

Individual differences in visual perception in adults

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2019-11-08 10:09:14

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Purpose

This document serves as the master protocol for the study.

Key references

- Abramov, I., Gordon, J., Feldman, O., & Chavarga, A. (2012). Sex & vision I: Spatio-temporal resolution. *Biology of Sex Differences*, 3(1), 20. Retrieved from <http://dx.doi.org/10.1186/2042-6410-3-20>
- Murray, S. O., Schallmo, M.-P., Kolodny, T., Millin, R., Kale, A., Thomas, P., Rammsayer, T. H., et al. (2018). Sex differences in visual motion processing. *Current Biology*. Retrieved from <http://dx.doi.org/10.1016/j.cub.2018.06.014>

IRB

This protocol, “Individual differences in visual perception in adults,” has been assigned protocol number 13345. The most recent IRB approval was granted on 2010-10-14. Files related to the approved (exempt) submission can be found [here](#).

Prior to data collection start

Equipment preparation

First, we need to do benchmark testing to determine what screen resolution will work at the highest temporal resolution (120 Hz). This study requires high temporal resolution in order to measure temporal thresholds—the shortest stimulus duration that participants require in order to accurately detect the direction of motion.

Once we have determined the best monitor settings, we will calibrate the monitor before we start collecting data. Those steps follow.

Calibrate Monitor

Prepare Computers

- In 503B Switch on power of large surge protector on bottom left shelf.

Prepare Photometer

- Take the photometer out of the box.
- Set it up by plugging in the power and the light meter.
- Turn on the photometer
- Ensure the following settings:
- Zero the photometer by placing the cap on the light meter and pressing the ‘zero’ button

Start Calibrating Luminance

- Turn on the computer
- In 503B switch on power of large surge protector on bottom left shelf.
- Log-in (Gilmore Lab)
- Start Psychopy - Click icon on Task Bar
- Open Monitor Settings - Go to Tools > Monitor Center
- Click **XXXX**
- Enter the Monitor Screen Width in centimeters
- Select **Start**

We may check the monitor calibration during data collection at a frequency we will decide later.

Survey preparation

This study uses Qualtrics to collect implied/oral consent and other data from participants. Yiming has generated a draft survey, saved here as a *.qsf format text file.

The URL for the survey is https://pennstate.qualtrics.com/jfe/form/SV_1FCXbmrfTWprQON

Scheduling participants

Overview

Rick Gilmore is the PI on the SONA Systems study (Study ID 2587) associated with this protocol. Yiming Qian and Andrea Seisler are researchers. The URL is https://pennstate.sona-systems.com/exp_info.aspx?experiment_id=2587.

The process of scheduling participants involves the following steps:

1. Create slots on SONA with specific dates and times
2. When slot is scheduled, email sent to Yiming and Andrea.
3. Scheduled slots will be added to lab calendar.
 - The scheduled RA will be added to the title of the slot
 - The RA will also be invited to the google calendar event.
4. Researchers will be contacted by email and Discord by Yiming or Andrea if they are needed for a slot that is not part of their regularly scheduled lab time.

Weekly testing slots

Day of Week	Time	Researcher(s)	Lead
Mon	09:00a	Rachel	Andrea
	10:15a	Sandy, Emily, Rachel	Andrea
	11:30a	Sandy, Emily, Amar	Yiming
	1p		Yiming
	2:15p		Yiming
	3:30p		Yiming
	4:45p		Yiming
Tue	9a	Michelle, Rachel	Andrea
	10:15a	Michelle, Rachel	Andrea
	11:30a	Amar, Michelle	Andrea
	12:45p	Michelle, Joseph, Amar	Andrea
Wed	10a	Sandy, Rachel, Amar, Emily	Yiming
	11:15a	Sandy, Rachel, Amar, Emily	Andrea
	12:30p	Luka	Andrea
	1:45p		Yiming
	3p		Yiming
	4:15p		Yiming
	5:30p		Yiming
Thu	9a	Joseph, Michelle, Luka, Rachel	Yiming
	01:00p		Yiming
	02:15p		Yiming
	03:30p		Yiming
	04:45p		Yiming
Tue	09:00a	Michelle, Rachel	Andrea
	10:15a	Michelle, Rachel	Andrea
	11:30a	Amar, Michelle	Andrea
	12:45p	Michelle, Joseph, Amar	Andrea
Wed	10:00a	Sandy, Rachel, Amar	Yiming
	11:15a	Sandy, Rachel, Amar, Emily	Andrea
	12:30p	Luka	Andrea
	01:45p		Yiming

Day of Week	Time	Researcher(s)	Lead
Thu	03:00p		Yiming
	04:15p		Yiming
	05:30p		Yiming
	09:00a	Joseph, Michelle, Luka,Rachel	Yiming
	10:15	Rachel	Yiming
	11:30a	Amar	Yiming
	01:30p	Luka	Yiming
	02:45p		Yiming
	04:00p		Yiming
	05:15p		Yiming
Fri	09:00a	Rachel	Yiming
	10:15a	Rachel, Emily, Amar	Yiming
	11:30a	Rachel, Emily, Amar	Andrea
	12:45p	Emily, Amar	Andrea
	02:00p	Michelle	Yiming
	03:15p		Yiming
	04:30p		Yiming

Day of visit

Before participant arrives

- Check to see if there have been any cancellations.
- If the scheduled study is still on the books, proceed as follows.

Set-up for Vision Screening

Preparation

Materials for vision screening are stored on the table next to Andrea's office.

- Make sure the black tape is on the floor 10ft from the HOVT Snellen Acuity Chart which is on the door to 503B
- Place Stereo Acuity Test and Glasses on table
- Place Color Vision Test on table
- Place the Vision Screening Score Sheet on the table

Review vision screening procedures

The vision screening protocol may be reviewed at [this link](#)

Set up for computer-based tasks

Stimuli Computer

- *Log into Data Collection Computer*
 - Turn on the power of the data collection computer
 - Turn on the CRT monitor in 503B
 - Log-in (Gilmore Lab)
- *Start Psychopy*

- Click **PsychoPy** icon on Task Bar

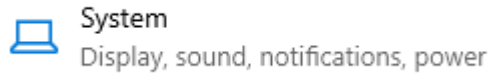


- *Double-check monitor settings within Windows*

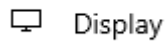
- Click Settings ('gear') icon on Task Bar



- Choose **System**



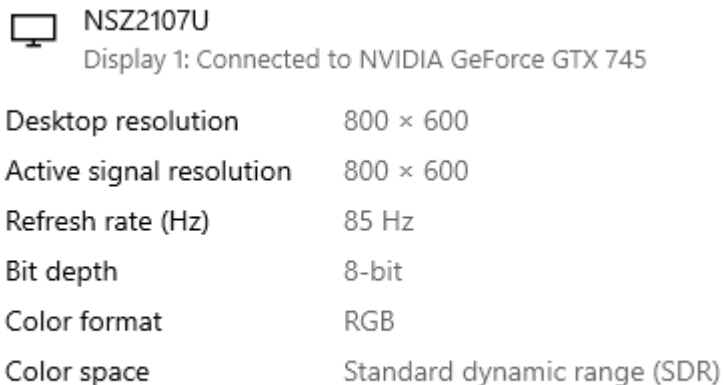
- Choose **Display**



- Choose **Advanced display settings** (You may need to scroll down to see this)

Advanced display settings

- Make sure the window that appears has the following Settings



Display adapter properties for Display 1

- *Double-check Brightness/Contrast of monitor*
 - Contrast:
 - Brightness:
 - Press any button on the monitor (except Signal A/B/OSD OFF and the Power button)
 - Navigate to the leftmost option in the settings menu (looks like a half moon)
 - Press the down button on the monitor
 - Adjust the Contrast (leftmost option) to the required setting using the +/- buttons on the monitor
 - Adjust the Brightness (second option from the left) to the required setting using the +/- buttons on the monitor
- *Check monitor within PsychoPy*
 - Go to **Monitor Settings**



- View Settings, they should be as follows

Survey Computer

- Log-in to survey computer
- Load page with surveys: https://pennstate.qualtrics.com/jfe/form/SV_1FCXbmrfTWprQON

After participant arrives

Welcome participant

Say:

“Welcome to the brain, behavior, and development lab. Are you here for the study about motion perception?”

If the participant answers yes, say:

“Great. You can put your coat on the back of the door and your bag here.”

- Store coat on back of main door and bags by the file/bookcase.

“Are you <NAME OF PERSON ON SONA SYSTEMS SITE SCHEDULED FOR THIS SESSION>?”

- If the participant answers yes, say:

“Ok. We want to make sure that you get credit for participation. Please sit here for the first portion of the study.”

- Have the person sit at the computer where the survey will be taken.

Begin the survey

- Enter the ID: YYYY-MM-DD-HHMM based on appointment time

Conduct the implied verbal consent. You may say to the participant or have them read the following text:

You are being invited to volunteer to participate in a research study. This summary explains information about this research.

- The purpose of this voluntary research study is to investigate how human beings perceive motion in an experimental setting and how this ability is related to personal interests and other abilities. The results of this research study will help scientists gain a deeper understanding of what contributes to individual differences in motion perception, and whether or how motion perception is correlated with other aspects of life.
- You will complete some computer-based surveys about your background, personal interests, spatial and verbal abilities (~25 min). Then, you will complete one or two short (10-20 min) computer tasks in which you will attempt to detect motion or recognize the direction of motion presented on a computer screen.
- All questionnaire and computer task data you provide will be saved using a numeric code. No information about your identity or how to contact you will be saved with the data.
- If you are participating as part of the Psychology Subject Pool, you will receive course credit for participating (at the rate of ½ credit per ½ hours) as specified in the syllabus provided by your instructor. This means you will get 1 credit for participating this research. Alternative means for earning this course credit are available as specified in the syllabus.

If you have questions, complaints, or concerns about the research, you should contact Yiming Qian at 814-863-3116 or Rick Gilmore at 814-865-3664. If you have questions regarding your rights as a research subject or concerns regarding your privacy, you may contact the Office for Research Protections at 814-865-1775.

Your participation is voluntary and you may decide to stop at any time. You do not have to answer any questions that you do not want to answer.

Clicking the “Take The Survey” button implies two things: (1) that you are at least 18 years of age, and (2) you voluntarily consent to participate in the research. Thank you!

Once the consent is complete, say:

“That’s great. Now we’d like to move on to the vision screening portion of the study. Are you ready?”

- If the participant says yes, proceed.

Complete pattern visual acuity testing

- Complete pattern acuity test
 - Adult - HOTV @ 10ft

Questionnaires

“Thank you. Now we’d like to move on to the questionnaire portion of the study. Are you ready?”

- Have the participant sit back down at the computer.
- Let the participants finish the questionnaire.
- Ask the participant if they need a little break. If the participant wants to keep going, lead them to the test room

Say:

“You have finished the first part of testing. Next you have behavioral testing. Do you want to continue or have a little break?”

Set-up for computer-based tasks


- Guide participant to the testing room.
- Have them sit in the chair.
- Adjust the monitor and participant position.
- The monitor should be located **60cm** from the bridge of the nose on the participant.
- The chair height should be set so the participant is looking in the middle of the screen.
- Guide the participant to use the arrow keys for responses and the space bar to advance the screen.

Run computer-based tasks

Select run order

The order of the computer experiments will be randomized across participants in Qualtrics - run the Murray et al. task first - run the Abramov et al. task first. *Record the task run first on the experiment run log.*

Murray et al.

- Open PsychoPy by clicking on the icon located on the desktop.
- When PsychoPy opens, open the file for this experiment.
 - From the **File** menu, select the **Open Recent...** command and select the `motion-temporal-threshold.py` file.
- When the file opens, run the experiment by pressing the green (running person) button. 
 - **Be careful not to type in the programming window.**
 - A welcome screen with the following message will appear: *Welcome to the motion duration threshold study. Press any key to continue.*
- When you are ready to enter the participant ID, press a key on the keyboard.
 - A pop-up window will appear.
 - Enter the participant ID and gender in the pop window, and press the **Ok** button to enter the data.
- Speak to the participant

“In this task, you will try to detect whether a small patch of stripes is moving to the left or to the right. The time the patch appears on the display will get shorter and shorter. Our goal is to find out the shortest duration you need to reliably detect the direction of motion.”

“This task takes about 2 min to complete. But to make sure that we get reliable results, we’ll need to do it 4 times. You can take a short break between the sections.”




“Put your fingers on the left and right arrow keys. You’ll press the left arrow if you see motion to the left and the right arrow if you see motion to the right. If you aren’t sure, make your best guess.”

“Remember, accuracy is more important than speed. Please take your time.”

“Are you ready. Ok, let’s go.”

Abramov et al.



- Open PsychoPy by clicking on the icon located on the desktop.
- When PsychoPy opens, open the file for this experiment.
 - From the **File** menu, select the **Open Recent...** command and select the `xxx.py` file.
- When the file opens, run the experiment by pressing the green (running person) button. 
 - **Be careful not to type in the programming window.**
 - A welcome screen with the following message will appear: *Welcome to the motion duration threshold study. Press any key to continue.*
- When you are ready to enter the participant ID, press a key on the keyboard.
 - A pop-up window will appear.
 - Enter the participant ID and gender in the pop window, and press the **Ok** button to enter the data.
- Speak to the participant

“In this task, you will try to detect the direction of a small patch of black and white stripes that are vertical or horizontal. The width of the stripes will get smaller and smaller. Our goal is to find out the smallest stripe width that you need to reliably detect the direction of stripes.”

“This task takes about 2 min to complete. But to make sure that we get reliable results, we’ll need to do it 4 times. You can take a short break between the sections.”

“Put your fingers on the down and right arrow keys. You’ll press the right arrow if you see horizontal stripes and the down arrow if you see vertical stripes. If you aren’t sure, make your best guess.”

“After you see the black dot, you will press the space bar to start the trial and wait for the white dot to appear to respond.”

“Remember, accuracy is more important than speed. Please take your time.”

“Are you ready. Ok, let’s go.”

(Optional) stereo acuity and color vision tests

If there is time left (5 min before the end of the 1 hr session),

“Thank you so much. It looks like we have time for two more short vision tests. Please come sit over here at this table.”

Escort participant to table.

- Complete Stereo Acuity Test
- Complete Color Vision Test

After session ends

Thank participant

- After the participant finishes all the tests, thank him/her.
“Thank you for participating this experiment. We appreciate your time. Do you have any questions?”
- Answer any questions the participant might have. You may direct them to Yiming or to Dr. Gilmore if you are unable to answer the question.

Give participant credit on SONA

- Yiming or Andrea will assign credit in SONA.

Clean-up

- Clean keyboard, mouse and table and begin data export (separate protocols).

Data processing

Gathering

Retrieve Behavioral Data

- Output data files from the computer task are stored
 - /Documents/PsychoPy-Stimuli/**Murray Folder Name**/csv
 - /Documents/PsychoPy-Stimuli/**Abramov Folder Name**/data
- Data must be copied to the **Gilmore Lab Participant Data** drive from the testing PC.
- Data will be copied to Box (XXX).
- After data export is complete, turn off computer and monitor in 503B.

Retrieve Qualtrics Data

- Log in to Qualtrics <https://pennstate.qualtrics.com/>
 - To review total summary, which shows total graph summary of survey distribution
 - * Click on **Distributions** tab
 - To review individual responses to survey questions
 - Click on **Data & Analysis** tab
 - Under **Actions** click to open drop down menu
 - Click **view response**

Transfer vision screening data

- Vision Screening Data will be entered into the last page of the Qualtrics Survey.

Validation and cleaning

The `analysis/session_qa.Rmd` script imports a data file specified as an input parameter, for example:

```
rmarkdown::render('analysis/session_qa.Rmd', params = list(data_fn='2019-10-29-140253_temp_thresh.csv'))
```

The script should be improved to output a custom HTML or PDF report for each participant file. To view an example, visit this link.

Visualization

Analysis

Appendices

Purpose

This following explains the terminology we use in this study.

Terms

Contrast-sensitivity function (CSF) task

This is the spatio-temporal contrast sensitivity function task from Abramov et al.

Temporal threshold task

This is the temporal threshold task from Murray et al.

Qualtrics

PsychoPy

SONA Systems

Purpose

The following summarizes the display and experimental parameters for the two studies in order to clarify which ones we have chosen for our replication.

Abramov, I., Gordon, J., Feldman, O., & Chavarga, A. (2012). Sex & vision I: Spatio-temporal resolution. *Biology of Sex differences*, 3(1), 20. [bsd.biomedcentral.com](http://dx.doi.org/10.1186/2042-6410-3-20). Retrieved from <http://dx.doi.org/10.1186/2042-6410-3-20>

Murray, S. O., Schallmo, M.-P., Kolodny, T., Millin, R., Kale, A., Thomas, P., Rammsayer, T. H., et al. (2018). Sex differences in visual motion processing. *Current Biology*, Retrieved from <http://dx.doi.org/10.1016/j.cub.2018.06.014>

Murray et al.

- contrast levels (low = 3%, high = 98%)
- Diameter = 0.84, 1.7 and 10°
- Motion speed was 4 cycles/s (Hz)
- spatial frequency was 1.2 cycles/°.
- Gratings were presented within a circular aperture, whose edges were blurred with a Gaussian envelope (SD = 0.21°)
- Trials began with a central fixation mark, a small shrinking circle (850 ms).
- This was followed by a blank screen (150 ms)
- after which the grating stimuli appeared (variable duration controlled by a staircase procedure, range 6.7 – 333 ms)
- followed by another blank screen (150 ms), and finally a fixation mark (the response cue)

Abramov et al. 2012

Tabular comparison

Parameter	Abramov	Murray
Stimulus	grating	grating
Spatial frequency (cyc/°)	0.6, 1, 2, 5, 12, 24.4	1(UR ¹), 1.2(UW ²)
Temporal frequency (cyc/s; Hz)	1, 4, 8, 15, 24	4(UW)
Speed (cyc/s)		4(UR), 4.8(UB ³)
Contrast	via staircase	0.3%(UW), 42%(UR), 95%(UB), 98(UW)%
Contrast modulation	sinusoidal counterphase	left/right motion
Temporal onset	0.5s ramp up; 1s steady at max contrast; 0.5s ramp down	trapezoidal rise, steady, decline
Mask/shape	circular	gaussian, SD=0.21°(UW), raised cosine(UR, UB)
Size (°)	3.5	0.85(UW), 1.7(UW), 2(UR, UB), 4(UR, UB), 6(UB), 8(UR, UB), 10(UW)
Surround	White 13° x 13°	
View distance	3600cm	66cm(UW), 146cm(UR)
Task	Orientation discrimination: horizontal/vertical	Direction discrimination: left/right
Response period	Unlimited	
Feedback	Auditory (correct trials)	
Training trials	No	
Staircase algorithm	QUEST	Psi(UW), QUEST(UR, UB)
Staircase trials		30 + 10 catch trials, 44(UB)
Threshold parameters		80%(UR), 82%(UB)
<i>n</i> staircases/condition		4(UW), 2 practice + 6(UR), 6(UB)
Threshold calculation		median of 4(UW); drop high+low then mean of 4(UR), drop high+low then mean of 4(UB)

¹University of Washington cohort

²University of Rochester cohort

³University of Bern cohort

Replication parameters

Criteria

1. Parameters that **maximize** sex differences.
2. Parameters that **minimize** sex differences.
3. Parameters that permit comparison between the two paradigms.

Choices and justification

Abramov

1. Maximize differences
 - High spatial frequency (12, 24.4 cyc/deg)
 - Lower temporal frequencies (1, 4, 8 Hz)
3. Compare between paradigms
 - Contrast varies, so can't equate
 - Use 3.5 or 4 deg in diam
 - Use 4 Hz to equate with Murray
 - Can't equate spatial frequency with Murray and maximize sex difference
 - 1 replications per condition

Murray

1. Maximize differences
 - High contrast (98% vs. 3%)
 - 4 deg in diam
3. Compare between paradigms
 - Used 1.2 cyc/deg, conflicts with maximizing sex differences in Abramov
 - 3.5 or 4 deg in diam
 - Can't equate contrast
 - Use 4 Hz as in Murray
 - Multiple replications per condition

Recommendations

MUST - Abramov: 12 cyc/deg, 4 Hz, 3.5 deg diam, 4 reps - Murray: 1.2 cyc/deg, 4 Hz, 3.5 deg diam, 4 reps, 98%contrast

POSSIBLE, IF TIME - Abramov: 1.2 cyc/deg (minimize sex differences) - Murray: 3% contrast (minimize sex difference)

- Decided **NOT** to have catch trials, but decide on criteria for dropping participants or runs based on threshold estimation.
-