Effects of Urban and Rural Environments on Mental Rotation

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Background

- Perception and spatial cognition are influenced by environmental experiences.
- Urban and rural environments shape visual perception differently:
  - Rural individuals are more susceptible to perspective illusions.
  - Urban individuals are more affected by horizontal-vertical illusions (Hagen, 1977).
- Environmental context affects spatial processing and cognitive abilities across the lifespan (Hirst et al., 2022; Saenz et al., 2022).

Research Gap + Objective

- Limited research explores how environmental context influences mental rotation.
- This study investigates whether priming with urban vs. rural imagery affects reaction time and accuracy in 45° and 90° rotations.
- Hypothesis: Urban-primed participants will respond faster than rural-primed participants, but accuracy will not significantly differ between groups.

Methods

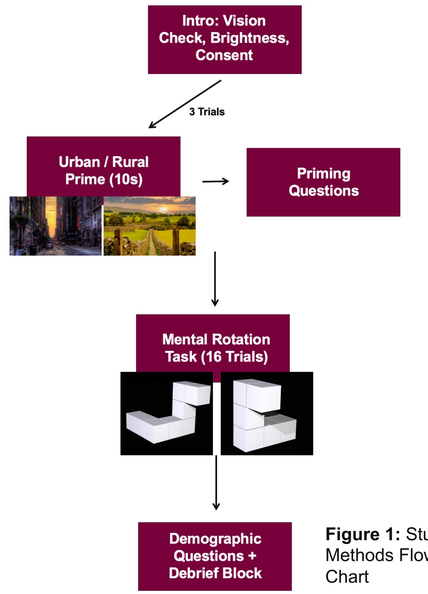

Figure 1: Study Methods Flow Chart

- 34 participants
- Participants were primed with images of either urban or rural environments.
- They completed a mental rotation task (judging if two rotated images were the same)
- Rotations tested at 45° and 90°.
- Reaction time (ms) and accuracy (%) recorded.

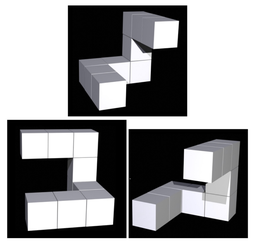

Figure 2: Mental Rotation Trial Example Top image is the reference image. Bottom left is the incorrect image rotation. Bottom right is the correct 45° rotation.

Results

- **Reaction Time:** Urban-primed participants responded significantly faster than rural-primed participants across both 45° and 90° angles.
- **Accuracy:** Significant differences in accuracy were found between Urban and Rural environments at both angles.
- **Rotation Angle Effect:**
  - No significant interaction between rotation angle and environment, but Urban participants showed higher accuracy and reaction time overall.

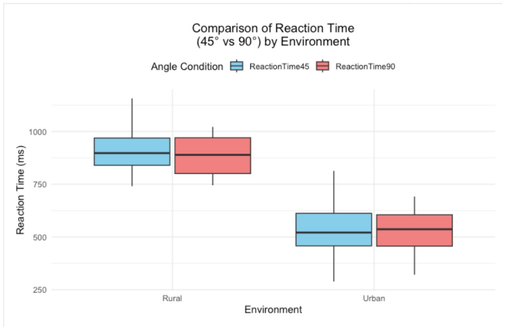

Figure 3: Reaction Time (45° vs 90°) by Environment: Boxplot with error bars showing reaction times for 45° and 90° rotations across environments. Urban-primed participants responded significantly faster.

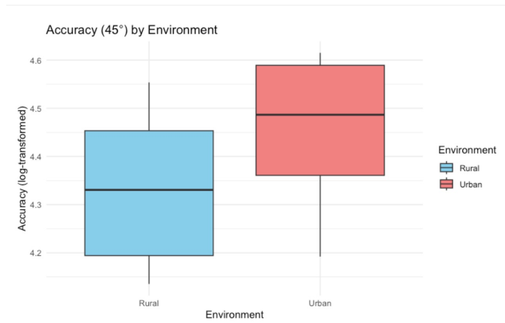

Figure 4: Accuracy (45°) by Environment: Boxplot with error bars illustrating significantly higher accuracy at 45° in the urban environment compared to the rural environment.

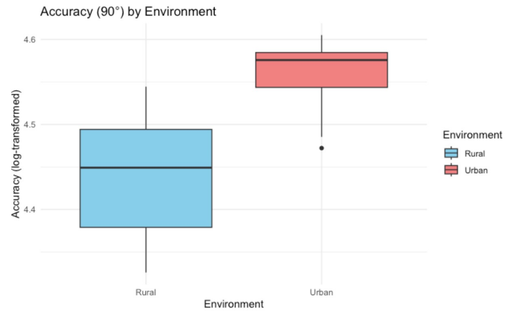

Figure 5: Accuracy (90°) by Environment: Boxplot with error bars demonstrating a highly significant accuracy difference at 90°, with urban-primed participants outperforming rural-primed participants

Conclusions

- Hypothesis supported: Urban-primed participants responded faster than rural-primed participants.
- Unexpected finding: Urban-primed participants also showed higher accuracy
  - Maybe due to urban environemnts being visually dense → need to recognize patterns and align objects correctly
- Environmental context affected performance regardless of rotation angle.
- Implications: Exposure to urban environments enhances spatial perception and cognition → can have implications on navigation and wayfinding

Limitations & Future Studies

- Developmental environment could have impacted study
- Priming strength: more immersive priming methods (e.g., VR simulations) could enhance effects.
- Exploring other spatial tasks such as navigation and depth perception.