

# PSYC 4165: Homework 3 (CSF)

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## Homework Assignment 3 - 10 Points

**Due by 23:30, Friday, 21 September 2018**

There are two parts to this homework assignment. Each part counts 5 points. Late homework will receive a grade of zero. Your homework must be prepared using R markdown language. Use the help file as a template, changing the date and the author name of course. Knit your Rmd markdown file to a pdf file, and upload the pdf file to the *Assignments:Homework Assignments:Homework 3 PDF Files* dropbox in Canvas before the deadline indicated above.

### Part 1: Data to Examine

The table below presents contrast thresholds (labeled “contrast”) for detecting low-contrast grating patches (“Gabor patches”) of 16 spatial frequencies (labeled “cpd”). This contrast allows detection of the patch with a  $d_a$  of 1.0. The third column (labeled “masked”) gives the detection threshold in the presence of a mask, discussed more fully in Part 2. The table values are available in the “csfData.csv” file included in the help folder.

Table 1: Detection threshold contrasts for different spatial frequencies. Spatial frequencies are given in cycles per degree (cpd).

cpd	contrast	masked
1.00	0.0041	0.0038
1.25	0.0038	0.0036
1.90	0.0027	0.0027
2.65	0.0023	0.0025
3.75	0.0017	0.0017
5.50	0.0016	0.0027
6.60	0.0016	0.0047
8.00	0.0018	0.0060
9.00	0.0021	0.0062
10.65	0.0028	0.0054
15.00	0.0049	0.0049
18.50	0.0085	0.0093
21.25	0.0150	0.0137
26.50	0.0378	0.0346
30.00	0.0702	0.0742
40.00	0.3621	0.3955

### Two Questions and a Graph

Assume that a specific spatial frequency patch having a contrast amplitude less than the corresponding contrast threshold would not be visible.

## Contrast Threshold Function

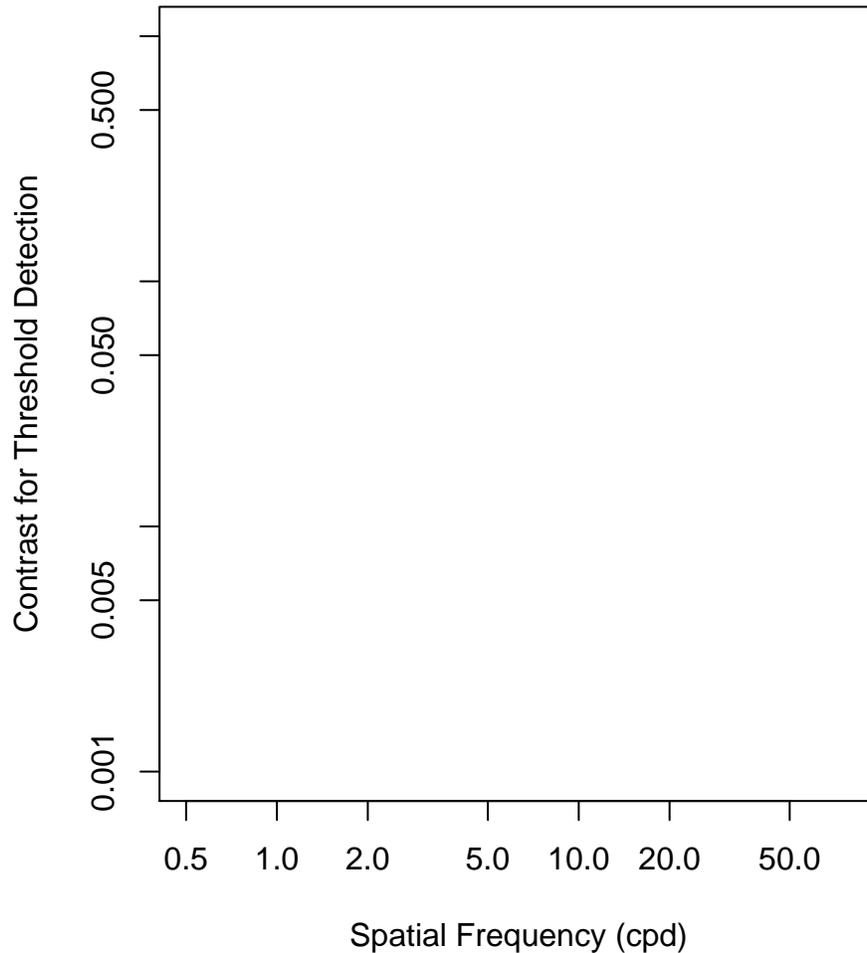


Figure 1: Contrast threshold function for Gabor patches of different spatial frequencies. The vertical lines show the contrasts of two stimuli, one at 3.0 cpd and the other at 30.0 cpd. Will they be visible?

1. Will a 3.0 cpd Gabor patch with contrast of 0.005 be visible? Why or why not?
2. Will a 30.0 cpd Gabor patch with contrast of 0.005 be visible? Why or why not?

Make a graph of the **contrast threshold** as a function of spatial frequency with black symbols connected with lines. Set both axes to be logarithmic. Set the axis ranges to these values: `xlim = c(0.5, 80)` and `ylim = c(0.001, 1)`. Use the `lines()` command to draw vertical lines marking the contrast values of the two stimuli in the above questions. Label the axes appropriately. In the R code chunk where you make the graph, set `fig.height=6` and `fig.width=5` to give a nice plot aspect ratio. Here is how the beginning of the plot code chunk should look: `{r fig.height=6, fig.width=5, fig.cap="Figure caption here"}` Your graph (with data of course) should look like Figure 1.

## Part 2: Contrast Sensitivity Function

### Effects of Masking: A Graph and Two Questions.

The data table gives the contrast thresholds when the Gabor patches were presented superimposed on a high contrast patch of a fixed spatial frequency (labeled “mask”). Using the contrast threshold data in the table to compute contrast sensitivity, plot a graph of the unmasked **contrast sensitivity** function (CSF) with black symbols connected with lines. Add the masked contrast sensitivity points using red symbols connected with lines. Finally, plot the threshold elevation by computing the ratio of the unmasked sensitivity to the masked sensitivity at each spatial frequency and plot these values in blue symbols connected with lines on the graph. Both axes of the graph should be in logarithmic scales ( $\log = "xy"$ ). Make the x-axis run from 0.5 to 80 and the y-axis from 1 to 1000. Label the axes appropriately. Your graph should look like Figure 2 (with data points added, of course).

Compare the graph with CSFs shown in class and in Figures 3.7, 3.9, 3.32, 3.36 and 3.37 of the textbook (Wolf, et al., 2015). Are they the same or are there differences? Explain.

Question: What was the spatial frequency of the high-contrast mask used in the masking experiment? Explain.

## References

Wolfe, J. M., Kluender, K. R., Levi, D. M., Bartoshuk, L. M., Herz, R. S., Klatzky, R. L., . . . Merfeld, D. M. (2015). *Sensation and Perception* (4th ed.). Sunderland, Massachusetts: Sinauer Associates, Inc.

## Unmasked and Masked Contrast Sensitivity

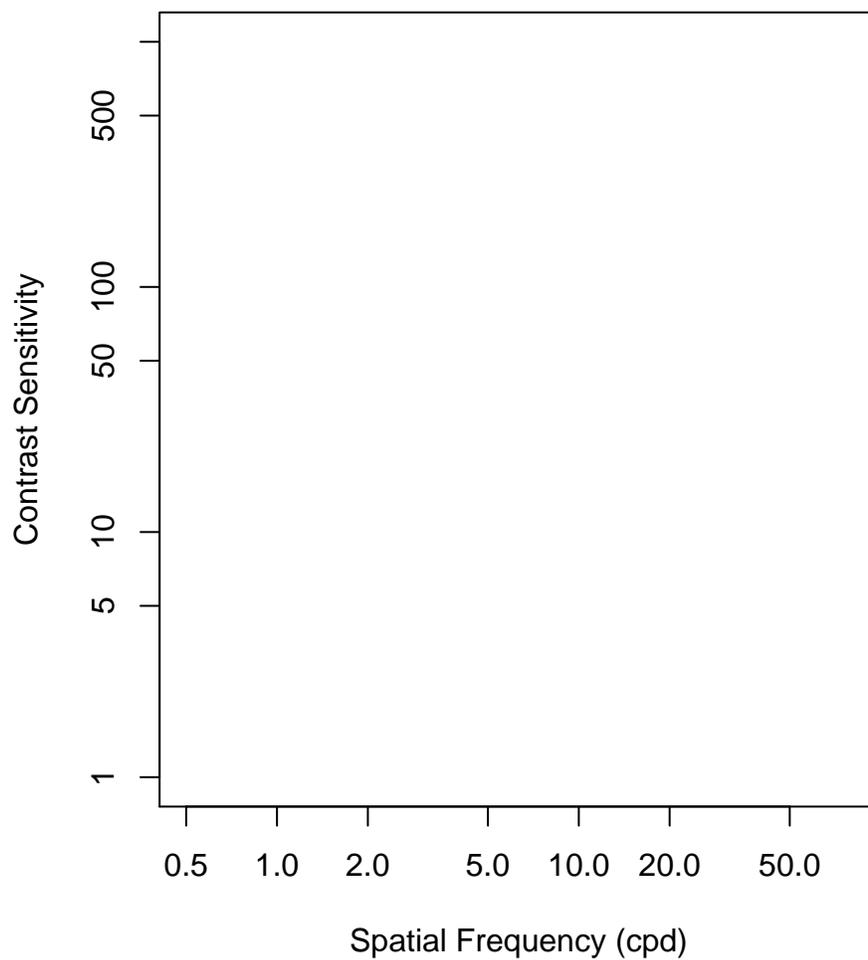


Figure 2: Contrast sensitivity functions for unmasked (red) and masked (blue) gabor patches. The ratio of the two sensitivities are plotted in blue.