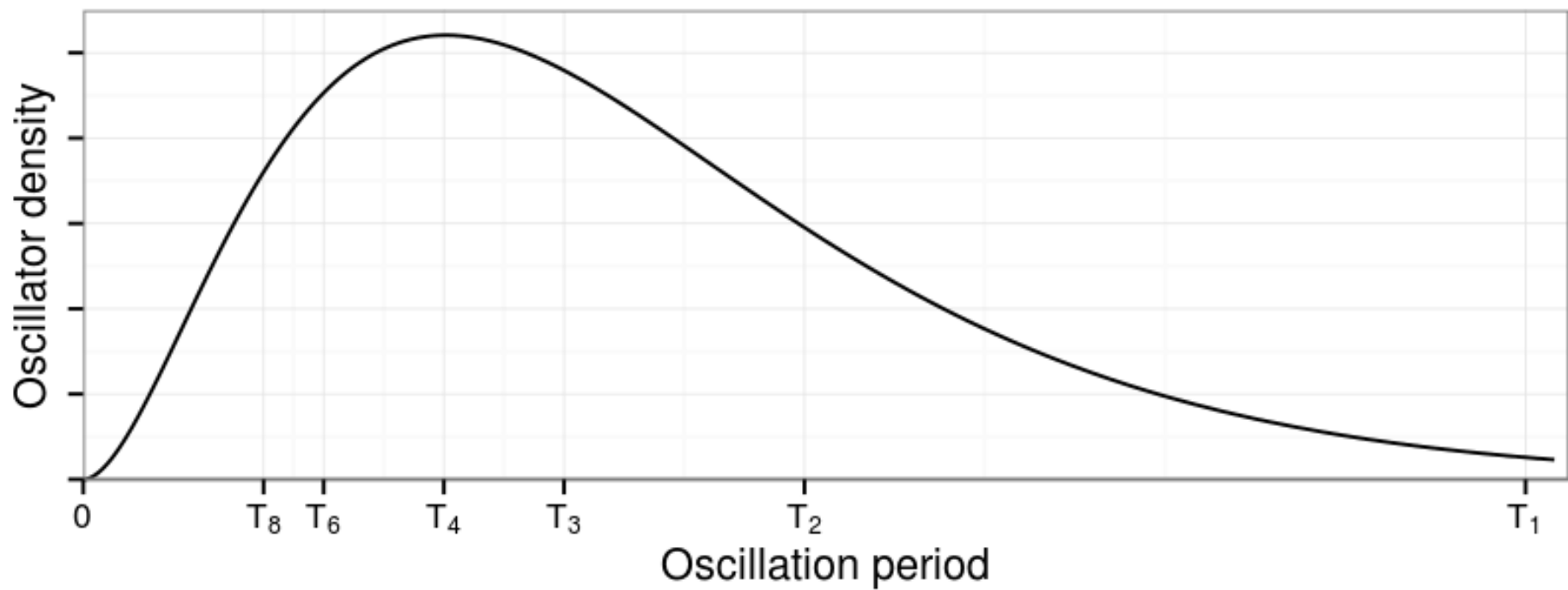
- Strong correlation for all participants between ISI and group size, mean Spearman's rank correlation:  $-0.77$ ,  $p < 0.05$  for all participants.

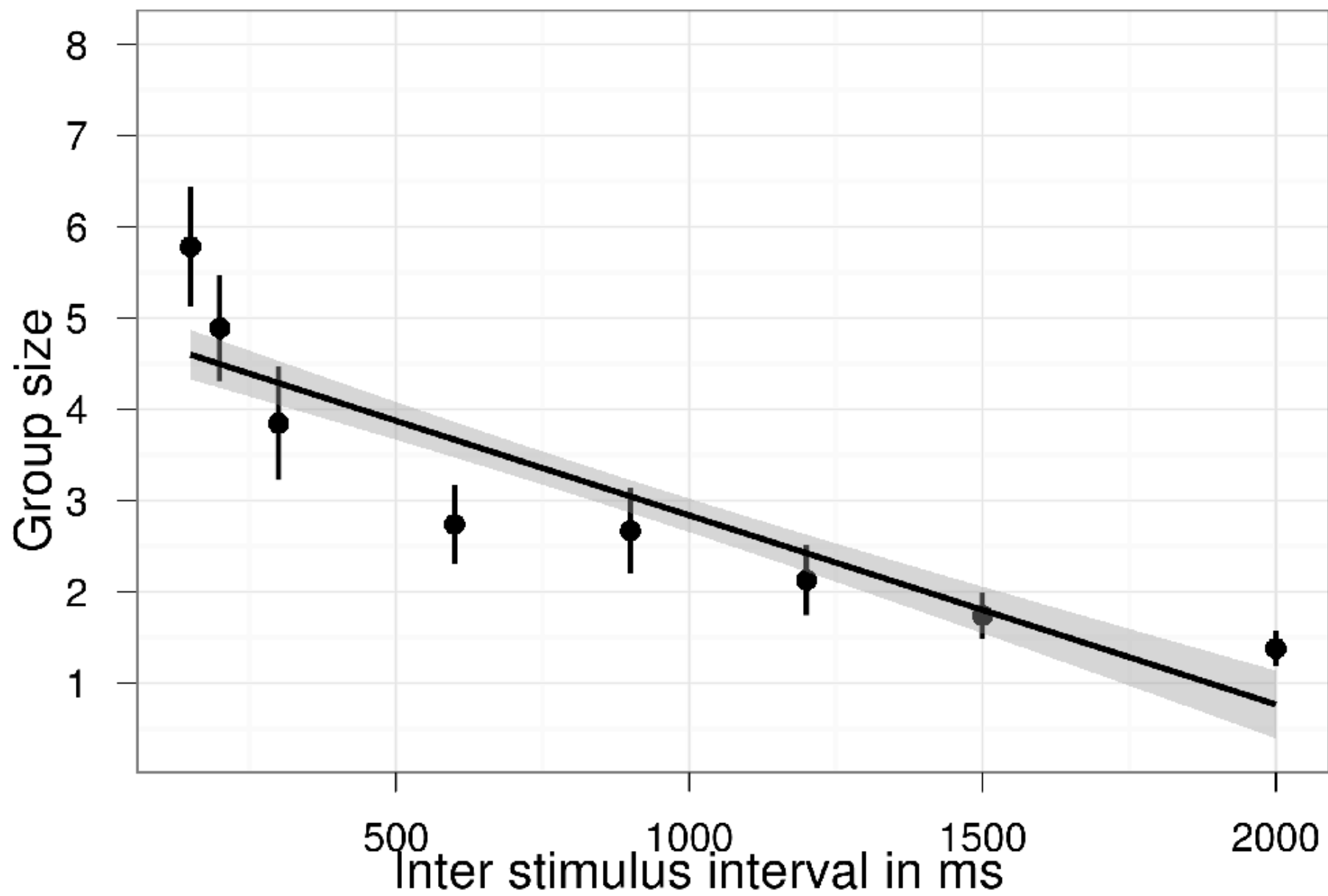


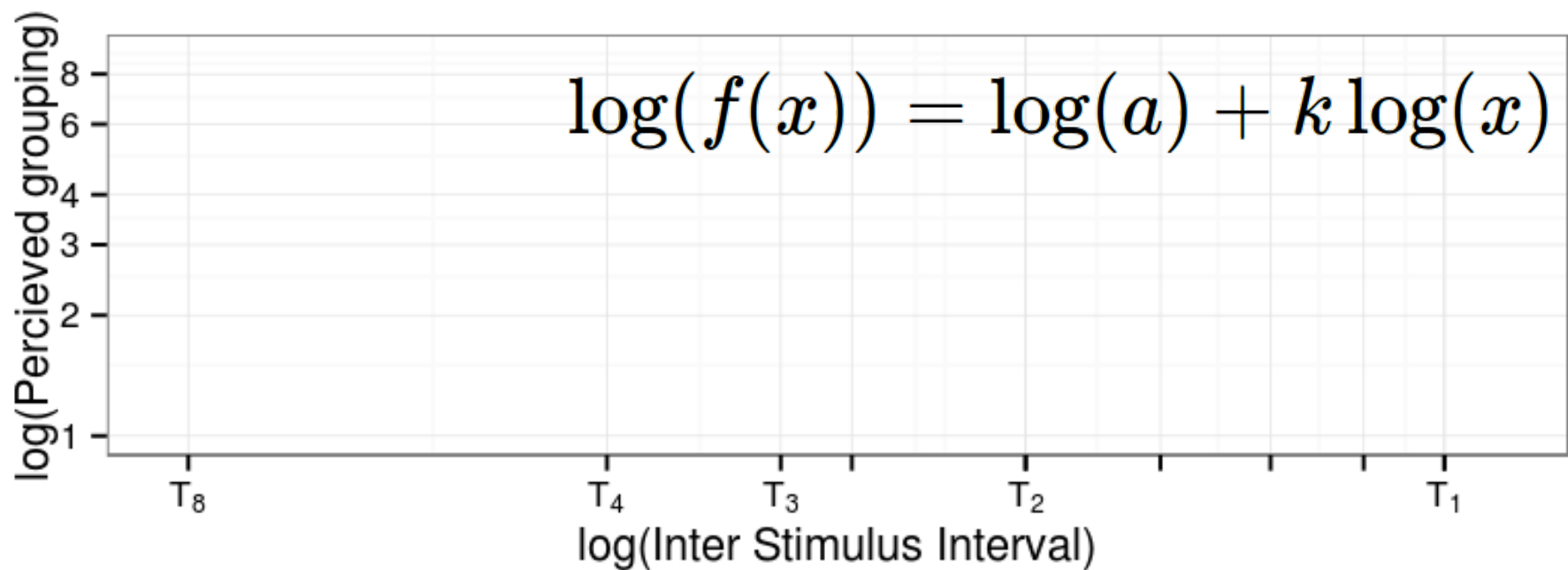
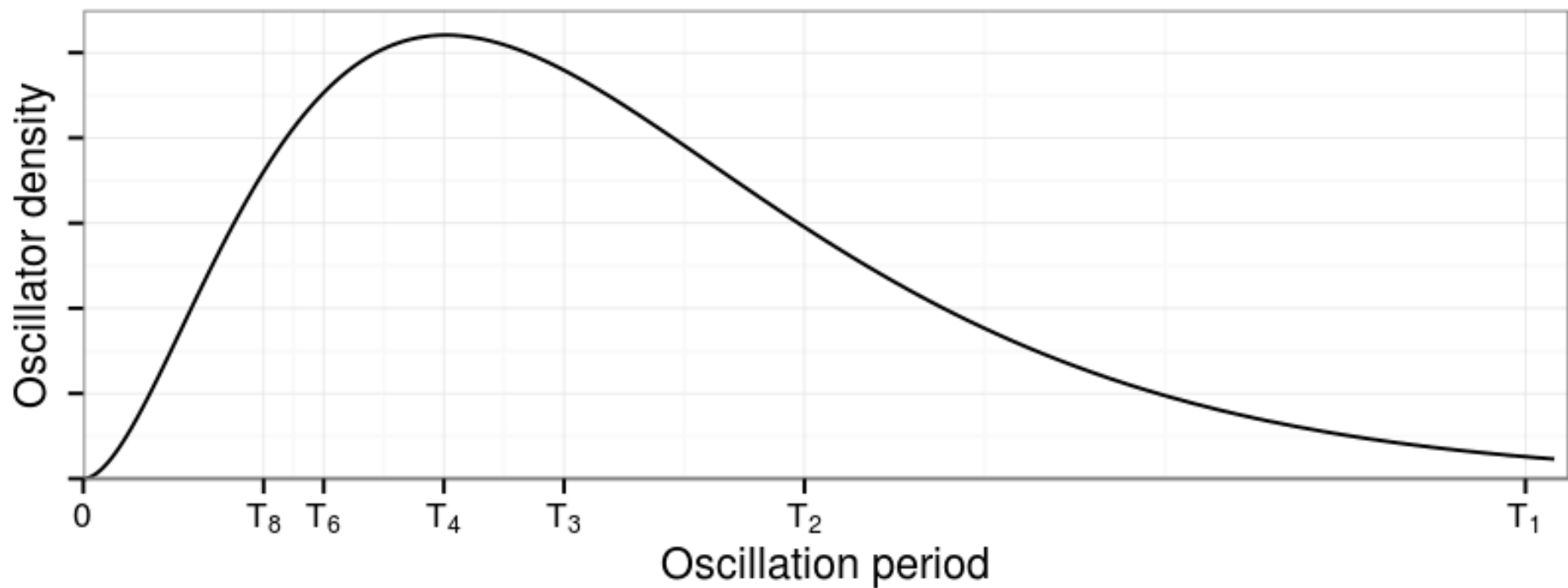
# Predictions

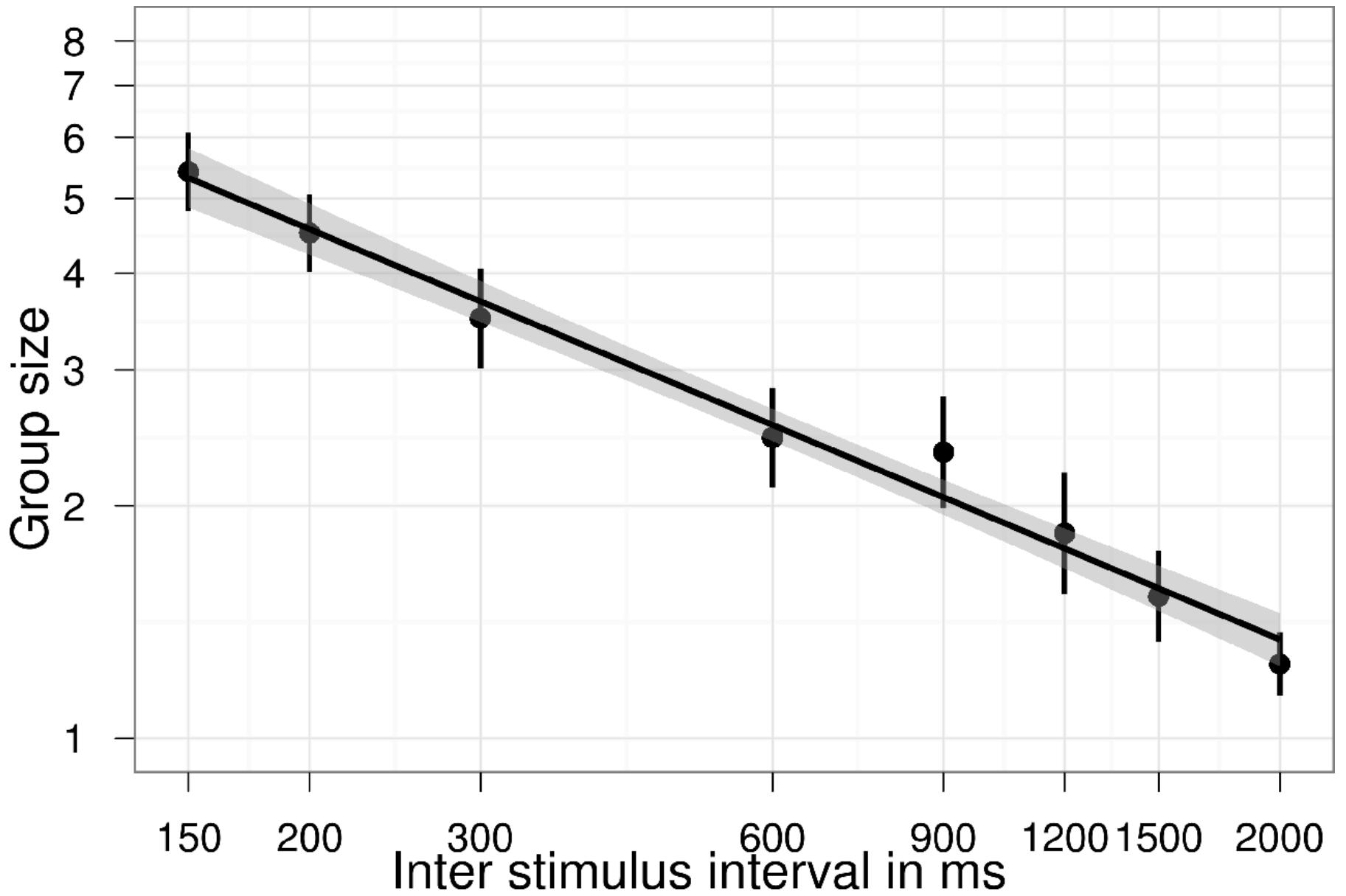
- There should be a negative correlation between interstimulus interval and perceived grouping.
- The relation between perceived grouping and interstimulus interval should roughly follow a power law.







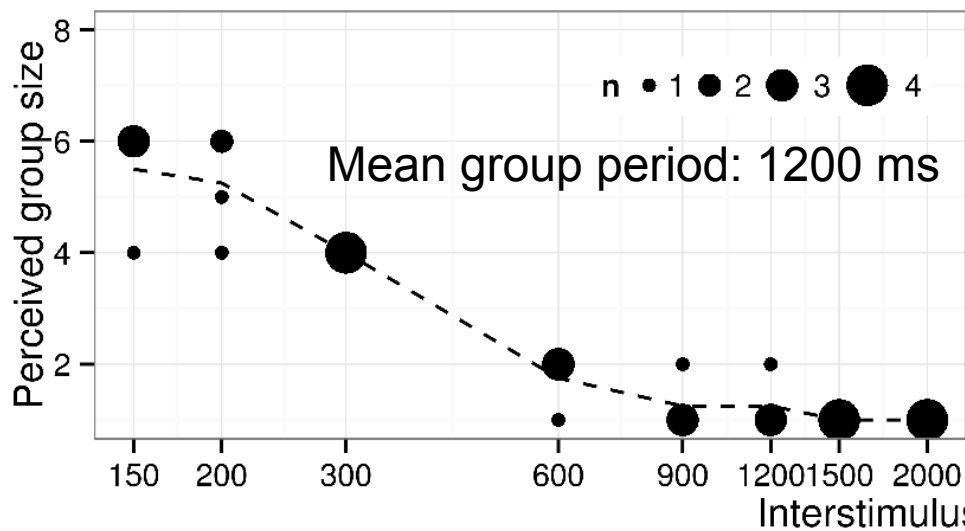




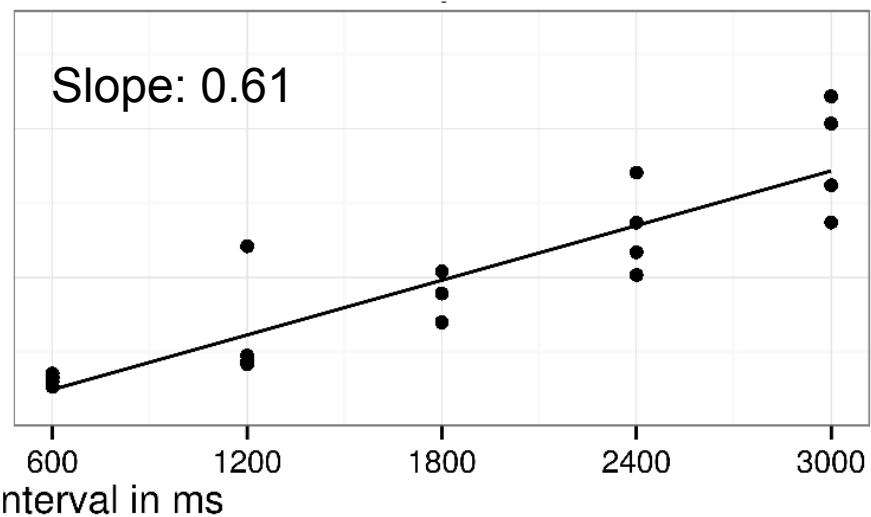
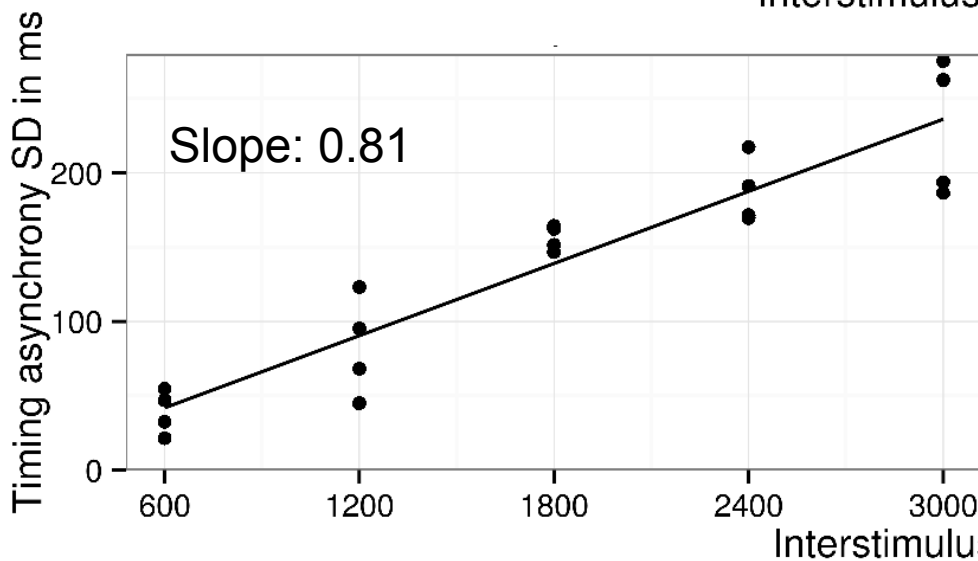
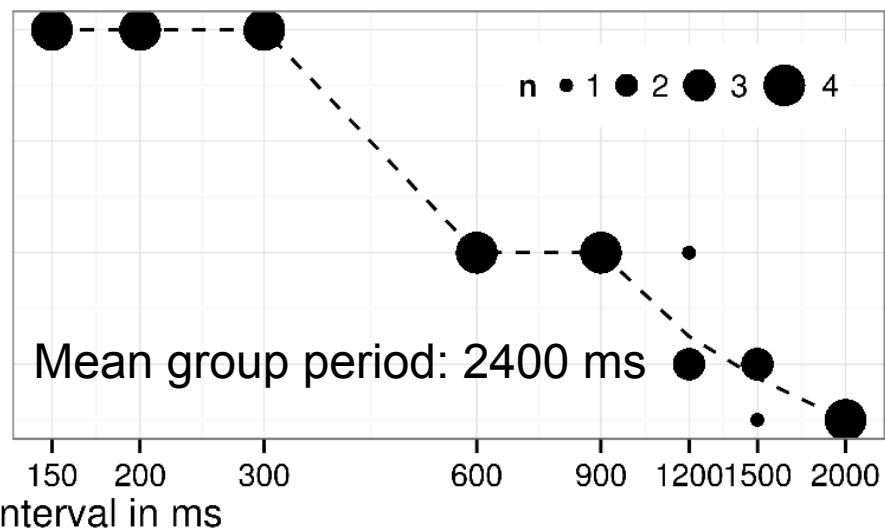
# Predictions

- There should be a negative correlation between interstimulus interval and perceived grouping.
- The relation between perceived grouping and interstimulus interval should follow a power law.
- Participants that experiences larger grouping should be better at finger tapping when the tempo is slow.

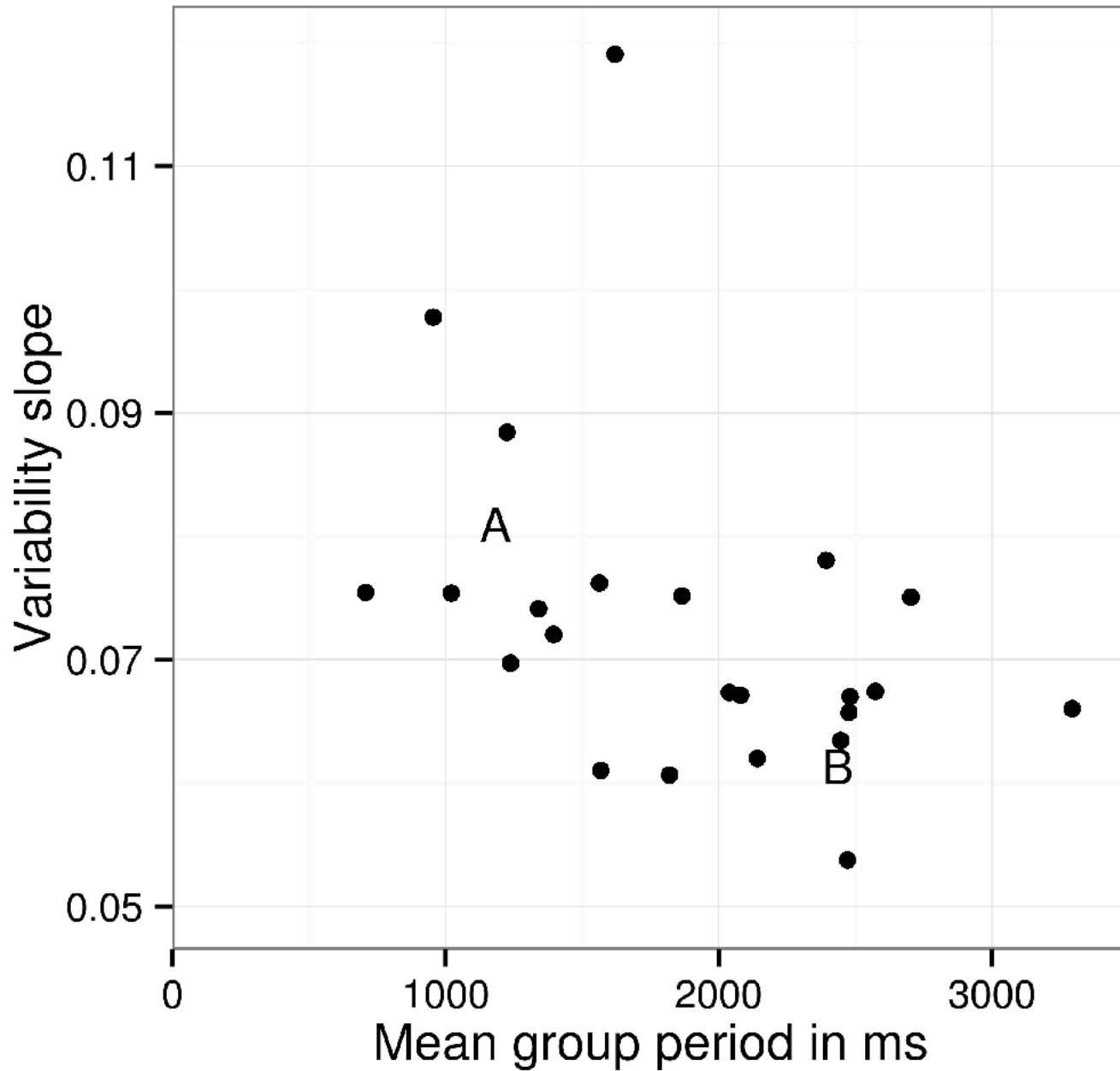
Participant A



Participant B



Spearman's rho = - 0.56,  $p = 0.0044$



# Summary of results

- The original findings of Bolton (1894) and Vos (1973) holds, that is
  - Subjective rhythmization is experienced by most participants
  - A strong correlation between tempo and grouping
  - A slower limit around an ISI of 2000 ms
- The resonance model of rhythm perception (Large, 2008) explains subjective rhythmization well.
  - Explains the phenomena and the correlation between tempo and grouping.
  - Predicts the relationship between tapping performance at slow tempi and subjective rhythmization





# A Next Step

- Looking at cultural differences in what groupings are experienced.
- So, anyone here working in the Balkans?

# References

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