The Impact of Geologic Coursework on Frame of Reference Thinking in Geologic and Non-Geologic Contexts

Bailey Zo Kreager and Dr. Nicole LaDue
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(Carlson-Radvansky and Irwin, 1993)¹ (Kastens and Ishikawa, 2006)² (Friederici and Levelt, 1990)³
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Example: The Fly is above the donkey

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Frame of reference in the geologic literature

- Navigation - map reading and GPS locating
- Seismology - used frames of reference for earthquake locations
- Plate motion
- Diagram interpretation

(Kastens and Ishikawa, 2006) (Groom, 2015)
Frame of reference in the geologic literature

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http://www.geo.mtu.edu/UPSeis/locating.html
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Frame of reference in the psychological literature

- People tend to use an environmental frame of reference\textsuperscript{1,2}

- Frame of reference can be manipulated by external factors\textsuperscript{2}

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Frame of reference in the psychological literature

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(Carson-Radvansky and Irwin, 1993)\(^1\) (Friederici and Levelt, 1990)\(^2\)
Hypotheses
H1: Expertise
That geologic training will impact the frame of reference geologists use when deciding where “above” is. Does expertise matter?
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H2: Context
Geologists will use an object frame of reference more often for both geologic and non-geologic content scenes. Does context matter?
Methods: Survey

• Survey dispersed at GSA 2017 at the Geocognit国资委 Lab booth.

• Two geologic scenes

• Two non-geologic scenes

• Demographics survey for geologic experience

Circle the object above the limestone layer.
Methods: Survey

• Survey dispersed at GSA 2017 at the Geocogniton Research Lab booth.

• Two geologic scenes

• Two non-geologic scenes

• Demographics survey for geologic experience

Circle the fly that is above the donkey.
Methods: Population

• Total of 116 participants

• Participants were scored using a modified Domain Experience scale.

• Scored on number of courses, highest degree completed, years of work experience.
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Typical Novice = undergraduate
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Typical Novice = undergraduate

Typical Intermediate = Graduate student or Early career
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Typical Novice = Undergraduate

Typical Intermediate = Graduate student or Early career

Typical Expert = Faculty or Later career
Results: Percent use of Object Centered

Carlson-Radvansky and Irwin

- Geologic Expert n=31
- Geologic Intermediate n=52
- Geologic Novice n=33
- Non-geologic
Results: Percent use of Object Centered

Expertise: Matters

Context: Did not matter

$X^2 (1)=0.254, \ p=0.614$
Results: Percent use of Object Centered

Expertise: Matters

Context: Matters

χ² (1)=20.422, p<0.001
**Results: Percent use of Object Centered**

![Bar chart showing percent use of object centered across different expertise levels.](chart)

- **Expert (n=31)**: 80% Geologic, 40% Non-geologic
- **Intermediate (n=52)**: 70% Geologic, 30% Non-geologic
- **Novice (n=33)**: 60% Geologic, 50% Non-geologic

**Expertise:** Matters

**Context:** Matters

\[X^2 (1) = 6.798, \ p = 0.009\]
Does Expertise Matter? H1

• Yes, overall, more participants and more responses reflect an object frame of reference than would be expected for a general audience.

• Manipulation of physical space can change the frame of reference an individual uses. So external factors (geologic training) can impact frame of reference thinking.

• Geologists separate out scenes naturally into distinct parts and focus on how the individual parts fit together.

• Geologic training teaches distinct tops and bottoms of layers, no matter the orientation.

Friederici and Levelt (1990)
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Friederici and Levelt (1990)
Does context matter? H2

Novices

• No significant difference

Intermediates

• Closer to instruction

Experts

• Less specified in experience
Does context matter? H2

Novices  

- Statistically significant difference
  - $p < 0.000$ (intermediates)
  - $p = 0.009$ (experts)

Intermediates  

Experts  

- Longer time since explicate instruction
- More specialized in geology
Implications

• That geologic training at any level impacts frame of reference thinking

• Context didn’t matter for novice geologists

• Context was important for Intermediates and experts

• Overall use of an object frame of reference higher than expected based on literature
Future Work

• Is this a product of Geologic training or STEM fields as a whole

• Does this relate to other spatial skills used by geologists

• Could this be a spatial predictor of geologic expertise.
Enjoy this study?
Apply for a Post-Doctoral Fellowship or Graduate Student Assistantship with the NIU Visualization & Geoscience Education Research Lab. Funding is currently available. Contact Nicole LaDue for more information.