

Chapter 14: Presenting Psychophysical Stimuli

Psychophysics is the study of the relationships between physical measures of stimuli and the psychological experiences that they produce. Researchers in psychophysics use precisely calibrated equipment to control sound levels, visual stimuli, olfactory stimuli (smells), vibrations, and other dimensions. They typically present these stimuli to a small number of trained observers (participants) in labs whose precise conditions can be controlled; for example, experiments with auditory stimuli are usually conducted in sound-proof chambers. Because Online researcher do not know what type of computer monitor, browser, or speakers (if any) their Internet participants are using, they really do not have the kind of control that those in psychophysics prefer to have in their research. In addition, some stimuli, (e.g., smells, tastes, tactile stimuli, etc.) simply cannot be sent yet via the Web.

However, despite difficulties, one can illustrate principles of psychophysics with demonstrations on the Internet, and one can still obtain reliable results, even with auditory stimulation (Welch & Krantz, 1996). This chapter will teach a few easy ways to include psychophysical materials in Web pages. At the same time, this chapter will also give some ideas of how to work with frames, tables, graphics, and sounds.

A. A Bit of History

Gustav Fechner lay in bed on the morning of Oct. 22, 1850, wondering how to measure psychological magnitudes. He was not a psychologist, for there was no such department at universities in those days. He was a physicist and a philosopher, but he was thinking about ideas that have become the domain of psychology. Fechner thought that if he could measure psychological values, then a science of psychology might be developed

that would have the kinds of laws one finds in physics. Could psychology have laws in which one can make accurate predictions by making computations with psychological measures? Fechner thought that if one could specify the relationship between the physical measure of a stimulus and its psychological impact, then a quantitative science of psychology would be possible.

Fechner considered Bernoulli's idea that the utility of money is a logarithmic function of its cash value. If Bernoulli were right, a poor man with \$1000 would be as happy to gain \$500 as a rich man with \$100,000 would be to gain \$50,000. He also thought about Weber's finding that the change in stimulus intensity that is just noticeably different is proportional to the standard stimulus. The just noticeable difference in weight is 5 g (the weight of one nickel) for a standard weight of 100 g. A *just noticeable difference* refers to the change in stimulation required to be correctly recognized 75% of the time. For weights, people judge that the weight of 21 nickels is heavier than the weight of 20 nickels 75% of the time. Weber's law, as Fechner called it, implies that it would take a 10 g increment to be just noticeably greater than 200 g; that is, it would take the weight of 42 nickels to be judged heavier than the weight of 40 nickels 75% of the time. For a standard of 400 g, the increase would have to be 20 g to be noticed equally often.

In 1860, Fechner published *Elements of Psychophysics*, a book that connected his theories with methods for quantifying psychological values. Fechner theorized that subjective values of stimuli are logarithmically related to physical values, a principle known as *Fechner's law*.

The logarithmic psychophysical law means that equal physical ratios produce equal psychological differences. For example, the psychological difference in heaviness between

100 g and 105 g equals the psychological difference between 200 g and 210 g. To test the idea, Fechner suggested methods for quantifying the psychological values of stimuli.

Since the days of Fechner, psychologists have applied Fechner's methods and suggested new methods for measurement of psychological values. The *Psychological Review* published a Centennial issue in 1994 celebrating contributions to psychological theory. Thurstone's (1927) law of comparative judgment, which built on Fechner's ideas, was selected as one of the most important contributions of the century (Luce, 1994; Dawes, 1994). Thurstone noted that his methods could be applied to stimuli without a physical measure; for example, they could be used to measure attitudes towards crimes.

A paper by Stevens (1957) on the psychophysical law, which criticized Thurstone's and Fechner's ideas, was also found to be one of the 20 most widely cited papers in the first century of *Psychological Review* (Kintsch & Cacioppo, 1994, p. 198). Stevens (1957) advocated another approach to psychological measurement based on "direct" judgments of magnitude. Stevens concluded that subjective values are a power function of physical values. This relation, known as *Stevens' law*, implies that equal physical ratios produce equal subjective ratios.

Psychologists have used techniques of psychological measurement to measure many different types of psychological values including heaviness of lifted weights, loudness of tones, brightness of lights, roughness of sandpaper, sweetness of drinks, intensity of odors, and the darkness of grays. They have also measured more complex stimuli such as the annoyance of traffic noises, experiences of pleasure and pain, beauty of women and men, the stressfulness of life changes, goodness or badness of moral deeds, and the prestige of occupations.

B. A Table of Neutral Colors

Suppose one wanted to present squares of varying darkness on the screen of the monitor, and ask people to judge relations among their experiences of darkness. The HTML in Figure 14.1, *Ch14_ex1.htm* on the CD, creates a table of stimuli.

Insert Figure 14.1 about here.

Figure 14.1. Use of table and color values. Try varying the `BORDER` and color values. When this stimulus is viewed, Mach Bands (psychological contrast edges) also appear at the edges between areas of different color. Try `CELLSPACING=10` to remove the Mach Bands; also try `BORDER=10`. A space in HTML is written as ` `.

```
<HTML><HEAD><TITLE>Use of a Table to Create Gray Stimuli</TITLE>
</HEAD>
<BODY BGCOLOR="ffffff" text="000000">
<TABLE BORDER=0 CELLPADDING=0 CELLSPACING=0>
<TR >
<TD WIDTH=50 HEIGHT=50 BGCOLOR="dddddd" > &nbsp;</TD>
<TD WIDTH=50 HEIGHT=50 BGCOLOR="bbbbbb" > &nbsp;</TD>
<TD WIDTH=50 HEIGHT=50 BGCOLOR="999999" > &nbsp;</TD>
<TD WIDTH=50 HEIGHT=50 BGCOLOR="777777" > &nbsp;</TD>
<TD WIDTH=50 HEIGHT=50 BGCOLOR="555555" > &nbsp;</TD>
<TD WIDTH=50 HEIGHT=50 BGCOLOR="333333" > &nbsp;</TD>
<TD WIDTH=50 HEIGHT=50 BGCOLOR="000000" > &nbsp;</TD>
</TR>
<TR ALIGN=center>
<TD WIDTH=50 HEIGHT=50 BGCOLOR="ffffff"> A</TD>
<TD WIDTH=50 HEIGHT=50 BGCOLOR="ffffff"> B</TD>
<TD WIDTH=50 HEIGHT=50 BGCOLOR="ffffff"> C</TD>
<TD WIDTH=50 HEIGHT=50 BGCOLOR="ffffff"> D</TD>
<TD WIDTH=50 HEIGHT=50 BGCOLOR="ffffff"> E</TD>
<TD WIDTH=50 HEIGHT=50 BGCOLOR="ffffff"> F</TD>
<TD WIDTH=50 HEIGHT=50 BGCOLOR="ffffff"> G</TD>
</TR></TABLE>
</BODY></HTML>
```

The trick used in this example is to create a table and change the color of each cell of the table. The `<TABLE></TABLE>` tags identify that material between is a table. Within a table there are rows, defined by `<TR>` and `</TR>`. Each cell in a table is defined by the table data tag, `<TD>table data</TD>`. Tables can include text, numbers, pictures, buttons, and `<INPUT>` devices such as text boxes. In *Ch14_ex1.htm*, the table contains spaces, which in HTML are written, ` `.

Borders allow one to create lines of trim or “picture frames” about material. By setting `BORDERS` to zero, one can use tables to align text and pictures in columns. The second example, *Ch14_ex2.htm*, illustrates how variation of `BORDER` can be used to create a frame around the panels of gray. `CELLSPACING` separates the table cells, eliminating the Mach Bands.

The colors in the table are defined by the `BGCOLOR="color"` in each `<TD>` tag, which sets the background of each table cell. These are specified in hexadecimal.

There are several very useful Web sites for computing colors in hexadecimal, which are linked from the list of examples for this chapter.

Hexadecimal means that there are sixteen possible values, which are 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, a, b, c, d, e, and f. The decimal number 10 is represented in hexadecimal by a, and f is fifteen; the hexadecimal number 10 is the decimal number 16. Two digit numbers in hexadecimal include 11, which is seventeen (1 in the 16 place plus 1), and ff, which is 255 in decimal. There are three colors, (red, green, and blue) each of which takes on 256 possible values from 00 to ff (i.e., 0 to 255, in decimal).

In previous chapters, you have seen tags such as `<BODY BGCOLOR="blue">`. You can also designate colors by a six digit number, as in the following example: `<BODY`

`BGCOLOR="0000ff">`. This hexadecimal code says, Red = 00, Green=00, and Blue is 255 (ff). That will produce a dark blue. It is dark because two of the lights (Red and Green) are turned off. If you are used to mixing paints, you know that as you "add" more colors, the mix becomes darker. That occurs because you are adding pigments, each of which absorbs some of the light. Mixing lights is different from mixing pigments--the more lights you add, the lighter the mix. Big numbers will be bright (ffffff), small numbers (000000) will be dark.

So, `BGCOLOR="ff0000"` will produce a dark red, and `BGCOLOR="00ff00"` will produce a dark green. Mixtures of lights will produce other colors, which you can explore in Web sites such as ColorCenterTM (<http://www.hidaho.com/colorcenter/cc.html>), or by trying different combinations yourself.

Colors in which Red, Green, and Blue are equal are sometimes called "neutral" colors, forming the gray scale from 000000 (black), through 888888 (gray) to fffffff (white). Not all colors will display the same on every monitor or with every browser. If someone's monitor looks "green" when it is displaying 666666, then that monitor needs adjustment.

Colors that work best with browsers are those in which both digits are equal within each color (red, blue, and green). The color Web sites also give information on how different browsers differ in their color values.

If you look at the example, notice that all of the digits are the same within each color. These are also neutral colors because the red, green, and blue components are equal. They are also selected to keep the digits within each component equal. If you load the example, you will see that a row of squares of different colors is produced.

C. An Application of Frames

As you learned in Chapter 4, the technique of frames allows you to divide the window into portions that can contain different files. In the next example, frames are used to keep the stimuli visible throughout the experiment, while the participants answer questions about them in another frame.

Consider *Ch14_ex3.htm*, which is listed in Figure 14.2.

Insert Figure 14.2 about here.

Figure 14.2. Illustration of FRAMESET and FRAME tags of HTML.

```
<HTML><HEAD><TITLE>Frameset Illustration</TITLE></HEAD>
<FRAMESET ROWS="100,*">
<FRAME SRC="tablegray.html">
<FRAME SRC="RateGray.htm">
</FRAMESET></HTML>
```

This HTML page uses the `FRAMESET` and `FRAME` tags and has no `BODY` tag. This `FRAMESET` tag divides the window into two rows. The first row is set to 100 pixels, and the `*` designates that the rest of the window is the second frame (see Chapter 4). The `FRAME SRC` tags designate that the first frame will contain the table of stimuli from the first example of this chapter. The second frame will contain an experiment that was made with surveyWiz. The observer (i.e., the participant) can now view the gray stimuli in the upper frame, while making the judgments requested in the form, which shows in the lower frame. In most browsers, the user can adjust the size of frames by clicking the mouse on the frame divider and dragging it to the desired position. Try this in *Ch14_exp1.htm*.

The method illustrated in *Ch14_exp1.htm* is called the *method of equal appearing intervals*, one of Fechner's techniques for measuring psychological value. It is also called the method of category rating. Another technique for judging the magnitude of psychological experiences is called magnitude estimation (Stevens, 1957). That technique is illustrated in *Ch14_exp2.htm*, which was also created by surveyWiz. The technique of magnitude estimation contains instructions that state that the numbers should be proportional to psychological magnitudes. If ratings are linearly related to subjective value, and if magnitude estimations are proportional to the same subjective values, these two scales should be linearly related to each other. The two techniques yield results that are not linearly related, which was a long-standing problem in psychological measurement

(Birnbaum, 1982). The issue of judgments based on intervals and based on ratios of subjective value will be taken up in more detail in Chapter 15.

Frames can be a useful technique when it is desired to display two Web pages at once on the screen. However, they can also be annoying when used inappropriately. One problem with frames is that once a page opens with a frame, then if a link from one frame selects another page with frames, the screen will become subdivided into smaller and smaller pieces. To escape the “tyranny of frames” it can be helpful to use one of the following types of links from pages to be displayed in frames (see also Chapter 4).

```
<A HREF=AnyPage.htm TARGET="_top">click here</A>
```

```
<A HREF=AnyPage.htm TARGET="_blank">or click here</A>
```

The former link TARGET will cause the new page to display at the top of the window, even if it is called by a page displayed within a frame. The latter link creates a new Web browser page, which also displays at the top. These tricks are illustrated in

Ch14_ex3b.htm, which also uses *Ch14_ex3c.htm*.

D. Working with Graphics

Another way to make stimuli is to create them in a program that supports drawing, such as Adobe Illustrator, or even programs like MS Word or PowerPoint, and then save as HTML to create JPEG (.jpg) or GIF (.gif) files. For example, you can make similar stimuli to the grays in *Ch14_ex1.htm* by means of MS Word. Word supports the creation of drawing objects. You can convert these drawing objects to pictures, and then you can *Save As HTML*, which will create files that can be displayed from HTML pages on the Web. MS Word was used to create the graphic shown in *Ch14_ex4.htm*.

Here are four pointers for this approach. First, you should save your files containing drawing objects *before* you convert them to pictures and before you save as

HTML. Once you convert drawing objects to pictures, you have much less control over the separate elements of the picture. Thus, if you decide you want to change something later (e.g., if you move a graphic element from here to there), you will be glad you saved your work as a drawing object in a separate file. Save files of drawing objects and pictures with separate names, so that you can make revisions later on those files. Second, when you are happy with your drawing object, group the elements of your drawings, and copy them to another file. When you copy them, use *Paste Special*, and paste the graphics in the new document as *pictures*. Save this file under a second name. Third, from the **File** menu, select *Save As HTML...* and save the HTML under a third name. If your document contained several pictures, these will be saved in a folder with names such as *image001.gif*, *image002.gif*, etc. You should be aware of the fact that when you convert from a drawing object to a picture, and then from a picture to JPEG or GIF, that the appearance of colors and figure elements may change. Fourth, realize that the appearance of a file as displayed by the program that created it may not be the same as its appearance when viewed in a browser.

Examples of similar sets of gray stimuli that were created with MS Word is included in *Ch14_ex4.htm*. If you look closely at these stimuli in the browser, you will see that the gray colors are not uniform in color, but grainy. The color values used in the creation of the stimuli are slightly different in the two sets displayed in the example.

A set of dot patterns, similar to those used by Thurstone (1929), in his classic study of Fechner's law, and by Birnbaum (1978; 1982), is also included on the CD. These seven figures were created as drawing objects in MS Word. Each figure was then grouped and copied to a new file, where they were pasted special as pictures, and the new file containing

seven pictures was saved as HTML. The seven images were then renamed from *image001.gif*, *image002.gif*, etc. to *dots1.gif*, *dots2.gif*, etc.

Next, factorWiz was used to create an experimental file containing symbolic values for the rows and columns (r1, r2, r3, etc. for rows, and r1, r2, etc. for columns). Then, with search and replace, each "r4" was replaced with the tag to insert the appropriate stimulus:

```
<IMG SRC=dots4.gif width=50 height=50 align=middle>
```

This process was repeated six times until all of the stimuli (i.e., r1, r2, ...r7) had been replaced by the appropriate tags. The stimuli and materials for factorial experiments of "ratio" and "difference" judgments are included on the CD. The trick of using search and replace would also work for extensive blocks of text that would not fit in the boxes of factorWiz. The analysis of this type of experiment will be taken up in Chapter 15.

Also included on your CD is an experiment on the Mueller-Lyer illusion, a classic perceptual illusion. Click the link in the examples and complete the experiment. The method of creating the experiment, which was also done with the help of factorWiz, will be explained next.

E. Mueller-Lyer Experiment

The Mueller-Lyer experiment uses a 5 by 6, factorial design of Horizontal Line length by Fin type. The five levels of horizontal line length were 98, 99, 100, 101, and 102 mm. The six levels of fins were no fins, in-going fins at 30 degrees, in-going at 60 degrees, right angle (90 degrees), outgoing fins at 120 degrees, and outgoing fins at 150 degrees. These 30 figures were made in Adobe Illustrator 5.0 and saved as .jpg files. They were given names of *L1F0.jpg* to *L5F5.jpg*, where the number following the letter *L* indicates the level of line length (from *L1* = 98 mm to *L5* = 102 mm). The number following the *F*

indicates the level of fin type ($F0$ = no fins, $F1$ = in going fins at 30 degrees to $F5$ = out going at 150 degrees).

In this experiment, the fins do not join the lines, and are clearly distinct from them. Some theories of the illusion hold that there should be no Mueller-Lyer illusion in these figures.

Realize that to display a figure requires an HTML tag such as the following:

```
<IMG SRC=l5f5.jpg ALIGN=MIDDLE>
```

Because the figures have been named in a factorial form, one can use factorWiz (Chapter 11) to make the experimental Web page for this experiment. The trick is to enter the first part of the HTML tag, up to the designation of the lines for the row factor, and to enter the second part, including the fins, for the column factor. There should be no separator, so be sure to delete any spaces in the separator field. Also be sure that there are no extra spaces after the Row designations. The screen appears as in Figure 14.3. It should be clear that the stimuli were made in a graphics program, and the HTML for creating the factorial design and randomizing the trials was created by factorWiz.

Insert Figure 14.3 about here.

Figure 14.3. Use of factorWiz to make the factorial experiment on the Mueller-Lyer illusion. Be sure to leave no spaces after each Row or in the Separator field.

The screenshot shows a Netscape browser window titled "Birnbaum's FACTORIAL formMaker - Netscape". The address bar shows the URL "http://psych.fullerton.edu/mbirnbaum/web/formMaker.htm". The main content area is a form with the following fields and values:

Experiment Name: <input type="text" value="Mueller-Lyer"/>	Exp Short Name: <input type="text" value="Mueller_Lyer"/>
Row Factor Name: <input type="text" value="Lines"/>	Col Factor Name: <input type="text" value="Fins"/>
No. levels of Row (9 or less): <input type="text" value="5"/>	No. levels of Col (9 or less): <input type="text" value="6"/>
Row 1= <input type="text" value="	Col 1= <input type="text" value="f0.jpg ALIGN=MIDDLE
<HR>"/>
Row 2= <input type="text" value="	Col 2= <input type="text" value="f1.jpg ALIGN=MIDDLE
<HR>"/>
Row 3= <input type="text" value="	Col 3= <input type="text" value="f2.jpg ALIGN=MIDDLE
<HR>"/>
Row 4= <input type="text" value="	Col 4= <input type="text" value="f3.jpg ALIGN=MIDDLE
<HR>"/>
Row 5= <input type="text" value="	Col 5= <input type="text" value="f4.jpg ALIGN=MIDDLE
<HR>"/>
Row 6= <input type="text"/>	Col 6= <input type="text" value="f5.jpg ALIGN=MIDDLE
<HR>"/>
Row 7= <input type="text"/>	Col 7= <input type="text"/>
Row 8= <input type="text"/>	Col 8= <input type="text"/>
Row 9= <input type="text"/>	Col 9= <input type="text"/>
Separator between Factors <input type="text"/>	

At the bottom of the form, there are three buttons: "1. Make Stimuli", "2. Make Trials", and "3. Make the Form". The "3. Make the Form" button is currently selected. The browser's status bar at the bottom shows "Document: Done".

F. Including Sounds in a Web Page

A Web site described by Welch and Krantz (1996) contains many interesting auditory demonstrations; this site has the URL:

<http://www.music.mcgill.ca/auditory/Auditory.html>

This site permits one to download copies of the files. This site is linked to the list of examples on the CD.

If you want to create or record your own sound files, you will need the equipment and software. That means you need a computer equipped with a microphone and software to record sounds, or you will need software to synthesize sounds. To search for software, try www.download.com and www.shareware.com, and search for *audio* and *audio recorder*. A good deal of freeware and shareware software is available for you to try out.

The HTML in *Ch14_ex5.htm* uses the Anchor tag (``) to load the sound.

```
<HTML><HEAD><TITLE>Presenting Sounds</TITLE>
</HEAD><BODY>
<H1>Using a link to Sound in a .WAV file</H1>
<P>
<A HREF=A.wav>Click here</A>

</BODY></HTML>
```

The next example, *Ch14_ex6.htm*, works in Netscape but not in Internet Explorer. Netscape allows one to use JavaScript to control the playing, pausing, and stopping of sounds. (Explorer uses a different procedure.) This example illustrates how to control the volume levels of sounds, sound "G" should be louder than sounds C or D. Despite this apparent ability to control sound levels, the listener can still readjust them.

Sound files can be saved in many formats. Until recently, sound files had to be sent before they could be played, which meant that one had to be very patient to wait for large sound files to arrive. New software has been recently developed for compression and transmission of sounds. This software speeds up the process considerably, with only a small reduction in quality for such stimuli as music and speech. The software can be downloaded free, including both the RealPlayer plug-in, which plays the music and RealEncoder, which allows you to convert standard sound files to "streaming audio" files. In streaming audio, you can begin playing the start of a musical selection, for example, while the rest of the file is loading. A link to <http://www.real.com/> is included on the CD.

If you want to send music as compressed files for an experiment, you need to ensure that your participants have the proper plug-in to play it. *Ch14_ex7.htm* compares a 10 MB WAV file with a 120K Real Audio file of the same music. You must download the RealPlayer plug-in to hear the compressed music. The 10 MB file, which represents about a minute of music, may give you "out of memory error." It could take a long time to download 10 MB file from the Internet. The music sounds almost as good in Real Audio as it does in the uncompressed format, but it arrives and plays much faster.

The transmission of sound via the Web lags behind the transmission of visual images; one can expect improvements in both in the next few years. Besides the long waits to load sound files, another difficulty with using sound in experiments is that there is a great variety of sound systems in use by the potential audience from no sound to poor quality speakers to advanced stereo systems. The problem is that you either have to limit your experiment to people with certain equipment, or hope that these differences in equipment do not make a difference to your research topic. If that is a concern to your

research, you should certainly include items asking the participants what type of hardware and software they are using so that you can analyze the data separately for people with different systems.

Compression of music in MP3 format is currently becoming quite popular, and this standard will probably dominate music coding for the next few years. MP3 is short for Moving Pictures Experts Group Layer 3. It refers to a standard for sound compression that takes advantage of the perceptual system to present only a fraction of the actual sound information in a way that will still sound good to a human ear. Further information on MP3 can be obtained from sites linked from the examples to this chapter.

G. Summary

This chapter reviewed methods for including visual and auditory stimuli within a Web page for psychophysical studies and demonstrations. HTML provides methods for controlling the colors presented on a monitor via the browser. Visual stimuli can also be created in programs that support drawings. This technique requires one to create the stimulus in the drawing program, then convert the graphic to a format such as GIF or JPEG that can be supported on the Web. The construction of sounds is currently more complex, requiring a recorder or synthesizer, the software for encoding the sound files to a format that can be handled by browsers (or their plug-ins), and the player programs or plug-ins to play back the sounds. Sites with more information, where you can download the needed software, are linked in the examples.

H. Exercises

1. Use HTML tables to create a screen of horizontal black bars (`color=000000`) and horizontal red stripes (`color=ff0000`). Then create another table of vertical black bars

separated by vertical green stripes (color=00FF00). Create two more tables, with horizontal bars separated by white stripes (color =000000), and the other with vertical black bars separated by white stripes. You can create an interesting illusion by alternately viewing these two colored stimuli, for 15 sec. each, repeating for a total of about 3-5 min, then look at a screen of horizontal or vertical black bars separated by white stripes. These stimuli create an orientation-specific after effect. You will see after-effect illusory contrasting colors between the black bars. The illusory colors depend on the orientation of the black bars.

2. Make a 5 by 5 table in which every cell has the same color except the one in the center. This table could be used to show contrast illusions with neutral or chromatic colors. Make a second 5 by 5 table with the same center square and different values for the color of the surround. (One solution is given in *Ch14_ex8.htm*).
3. Create a test of the horizontal-vertical illusion by dividing the screen into frames. In the upper frame, place a horizontal line of 75 mm. In the lower frame, place vertical lines of 50 to 100 mm, labeled with letters. Ask the observer to choose which of the vertical lines is equal in length to the horizontal line. Measure the strength of the illusion by computing the difference between lengths of the two lines that are supposedly equal for each person.
4. Use a graphic program to create figures for a visual illusion such as the Ponzo illusion, Poggendorf illusion, Baldwin illusion, or another. Manipulate two factors in the construction of the figures. For example, in the Ponzo illusion, one could manipulate the angle of the “railway lines”, and the vertical separation between the two horizontal lines. Use factorWiz to randomize and create the HTML form for the study.

5. Try out the “extra” examples on the CD with Netscape. You will need to install Real Player to hear the compressed musical selection. The file, melissa4.wav, is about 10 MB in size. This file was compressed to melissa4.rm, which is only 120K, by RealEncoder. To play the larger file, you must be patient to allow it to load.
6. Project idea: Collect data with Ch14_exp1.htm and Ch14_exp2.htm. Plot the median magnitude estimation of each stimulus against the mean category rating of the same stimulus. Is the function linear? Compare your results to those of Birnbaum (1982). If your results agree with typical results of such "direct" scaling, you will find that magnitude estimations are a nonlinear, positively accelerating function of category ratings. This nonlinear relationship puzzled psychologists for many years.
7. Project idea: Download software to record, encode, and play back sounds. Create your own sounds, and include them in a Web page. Be sure to include a link within your Web page so that the reader can figure out how to download any needed player or plugin to play back the sounds.
8. Project idea: collect data for the Mueller-Lyer experiment and see if there is an illusion with this variation of the figure in which the lines do not join the fins.
9. Project idea: collect data for "ratios" and "differences" of darkness of dot patterns. Compare your Web research results with the results of the two lab procedures of Birnbaum (1978; 1982).