

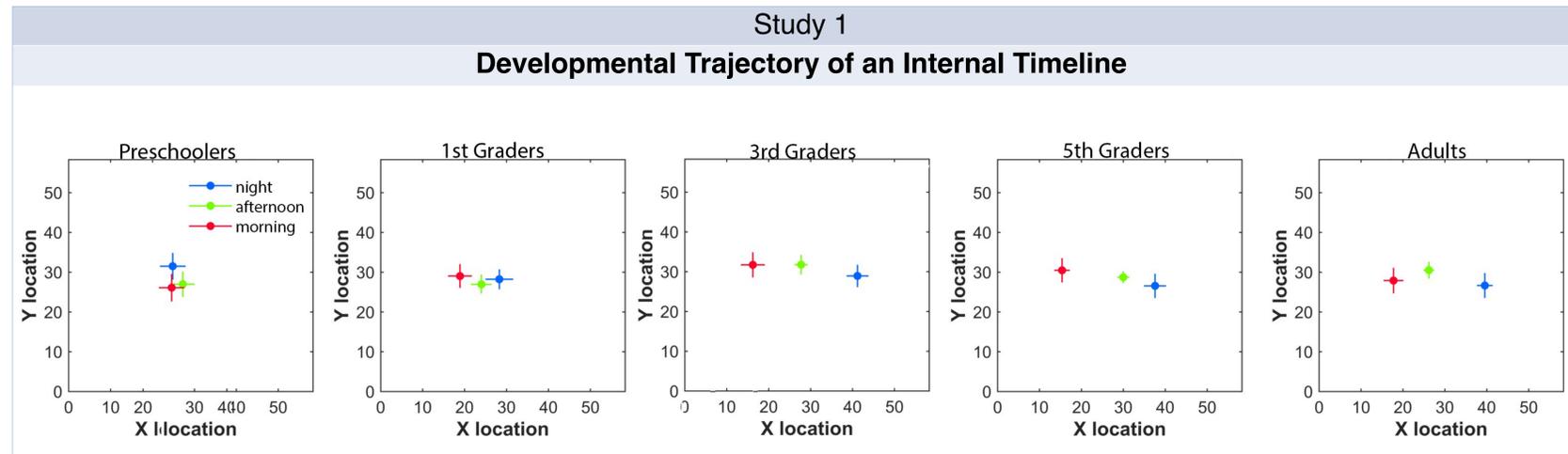
Developmental and Cognitive Approaches for Studying the Internal Representation of Time

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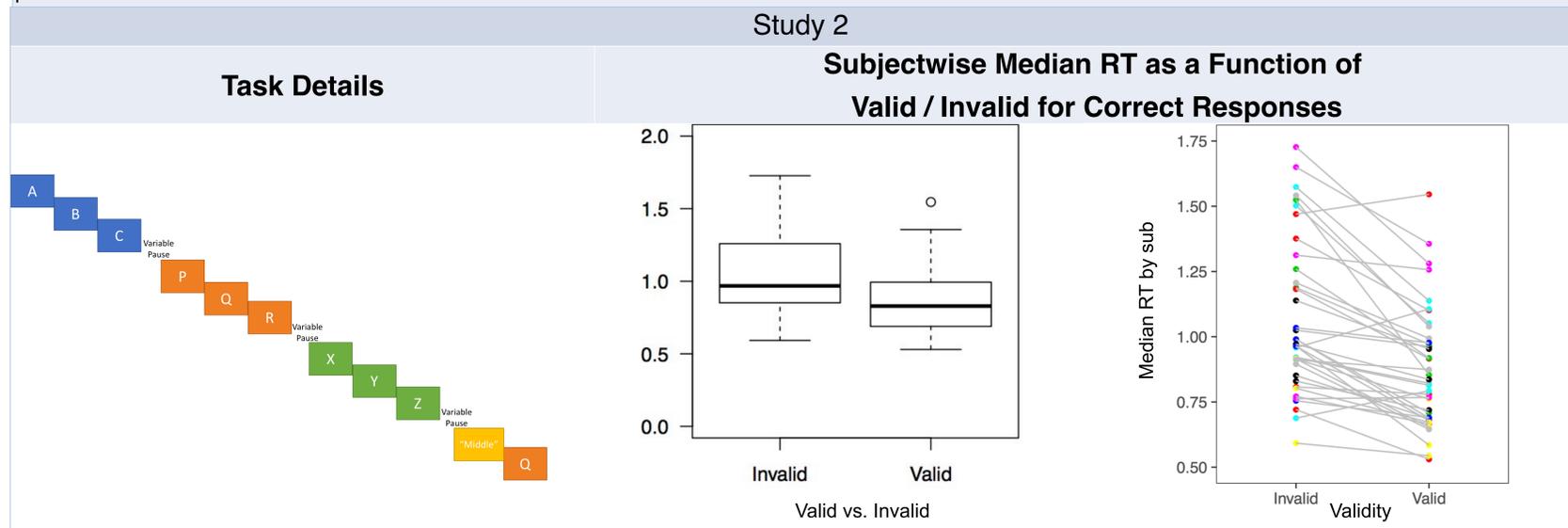
Opportunity

Prior work has shown that humans conceptualize time in a linear fashion (Boroditsky, Fuhrman, & McCormick, 2001). This fact is also evident in common phrases such as “arrow of time” and “looking forward to the future.” Here we present two complementary approaches to studying how this representation develops and how it can be accessed. In a developmental study, we investigated the conceptualization of time by asking preschoolers through adults to locate different temporal events visually. In a second study, using a cognitive task, we investigated how attention interacts with an internal temporal representation.

Results



By the age of eight, participants reliably represented events along a line, suggesting that humans perceive time as a line along the horizontal axis from past to future.



Participants responded faster when a subsequent test probe was from the attended vs. the unattended cluster (paired t-test: $t(34)=6.6, p<0.001$). This is analogous to the results obtained when attention is selectively deployed to a region in space.

Approach

Study 1

Participants: Preschoolers (N=23), 1st graders (N=27), 3rd graders (N=27), 5th graders (N=31), Adults (N=25)

Method:

- Participants were asked to locate time events (e.g. morning, afternoon and evening) on a square canvas.
- During a follow up interview, participants were asked to explain why they located the items a certain way.

Study 2

Participants: Adults (N=35)

Method:

- Participants were shown a series of images in three clusters of three images each. The clusters were separated by a variable amount of time.
- The list was followed by a temporal cue (early, middle, or late) and participants were instructed to direct their attention to the corresponding cluster.
- Participants were then presented with a test probe and were asked to indicate whether or not the image was in the cued cluster.

Impact

- Multimodal approaches:** A unique feature about this research is that it uses both developmental and cognitive approaches. Using these different frameworks, we found converging evidence for an internal representation of time.
- Space and time in the brain:** There is a large body of literature showing facilitation in performance on spatial tasks due to deployment of attention to a region in space. Study 2 shows similar performance facilitation for attention deployed in time. These results allude to similarities between how the brain processes spatial and temporal information.
- Understanding deficits in Alzheimer’s Disease:** This research approaches the question of how an internal representation develops and how it can be accessed. This work could potentially help us understand the link between spatial and temporal deficits in various neurological ailments (Baldelli, Boiardi, Fabbo, Pradelli & Neri, 2002).

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