

Fixated in Unfamiliar Territory: Mapping Estimates Across Typical & Atypical Number Lines

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Introduction

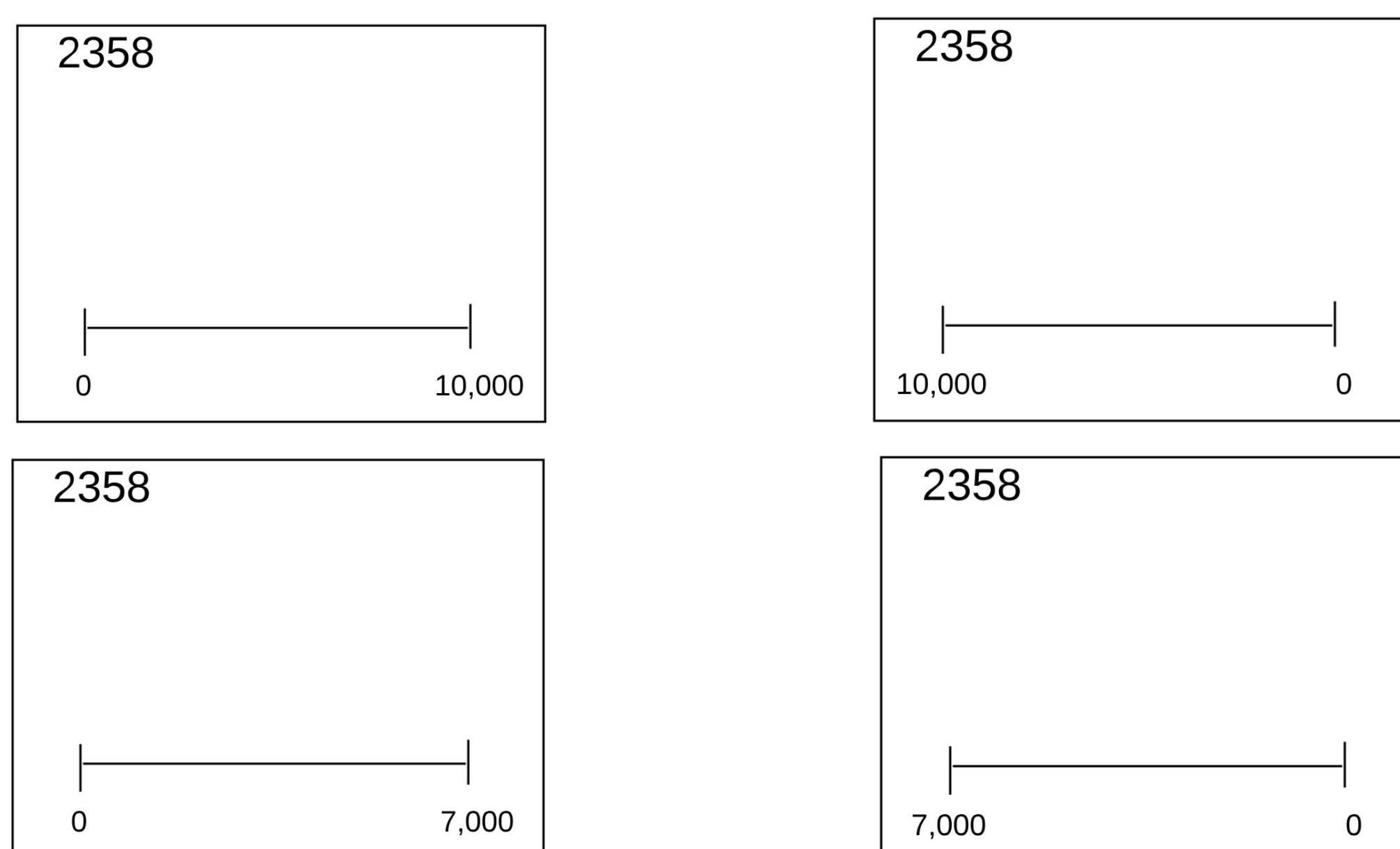
- When estimating on a number line, adults tend to make estimates that are evenly spaced across the number line and are best fit by a linear function.
- Adults tend to use the midpoint and endpoints as references to make their estimations.
- Accuracy patterns tend to reflect an “M” shape, with more accurate estimates being made around the reference points.
- Little is known about how estimation behaviour is affected by atypical number line ranges (e.g., 0 – 7,000) or by changing the direction of the number line (e.g., right to left).

Hypotheses:

1. Individuals presented with atypical number line (either range or direction) will make less accurate estimates than those presented with typical number line.
2. Individuals presented with atypical number line (either range or direction) will use different strategies of estimation than those presented with typical number line.

Method

- Participants ($n = 95$) estimated visually-presented target numbers by fixating on a number line
- Estimates were recorded using eye-tracking
- Participants were presented with one of four number lines: Typical (i.e., 0-10,000) or atypical range (i.e., 0-7,000) number line that was either in the typical (i.e., 0 left endpoint) or atypical direction (i.e., 0 right endpoint)



Results

Hypothesis 1: Accuracy

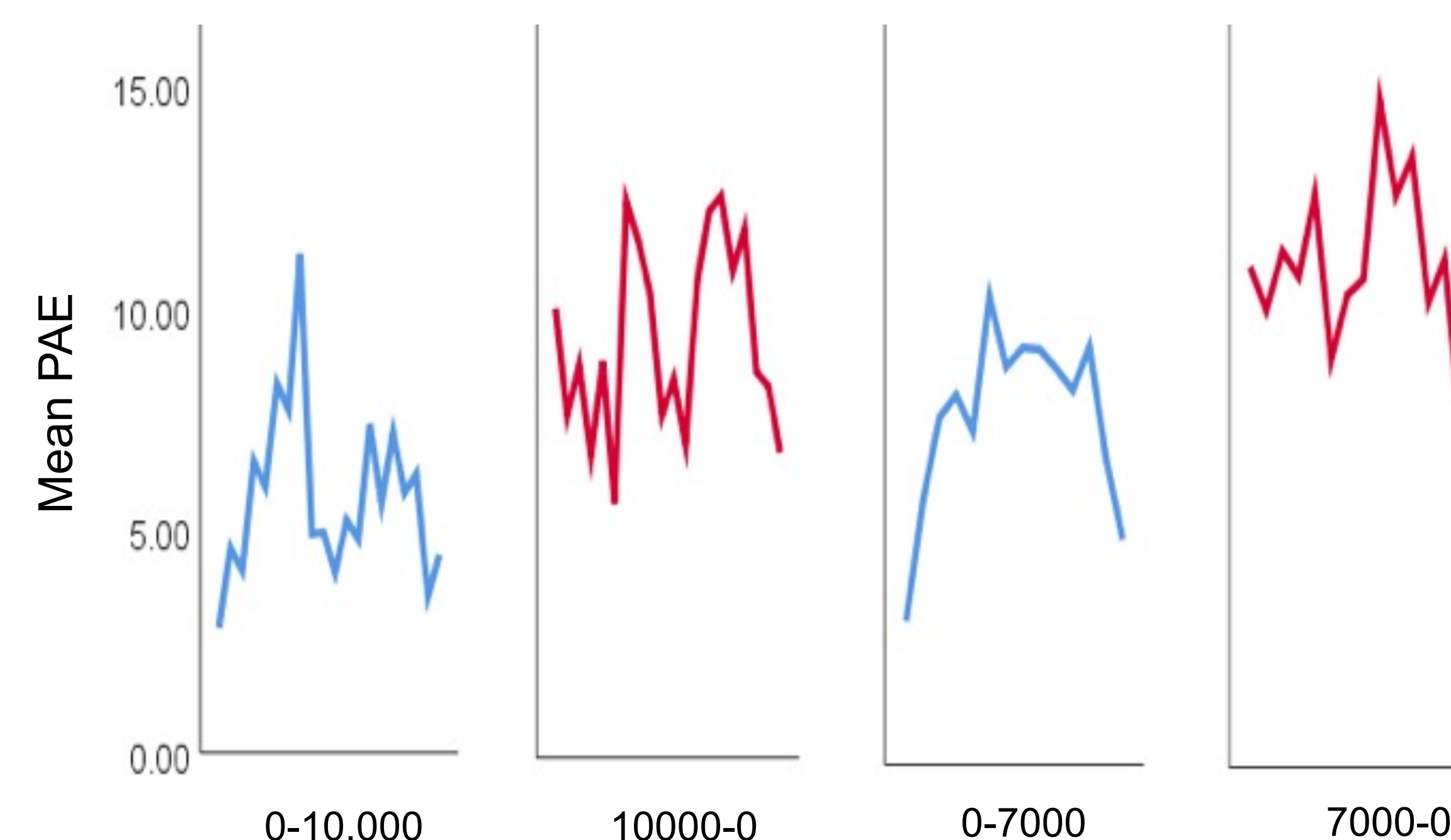


Figure 1. Percent Absolute Error (PAE) Across the Number Lines

- Participants made less accurate estimates for both the atypical range and direction conditions.
- More error for atypical direction than typical direction.
- Classic M pattern for 10,000 left; more error in left tail for 10,000 right; no M pattern for 7,000.

Hypothesis 2: Strategy Use as Reflected in Fixation Patterns

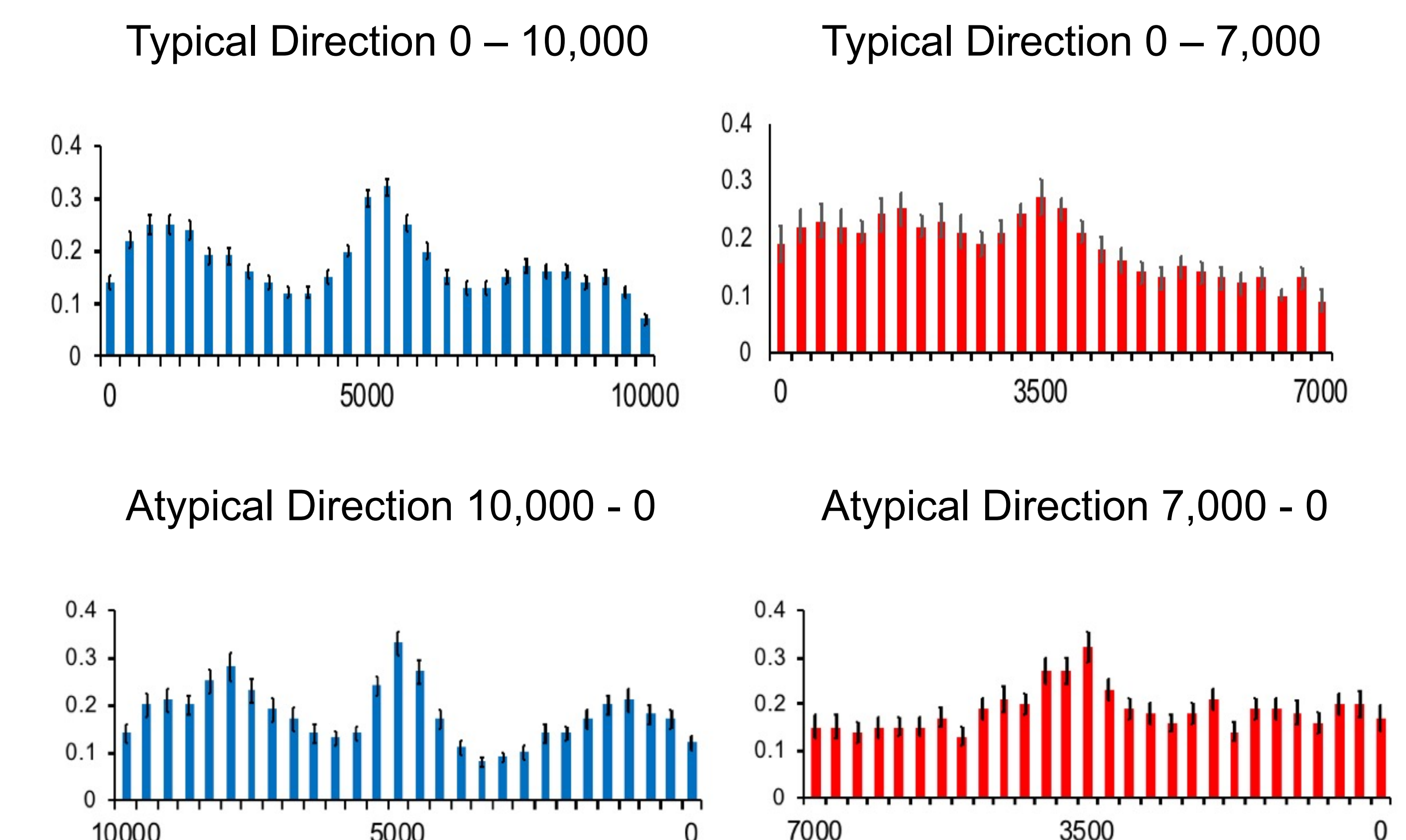


Figure 2. Average proportion of fixations

- Classic W shaped pattern for 10,000 condition
- Evidence for use of midpoint in all conditions
- For 7,000 condition, more uniform distribution of fixations

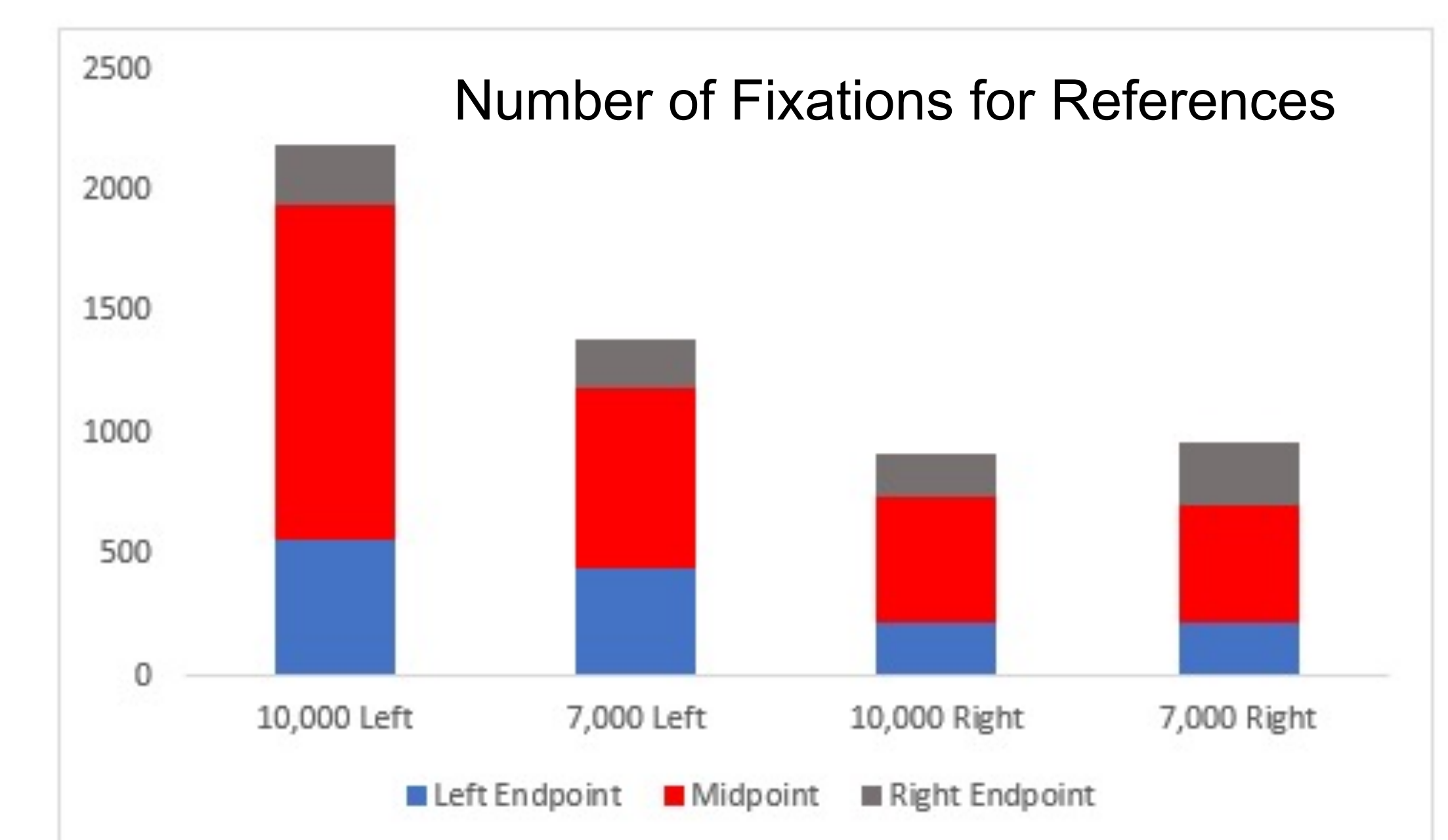


Figure 3. Number of fixations made in reference areas

- Reference points used most for typical number line
- Midpoint was most used reference for all conditions
- When presented with atypical number lines, individuals adjusted their strategies and made less use of reference points

Discussion

- Participants are less accurate when placing estimates on atypical than on typical number lines.
- Fixation patterns suggest that participants make more fixations at the midpoint and endpoints than in other regions on 10,000 range number line.
- For the 7,000 range number line, participants make more uniform fixations across the target numbers.
- Analyses of strategy suggest that strategy (i.e., using reference points) breaks down when estimating on an atypical number line.

Conclusions

- Collecting number line estimates using eye tracking generally resulted in similar patterns as standard methods but provided more detailed information about strategies and reference point usage.
- Both range and direction influenced accuracy, looking patterns, and amount of reference usage on number lines.