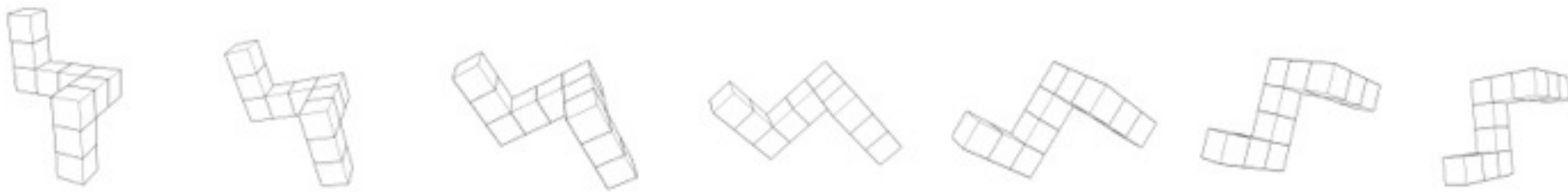


# So You Think You Can Fly? A Differential Investigation in the Domain of Visual Perception

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# Overview

Prior Research

Method

Results

Implications



# Prior Research

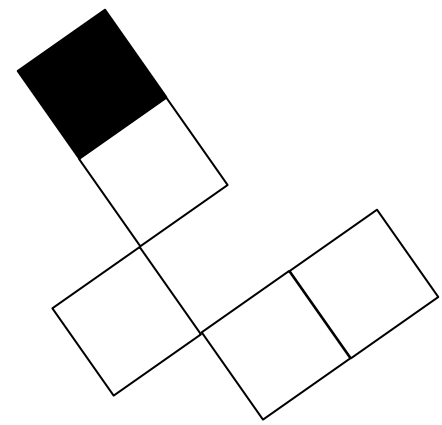
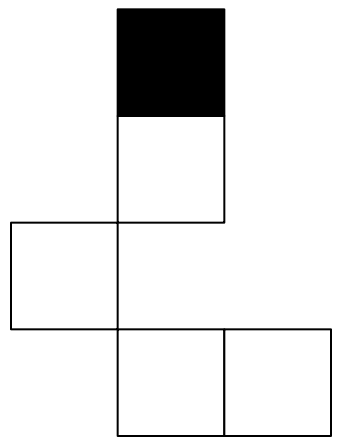
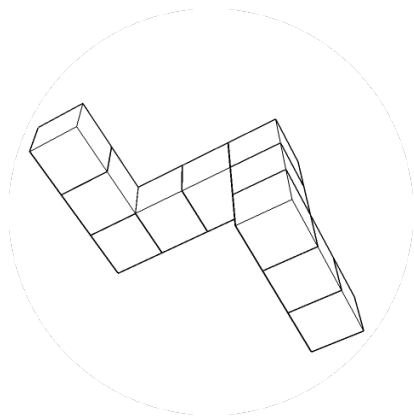
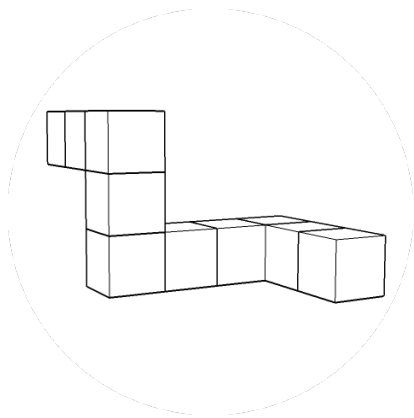
## Domain of Visual Perception (Carroll, 1993)

- Visualization (Vz)
- Spatial Relations (SR)



# Prior Research - Mental Rotation

Mental images research and use with aviators  
(Dror, Kosslyn, & Waag, 1993; Shepard & Metzler, 1971))

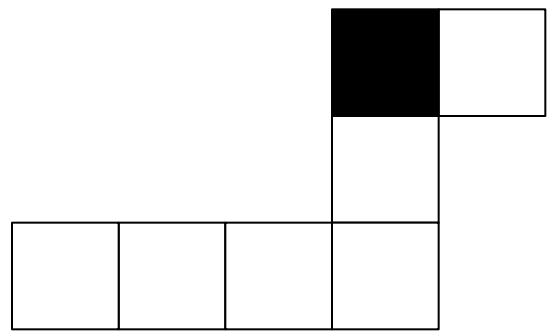
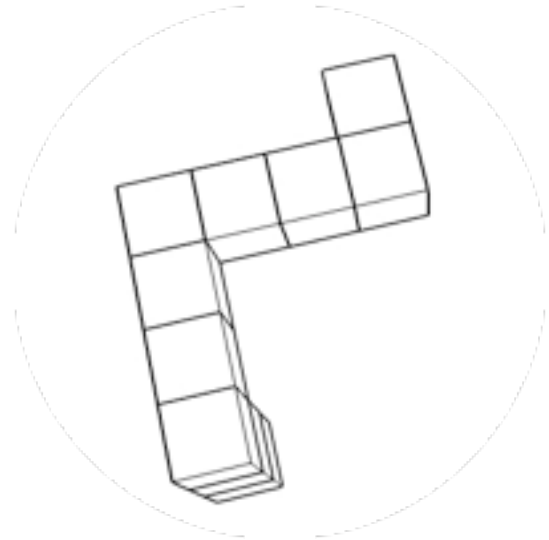




# Prior Research - Mental Rotation

Building mental rotation tasks (Shepard & Cooper, 1982; Han, Chien, Chen, Chao, & Wu, 2001)

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# Hypotheses

- (1) Response latency (a) and response accuracy (b) are linear functions of MRT disparity (Shepard & Metzler, 1971).
- (2) Response latency will differ between groups. Pilots will respond more quickly (Dror, Kosslyn, & Wagg, 1993) than non-pilots.
- (3) No differences on response accuracy (Dror, Kosslyn, & Wagg, 1993).



# Method

Sample: Aviation students and instructors (pilots); aviation management students and psychology undergraduate students (non-pilots).

## Measures

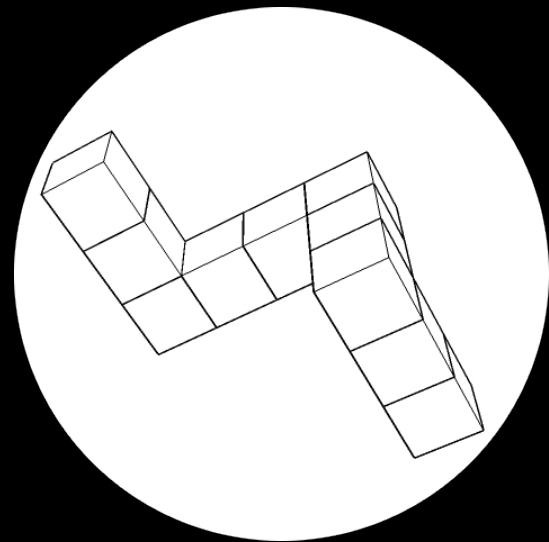
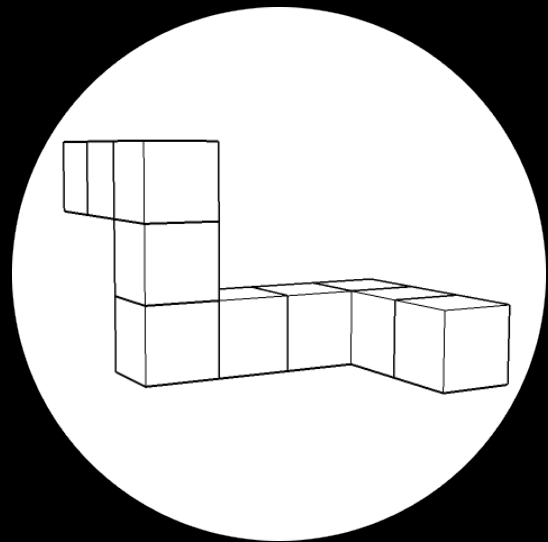
- MRTac: Accuracy same/difference rotation task (100 items; 50:50 Same:Different)
  - 5 Disparities: 20, 60, 100, 140, 180
- MRTrt: Response latency same/difference rotation task
- AJTac: Accuracy less/greater rotation task (60 items; 10/disparity)
  - 6 Disparities: 40, 60, 80, 100, 140
- AJTrt: Response latency less/greater rotation task
- General mental ability: Wonderlic WPT-Q
- Conscientiousness

We believe that response accuracy reflects Visualization (Vz) and that response latency reflects Spatial Relations (SR).



Shepard & Cooper, 1982

# Same or Different?

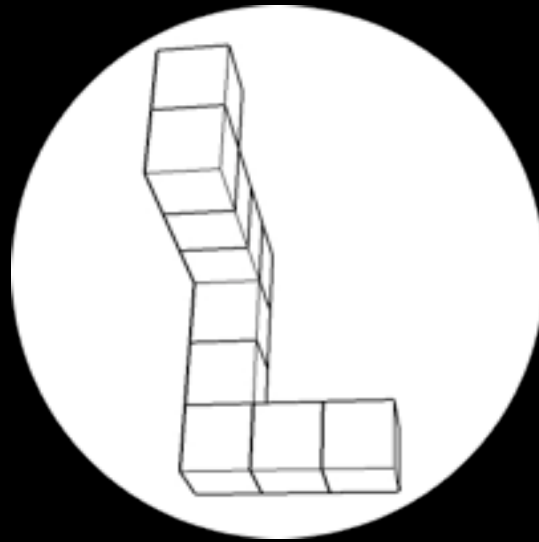
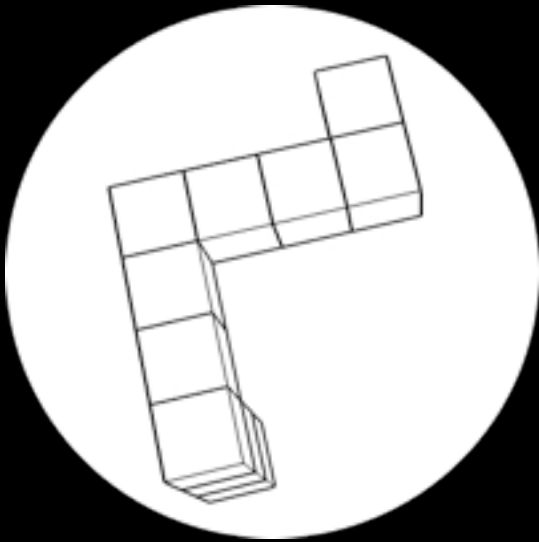






Han, Chien, Chen, Chao, & Wu, 2001

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# Procedure

Demographics & Conscientiousness Survey

E-Prime (Garson, 2003)

Participant training for using the Cedrus response pad

Using a “home key” (Jensen, 2006) to capture reaction time and movement time

“Response latency” is the sum of reaction time and movement time.

## Mental Rotation Tasks

This exercise tests your ability to compare three dimensional objects in two dimensional space. You will be presented with a pair of three dimensional objects and asked to identify whether these objects are the “same” objects or “different” objects using the response pad.

Push button 1 to select the “same” option.

Push button 2 to select the “different” option.

Remember to keep the HOME button pressed until you are ready to answer and respond quickly without sacrificing accuracy

Press button 1, 2, or HOME to advance.

## Angular Judgement Tasks

This exercise tests your ability to make angular judgements regarding pairs of three dimensional objects. You will be presented with a pair of three dimensional of three dimensional objects and asked to identify whether the disparity between the two objects is “less than” or “greater than” 90 degrees.

Push button 1 to select the “same” option.

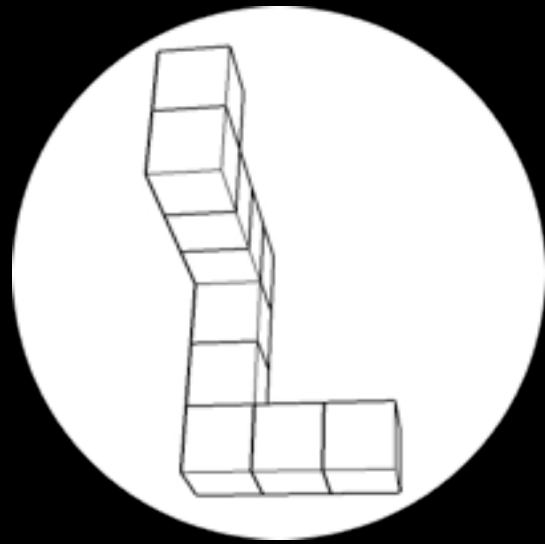
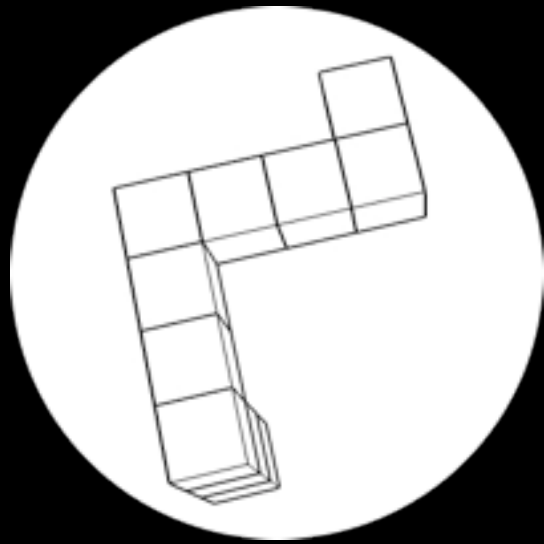
Push button 2 to select the “different” option.

Remember to keep the HOME button pressed until you are ready to answer and respond quickly without sacrificing accuracy.

Press button 1, 2, or HOME to advance.

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# Descriptive Statistics

Age ( $M = 21.39$ ,  $SD = 3.73$ )

Male biased sample (47 males, 15 females)

Predominantly white sample (74%)

Gender was controlled for comparisons purposes  
(Geary & DeSoto, 2001)



Descriptive statistics for the mental rotation tasks (MRT), angular judgement tasks (AJT) (“ra” - response accuracy; “rt” - response latency), general mental ability, and conscientiousness tests.

	<i>M</i>	<i>SD</i>	1	2	3	4	5	6
MRTra	76.74	12.63	(.91)					
MRTrl	6.110	2.615	<b>.47***</b>					
AJTra	59.80	11.76	<b>.62***</b>	<b>.27*</b>	(.79)			
AJTrl	3.502	2.184	<b>.37**</b>	<b>.61***</b>	<b>.30*</b>	-		
GMA	24.68	3.562	.24	-.05	.18	.06		
Consc.	78.79	11.99	.22	.17	.22	.07	.22	(.91)

Note:  $N = 58$ .

\* $p < .05$ ; \*\* $p < .01$ ; \*\*\* $p < .001$

## Hypotheses 1a & 1b

Response latency (a) and response accuracy (b) are linear functions of rotation disparity for “same” tasks.

Multivariate results for the effect of task disparity on response latency for the mental rotation task.

	<i>Pillai's Trace</i>	<i>F</i>	<i>df</i>	<i>Sig</i>	<i>Partial Eta Squared</i>
Disparity	.587	19.177	(4, 54)	.000	.587

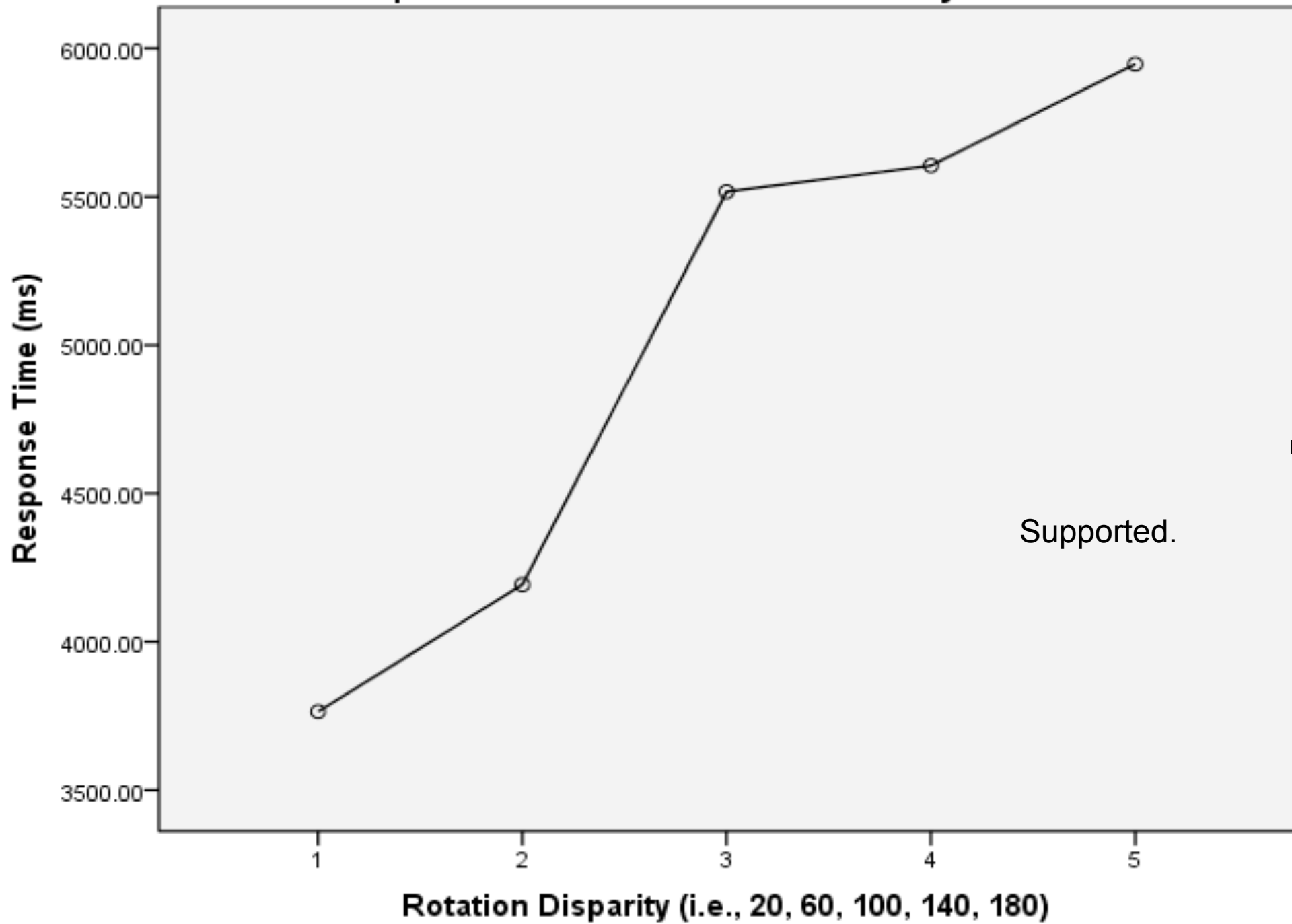
*N* = 58. Both groups analyzed together.

Results of test of within-subjects contrast to test for linear effects of disparity on response latency.

		<i>F</i>	<i>Sig</i>	<i>Partial Eta Squared</i>	<i>Observed Power</i>
Disparity	<b>Linear</b>	<b>66.859</b>	<b>.000</b>	<b>.539</b>	<b>1.000</b>
	<b>Quadratic</b>	<b>7.721</b>	<b>.007</b>	<b>.119</b>	<b>.780</b>
	<b>Cubic</b>	<b>4.600</b>	<b>.036</b>	<b>.075</b>	<b>.559</b>
	<b>Order 4</b>	<b>16.906</b>	<b>.000</b>	<b>.229</b>	<b>.981</b>

*N* = 58. Both groups analyzed together.

**Response Time for "Same" Tasks Only**



Multivariate results for the effect of task disparity on response accuracy for the mental rotation task.

	<i>Pillai's Trace</i>	<i>F</i>	<i>df</i>	<i>Sig</i>	<i>Partial Eta Squared</i>
Disparity	.543	16.028	(4, 54)	.000	.543

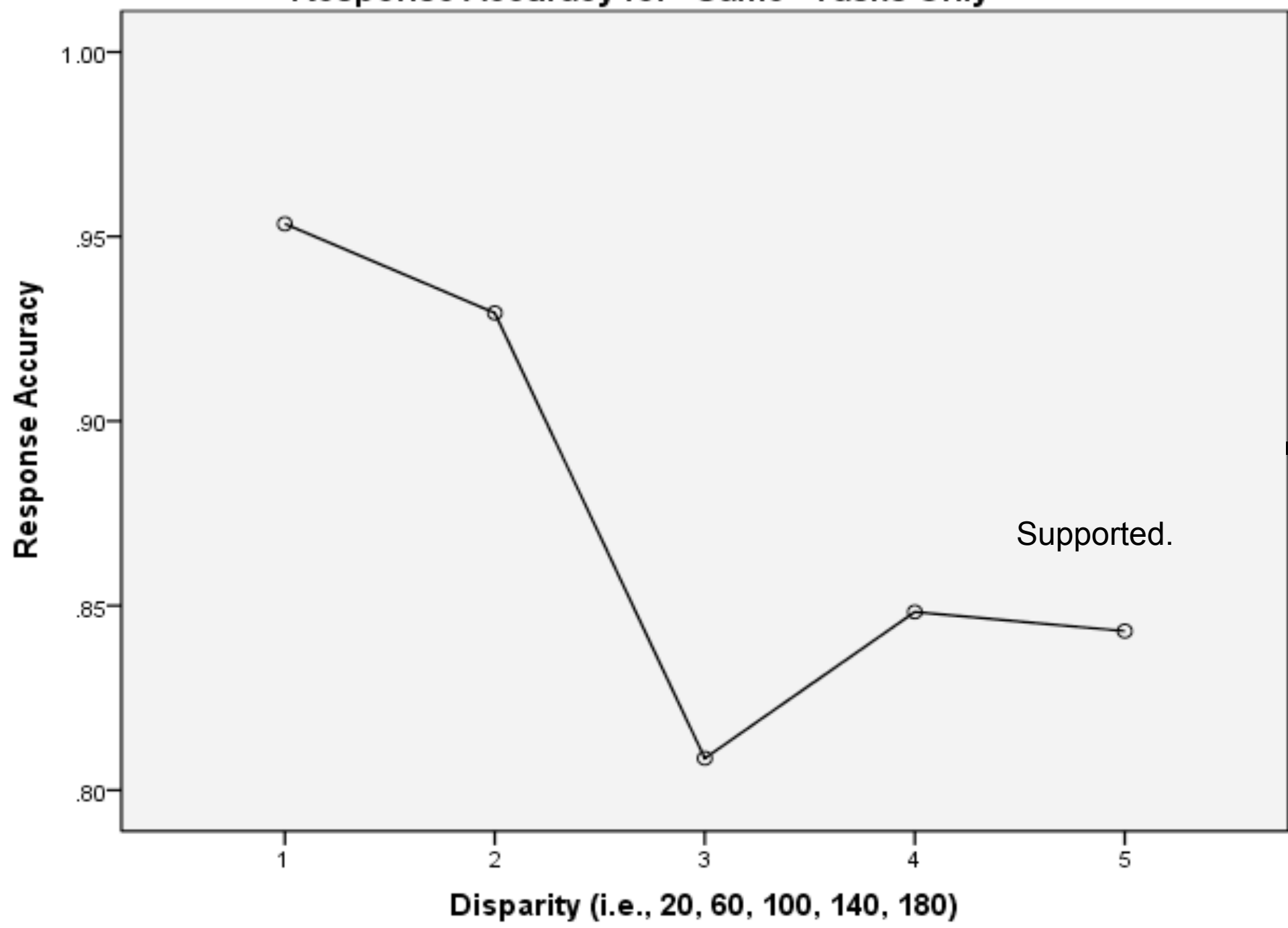
*N* = 58. Both groups analyzed together.

Results of test of within-subjects contrast to test for linear effects of disparity on response latency.

		<i>F</i>	<i>Sig</i>	<i>Partial Eta Squared</i>	<i>Observed Power</i>
Disparity	<b>Linear</b>	<b>51.804</b>	<b>.000</b>	<b>.476</b>	<b>1.000</b>
	<b>Quadratic</b>	<b>13.195</b>	<b>.001</b>	<b>.118</b>	<b>.946</b>
	Cubic	2.055	.157	.035	.291
	<b>Order 4</b>	<b>9.498</b>	<b>.003</b>	<b>.143</b>	<b>.858</b>

*N* = 58. Both groups analyzed together.

**Response Accuracy for "Same" Tasks Only**



## Hypotheses 2 and 3

- (2) Response latency will differ between groups. Pilots will respond more quickly than non-pilots.
- (3) No differences on response accuracy.

Results of MANCOVA for Sex and Group Effects on Response Accuracy and Response Latency for both the Mental Rotation Tasks and Angular Judgement Tasks.

	<i>Pillai's Trace</i>	<i>F</i>	<i>df</i>	<i>Sig</i>	<i>Partial Eta Squared</i>	<i>Observed Power</i>
Sex	.063	.846	(4, 50)	.503	.063	.250
Group	.336	6.448	(4, 50)	.000	.336	.970

*N* = 56. Both groups analyzed together.

Main Effects of Group on Response Accuracy and Response Latency

	<i>F</i>	<i>Sig</i>	<i>Partial Eta Squared</i>	<i>Observed Power</i>
<b>MRTac</b>	<b>4.480</b>	<b>.039</b>	<b>.078</b>	<b>.547</b>
MRTrl	.259	.613	.005	.079
<b>AJTac</b>	<b>23.415</b>	<b>.000</b>	<b>.306</b>	<b>.997</b>
AJTrl	.704	.405	.013	.131

*N* = 56. Both groups analyzed together.





# Summary of Results

Response latency and accuracy seem to be linear functions of disparity.

- Nonlinear effects are puzzling.

Group differences on response latency hypothesis was not supported (Dror, Kosslyn, & Waag, 1993).

- Power

Mixed support regarding accuracy



# Future Research

g and s in pilot performance and relative importance (Lohman, 1993; Ree & Carretta, 1996; Grömpling, 2007; Lang, Kersting, Hülshager, & Lang, 2010)

Dimensionality (Colom, Contreras, Botella, & Santacreu, 2001; Burton & Fogarty, 2003)



Thank You!