

Individual differences in visual perception in adults

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Contents

Purpose	2
Key references	2
IRB	2
Prior to data collection start	2
Equipment preparation	2
Calibrate Monitor	3
Prepare Computers	3
Prepare Photometer	3
Start Calibrating Luminance	3
Survey preparation	3
Scheduling participants	3
Overview	3
Weekly testing slots	4
Day of visit	5
Before participant arrives	5
Set-up for Vision Screening	5
Set up for computer-based tasks	5
After participant arrives	8
Complete pattern visual acuity testing	9
Questionnaires	9
Set-up for computer-based tasks	9
Run computer-based tasks	10
Stereo acuity and color vision tests	12
After session ends	13
Thank participant	13
Give participant credit on SONA	13
Clean-up	13
Data processing	14
Gathering	14
Retrieve Behavioral Data	14
Retrieve Qualtrics Data	14
Transfer vision screening data	14
Validation	14
Visualization	14
Analysis	15

Appendices	15
Purpose	15
Terms	15
Contrast-sensitivity function (CSF) task	15
Temporal threshold task	15
Qualtrics	15
PsychoPy	15
SONA Systems	15
Purpose	15
Murray et al.	16
Abramov et al. 2012	16
Tabular comparison	16
Replication parameters	17
Criteria	17
Choices and justification	17

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. Minor modifications of the items in the forms do not need to submit a modification.

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. Replication of Abramov et al. (2012) study requires the best luminance resolution, which permitted the presentation of very low contrast stimuli. 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_5AoCVwYH7ZsXFQh. **UPDATED 2020-1-23.**

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 in the system.

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	Emily, Luka	Andrea, Yiming
	10:00a	Emily, Luka	Andrea, Yiming
	11:00a	Emily, Luka	Yiming
	12:00p	Sandy	
	01:00p	Emily	Yiming
	02:00p	Amar	Yiming
	03:00p	Amar	Yiming
	04:00p	Amar	Yiming
	05:00p	Rachel*	
Tue	09:00a		Yiming, Andrea
	10:00a	Michelle	Yiming, Andrea
	11:00a	Amar, Michelle	Yiming, Andrea
	12:00p	Luka, Rachel	Yiming, Andrea
	01:00p	Luka, Rachel	Yiming, Andrea
	02:00p	Luka, Rachel	
	03:00p		
	04:00p		
	05:00p	Michelle*	
Wed	06:00p	Michelle*	
	10:00a		Andrea
	11:00a		Andrea
	12:00p	Sandy	Andrea
	01:00p	Sandy	Andrea
	02:00p	Amar	Yiming
	03:00p	Amar	Yiming
	04:00p		Yiming
	05:00p	Rachel*	
Thu	09:00a		Yiming
	10:00a		Yiming
	11:00a	Amar	Yiming
	12:00p	Amar, Luka, Michelle, Rachel	Yiming
	01:00p	Luka, Michelle, Rachel	Yiming
	02:00p	Luka, Michelle	
	03:00		
	04:00		
	05:00p	Michelle*	
Fri	06:00p	Michelle*	
	09:00a	Emily	Yiming
	10:00a	Emily	Yiming
	11:00a		Yiming
	12:00p		Yiming
	01:00p		Yiming

Day of Week	Time	Researcher(s)	Lead
	02:00p	Amar*	Yiming
	03:00p	Amar*	Yiming
	04:00p		Yiming
	05:00p		Yiming

Notes: * Possible

* Luka available most evenings

Day of visit

Before participant arrives

- Please arrive *10 minutes prior* to the participant testing time.
- Check with Andrea/Yiming to see if there have been any cancellations or check the green folder with the daily schedule in it.
- 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 (use your individual PSU login)
- *Start Psychopy*

- Click **PsychoPy** icon on Task Bar

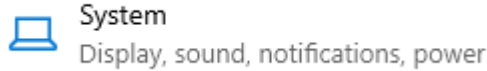


- *Double-check monitor settings within Windows*

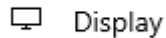
- Click Settings ('gear') icon on Task Bar



- Choose **System**



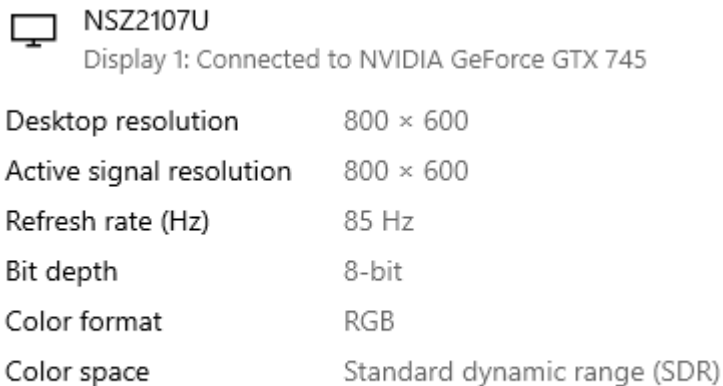
- Choose **Display**



- 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

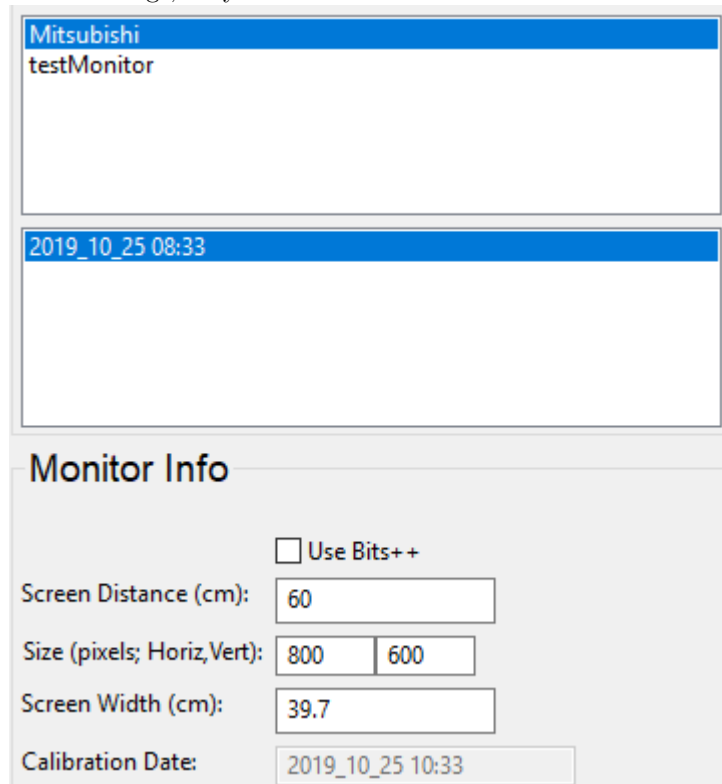


Display adapter properties for Display 1

- *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 with your individual PSU login
- Load page with surveys: https://pennstate.qualtrics.com/jfe/form/SV_5AoCVwYH7ZsXFQh. **UP-DATED 2020-1-23.**

Pick Participant ID

- Participant IDs are listed on the whiteboard in the lab.
- Please select the smallest number
 - Enter this into the Qualtrics Survey
 - Enter this into the Temporal duration threshold task
 - Enter this into the Contrast sensitivity task
 - Write this on the Vision Scoring Sheet
- Cross this number out with the brown marker on the whiteboard.

Daily Schedule

- The Daily Schedule will be located in the green folder

After participant arrives

Welcome participant

Say:

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

Close the door. If the participant answers yes, say:

“Great. You can sit in this chair and put your coat and bags beside you.”

“Do you have your cell phone or is it with your bag/coat? If you have your cell phone, please place it with your bag/coat.”

- 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

Conduct the implied verbal consent.

“Welcome. Today you are going to participate in a set of questionnaires, two computer visual tasks and a few vision screening measures. 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. You will receive course credit for your participation. You may review the consent form on the screen in front of you. Do you have any questions?”

Once the consent is complete (It means the participant clicks to the next page), enter participant ID

- Following the consent page, there is a Participant ID blank spot on the top of visual acuity test page. Please use the smallest number available on the white board. *Take a note* of this participant ID in “Penn State Vision Screening Score Sheet”. Enter this number into the Qualtrics Survey and each of the computer tasks.
- Do not choose a number before the participant arrives.
- When you use a Participant ID from the white board, please cross it out with the brown dry erase marker. All used numbers will be erased at the end of the day.

Then say,

“Great. Now we’d like to move on to the first vision screening test. Could you stand behind this line?”

Complete pattern visual acuity testing

Procedure

- Have participant stand 10 feet away from the chart on the wall (black tape on the floor)
- Ask the participant to start with the top line and have the participant read the first symbols in every line in descending order

“Could you read the first symbols in each line for me from the top to bottom?”
- If they miss a letter, circle it on the score sheet.
- Move back up one line and ask the participant to identify all the optotypes on that line. If the participant identifies all symbols correctly, go to the next line with smaller optotypes and ask the participant to identify all optotypes on the line.

“Could you read all the symbols in this line? And this line?”
- Their visual acuity will be the one that matches the line on which 50% (3 of 5, 4 of 6) of the symbols are identified correctly.

Report results

- Log the answer to each item on the score sheet.
- Log the acuity for the participant in terms of 10 ft (e.g. 10/10)
- Report the result into Qualtrics

Questionnaires

“Thank you. Now we’d like to move on to the questionnaires. Please sit down. You can follow the instructions and finish the survey. Feel free to ask me if you have any questions. Let me know when you finish it.”

- Have the participant sit back down at the computer.
- Let the participants finish the questionnaire.
- Answer the questions if the participants have any, when they work on the questionnaires.
- But be in careful in the hobby page, spatial and verbal page, because the time is recorded. The page will vanish when the time has passed. So, depending on the nature of the questions, answer them fast and emphasize the time is recorded in this page.

After answering the question, say:

>“*Beware: there is a time limit for this page.*”

- If the participant has questions in the instruction page of the hobby test, spatial and verbal test, answer carefully and make sure the participants understand.
- After the participants finish the questionnaire, ask them if they need a little break. If the participant wants to keep going, lead them to the test room

Say:

“You have finished this part. Next you have two computer tasks. 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.
- *place the rear legs of the chair exactly in front of black strips*
- 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.
- *check with participants that they do not bring the cell phone to the dark room*

Say:

“Please come to this room for the behavioral tests. Sit in the chair. Could I move the chair a little bit? I want to make sure every participant is the same distance from the computer screen. Please sit up straight and have your back touching the chair. Do not move your chair.”

“Please do your best and focus on the center of the screen during these tasks.”

Run computer-based tasks


Select run order

The order of the computer experiments will be randomized across participants based on the participant ID entered into Qualtrics.

- run the *temporal duration threshold task* first (Murray et al.) if the ID number is *EVEN*.
- run the *contrast sensitivity task* first (Abramov et al.) if the ID number is *ODD*. *Record the task run first on the experiment run log.*

Temporal duration threshold task (Murray et al.)

Run FIRST if EVEN number for Participant ID

- 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 press the green (running person) button. 
- **Be careful not to type in the programming window.**
- Experimenters need to fill in the participant ID and gender.
 - A pop-up window will appear.
 - Enter participant ID. Make sure it is the same ID that you entered into Qualtrics.
 - Enter gender (enter “f” or “m”, no upper case) in the pop window, and press the **Ok** button to enter the data.
- Speak to the participant

“In this task, you need to detect the moving direction of a small patch of stripes. 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 detect the direction of motion.”

“Which hand do you prefer to press the arrow keys?”

“Put your fingers of your preferred hand 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.”

“Press the SPACE BAR to proceed to the next trial.”



For the left-handed: “You could press this ENTER key on the right side to proceed instead of SPACE BAR.”

“On the computer screen, you will see a black dot at first. When the black dot appears, press the SPACE BAR to start the trial. Then you will see the patch. Make responses of LEFT or RIGHT when the white dot appears.

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

“Do you have any questions right now? I will leave you in the room. Follow the instructions on the screen. Call me when you finished this part.”

- close the door for participants

Contrast sensitivity task (Abramov et al.)

Run FIRST if ODD number for Participant ID

- 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 press the green (running person) button.
- Experimenters need to fill in the participant ID and gender.
 - A pop-up window will appear.
 - Enter participant ID. Make sure it is the same ID as that in qualtrics.
 - Enter gender (enter “f” or “m”, no upper case) in the pop window, and press the **Ok** button to enter the data.
- Speak to the participant



“You will see a small patch of black and white stripes which are horizontal or vertical. Be careful. You need to detect the DIRECTION OF THE STRIPES not the moving direction. (Show the example pictures put in the left side of desk). You can **press the LEFT key if you see the stripes are horizontal, DOWN key if you see the stripes are vertical**. But if you aren’t sure, just guess.”

“The luminance of the stripes will get smaller and smaller. Our goal is to find out the smallest luminance that you need to detect the direction of stripes.”

“Which hand do you prefer to press the arrow keys?”

“Put your fingers of your preferred hand on the left and down keys. You’ll press the LEFT key if you see HORIZONTAL stripes and the DOWN key if you see VERTICAL stripes. If you aren’t sure, make your best guess.”

“Press the SPACE BAR to proceed to the next trial.”

For the left-handed: “You could press this ENTER key on the right side to proceed instead of space bar.”

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

“Do you have any questions right now? I will leave you in the room. Follow the instructions on the screen. Call me when you finish this part.”

- close the door for participants

Stereo acuity and color vision tests

“Thank you. We are going to complete two more short vision tests. Please come sit over here at this table.”

Escort participant to table.

Color Test

Procedure

- The examination should be done indoors with bright, natural illumination of more than 300 lux (lux is a unit of illuminance. 320-500 lux is equivalent to office lighting).
- The plates should be held at a distance of 50 - 75 cm (20-30 inches)

Say:

“This test assesses your color vision. Look at this picture and tell me what you see.” “Now trace the curve.”

- The first exam:
 - *Skip: Examiner shows the participant plate 1 or 2, tracing the red line. Recognized as “circle”, “square”, or some other design.
 - Plate 3 and 4. The participants are required to say outloud “circle”, “square”, or some other design. If the shape is correctly recognized, mark as normal. If the shape is not correctly recognized, mark as abnormal.
- The second exam:
 - Skip: Examiner shows the participant plate 5. Recognized as a curve line.
 - Plate 6: In tracing the winding line between the upper left mark x and lower right mark x, the normal traces the red curve, but the abnormal usually trace the blue.
 - Plate 7: In tracing the winding line between the upper left mark x and lower right mark x, the normal traces the upper green curve, but the abnormal usually trace the lower red curve.
 - Plate 8: In tracing the winding line between the upper left mark x, the normal can trace upper and lower curve and come back to the starting mark. In case of abnormal color vision, some can trace either contour.

When the participant is finished, say:

“Great. Thank you.”

Report results

- Log the answer to each item on the score sheet.
- Those who can not recognize any curve in plate 8 at all, or any lower curve are definitely abnormal.
- They might be abnormal if they misjudge more than 3 plates among plates 3,4,6,7
- If they misjudge 1-2 plates among plates 3,4,6,7, it is better to re-examine him in details from plate 1-8.
- Report the result into Qualtrics

Stereo Vision Test

Procedure

- Have the participant put the stereo glasses on.
- Have the participant sit at the desk and hold the book at arms length approximately perpendicular to their line of sight.

- Provide good light, make sure the pictures maintain the proper axis of polarization before the participants at 15 minutes of arc at a distance of 16 inches.
- Only do the circle test. Point to each item on the left hand side of the page going left to right and up to down.
- Start with No.1.

Say:

“This test assesses your stereoacuity. Do you see the butterfly? Can please trace it? Look at each of the four circles and tell me which one seems to come out closer to you-top, bottom, right, or left.”

Continue until participant gives up trying, or making two successive mistakes. - Some participants may develop this perceptual response slowly. So let them study it for a while or let them change the viewing angle, if needed.

Report results

- Log the answer to each item on the score sheet.
- Record the level of stereopsis into Qualtrics at the last one chosen correctly.

After session ends

Thank participant

- After the participant finishes all the tests, thank him/her.
- *“These are all the tasks for today. Thank you for participation. 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.
- If the participant ask the purpose of this study, read the debrief

debrief

"In this study, the visual acuity test, color vision test and stereo vision test are conducted to make sure you have normal vision to detect the motion in short period or low luminance.

You also have done two computer tests, which examine your performance in motion perception. In this study, we want to investigate whether or how motion perception is correlated with individual's verbal ability, spatial ability, or personal interests. "

“Okay. The principal investigator will give you the credit by the end of the next business day.”

- Say bye to participants

Give participant credit on SONA

- Yiming or Andrea will assign credit in SONA.

Clean-up

- Mark on the daily schedule sheet in the green folder if:

- the participant was Present or a No Show
- the number used for that participant if Present
- Clean keyboard, mouse and table and begin data export (separate protocols).

For the last participant of the day: - Copy the data of this participant to the hard drive

Data processing

Gathering

Retrieve Behavioral Data

- Output data files from the computer task are stored
 - /Documents/PsychoPy-Stimuli/sex-diffs-murray-2018-replication/motion_temporal_threshold_data
 - /Documents/PsychoPy-Stimuli/sex-diffs-abramov-2012-replication/contrast_sensitivity_task_data
- Data must be copied to the **Gilmore Lab Participant Data** drive from the testing PC.
- Data will be copied to Box "`~/Box\ Sync\ Project_Sex_difference_on_Motion_Perception\data/`".
 - There are separate subfolders for each task: `contrast_sensitivity_task_data` and `motion_temporal_threshold_data`.
- 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

- Enter the vision screening data using **SPECIFY**. The experimenter can submit the result in qualtrics.

Validation

Run the group QA report periodically, e.g., at least twice a week:

1. From the `sex-differences-in-motion-perception` project, run `rmarkdown::render('analysis/session_qa.Rmd')`.
2. Review the generated report in your browser located at `analysis/session_qa.html`.

Visualization

A set of commands to generate separate `*.html` reports for each computer task and session can be run:

1. Run `source("analysis/R/batch_qa.R")` from the console to load the scripts into the working environment.
2. Run `visualize_all_computer_task_data()` to generate a set of reports.

3. Run `copy_qa_rpts_to_box()` to copy these reports to Box.

Note that data files and summaries should **NOT** go on GitHub. This workflow ensures that this doesn't happen.

These commands presume that your local Box folder for the project is mounted locally at `~/Box\Sync\Project_Sex_difference_on_Motion_Perception/`. If you have a different local path, e.g. `<MY_PATH>` to Box, you will need to enter it as a parameter to `visualize_all_computer_task_data(<MY_PATH>)` and `copy_qa_rpts_to_box(<MY_PATH>)`.

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)

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.

¹University of Washington cohort

²University of Rochester cohort

³University of Bern cohort