

Attentional Bias towards Sensory- but not Semantic-level Regularity

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Introduction

Background:

Humans are adept at extracting and utilizing potential regularities in the environment. Previous research has revealed an attention bias toward statistical regularity based on the temporal order of unrelated meaningless symbols.

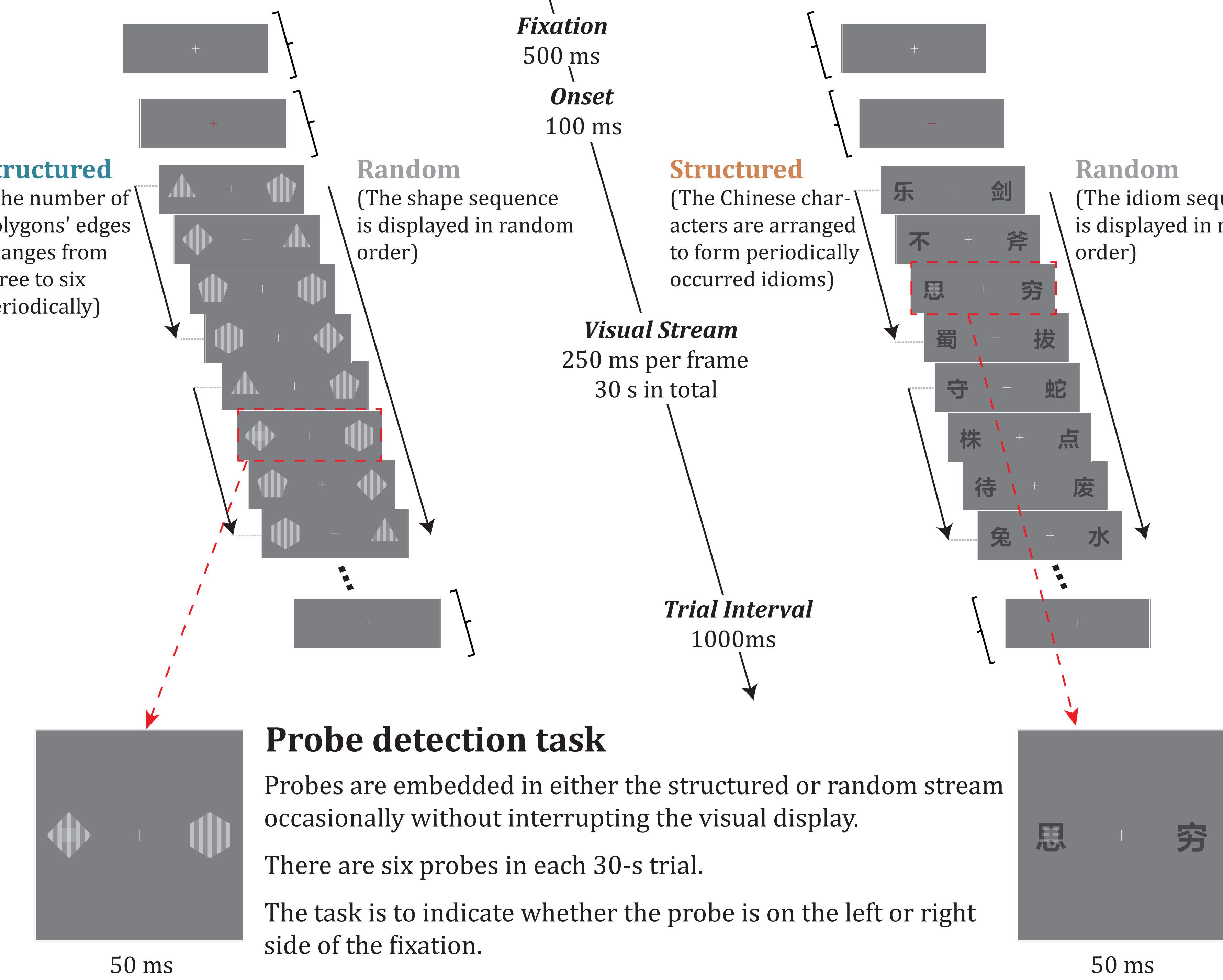
However, in the real world, regularities in visual inputs are multitudinous and emerge from not only stimulus order but also the organization of visual information at different levels.

Questions:

- 1) Could temporal regularities in multi-level information, based on either sensory or semantic associations among the visual inputs, bias the allocation of attention, and what is the potential difference between these regularities in their ability to attract attention?
- 2) How does the regularity-induced attentional effect unfold over time and build up via learning?

Methods

Experiment 1: Shape



Experiment 2: Idiom

Dot-probe paradigm

Structured and random streams are simultaneously presented on two sides of the fixation when observers performed a probe detection task.

Attentional bias: measured by the *differences in RTs* at the locations of *structured* streams and *random* streams.

Structured stream vs. Random stream

Structured: organized based on sensory- or semantic-level regularity

Random: randomizing the sequence order of the structured stream

Sensory-level regularity vs. Semantic-level regularity

Sensory-level: periodically changed shape sequence

Semantic-level: periodically changed Chinese idiom sequence

Switch trial vs. Nonswitch trial

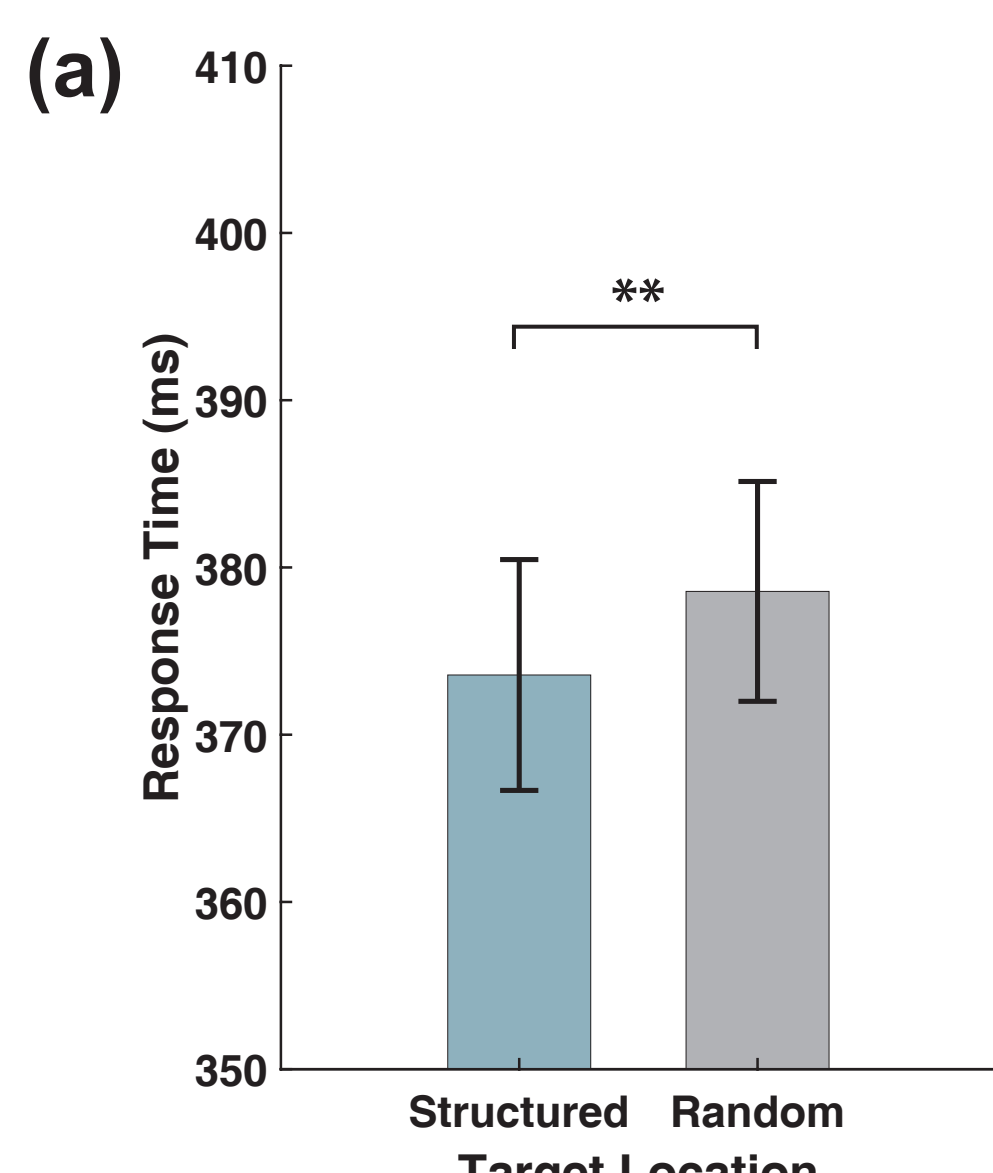
Switch trial: the location of the structured visual stream is changed compared to the previous trial

Nonswitch trial: the structured visual stream appears in the same location as in the previous trial & the first trial after each break

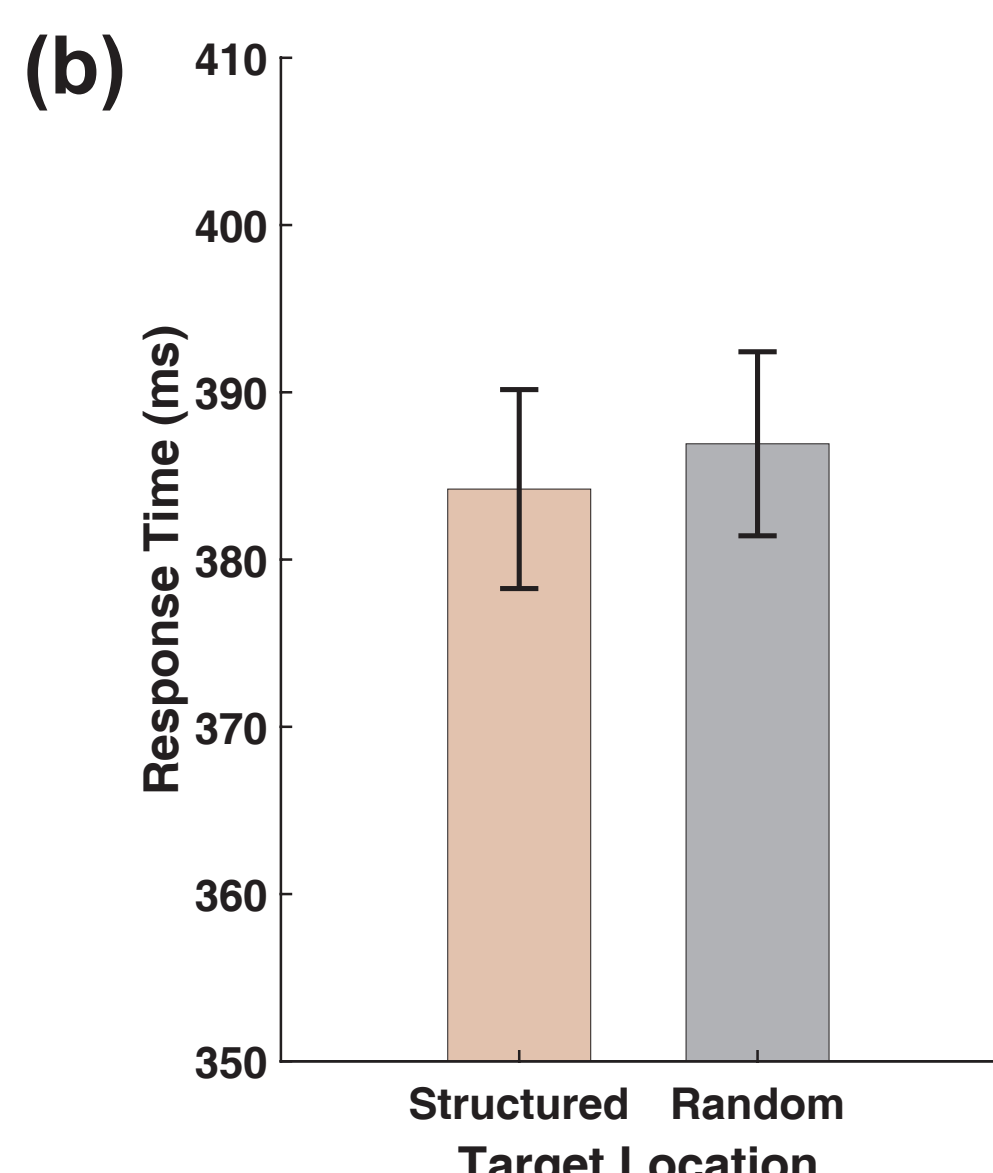
Results

Overall attention effect

Shape

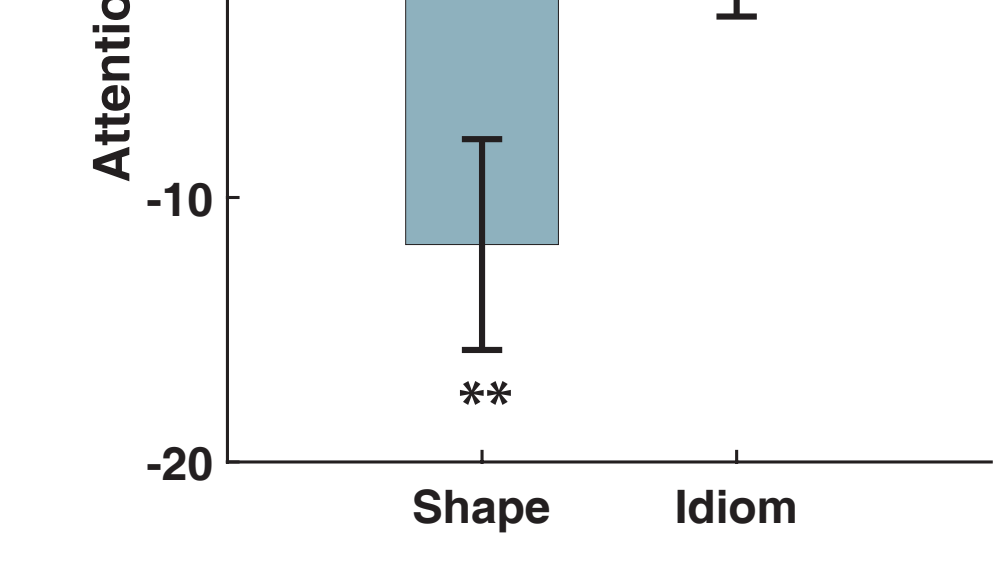
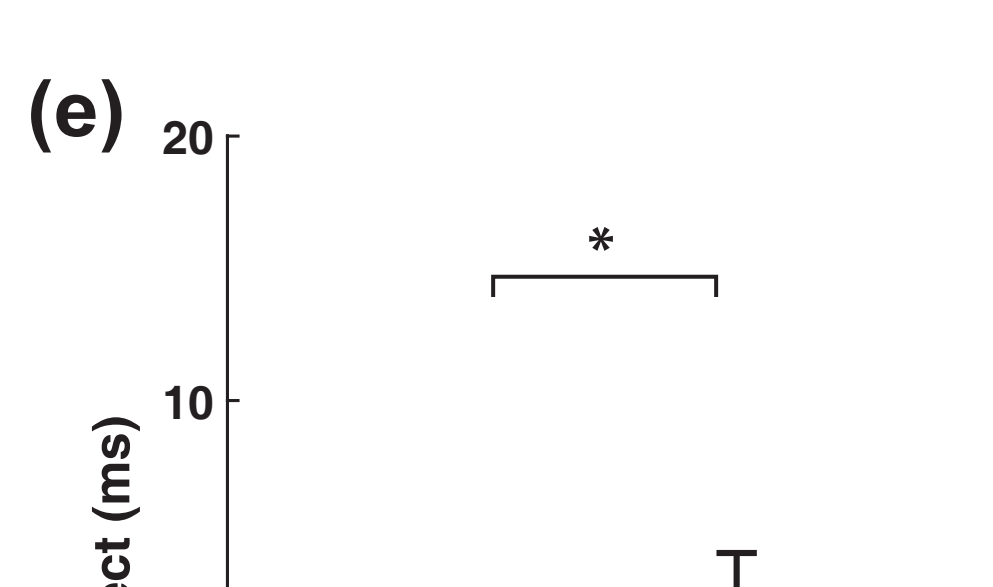
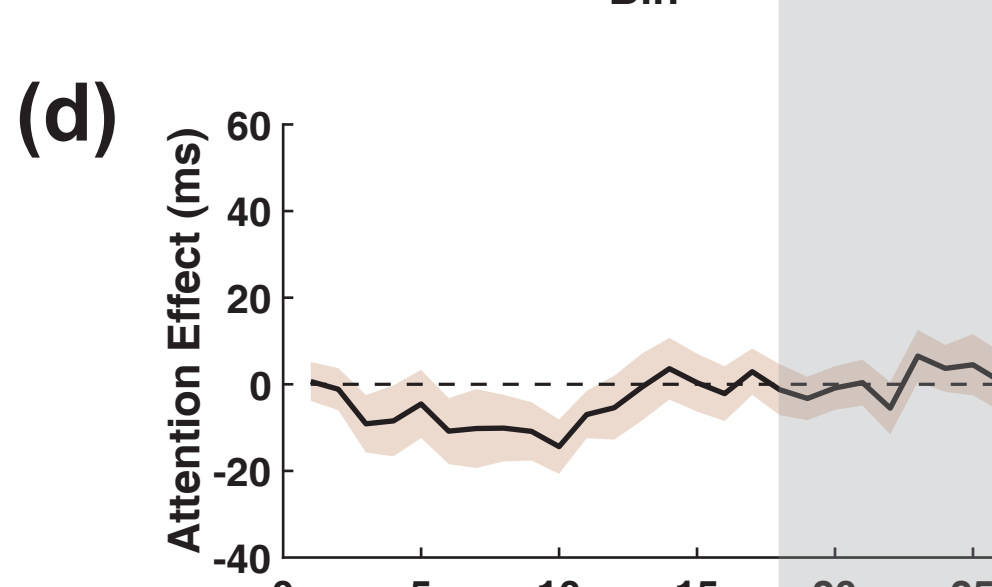
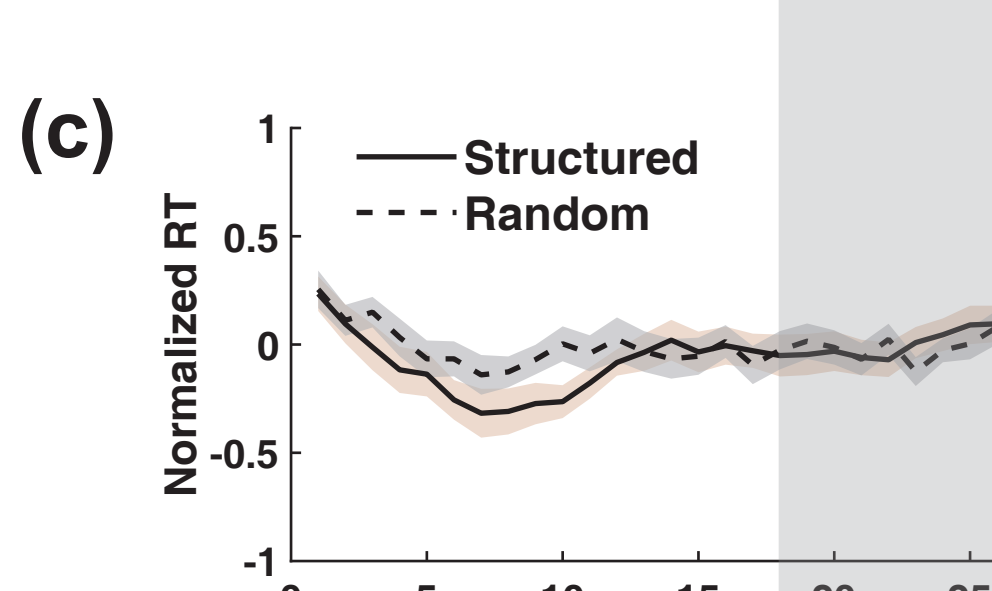
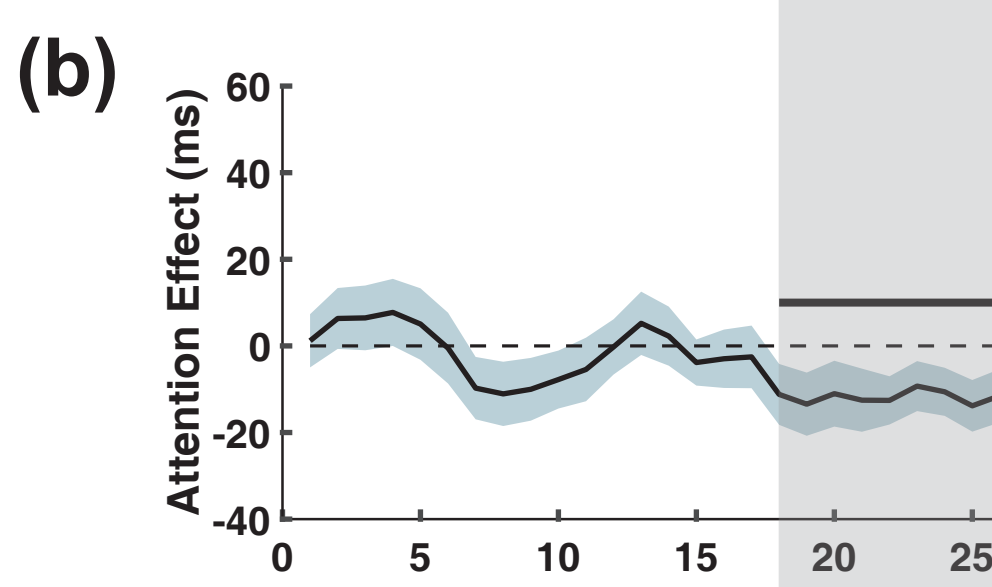
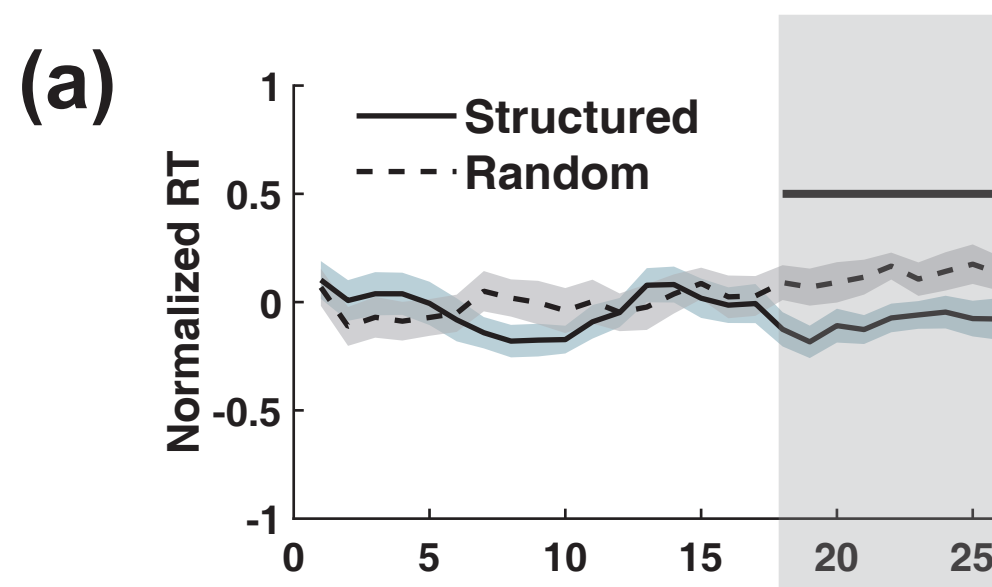


Idiom



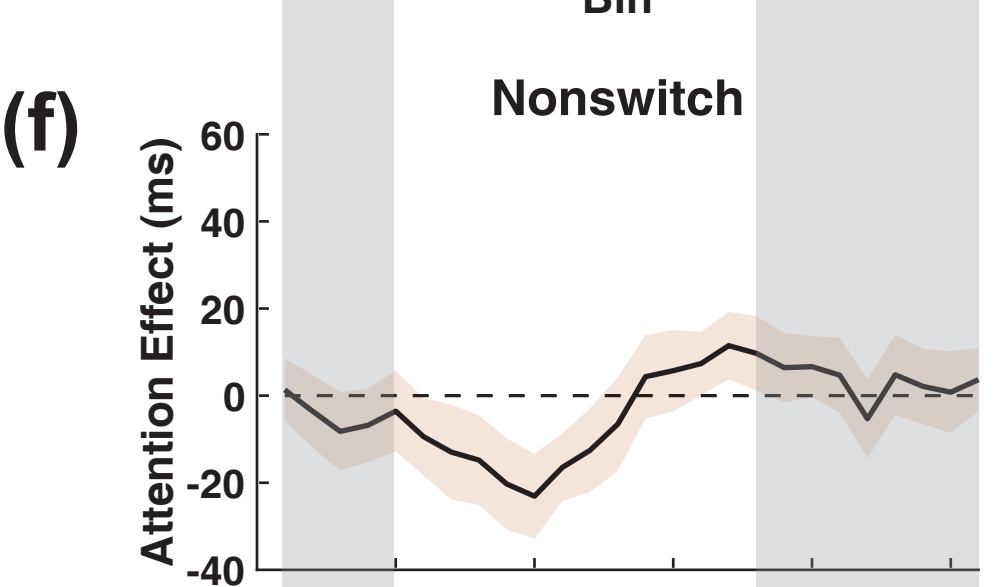
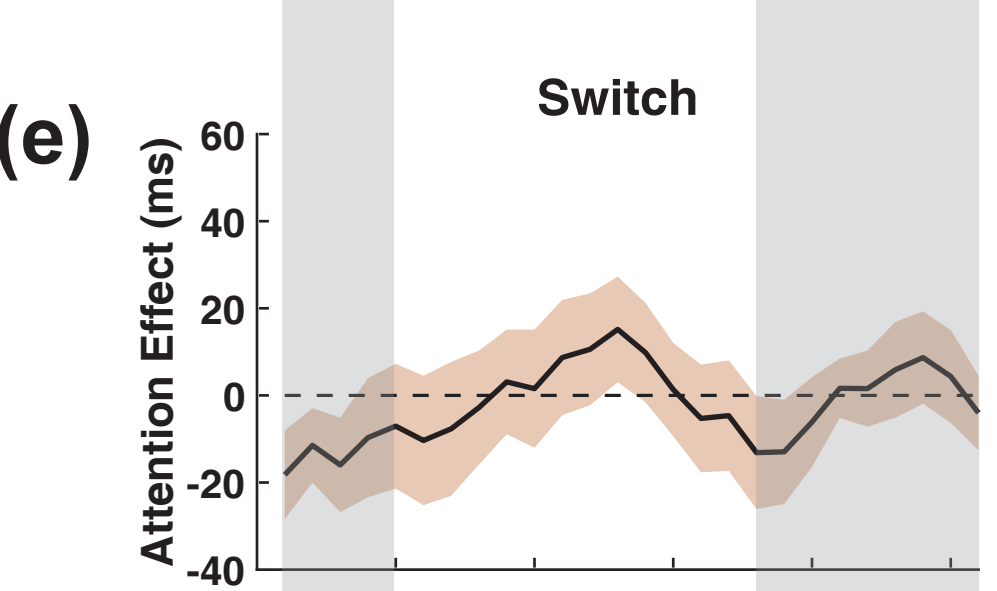
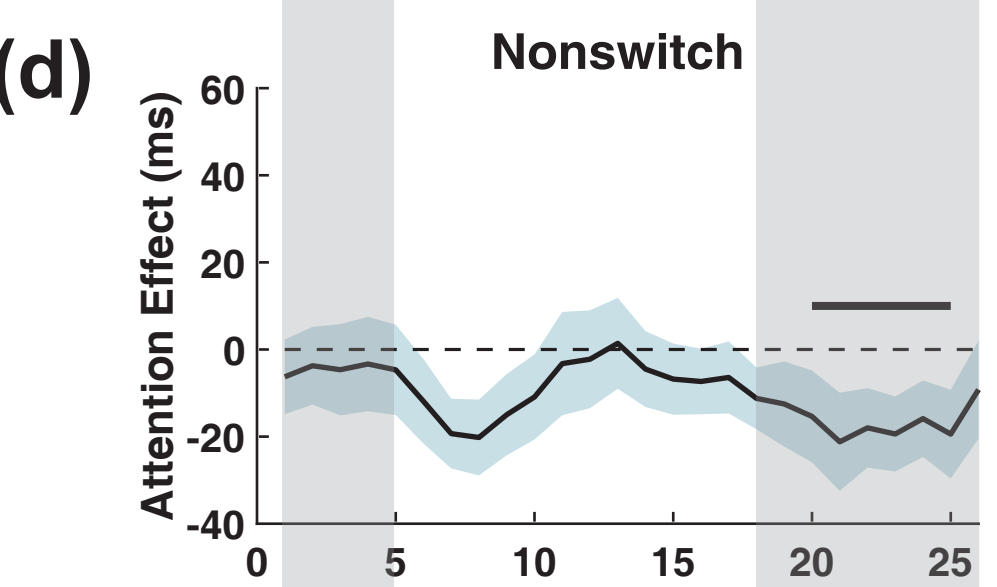
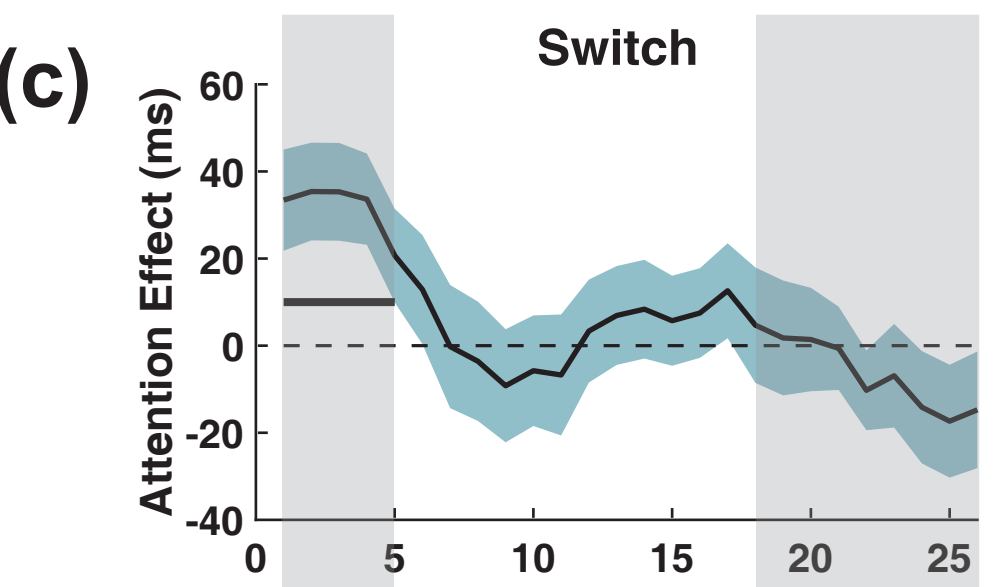
Intra-trial

Shape



Inter-trial

Shape



1) An overall attention bias toward temporal regularity exists in shape but not idiom streams

Significantly faster reaction time at the structured-stream location than at the random-stream location, for shape streams only.

2) The temporal profile and acquisition of the attention bias (for sensory-level regularities)

-- Intra-trial: built up gradually, relying on implicit statistical learning

Attention bias toward structured streams is significant in the late period of a trial, only in the shape condition.

-- Inter-trial: transferable to the subsequent trial but is malleable

Only for shape streams, a reverse attention effect appears at the initial stage of the switch trials, and such an effect diminishes in the late period.

Conclusion

- The attentional bias toward regularity hinges on the visual information processing hierarchy - structured streams containing sensory- but not semantic-level regularity receive priority in selective attention.
- The effect of regularity-guided attention needs to be built up gradually through implicit statistical learning, while this effect can persist across trials and is sensitive to changes in the environment.