We Are Wanderers:
Abstract geometry reflects spatial navigation

Yi Lin & Moira R. Dillon

Supplemental Materials and Methods

Stimuli Due to an error in the stimuli presentation code of Experiment 1, each participant in that experiment saw 82 of the 84 videos once, one video (video 59, which displays a 125° angle) twice, and did not see one video (video 58, which also displays a 125° angle) at all. We included both responses to the repeated video in our analysis because participants viewed these videos in two separate blocks and were thus unlikely to have noticed the repetition. Participants in Experiment 2 saw all 84 unique videos.

Procedure Participants were given four comprehension questions prior to seeing any test trials. These questions are provided in **Tables S1**-**S3**. The full instructions for each condition are provided in **Tables S2**-**S3**. Due to an oversight in updating the preregistration document with the final experiments' wording, the final experiments' instructions had minor deviations in wording compared with the wording that was preregistered. Participants were given one catch question after seeing half of the test trials. This question is provided in **Figure S1**.

Supplemental Results

Identical preprocessing and kernel density estimation analyses were run on the angles partially reported in the main text. Those results are consistent with the results in the main text and so they are reported in **Figures S2**-**S11**.

The preregistration of Experiment 2 specified an analysis in which the last visible point and participants' mouse-click responses would be connected by interpolated lines to form polygons. The data would then be visualized and analyzed using the resulting polygons. For consistency with Experiment 1, we included in the main text the visualization and analysis of just the mouse-click response data, not of any interpolated lines between the clicks. The results from this planned analysis, which includes the interpolated lines, are nevertheless consistent with the results included in the main text and are provided in **Figures S12**-**S17**.

Table S1. *Comprehension questions 1-3.*

1. Will you see multiple videos for each question? Yes No
2. How many times will each video play? Once Twice Loop until you click
3. When are you allowed to make your response? Before the video starts Anytime during the video After the video ends

Table S2. *Experiment 1: Full instructions and comprehension question four*

Anywhere Condition For each question, you will see one video. Please watch the video closely. After the video ends, click anywhere you'd like. You must wait until the end of the video to provide your response. Each video will play only once, so please pay close attention as it plays. *Comprehension question 4*: 4. Where should you click after the video ends? The right arrow Anywhere inside the grey area Anywhere outside the grey area *Reminder on each trial*: Click anywhere you'd like.
Triangle Condition For each question, you will see one video showing part of a triangle. The sides of the triangle will disappear, but the vertices will remain visible. Please watch the video closely. After viewing the video, click to complete the triangle. You must wait until the end of the video to provide your response. Each video will play only once, so please pay close attention as it plays. *Comprehension question 4*: 4. Where should you click after the video ends? The right arrow Click to complete the triangle Anywhere outside the grey area *Reminder on each trial*: Click to complete the triangle.
Object Condition For each question, you will see one video of some of the edges and corners of one side of an object. Please watch the video closely. The edges will disappear at the end of the video, but two corners will remain visible. After viewing the edges and corners, click where you think the next corner of that object will be. You must wait until the end of the video to provide your response. Each video will play only once, so please pay close attention as it plays. *Comprehension question 4*: 4. Where should you click after the video ends? The right arrow Where you think the next corner of that object will be Anywhere outside the grey area

Reminder on each trial: Click where the next corner of the object will be.

Navigation Condition

For each question, you will see one video of some of the paths and stops that an agent has travelled on a land. Please watch the video closely. The paths will disappear at the end of the video, but two stops the agent visited will remain visible. After viewing the paths and stops, click where you think the next stop of that agent will be. You must wait until the end of the video to provide your response.

Each video will play only once, so please pay close attention as it plays.

Comprehension question 4:
4. Where should you click after the video ends?
The right arrow
Where you think the next stop of that agent will be
Anywhere outside the grey area

Reminder on each trial: Click where the next stop of the agent will be.

Abstract Condition

For each question, you will see one video of some points and lines on a surface. The lines will disappear, but two points will remain visible. Please watch the video closely. After viewing the points and lines, click where you think the next point will be. You must wait until the end of the video to provide your response.

Each video will play only once, so please pay close attention as it plays.

Comprehension question 4:
4. Where should you click after the video ends?
The right arrow
Where you think the next point will be
Anywhere outside the grey area

Reminder on each trial: Click where the next point will be.

Table S3. *Experiment 2: Full instructions and comprehension question four*

Anywhere Condition For each question, you will see one video. Please watch the video closely. After the video ends, click anywhere you'd like. You can add up to 10 clicks. You must wait until the end of the video to provide your responses. Each video will play only once, so please pay close attention as it plays. *Comprehension question 4*: 4. Where should you click after the video ends? The right arrow Anywhere inside the grey area, up to 10 responses Anywhere outside the grey area, up to 10 responses *Reminder on each trial*: Click anywhere you'd like, up to 10 clicks.
Triangle Condition For each question, you will see one video showing part of a triangle. The sides of the triangle will disappear, but the vertices will remain visible. Please watch the video closely. After viewing the video, make clicks to form the triangle. You can add up to 10 clicks. You must wait until the end of the video to provide your responses. Each video will play only once, so please pay close attention as it plays. *Comprehension question 4*: 4. Where should you click after the video ends? The right arrow Make clicks to form the triangle, up to 10 clicks Anywhere outside the grey area, up to 10 clicks *Reminder on each trial*: Make clicks to form the triangle, up to 10 clicks.
Object Condition For each question, you will see one video of some of the edges and corners of one side of an object. Please watch the video closely. The edges will disappear at the end of the video, but two corners will remain visible. After viewing the edges and corners, click where you think the next corners of that object will be. You can add up to 10 corners. You must wait until the end of the video to provide your responses. Each video will play only once, so please pay close attention as it plays. *Comprehension question 4*: 4. Where should you click after the video ends? The right arrow Where you think the next corners of that object will be, up to 10 corners Anywhere outside the grey area, up to 10 corners

Reminder on each trial: Click where the next corners of the object will be, up to 10 corners.

Navigation Condition

For each question, you will see one video of some of the paths and stops that an agent has travelled on a land. Please watch the video closely. The paths will disappear at the end of the video, but two stops the agent visited will remain visible. After viewing the paths and stops, click where you think the next stops of that agent will be. You can add up to 10 stops. You must wait until the end of the video to provide your responses.

Each video will play only once, so please pay close attention as it plays.

Comprehension question 4:
4. Where should you click after the video ends?
The right arrow
Where you think the next stops of that agent will be, up to 10 stops
Anywhere outside the grey area, up to 10 stops

Reminder on each trial: Click where the next stops of the agent will be, up to 10 stops.

Abstract Condition

For each question, you will see one video of some points and lines on a surface. The lines will disappear, but two points will remain visible. Please watch the video closely. After viewing the points and lines, click where you think the next points will be. You can add up to 10 points. You must wait until the end of the video to provide your responses.

Each video will play only once, so please pay close attention as it plays.

Comprehension question 4:
4. Where should you click after the video ends?
The right arrow
Where you think the next points will be, up to 10 points
Anywhere outside the grey area, up to 10 points

Reminder on each trial: Click where the next points will be, up to 10 points.

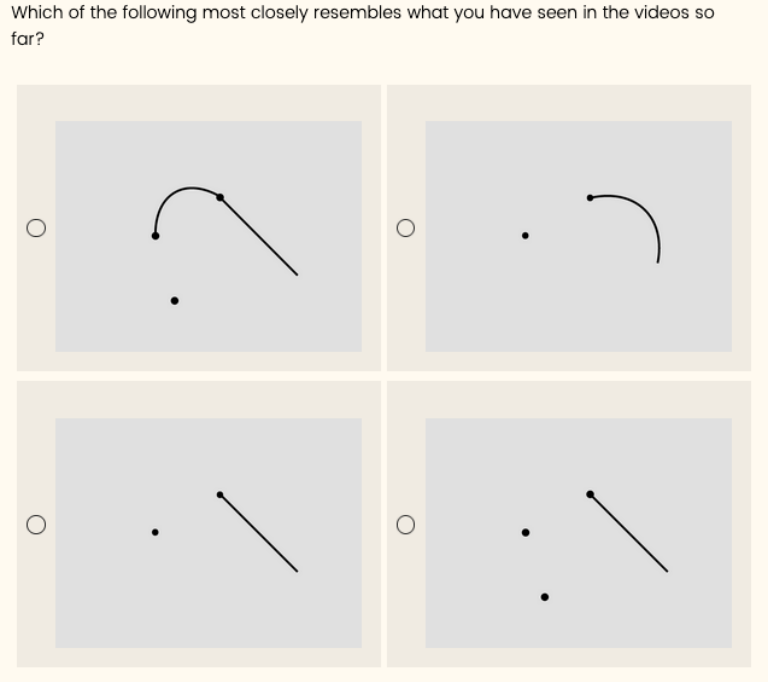

Figure S1. The catch question after the first block of trials and before the first optional break in Experiments 1 and 2. The correct answer is displayed on the bottom left.

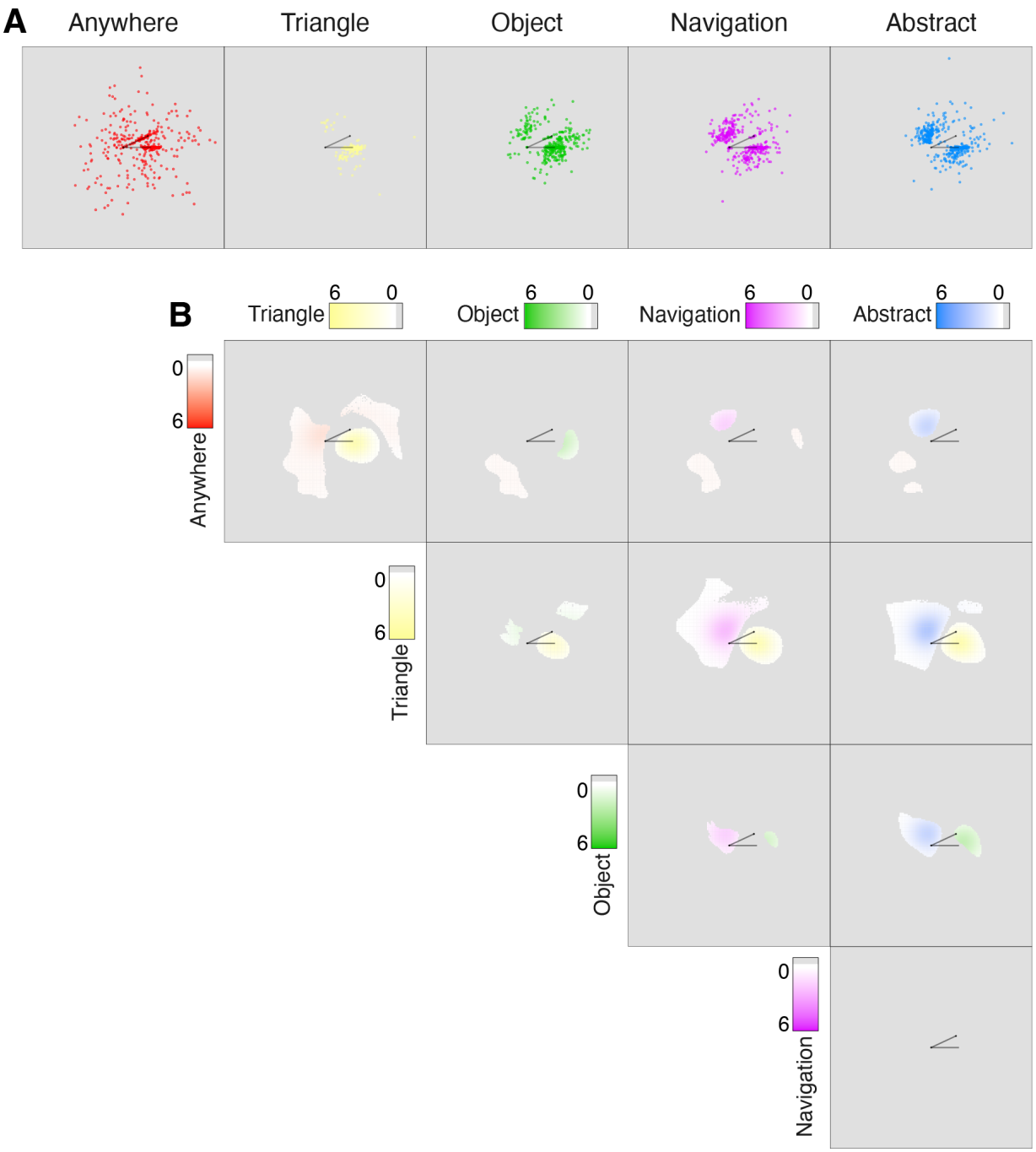

Figure S2. A Scatter plots of all mouse-click responses to the 25° angle in Experiment 1. **B** Results of the kernel density estimation analysis, with the colored patches in each plot representing significantly different response densities ($p < .05$, Holm-corrected) across the two compared conditions. The range of the kernel density estimations are provided on the figure's color scale. A magnitude of 6 (the scale's maximum) refers to a 0.15 percentage-point increase of responding at that location in the grid in the indicated condition.

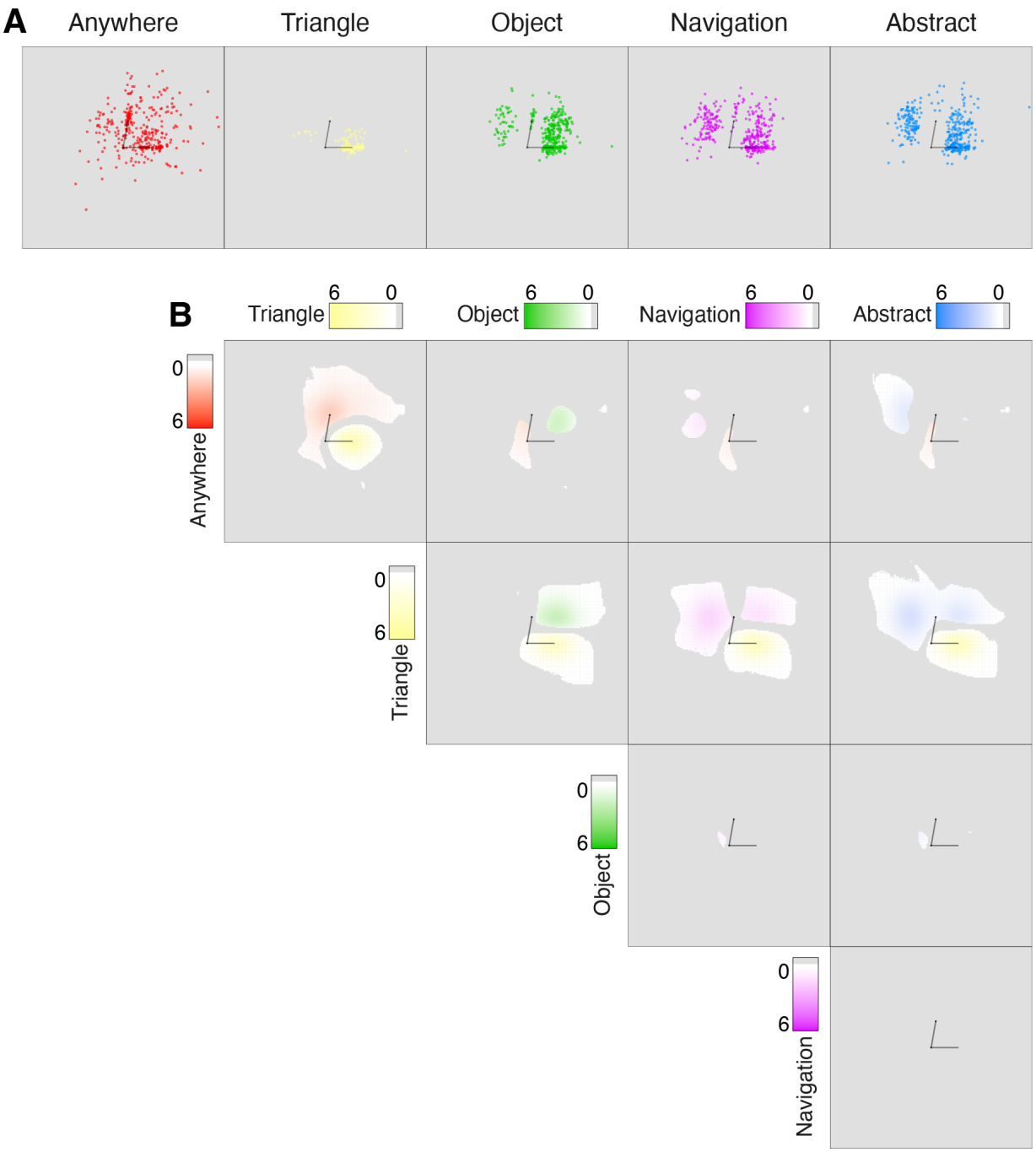

Figure S3. A Scatter plots of all mouse-click responses to the 80° angle in Experiment 1. **B** Results of the kernel density estimation analysis, with the colored patches in each plot representing significantly different response densities ($p < .05$, Holm-corrected) across the two compared conditions. The range of the kernel density estimations are provided on the figure's color scale. A magnitude of 6 (the scale's maximum) refers to a 0.15 percentage-point increase of responding at that location in the grid in the indicated condition.

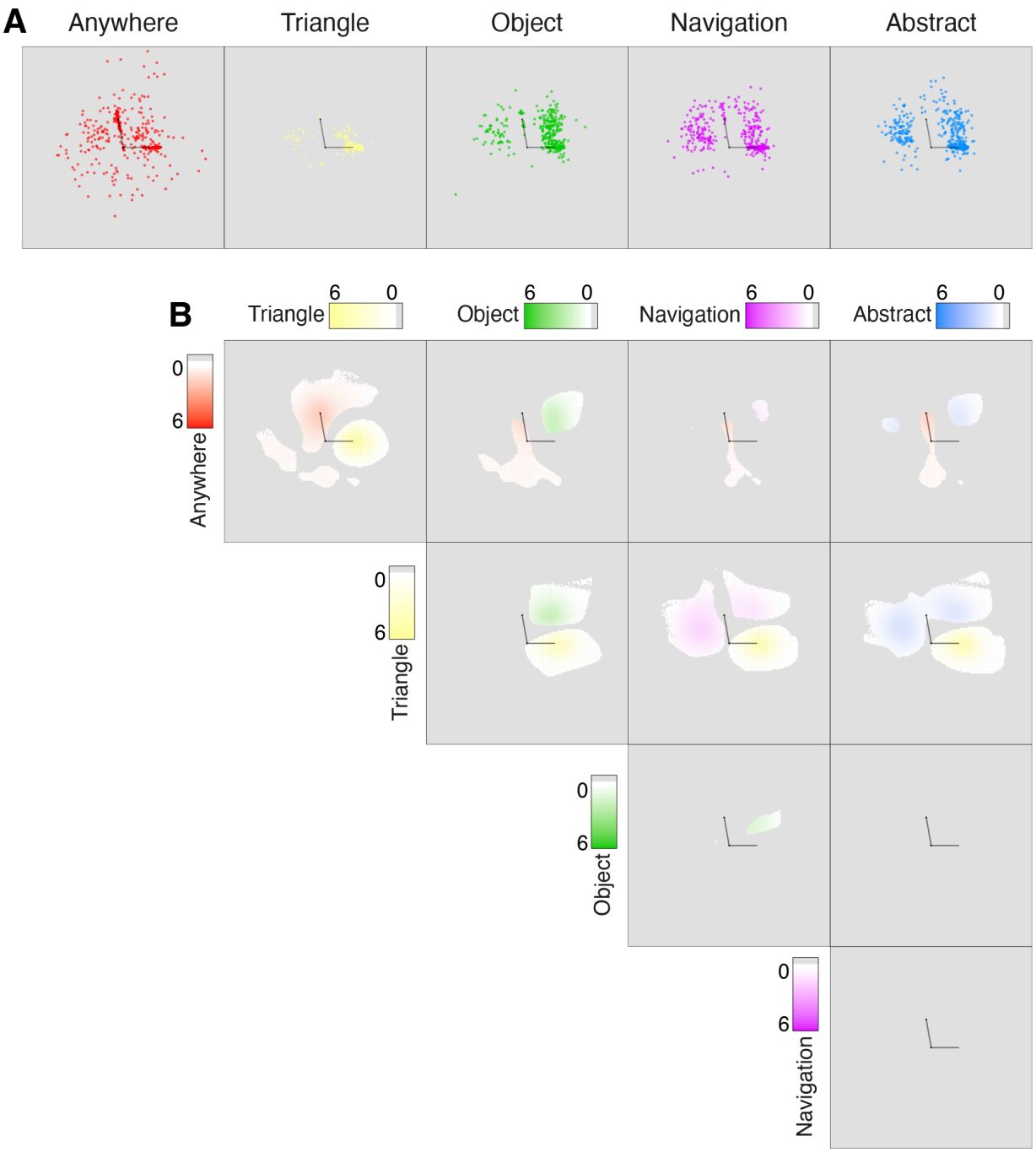

Figure S4. A Scatter plots of all mouse-click responses to the 100° angle in Experiment 1. **B** Results of the kernel density estimation analysis, with the colored patches in each plot representing significantly different response densities ($p < .05$, Holm-corrected) across the two compared conditions. The range of the kernel density estimations are provided on the figure's color scale. A magnitude of 6 (the scale's maximum) refers to a 0.15 percentage-point increase of responding at that location in the grid in the indicated condition.

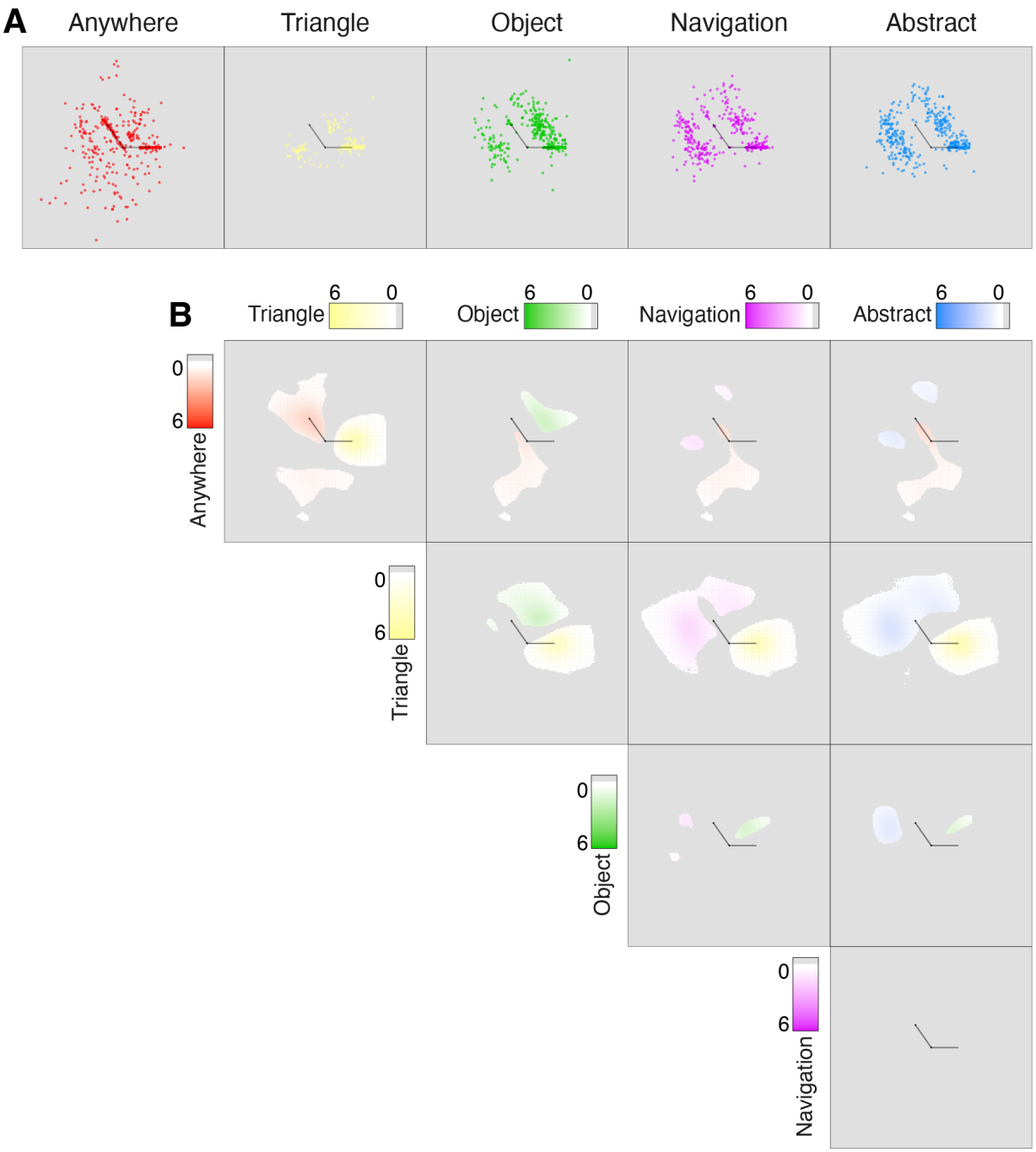

Figure S5. A Scatter plots of all mouse-click responses to the 125° angle in Experiment 1. **B** Results of the kernel density estimation analysis, with the colored patches in each plot representing significantly different response densities ($p < .05$, Holm-corrected) across the two compared conditions. The range of the kernel density estimations are provided on the figure's color scale. A magnitude of 6 (the scale's maximum) refers to a 0.15 percentage-point increase of responding at that location in the grid in the indicated condition.

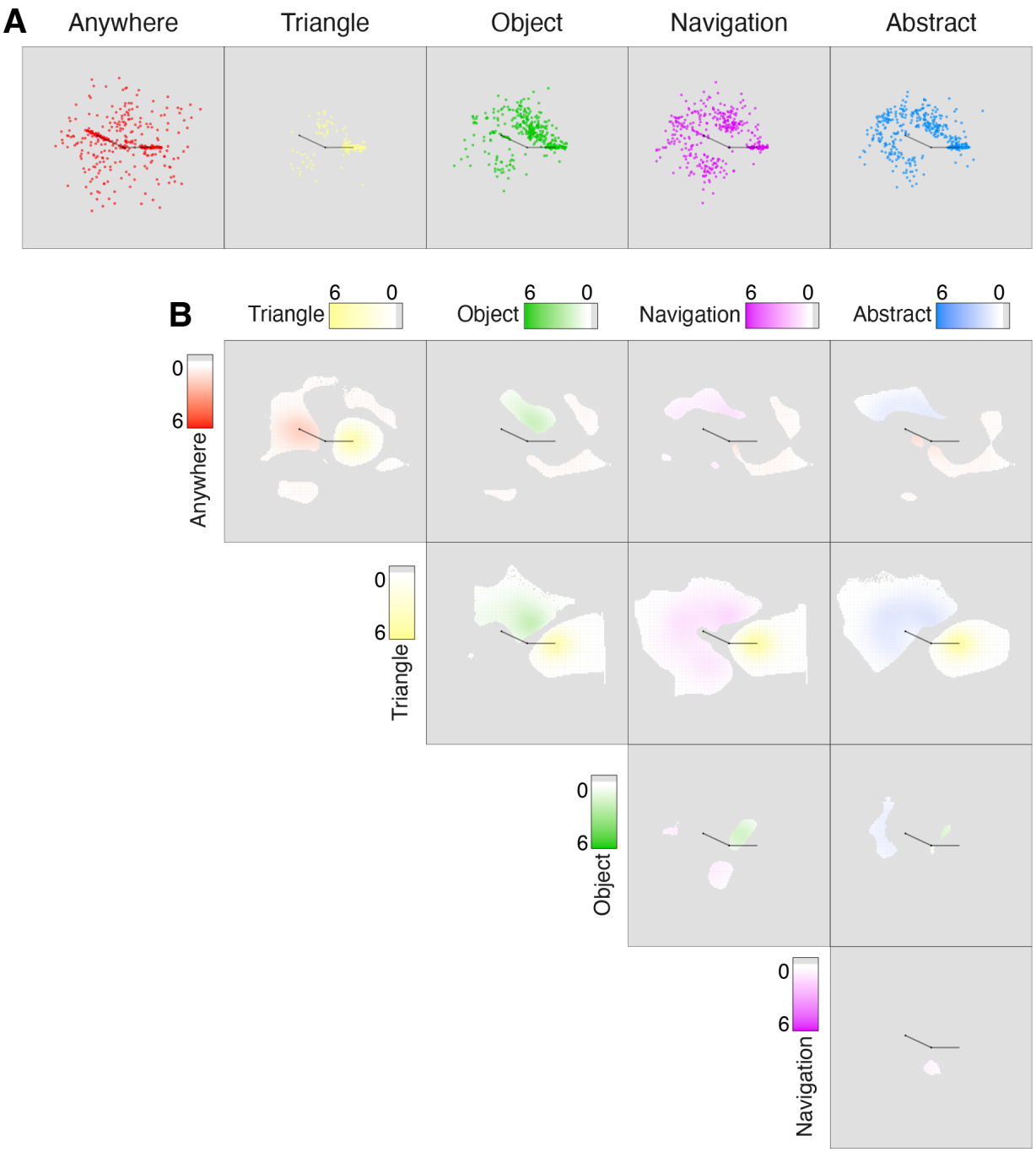

Figure S6. A Scatter plots of all mouse-click responses to the 155° angle in Experiment 1. **B** Results of the kernel density estimation analysis, with the colored patches in each plot representing significantly different response densities ($p < .05$, Holm-corrected) across the two compared conditions. The range of the kernel density estimations are provided on the figure's color scale. A magnitude of 6 (the scale's maximum) refers to a 0.15 percentage-point increase of responding at that location in the grid in the indicated condition.

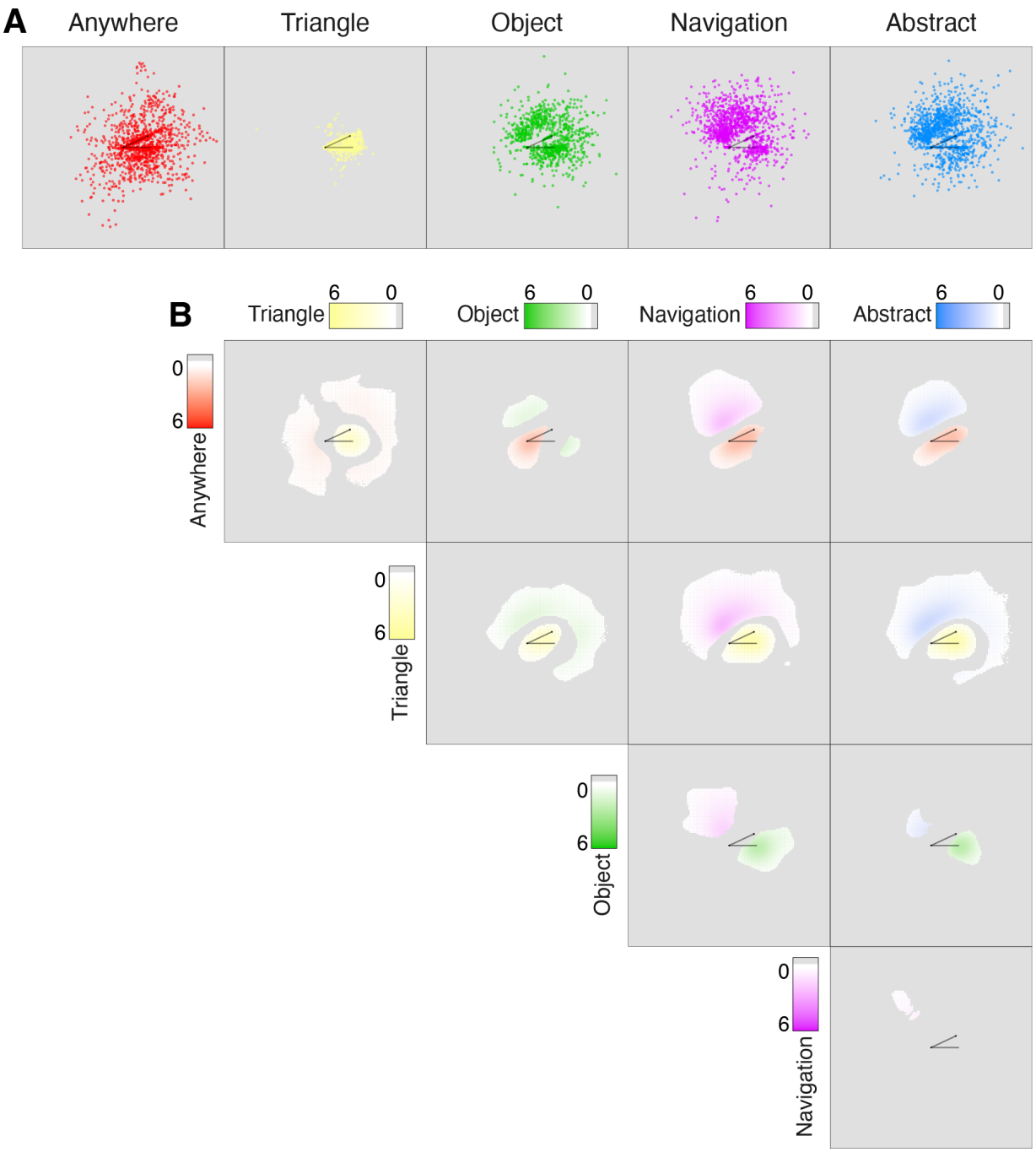

Figure S7. A Scatter plots of all mouse-click responses to the 25° angle in Experiment 2. **B** Results of the kernel density estimation analysis, with the colored patches in each plot representing significantly different response densities ($p < .05$, Holm-corrected) across the two compared conditions. The range of the kernel density estimations are provided on the figure's color scale. A magnitude of 6 (the scale's maximum) refers to a 0.15 percentage-point increase of responding at that location in the grid in the indicated condition.

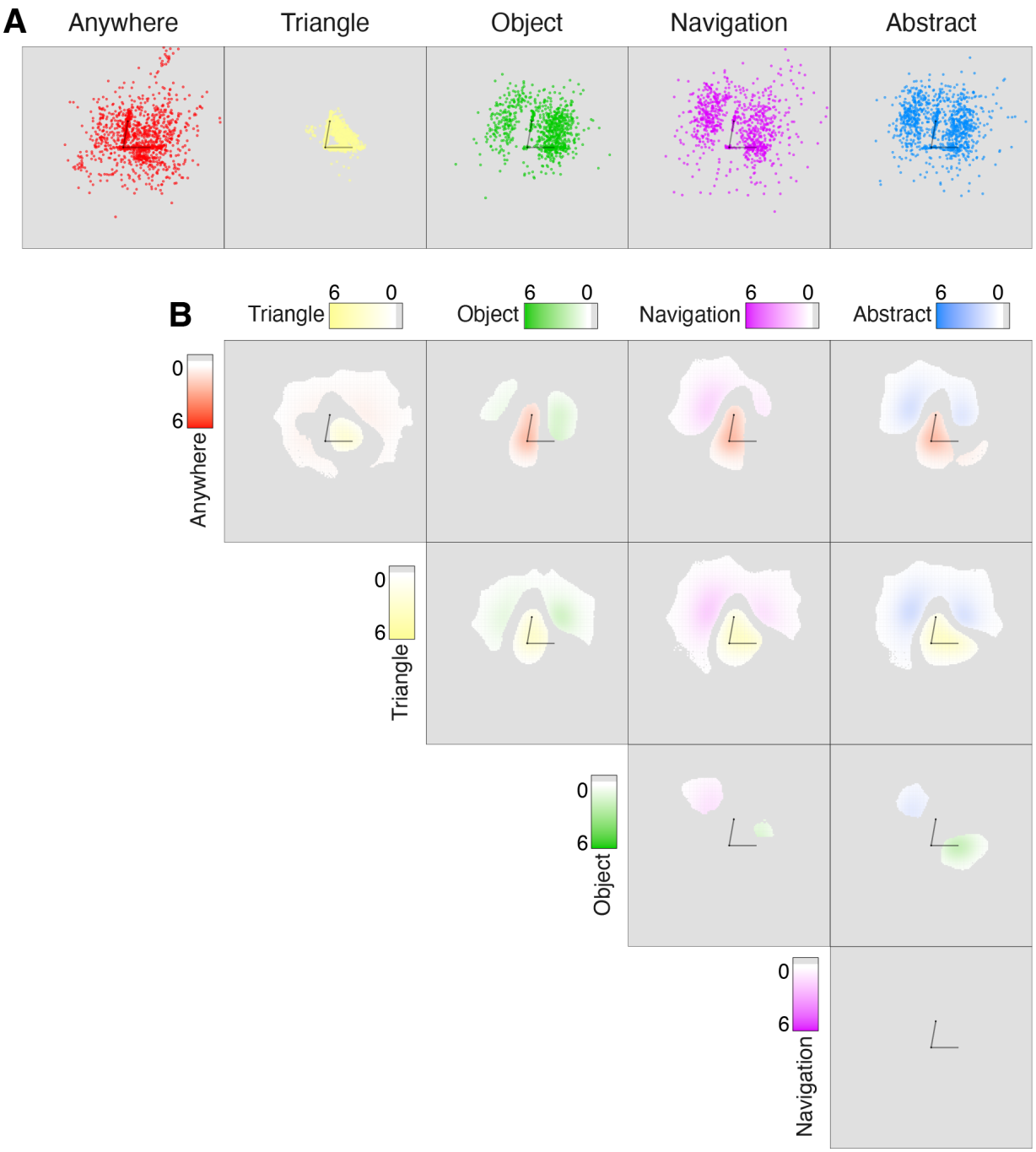

Figure S8. A Scatter plots of all mouse-click responses to the 80° angle in Experiment 2. **B** Results of the kernel density estimation analysis, with the colored patches in each plot representing significantly different response densities ($p < .05$, Holm-corrected) across the two compared conditions. The range of the kernel density estimations are provided on the figure's color scale. A magnitude of 6 (the scale's maximum) refers to a 0.15 percentage-point increase of responding at that location in the grid in the indicated condition.

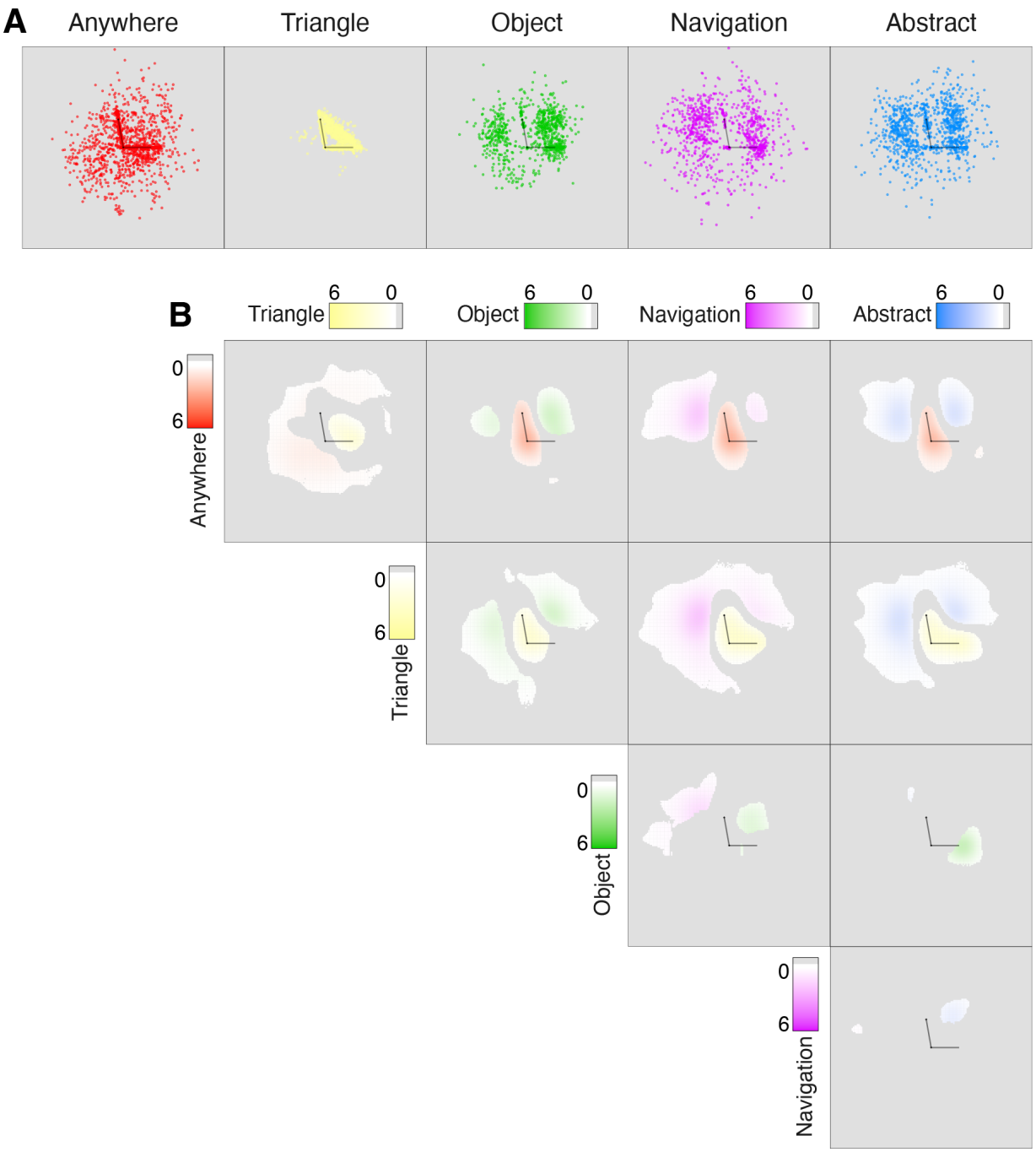

Figure S9. A Scatter plots of all mouse-click responses to the 100° angle in Experiment 2. **B** Results of the kernel density estimation analysis, with the colored patches in each plot representing significantly different response densities ($p < .05$, Holm-corrected) across the two compared conditions. The range of the kernel density estimations are provided on the figure's color scale. A magnitude of 6 (the scale's maximum) refers to a 0.15 percentage-point increase of responding at that location in the grid in the indicated condition.

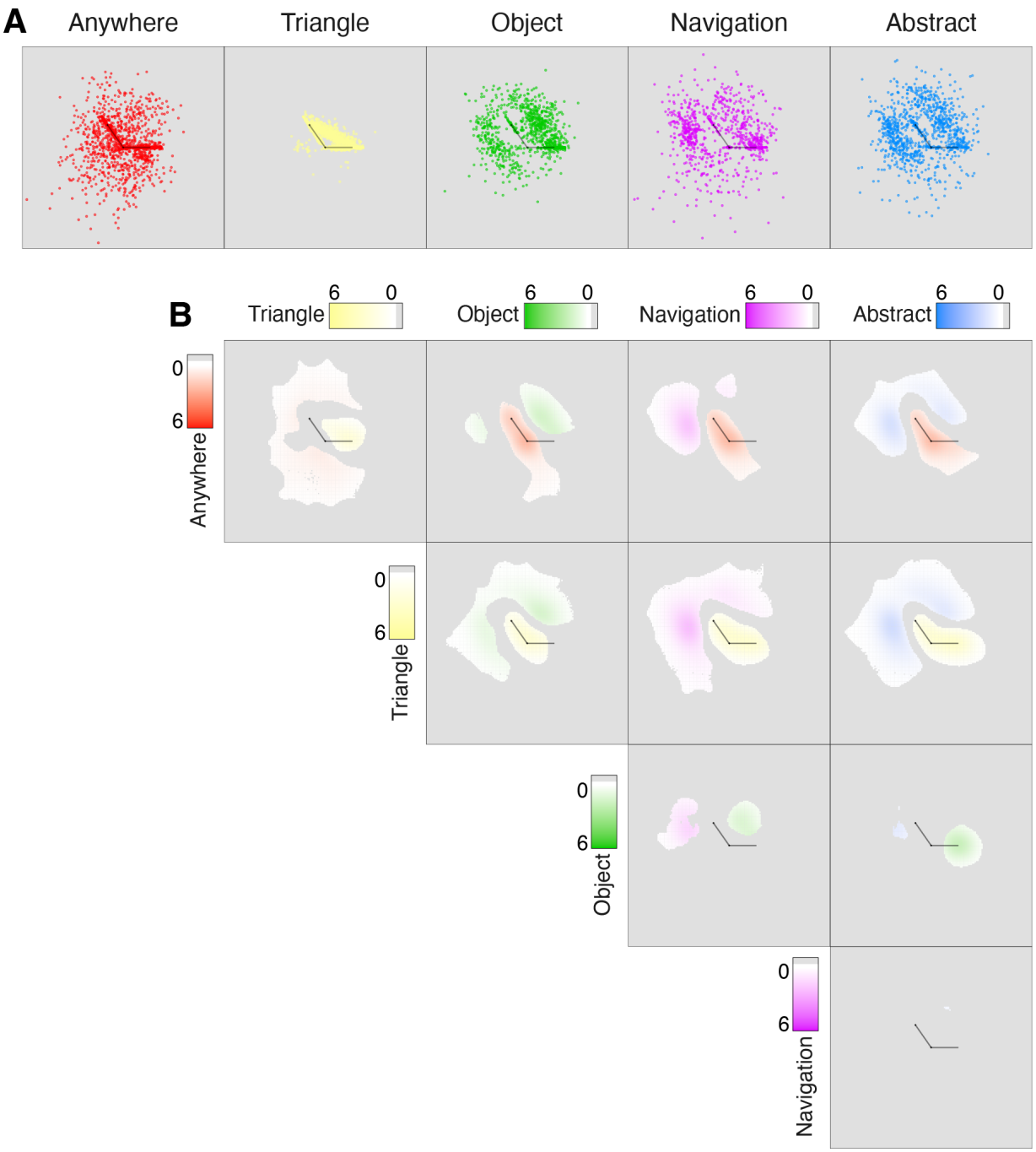

Figure S10. A Scatter plots of all mouse-click responses to the 125° angle in Experiment 2. **B** Results of the kernel density estimation analysis, with the colored patches in each plot representing significantly different response densities ($p < .05$, Holm-corrected) across the two compared conditions. The range of the kernel density estimations are provided on the figure's color scale. A magnitude of 6 (the scale's maximum) refers to a 0.15 percentage-point increase of responding at that location in the grid in the indicated condition.

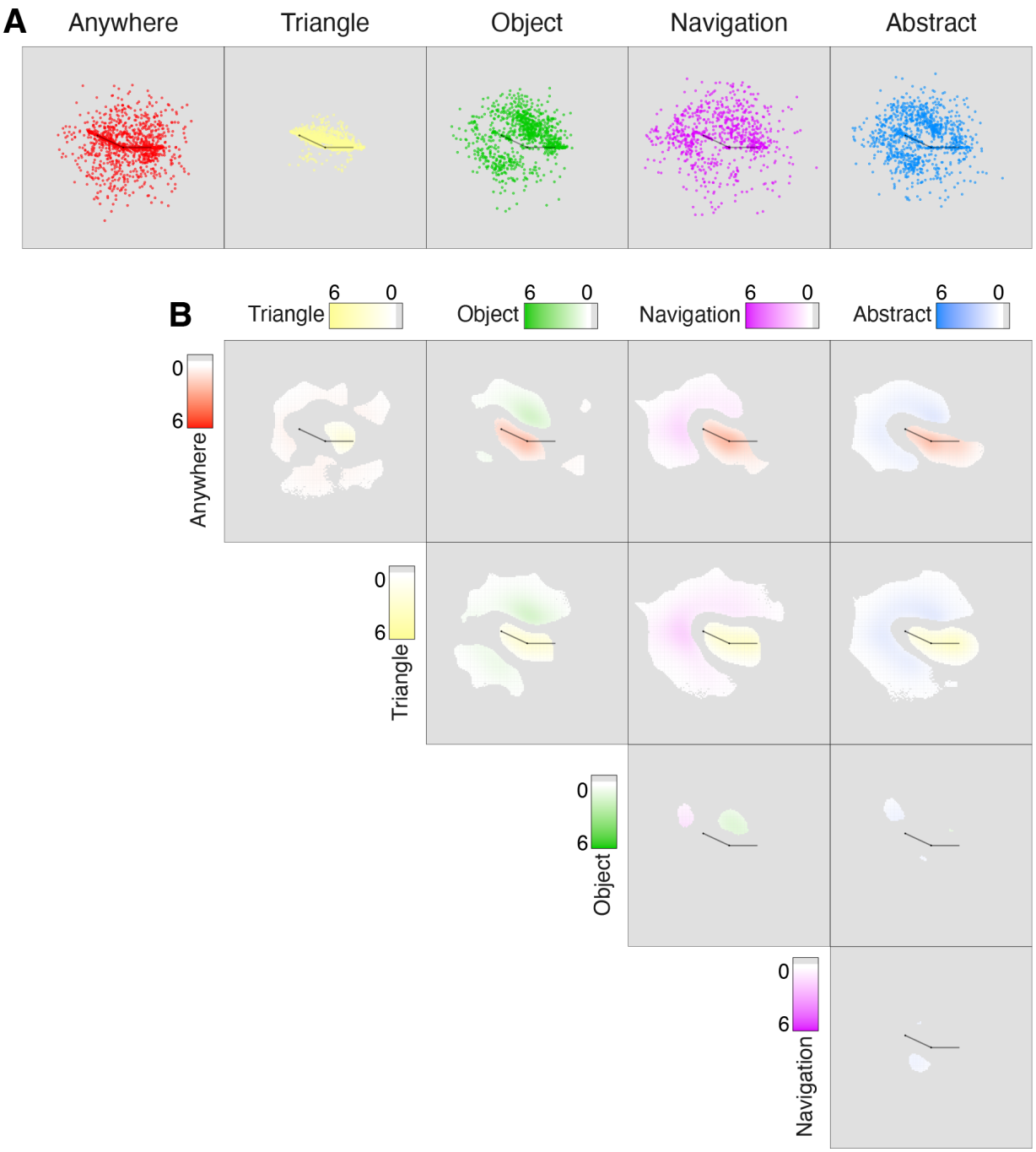

Figure S11. A Scatter plots of all mouse-click responses to the 155° angle in Experiment 2. **B** Results of the kernel density estimation analysis, with the colored patches in each plot representing significantly different response densities ($p < .05$, Holm-corrected) across the two compared conditions. The range of the kernel density estimations are provided on the figure's color scale. A magnitude of 6 (the scale's maximum) refers to a 0.15 percentage-point increase of responding at that location in the grid in the indicated condition.

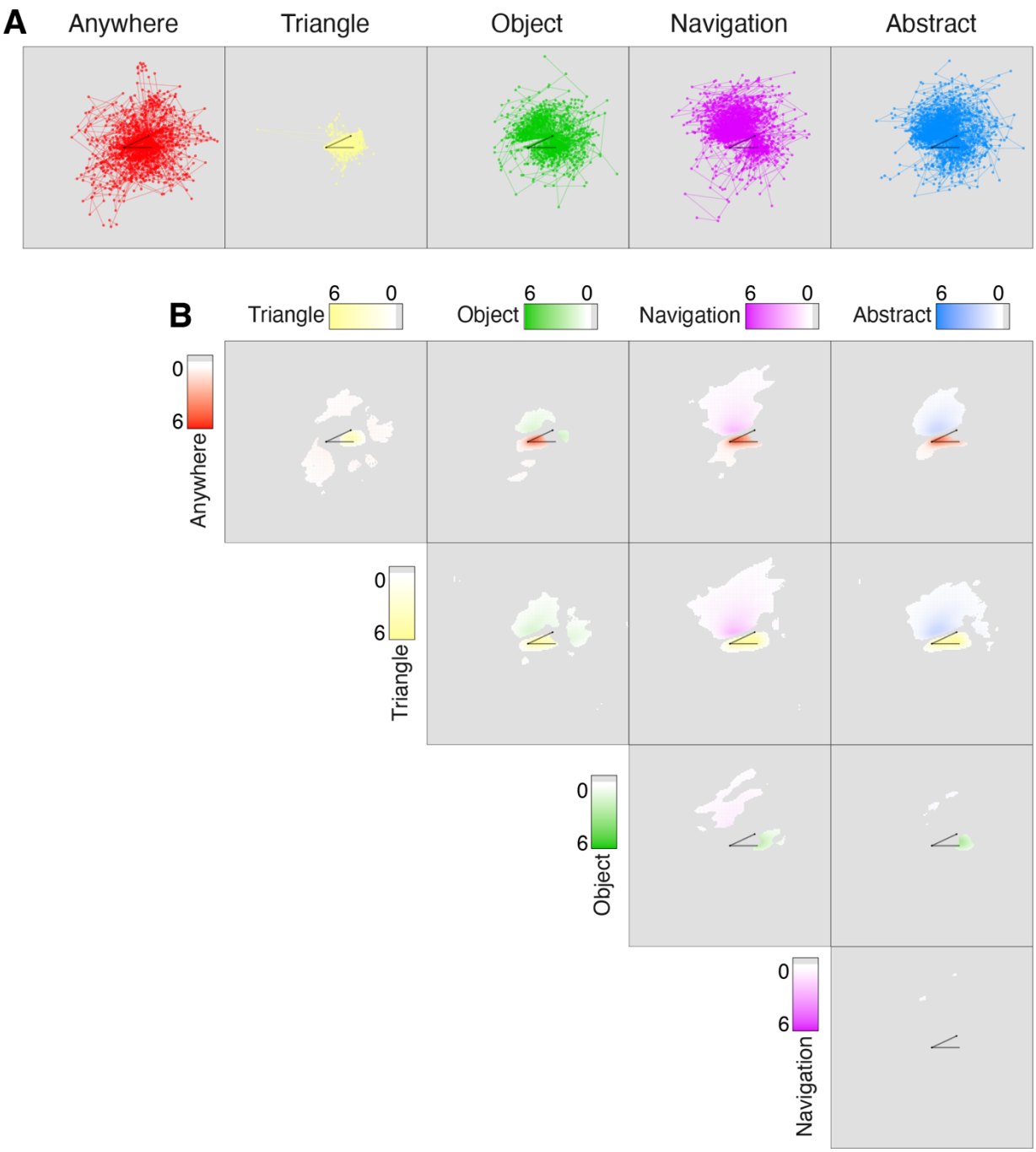

Figure S12. A Plots of interpolated lines that connect the second visible point and mouse-click responses to the 25° angle in Experiment 2. **B** Results of the kernel density estimation analysis, with the colored patches in each plot representing significantly different response densities ($p < .05$, Holm-corrected) across the two compared conditions. The range of the kernel density estimations are provided on the figure's color scale. A magnitude of 6 (the scale's maximum) refers to a 0.15 percentage-point increase of responding at that location in the grid in the indicated condition.

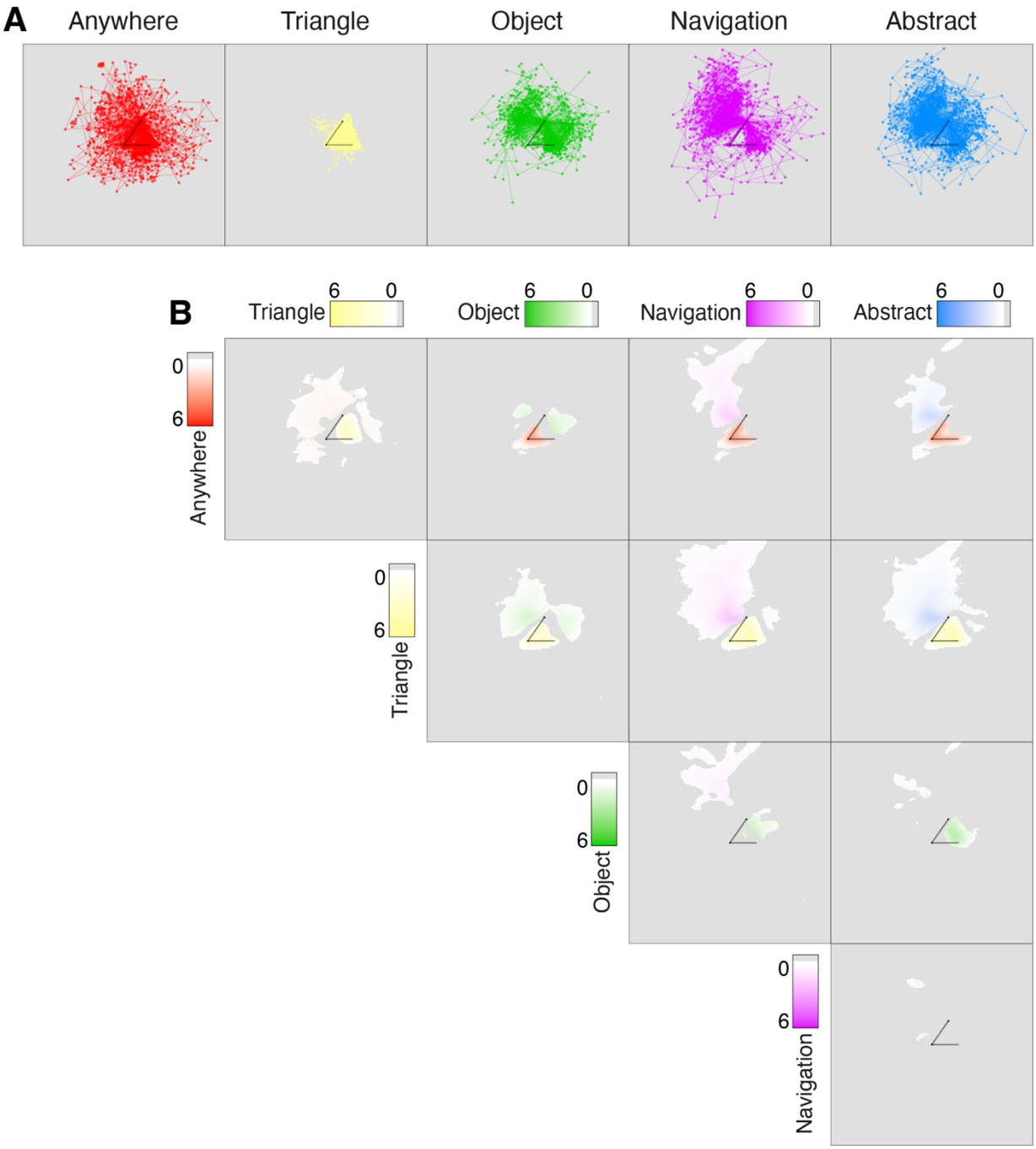

Figure S13. A Plots of interpolated lines that connect the second visible point and mouse-click responses to the 55° angle in Experiment 2. **B** Results of the kernel density estimation analysis, with the colored patches in each plot representing significantly different response densities ($p < .05$, Holm-corrected) across the two compared conditions. The range of the kernel density estimations are provided on the figure's color scale. A magnitude of 6 (the scale's maximum) refers to a 0.15 percentage-point increase of responding at that location in the grid in the indicated condition.

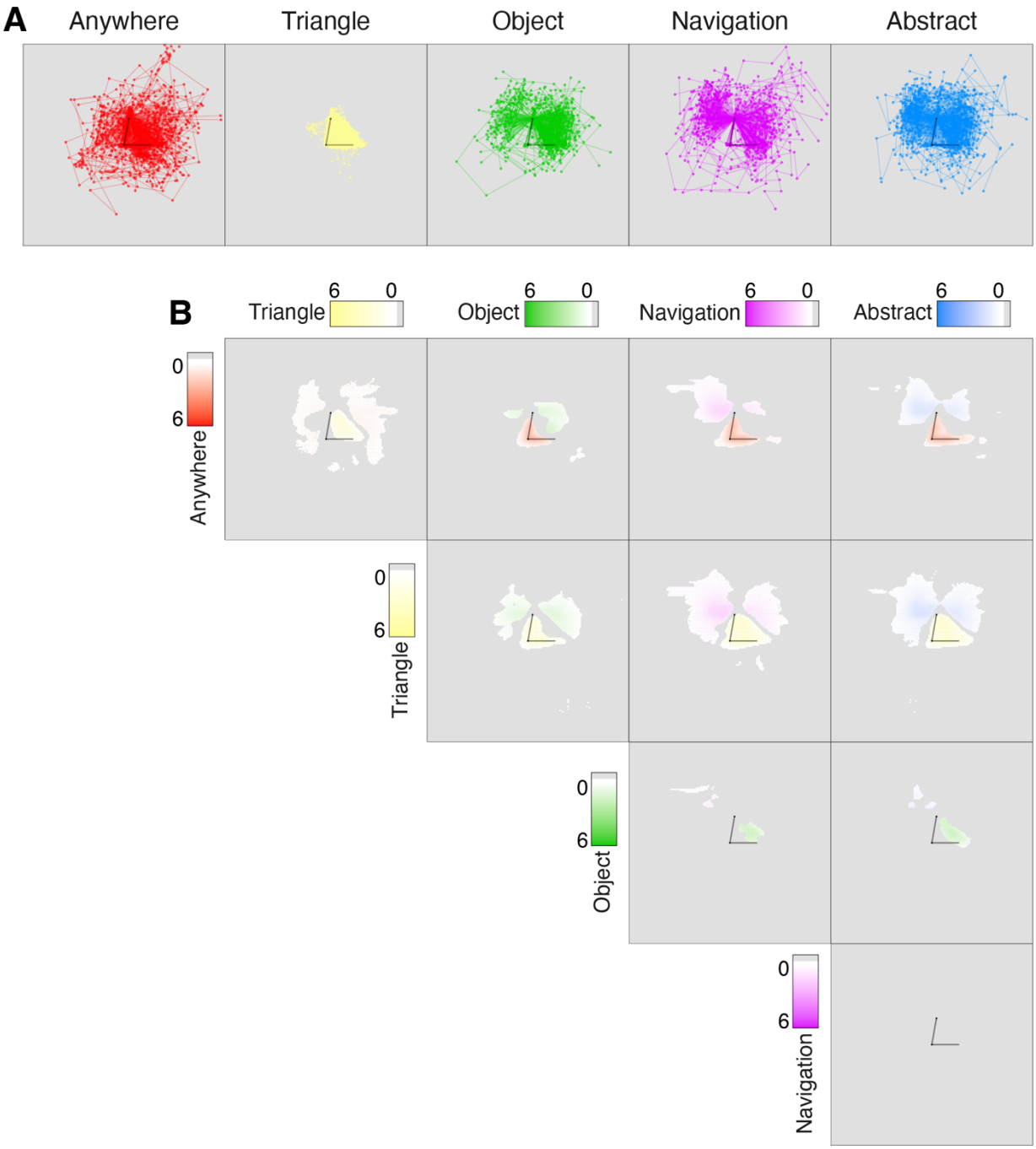

Figure S14. A Plots of interpolated lines that connect the second visible point and mouse-click responses to the 80° angle in Experiment 2. **B** Results of the kernel density estimation analysis, with the colored patches in each plot representing significantly different response densities ($p < .05$, Holm-corrected) across the two compared conditions. The range of the kernel density estimations are provided on the figure's color scale. A magnitude of 6 (the scale's maximum) refers to a 0.15 percentage-point increase of responding at that location in the grid in the indicated condition.

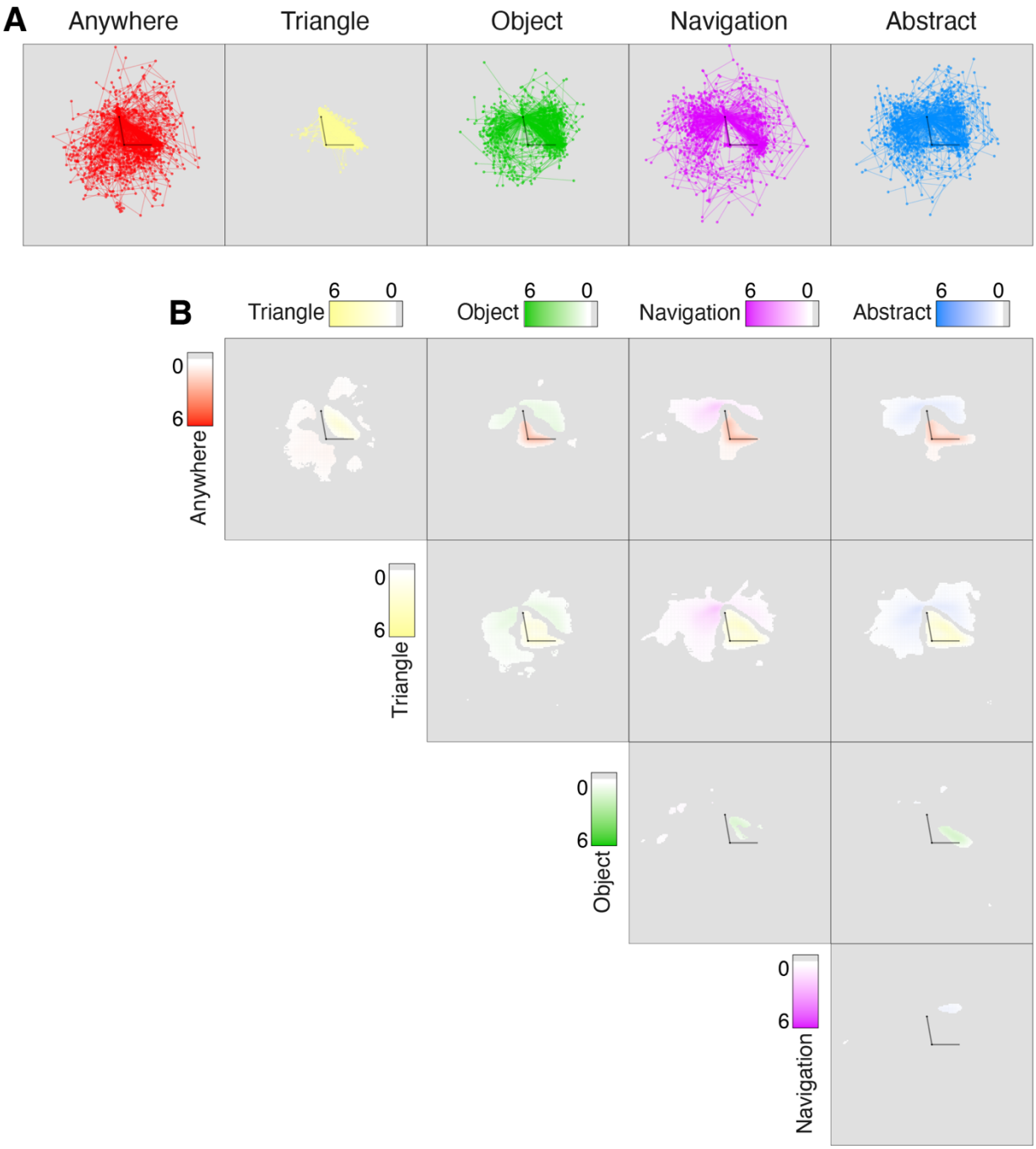

Figure S15. A Plots of interpolated lines that connect the second visible point and mouse-click responses to the 100° angle in Experiment 2. **B** Results of the kernel density estimation analysis, with the colored patches in each plot representing significantly different response densities ($p < .05$, Holm-corrected) across the two compared conditions. The range of the kernel density estimations are provided on the figure's color scale. A magnitude of 6 (the scale's maximum) refers to a 0.15 percentage-point increase of responding at that location in the grid in the indicated condition.

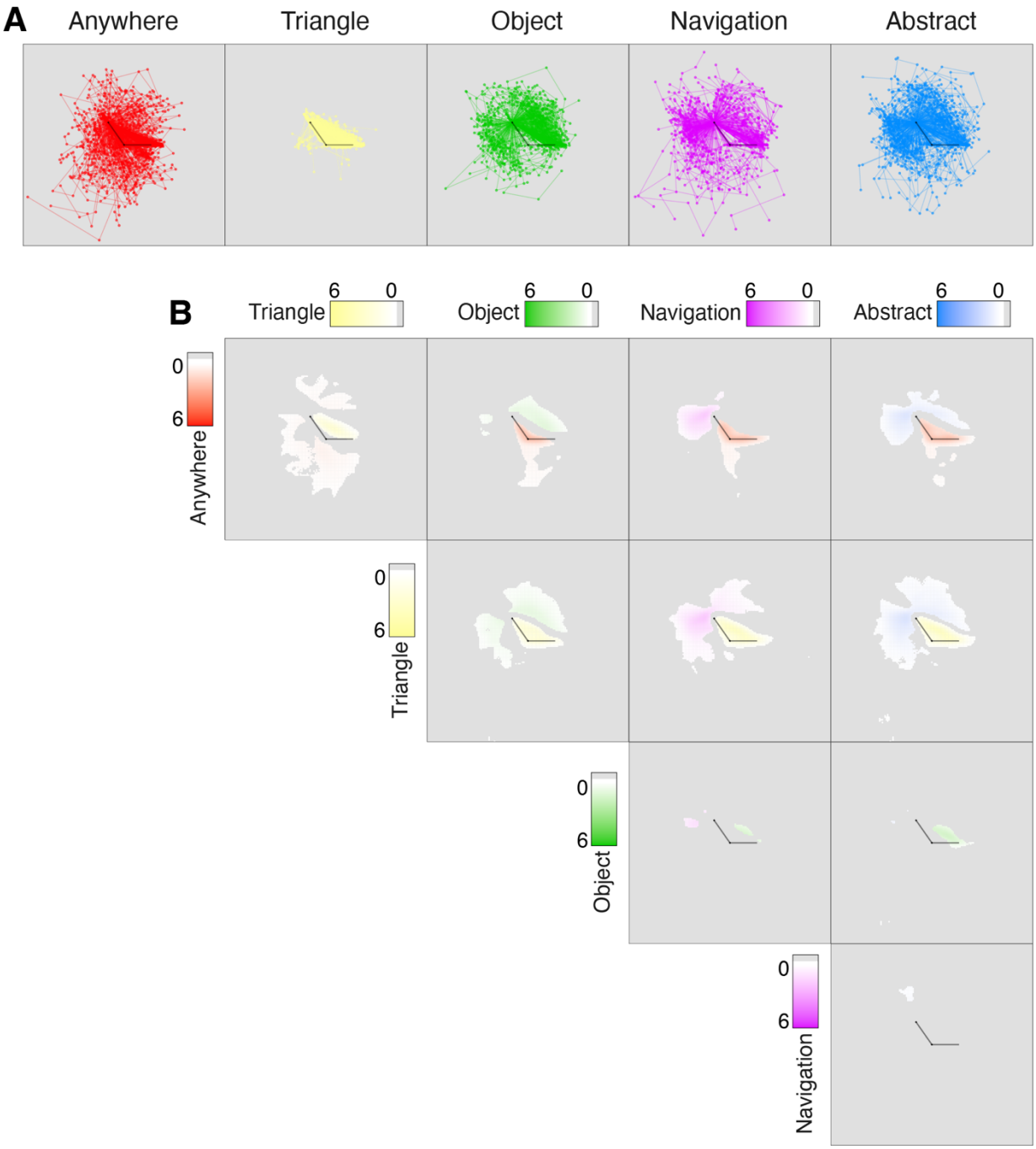

Figure S16. A Plots of interpolated lines that connect the second visible point and mouse-click responses to the 125° angle in Experiment 2. **B** Results of the kernel density estimation analysis, with the colored patches in each plot representing significantly different response densities ($p < .05$, Holm-corrected) across the two compared conditions. The range of the kernel density estimations are provided on the figure's color scale. A magnitude of 6 (the scale's maximum) refers to a 0.15 percentage-point increase of responding at that location in the grid in the indicated condition.

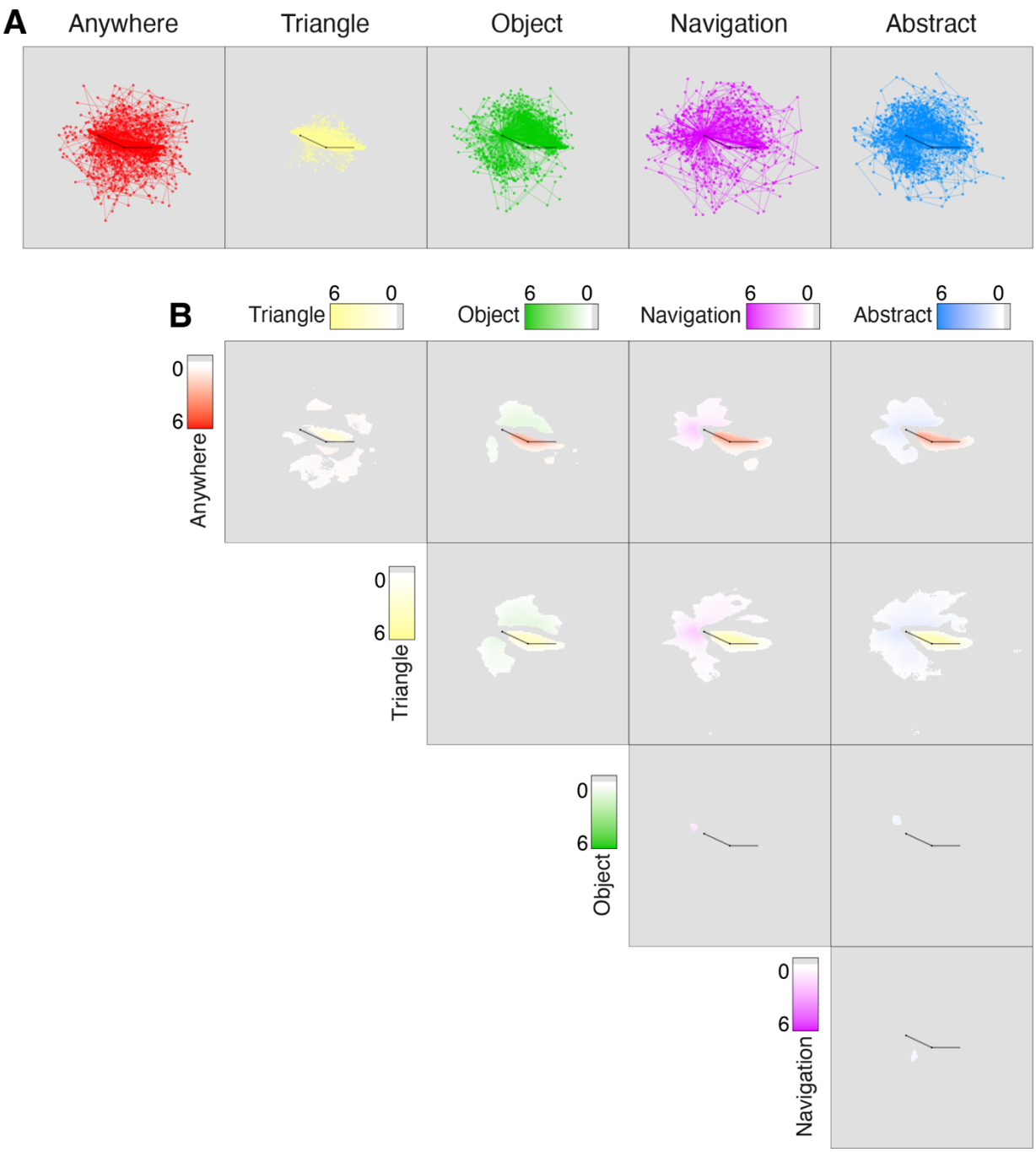

Figure S17. A Plots of interpolated lines that connect the second visible point and mouse-click responses to the 155° angle in Experiment 2. **B** Results of the kernel density estimation analysis, with the colored patches in each plot representing significantly different response densities ($p < .05$, Holm-corrected) across the two compared conditions. The range of the kernel density estimations are provided on the figure's color scale. A magnitude of 6 (the scale's maximum) refers to a 0.15 percentage-point increase of responding at that location in the grid in the indicated condition.

Movie S1. Example 55° stimulus video.

https://osf.io/24a73