How Students Describe and Interpret Different Spatiotemporal Data Visualizations

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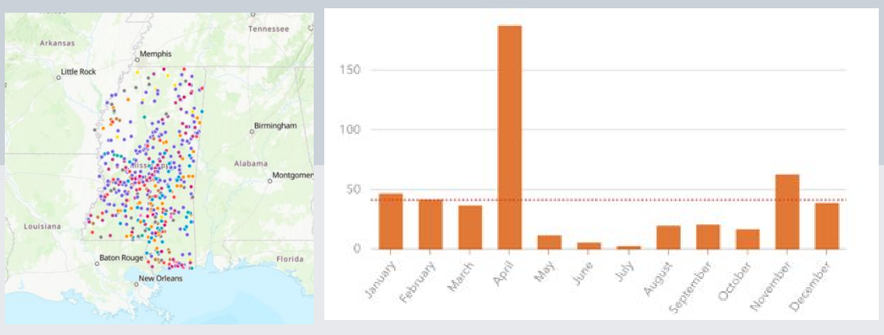
Introduction

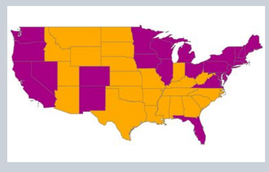
- Spatiotemporal (ST) visualizations illustrate data across many disciplines, so it is important for students to learn to interpret ST data (NASEM, 2018; Yang et al., 2020).
- The form of spatial representations (Shipley et al., 2013) and type of temporal data (Shipley & Zacks, 2008) affect students' thinking.
- Students often struggle to integrate spatial *and* temporal data (Myer et al., 2018).
- We asked how students' use of spatial and temporal language varies when interpreting different types of ST visualizations and across different levels of context.

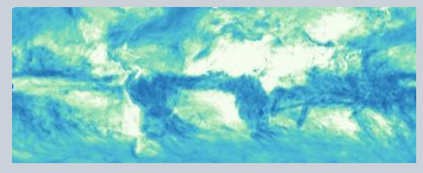
Methods

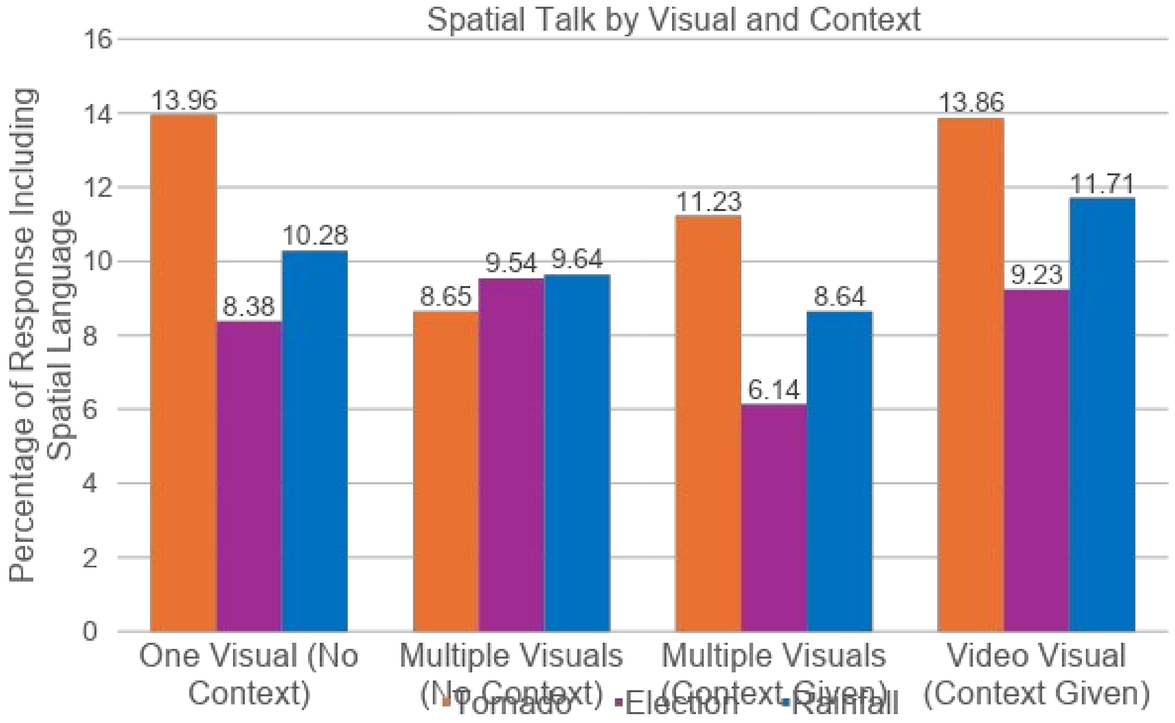
- Eighteen high school students met with a researcher on Zoom.
  - Gender: 66% female, 33% male
  - Ethnicity: 37% white, 21% Asian, 11% black, 11% Latine, 20% Multi-racial
- Students were shown three types of ST data visualizations (see below) and asked to describe what they noticed and what patterns they observed.
- Throughout the procedure, students were provided different levels of context:
  1. One Visual (No Context)
  2. Multiple Visuals (No Context)
  3. Multiple Visuals (Context Given)
  4. Video Visual (Context Given)
- Using Linguistic Inquiry and Word Count (LIWC; Pennebaker et al., 2001) software, we analyzed the percentage of words in students' responses that were spatial (e.g., across, backward) and temporal (e.g., before, changing).

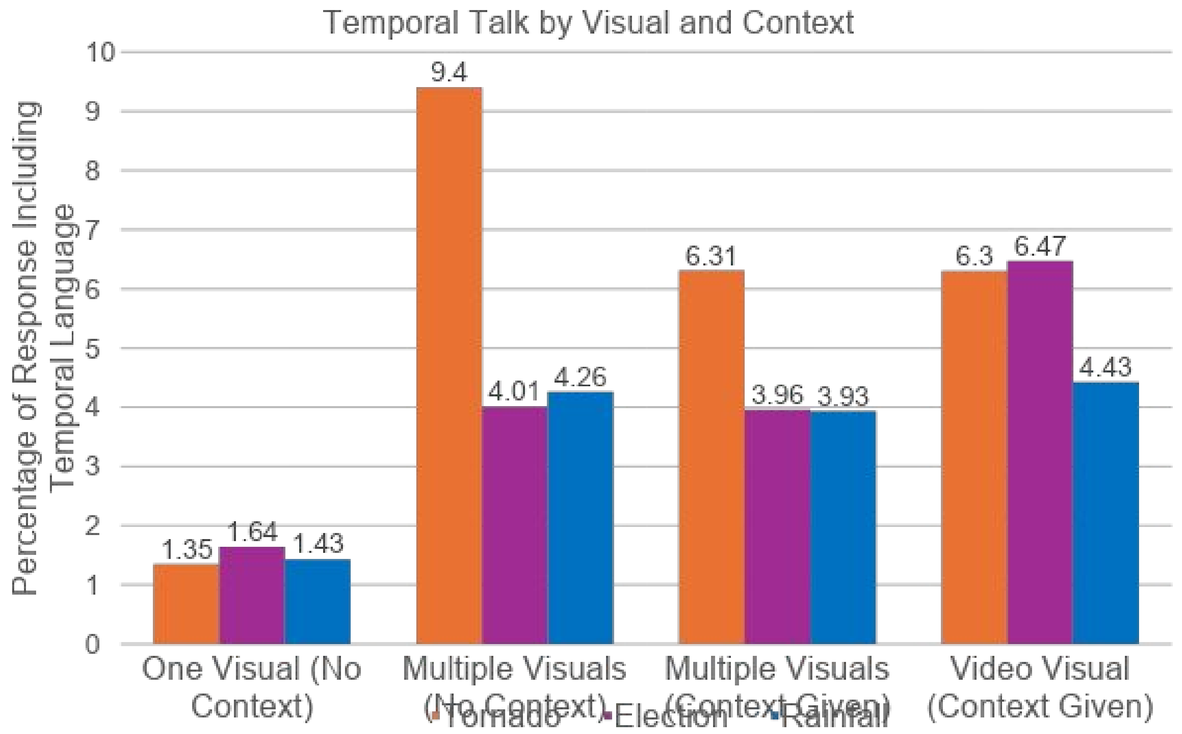
Tornado Point Data	Election Thematic Data	Rainfall Raster Data











Results

	F	*p*	*F*	*p*
	Spatial Talk by Context		**Temporal Talk by Context**	
Tornado Point	5.65	.003	30.54	<.001
Election Thematic	4.48	.007	10.88	<.001
Rainfall Raster	1.84	.156	2.71	.058
	Spatial Talk by Visualization Type		**Temporal Talk by Visualization Type**	
One Visual-No Context	13.66	<.001	0.47	.631
Multiple-No Context	0.06	.941	35.32	<.001
Multiple-Context Given	6.98	.003	1.70	.202
Video Visual-Context Given	11.38	<.001	1.67	.209

Discussion

- For the election and rainfall data, videos promoted temporal thinking.
- The most spatial talk occurred for the tornado point data, followed by the rainfall raster data.
- For the tornado data, the most temporal language occurred for the bar chart. Providing a variety of visuals may support students' understandings of ST information.
- To better inform educational practice, additional analyses will examine students' strategies and challenges when analyzing ST data.

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