UNIVERSITY OF GEORGIA

Understanding the Implications of Categorical vs. Continuous Graphical Depictions of Risk:

Different Colors, Risk Conditions, and Risk Boundaries

Presented by:

Jada Lamar, University of Georgia
jada.lamar@uga.edu

Coauthors:

Dr. Andrew Grundstein, University of Georgia
Dr. Castle Williamsberg, NOAA Affiliate

Background



SPC has issued the convective outlook since the 1950s.

Introduced categorical names: “High Risk,” “Moderate Risk,” and “Slight Risk” after 1974. Later, “Enhanced Slight” and “Marginal” were added for better distinction, along with corresponding “risk colors.”



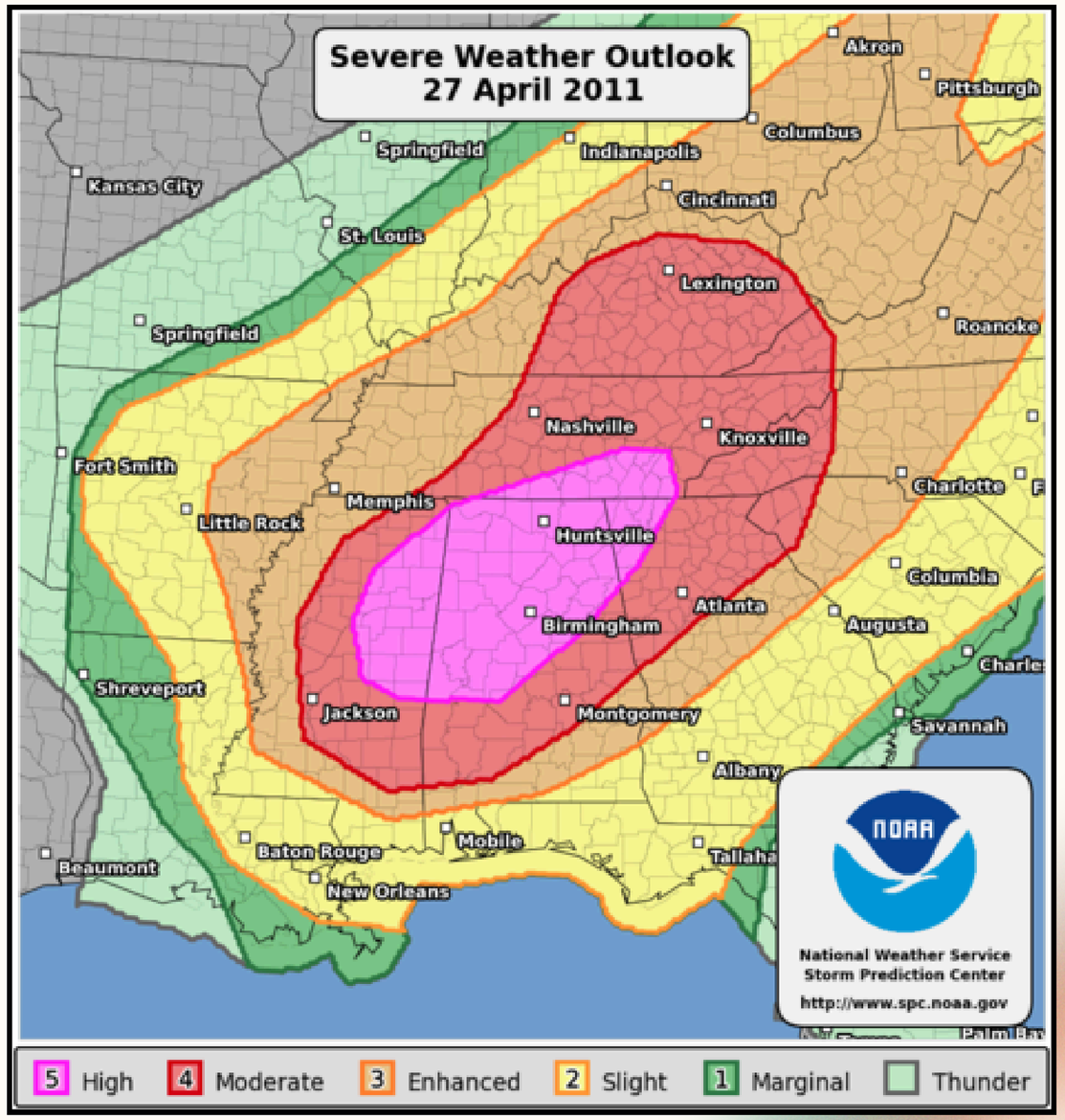
Recent studies highlight challenges for interpreting SPC’s categorical scales.

Research has shown that the public often misclassifies risk categories and colors, introducing more vulnerability for at-risk communities.



Introducing outlook with continuous and non-discrete boundaries.

The SPC has proposed transitioning to a convective outlook with non-discrete boundaries, which capture the nuanced progression of risks.



https://www.weather.gov/news/141021-spc-outlook-story

Research Question

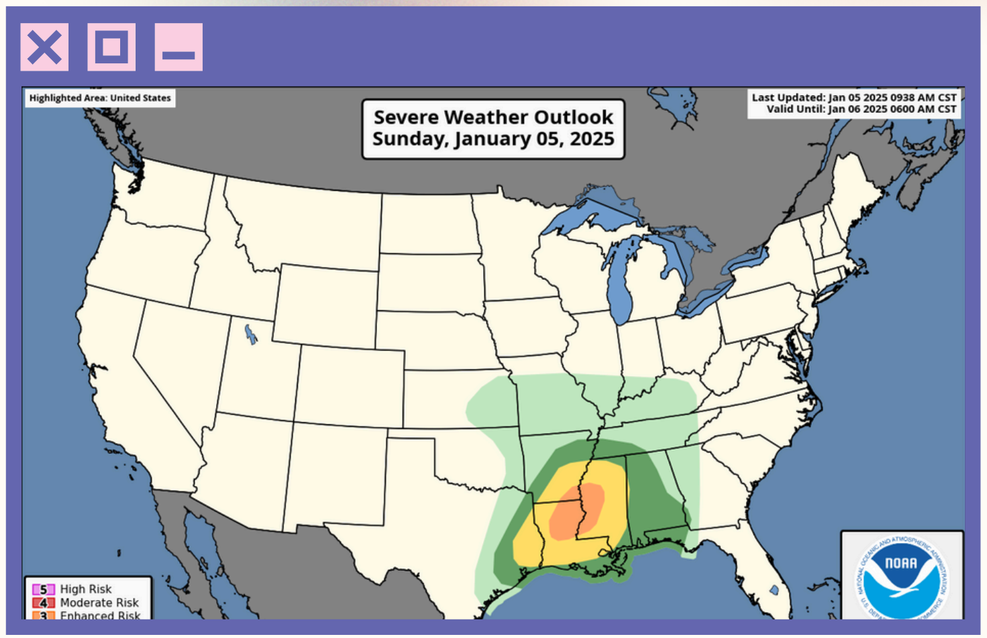
How does changing to a continuous depiction of risk (e.g., removing the distinct boundaries between risk areas) change or affect the public's risk perception, uncertainty, and behavioral intentions?

Methodology

- A survey on severe weather graphics and messaging was deployed to a representative sample of the U.S. public (n=696).

- The forecast graphic(s) provided were manipulated by **boundary type** (continuous vs categorical), **risk gap** (-1, 0, +1), and **color** (SPC color scheme, light color scheme, and Weather Channel color scheme).

Current Severe Weather Convective Outlook used by SPC

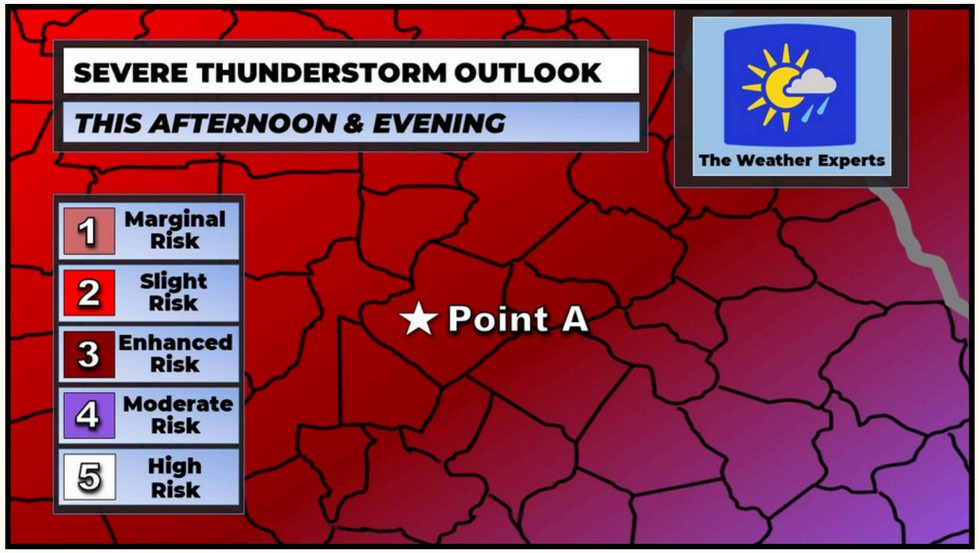


https://www.spc.noaa.gov/partners/outlooks/

Experimental Design

FORECAST SCENARIO: Imagine you are home on a Saturday morning in August. You learn that meteorologists are forecasting severe thunderstorms for your area this afternoon. You decide to search for information about the severe thunderstorm threat and come across a single forecast graphic (the graphic will appear below).

[INSTRUCTION]: Please take a look at the severe thunderstorm forecast graphic below. Keep in mind that your home is located at point A.

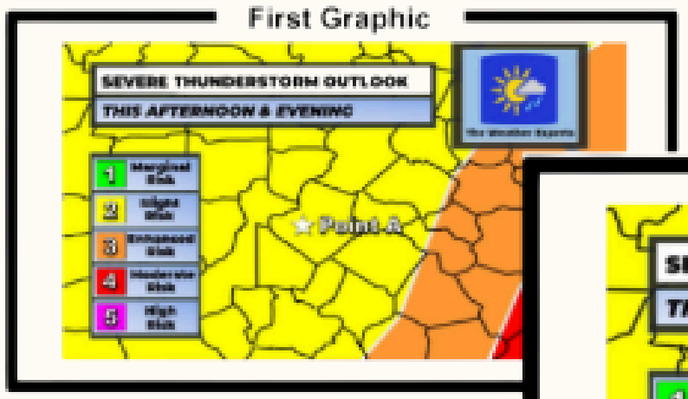


Participants were asked a series of questions following this prompt and were instructed to respond on a Likert scale from 1 to 7 (low to high)

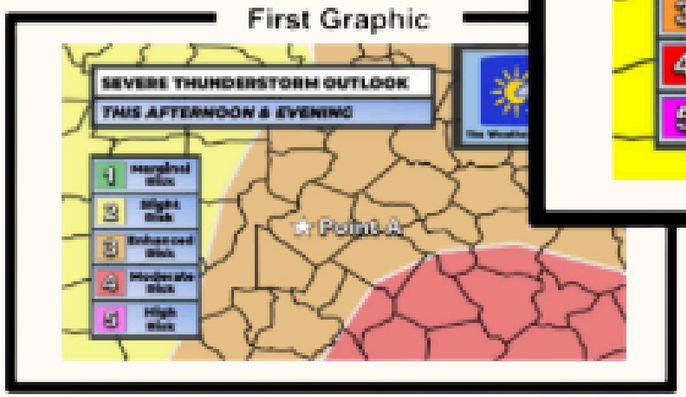
- Perceived susceptibility
- Perceived severity
- Information Seeking
- Intentions to Change Plans
- Intentions to Prepare Home

Experimental Conditions

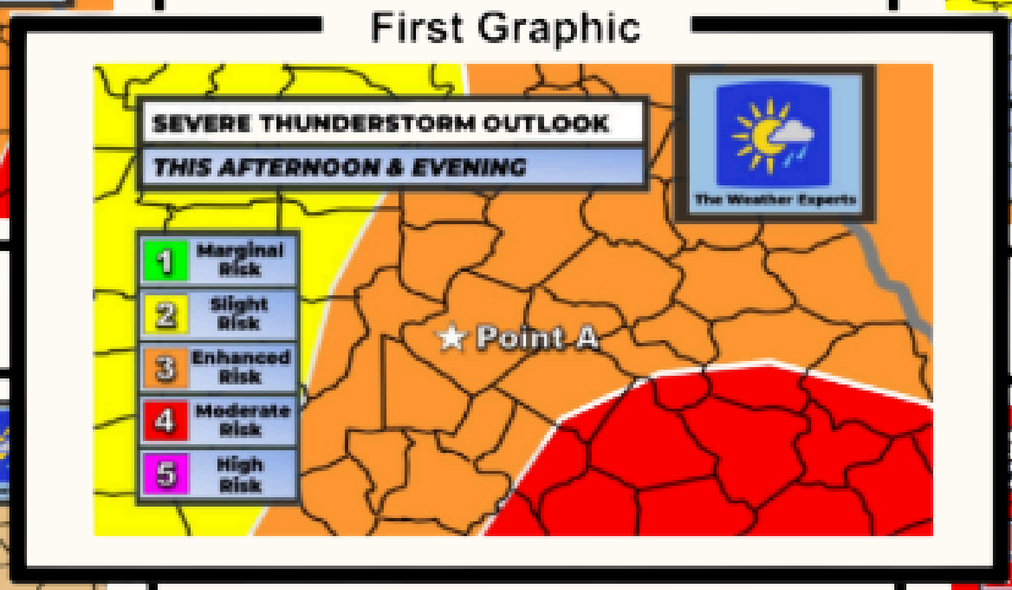
Risk Gap -1



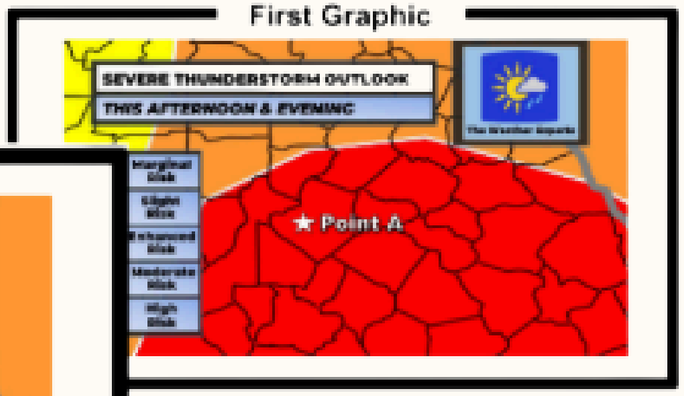
Light Colors



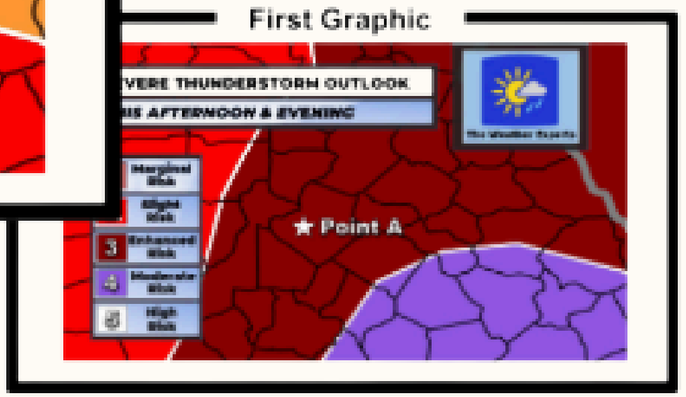
Risk Gap 0 & SPC Colors (Control)



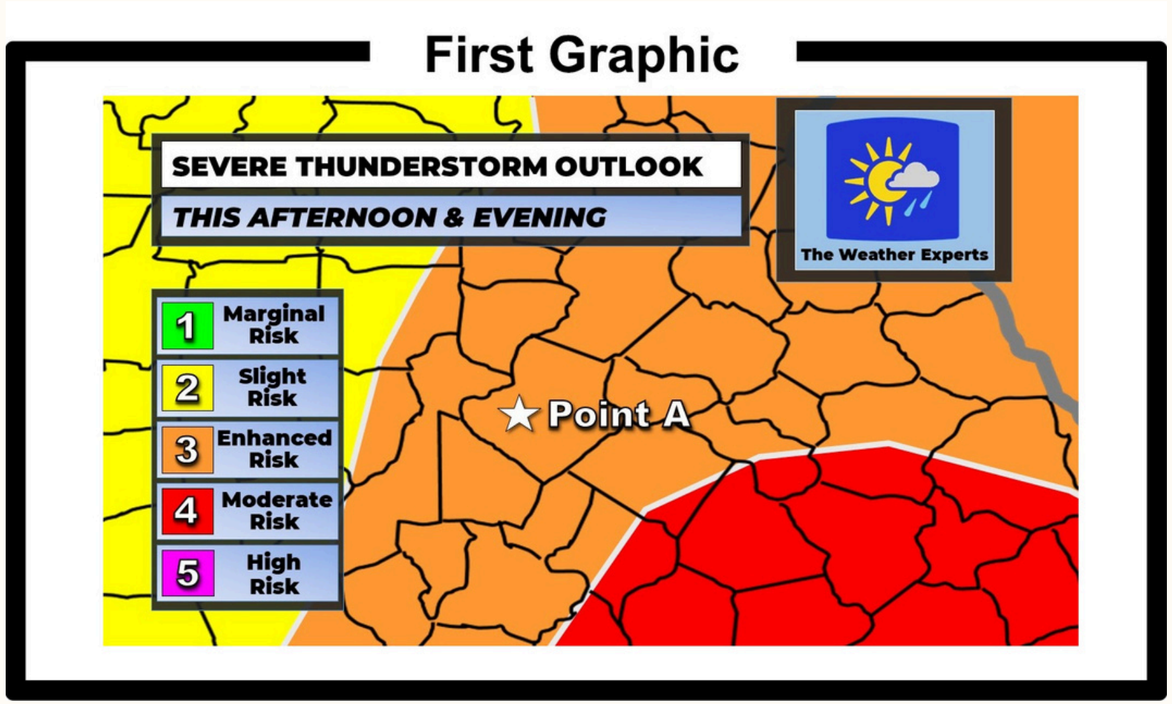
Risk Gap 1



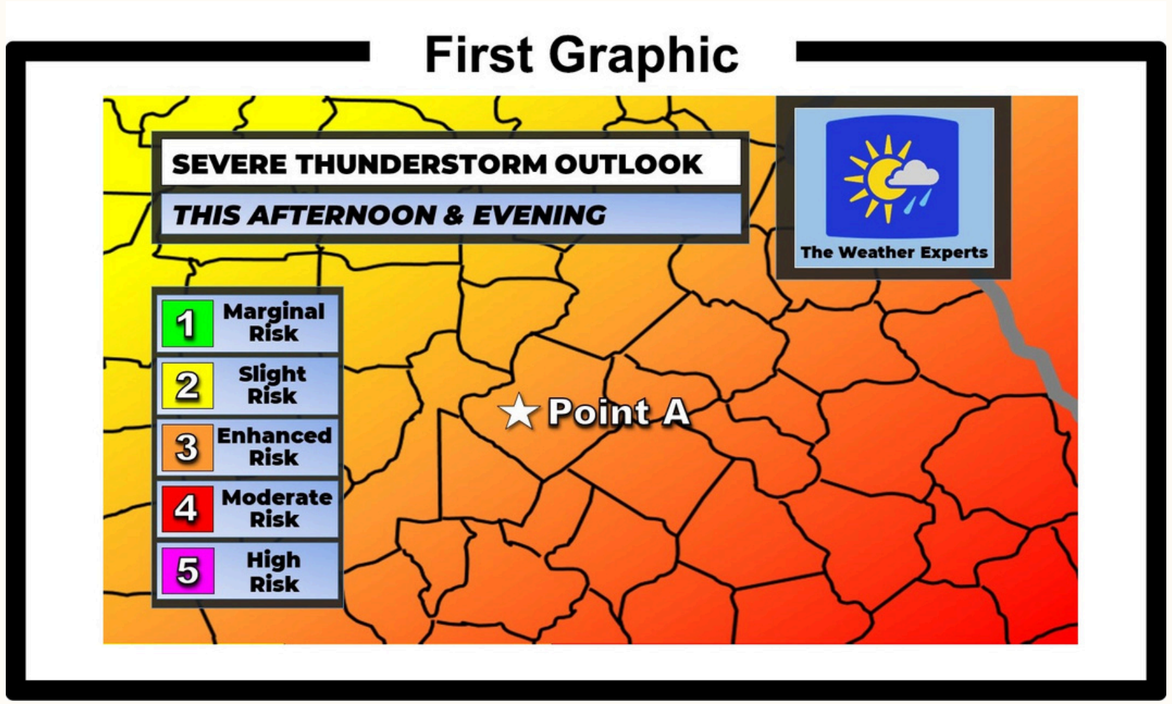
Weather Channel Colors



Categorical vs. Continuous Forecast Graphics



CATEGORICAL



CONTINUOUS

Results

Risk -1					
Graphic Type (Mean)	Susceptibilty	Severity	Info Seeking	Change Plans	Prepare home
Categorical	3.36	3.03	4.45	3.15	3.45
Continuous	3.41	3.06	4.47	3.42	3.76

Color -1 (Lighter)					
	Susceptibilty	Severity	Info Seeking	Change Plans	Prepare home
Cat	4.87	4.51	4.99	4.41	4.86
Cont	4.88	4.22	5.16	4.54	4.53

Risk (Control)					
	Susceptibilty	Severity	Info Seeking	Change Plans	Prepare home
Cat	5.02	4.75	5.35	4.72	4.9
Cont	5	4.57	5.4	4.86	5.05

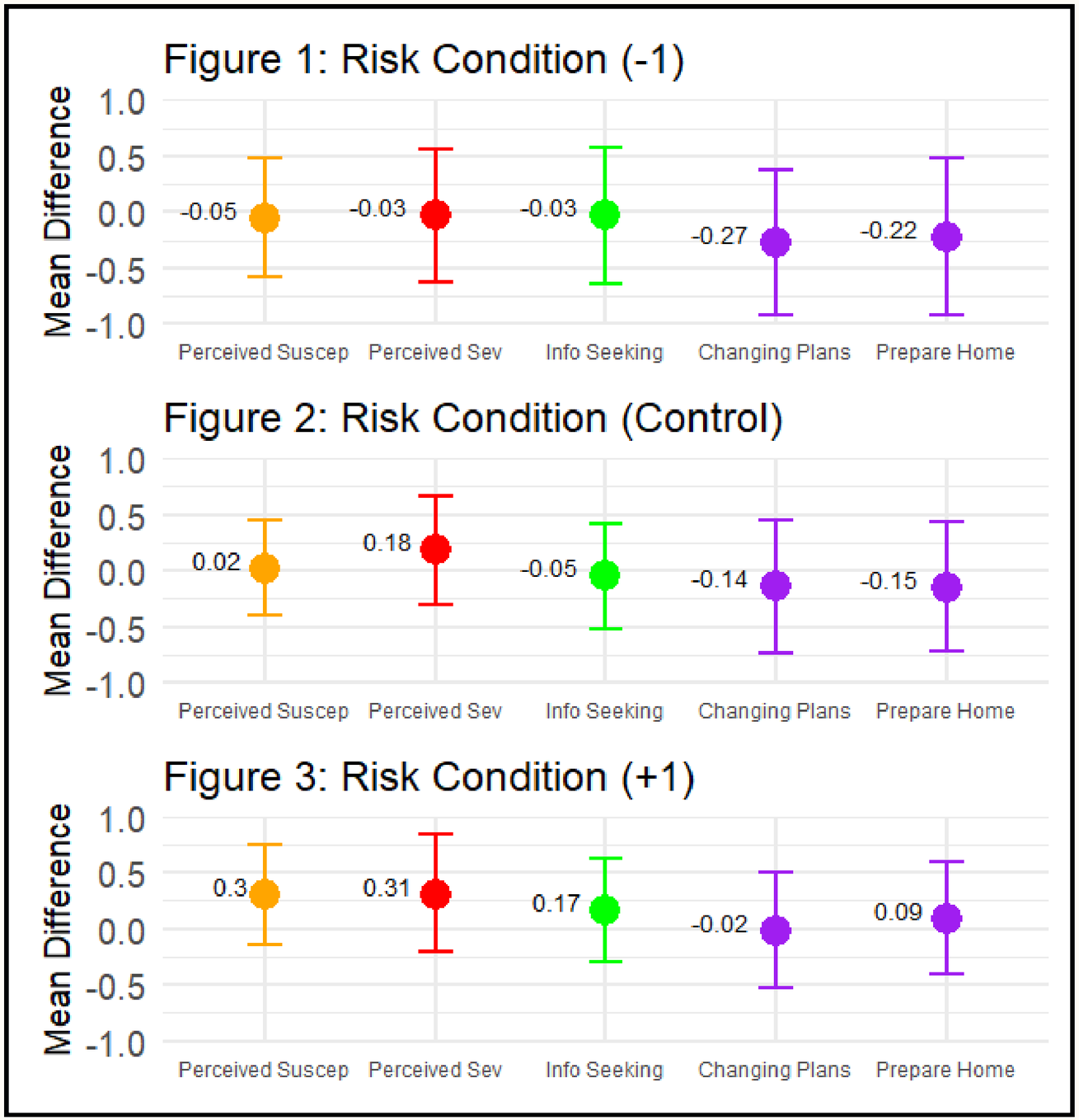
Color (Control/SPC)					
	Susceptibilty	Severity	Info Seeking	Change Plans	Prepare home
Cat	5.02	4.75	5.35	4.72	4.9
Cont	5	4.57	5.4	4.86	5.05

Risk +1					
	Susceptibilty	Severity	Info Seeking	Change Plans	Prepare home
Cat	5.9	5.56	5.94	5.45	5.71
Cont	5.6	5.25	5.76	5.47	5.62

Color +1 (Wx Channel)					
	Susceptibilty	Severity	Info Seeking	Change Plans	Prepare home
Cat	5.25	4.76	5.57	4.76	4.96
Cont	4.95	4.54	5.28	4.59	4.87

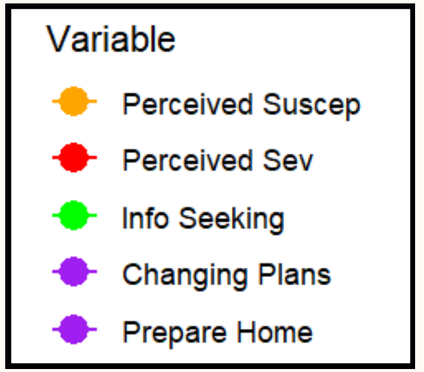
These are the mean responses to survey questions.

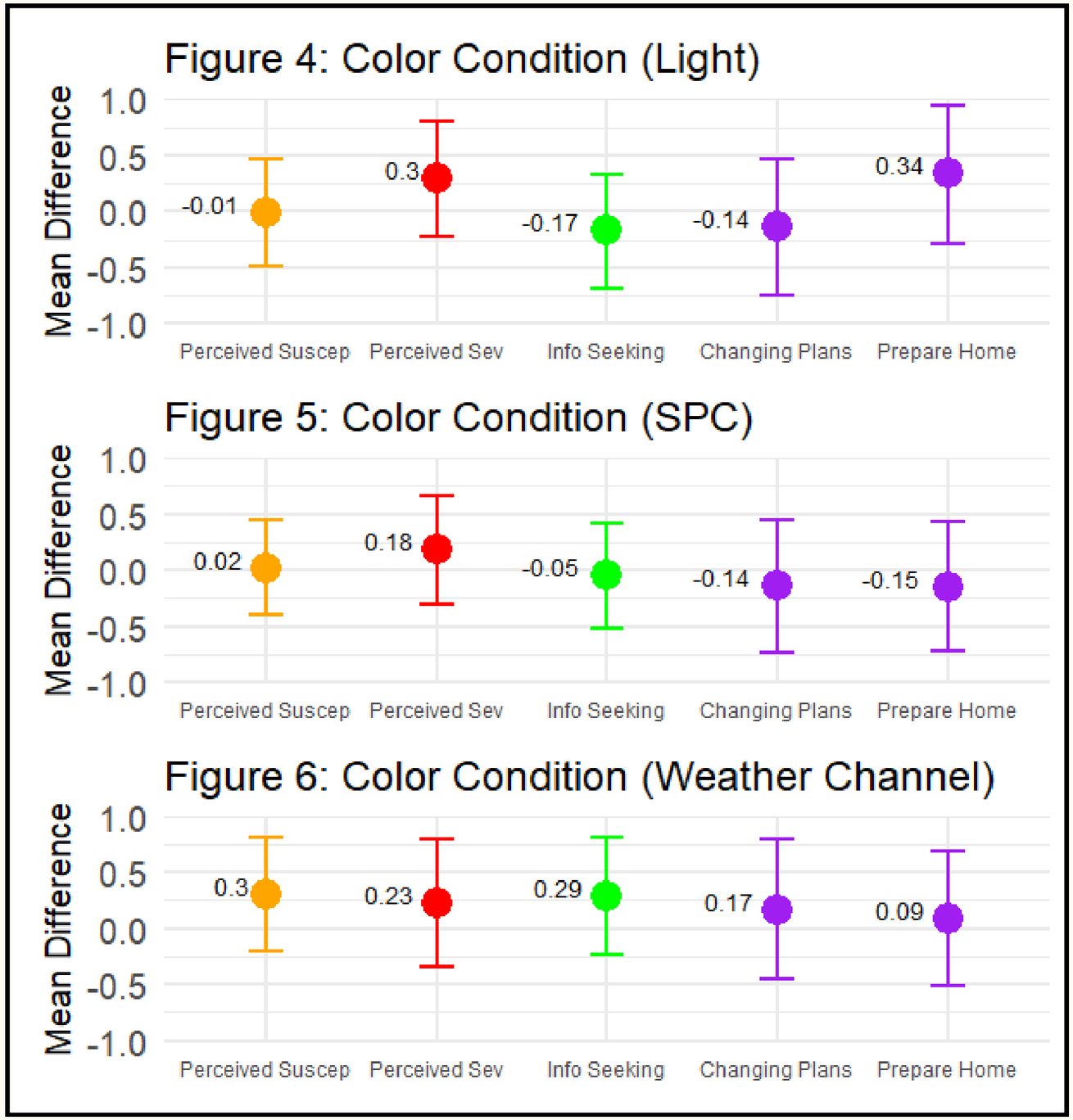
Likert Scale: 1 = Lowest, 7 = Highest



Results: *Risk Condition*

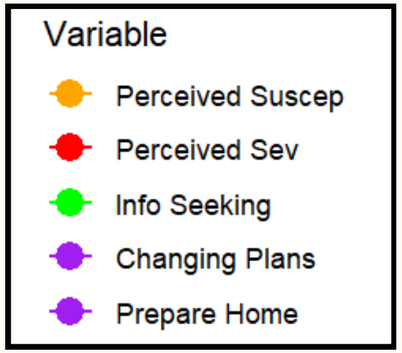
There is **no significant difference among boundary types** in risk perception, uncertainty, or behavioral response at different risk levels.





Results: *Color Condition*

There is **no significant difference among boundary types** in risk perception, uncertainty, or behavioral response with different color palettes.



Major Takeaways

- The results suggest that participants' responses to forecasts—measured through perceived susceptibility, perceived severity, information-seeking intentions, and behavioral intentions—**are similar whether the forecasts use continuous boundaries or categorical boundaries**.

- These findings were consistent even with different risk levels and color palettes.

Limitations & Future Works

Hypothetical forecasts provide limited insight.

- Future studies should consider conducting a similar study utilizing real-world graphics and sources from a past event OR measuring the variables during a real-time weather event.

Indirect comparison of categorical and continuous forecasts.

- We suggest conducting a study to measure message consistency when provided with a categorical forecast and a continuous forecast simultaneously, to closely examine how perceptual variables change between both graphics.

Limitations & Future Works

<u>Next Step</u>: Use a repeated-measures experimental design to examine message consistency.

- In practice, individuals often rely on various forecasts to comprehend and evaluate their risk during severe weather events.
- Moving forward, we aim to evaluate the consistency of message responses after presenting a second forecast that alters the risk or color of the initial one.

References

- Williamsberg, Castle et al. (2023). Implications of Inconsistent Visual Displays on End User Risk Perception, Uncertainty, and Behavioral Intentions. https://doi.org/10.25923/8vg7-4f28

- NWS (2013). Changes to Storm Prediction Center Outlooks Effective Today. https://www.weather.gov/news/141021-spc-outlook-story

- SPC (2025). Severe Weather Outlook: January 05, 2025. https://www.spc.noaa.gov/partners/outlooks/

Q&A Session

Thank you for listening!

Collaborators: Dr. Russell Schneider, Dr. Patrick Marsh, Bill Bunting, and Greg Schoor (SPC)

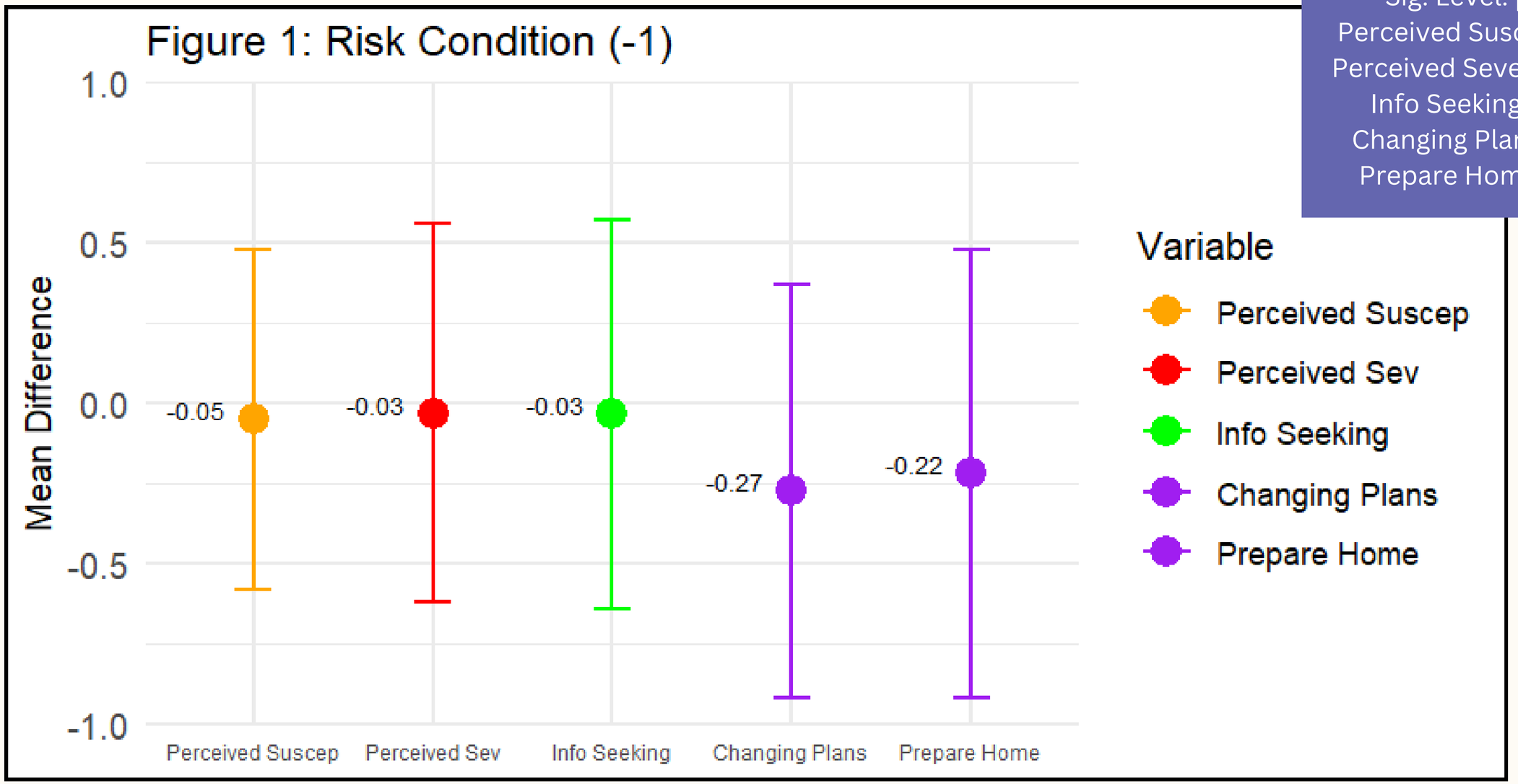
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Contact Me
Email: jada.lamar@uga.edu
Twitter/X: @jadalamarwx
LinkedIn: www.linkedin.com/in/jada-lamar

SCAN ME

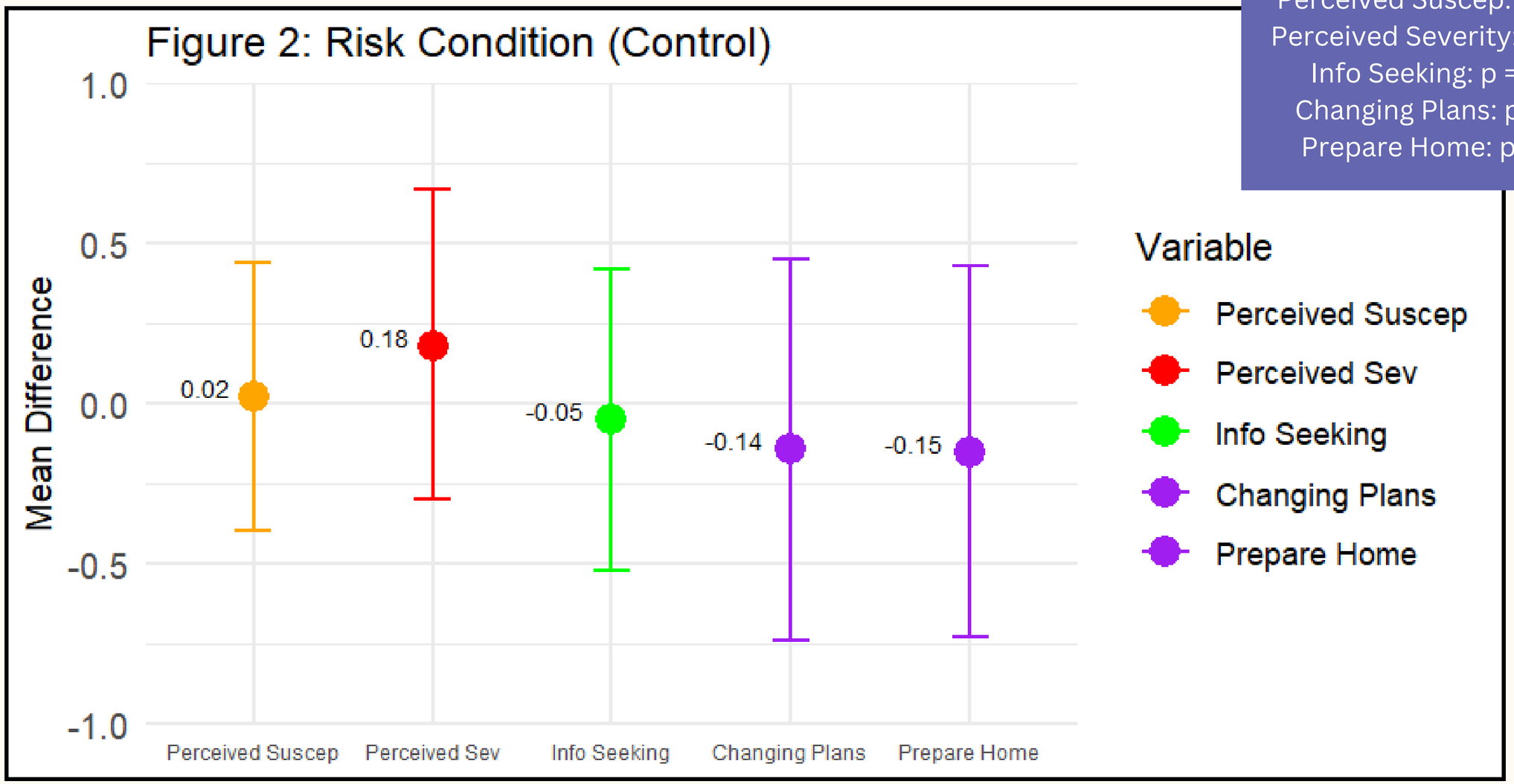
Results: Risk Condition (-1) – Decreased Risk

Sig. Level: p = 0.05
Perceived Suscep: p = 0.54
Perceived Severity: p = 0.97
Info Seeking: p = 0.57
Changing Plans: p = 0.99
Prepare Home: p = 0.52



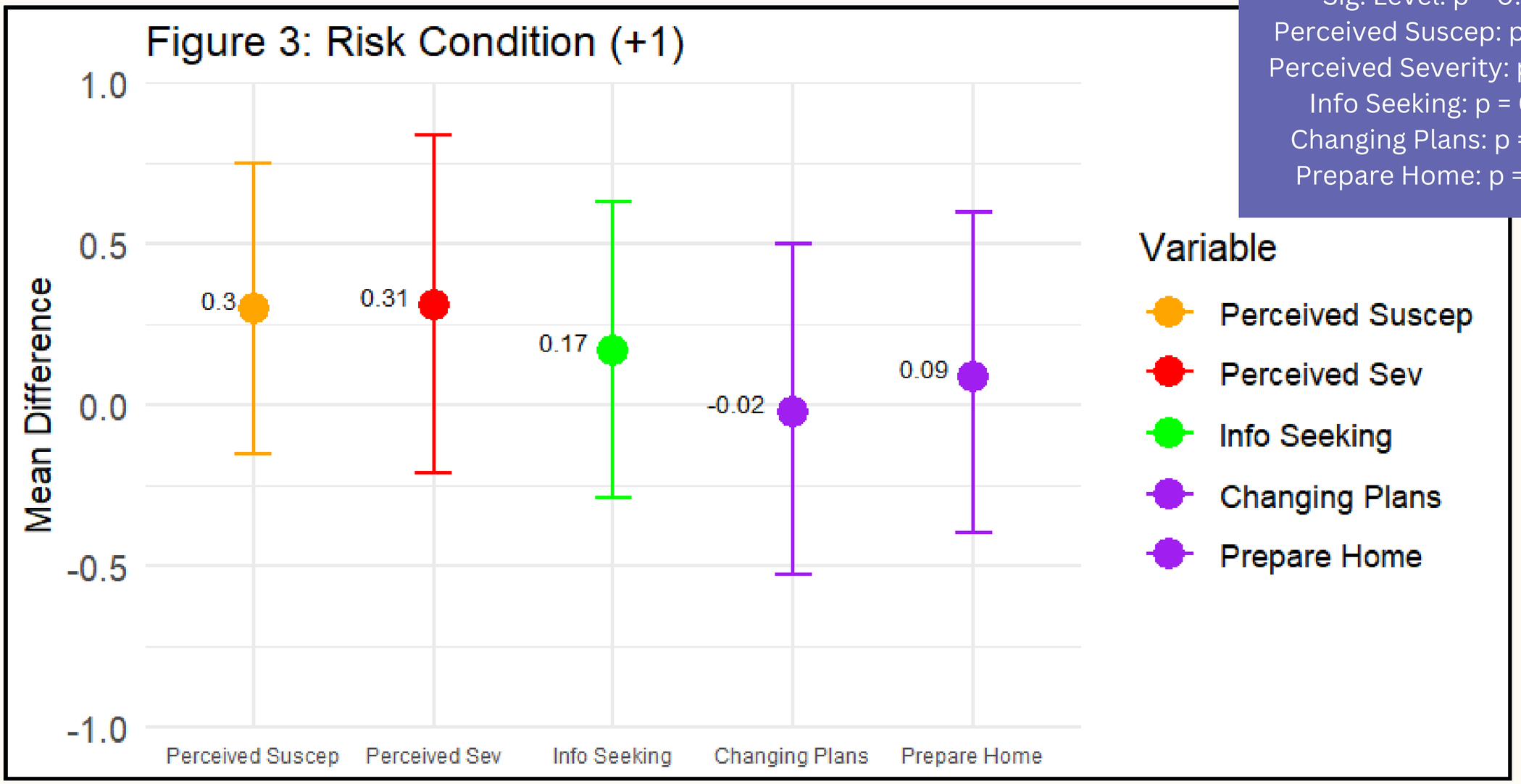
Results: Risk Condition (Control)

Sig. Level: p = 0.05
Perceived Suscep: p = 0.03
Perceived Severity: p = 0.89
Info Seeking: p = 0.92
Changing Plans: p = 0.18
Prepare Home: p = 0.57



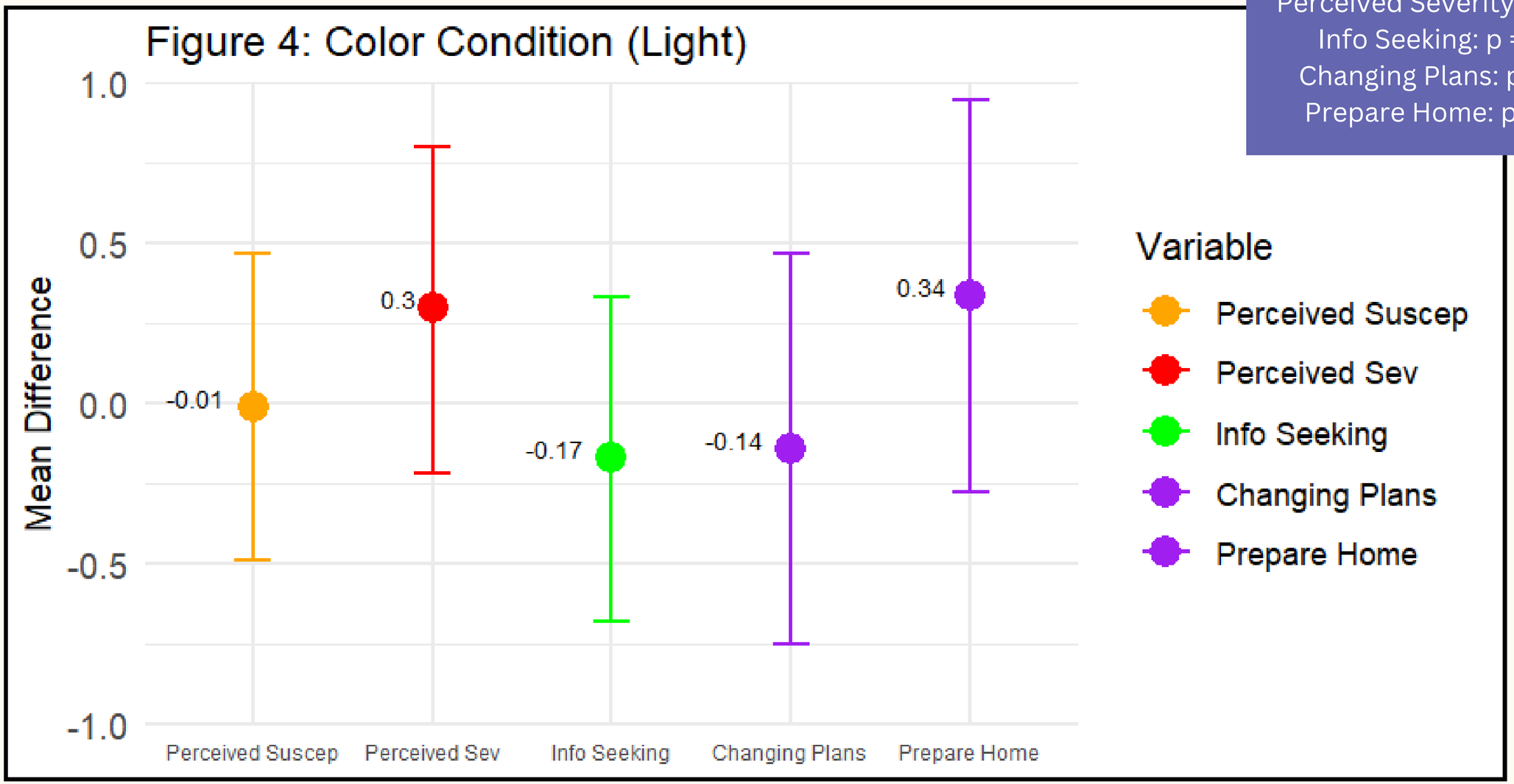
Results: Risk Condition (+1) – Increased Risk

Sig. Level: p = 0.05
Perceived Suscep: p = 0.30
Perceived Severity: p = 0.38
Info Seeking: p = 0.48
Changing Plans: p = 0.26
Prepare Home: p = 0.63



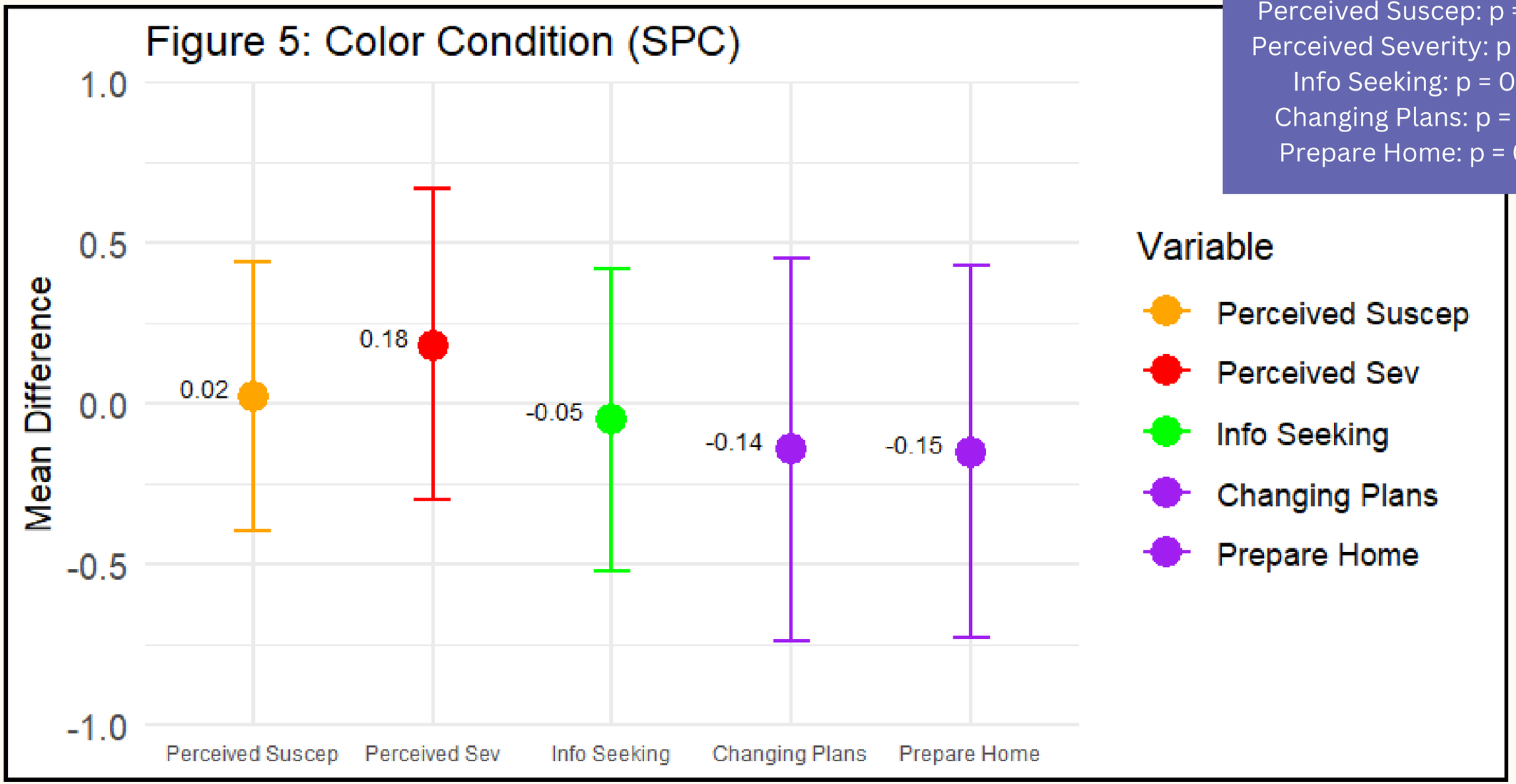
Results: Color Condition (-1) - Light

Sig. Level: p = 0.05
Perceived Suscep: p = 0.88
Perceived Severity: p = 0.91
Info Seeking: p = 0.36
Changing Plans: p = 0.38
Prepare Home: p = 0.24



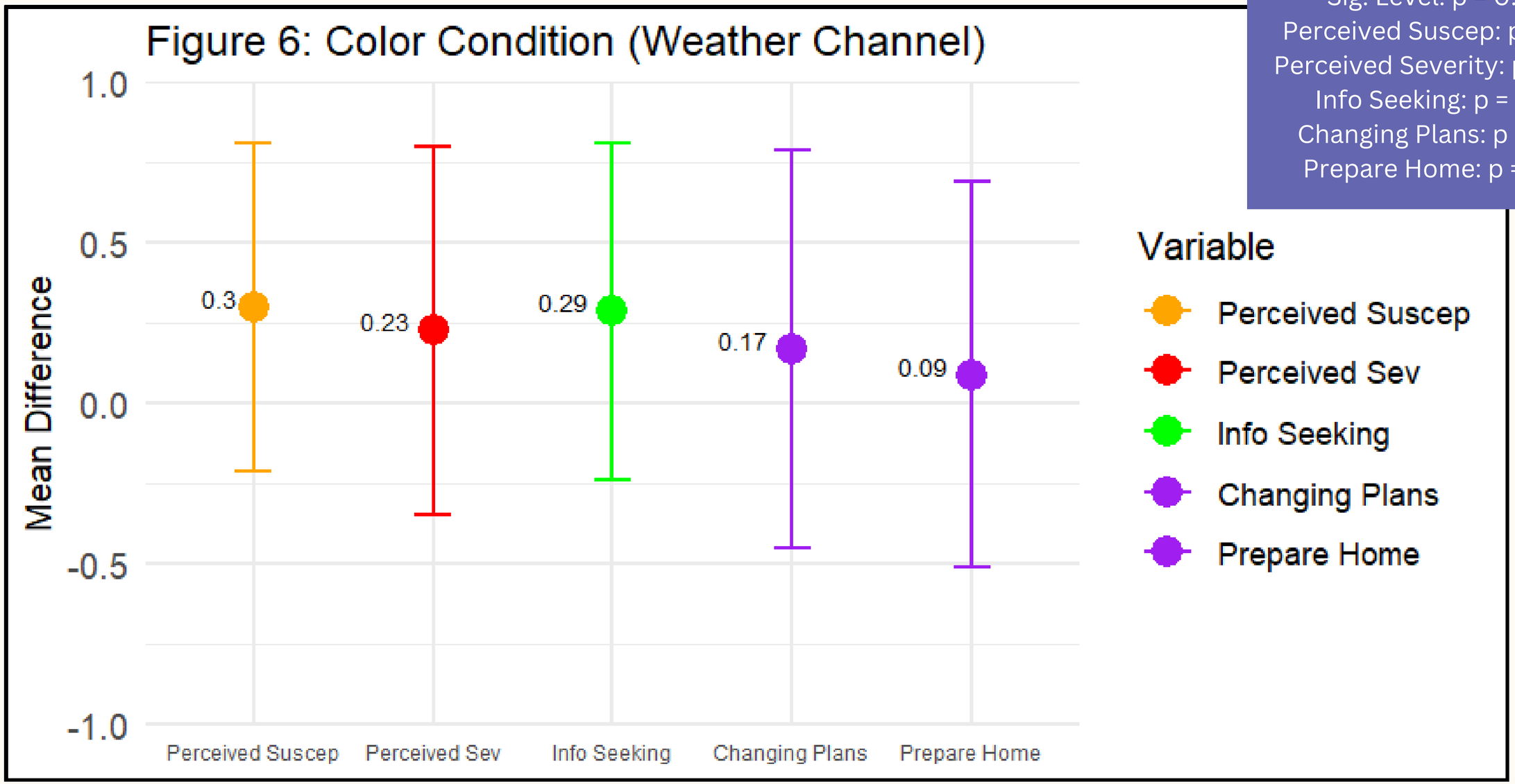
Results: Color Condition (Control) – SPC

Sig. Level: p = 0.05
Perceived Suscep: p = 0.03
Perceived Severity: p = 0.89
Info Seeking: p = 0.92
Changing Plans: p = 0.18
Prepare Home: p = 0.45



Results: Color Condition (+1) – Weather Channel

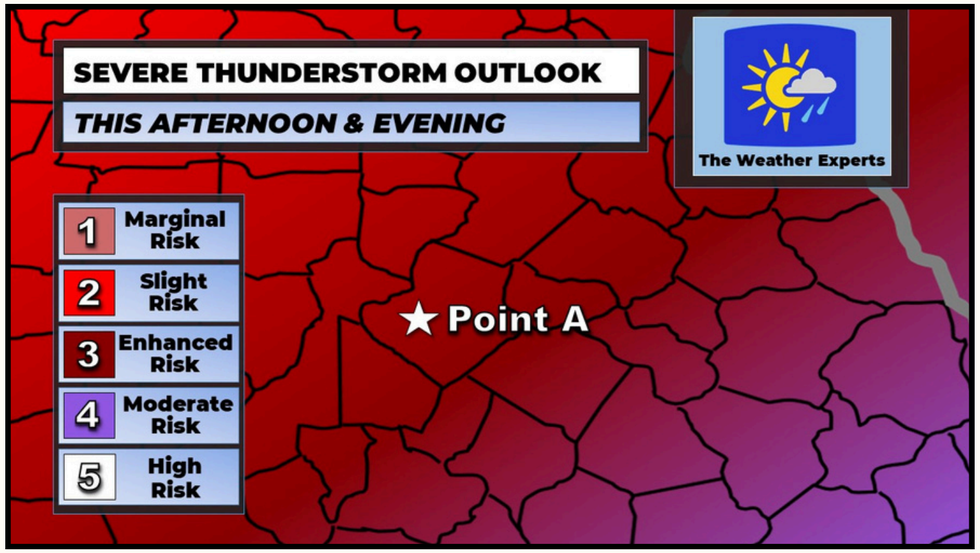
Sig. Level: p = 0.05
Perceived Suscep: p = 0.12
Perceived Severity: p = 0.03
Info Seeking: p = 0.25
Changing Plans: p = 0.21
Prepare Home: p = 0.27



A Repeated-Measures Experimental Design

FORECAST SCENARIO: Imagine you are home on a Saturday morning in August. You learn that meteorologists are forecasting severe thunderstorms for your area this afternoon. You decide to search for information about the severe thunderstorm threat and come across a single forecast graphic (the graphic will appear below).

[INSTRUCTION]: Please take a look at the severe thunderstorm forecast graphic below. <u>Keep in mind that your home is located at point A.</u>



***Scenario Continued*:** After seeing the previous forecast graphic, you search for more information and come across a second forecast graphic from a different source. To better understand the threat for your area, you decide to look at both graphics at the same time.

