Individual differences in visual perception in adults

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2019-11-13 17:06:09

Contents

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_0Cad5AtrbQN0GKV

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	Rachel	Andrea
	10:15a	Sandy, Emily, Rachel	Andrea
	11:30a	Sandy, Emily, Amar	Yiming
	1p	Emily	Yiming
	2:15p		Yiming
	3:30p		Yiming
	4:45p		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, Emily	Andrea
	01:45p		Yiming
	03:00p		Yiming
	04:15p		Yiming
	05:30p		Yiming
Thu	09:00a	Joseph, Michelle, Luka,Rachel	Yiming
	10:15	Rachel	Yiming
	11:30a	Amar	
	01:30p	Luka	Yiming (every two weeks)
	02:45p		Yiming (every two weeks)
	04:00p		Yiming
	05:15p	Emily	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

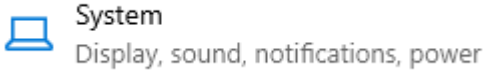
Review vision screening procedures

The vision screening protocol may be reviewed at this link

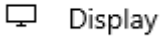
Set up for computer-based tasks

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**

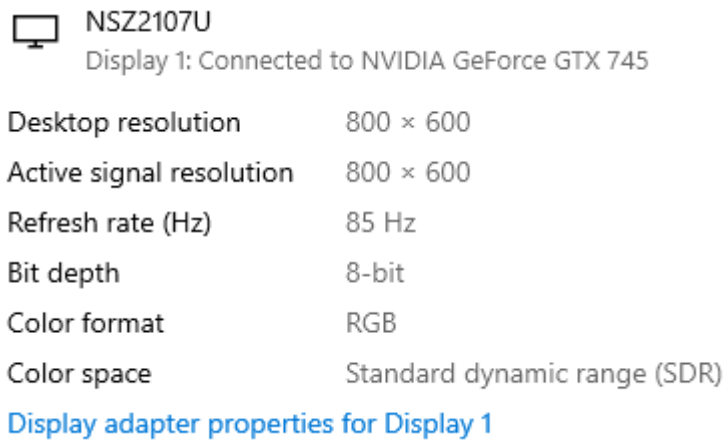
  - Choose **Display**

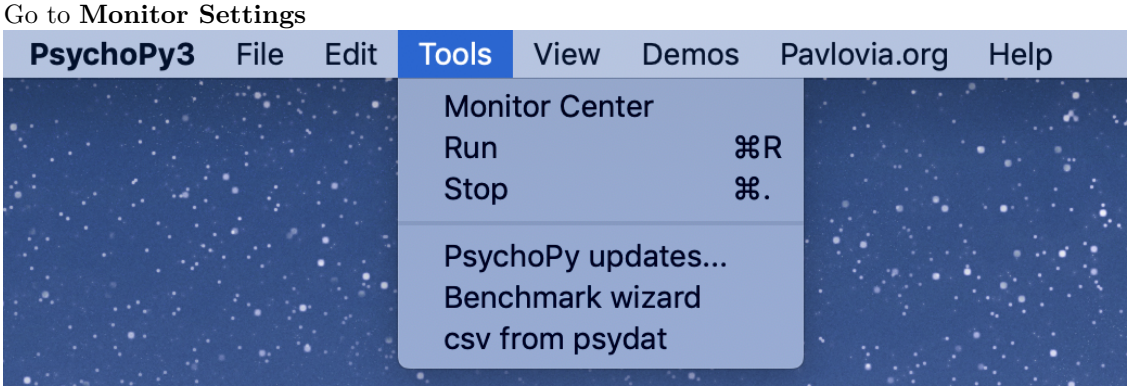
  - Choose **Advanced display settings** (You may need to scroll down to see this)

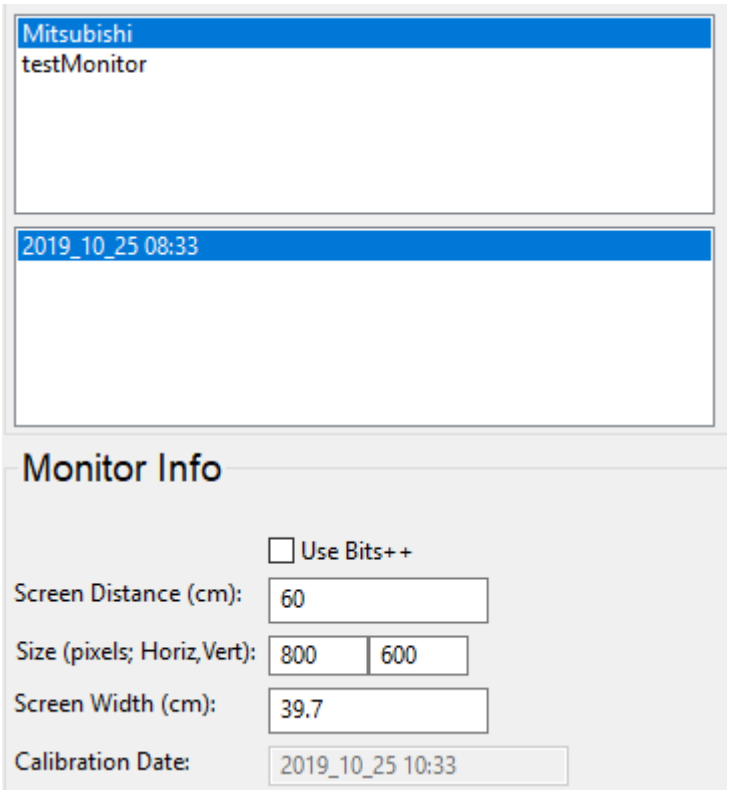
  - Make sure the window that appears has the following Settings



- *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_0Cad5AtrbQN0GKV

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.*"

- 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

- You will see the Participant ID on the top of implied consent. *Take a note* of this participant ID (only the numeric code without comma or hyphen) in "Penn State Vision Screening Score Sheet".

Conduct the implied verbal consent.

> "*Welcome to this study. You could read the summary explanation of this study and click next button to move to the next page. There is one thing I want to highlight: 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.* "

Optional: You may say to the participant or have them read the following text:

"You are being invited to participate in a research study.

- The purpose of this voluntary research study is to investigate how human beings perceive motion in an experimental setting. 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 one computer-based surveys. Then, you will complete two short computer tasks in which you will attempt to detect motion 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 participation 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 could contact principal investigator Yiming Qian or her advisor Rick Gilmore. If you have questions regarding your rights as a research subject or concerns regarding your privacy, you could contact the Office for Research Protections.

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 "Next" 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 (It means the participant clicks to the next page), say:

> "*Great. Now we'd like to move on to the 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. And 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 works on the questionnaires. But in careful in the hobby page, spatial and verbal page, because the time are recorded. The page will vanish when the time have 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 participants have questions in the instruction page of hobby test, spatial and verbal test, answer careful and make sure the participants understand well.
- 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 tests. 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.

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 you are at the right distance to the computer screen. Please sit straight and have you back touching the chair.Do not move your chair.*"

Run computer-based tasks

Select run order

The order of the computer experiments will be randomized across participants based on the participant ID shown in Qualtrics

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

Temporal duration threshold task (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 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.
  - Participant ID in the pop-up window have shown "YYYYMMDD", which is the first part of participant ID. Enter the rest numbers of participant ID based on the note you take from the beginning of 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 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."

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

  "On the computer screen, you will see a black dot at first. When the black dot appear, 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."

  "This task takes about 1 min to complete. But to get reliable results, there are 4 sections. You can take a short break between the sections."

  "Do you have any questions right now? Okay. 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.)

- 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.
  - Participant ID in the pop-up window have shown "YYYYMMDD", which is the first part of participant ID. Enter the rest numbers of participant ID based on the note you take from the beginning of 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 is horizontal or vertical.Be careful. You need to detect the direction of the stripes not the moving direction. (Show her 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 on the left and down keys. You'll press the left key if you see see horizontal stripes and the down key if you see vertical stripes. If you aren't sure, make your best guess."

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

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

  "This task takes about 1 min to complete. But to make sure that we get reliable results, there are 4 sections. You could take a short break between the sections."

  "Do you have any questions right now? Okay. 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

(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.

Color Test

Procedure

- The examination should be done indoors with bright, natural illumination of more than 300 lux.
- 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 the abnormal, some can trace either
- You could provide some feedback to them, say >" You have done excellent job."

Report results

- Log the answer to each item on the score 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.
- 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? 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. - You could provide some feedback to them, say >" You have very good stereo vision."

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. 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 scuity 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 principle investigator will give you the credit later today.*"

- Say bye to participants

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).
- Copy the data of this participant into 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 (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

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

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 constrast 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. 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)

[1]University of Washington cohort
[2]University of Rochester cohort
[3]University of Bern cohort

Parameter	Abramov	Murray
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)
n 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.
