Legibility As A Function of Size 可读性

Your previous study of color theory indicated that legibility is a function of contrast, and that colors should be selected based on tonal values to ensure that legibility is maintained throughout the design due to a difference in tonal contrast; however, size is also a very important factor in determining legibility. Therefore, legibility is a function of size, color, and contrast. In summary legibility in a design, or presentation, means that all the elements within the design can be seen clearly by the viewer.

之前对颜色理论的学习了解了可读性的重要性，根据色调值选择颜色确保由于色调对比度的差异在整个设计中保持可读性；然而，尺寸也是决定可读性的一个非常重要的因素。因此，可读性是由大小、颜色和对比形成的。总之，设计或展品的可读性意味着观众是否能够清楚地看到设计中的所有元素。

Mathematical Overview 数学概述

Using several different mathematical calculations you will scientifically determine the minimum acceptable font size that you can use in your presentation. Different equations will be used to calculate things such as: the enlargement factor of your presentation when shown on the projector screen, determining both minimum and maximum viewing distances in a standard classroom, and determining the relative viewing angle at these distances.

使用几种不同的数学计算能科学地确定在演示文稿中使用的最小可接受字体大小。不同的方程式将用于计算如在投影仪屏幕上演示文稿时的放大系数，标准教室中的最小和最大观看距离，以及这些距离的相对观看角度等。

In order to understand why it is important to consider the sizes of the elements that are used in a design you must first understand how the perceived size of an object can change. It is important to note that although the physical size of an object will not change, its perceived size will change with distance.

理解为什么要考虑在设计中使用的元素大小是重要的，首先必须理解对象的感知大小是如何变化的。注意，尽管物体的实际尺寸不会改变，但其感知尺寸会随着距离而改变。

For example a tall building such as the Shanghai Pearl does not seam very tall from the opposite side of the river. This is because you are far away from the building. As you move further away the building will continue to appear smaller and smaller; however as you get closer to the Shanghai Pearl the shear size of the tower becomes more evident. This is because of perspective. This example clearly demonstrates how the perceived size of any object will change with distance; therefore you will need to consider the perceived size of different elements in your presentation to ensure that all the elements in the design are visually legible to the audience.

例如，像上海东方明珠这样的高层建筑，从河的对岸看，并不是很高。这是因为你离大楼很远。随着你越走越远，建筑将越来越小；然而，随着你越来越接近它，这座塔的尺寸变得越来越明显。这是由于角度的问题。这个例子清楚地说明了物体的感知大小会随距离而变化；因此，在设计演示文稿时，也要考虑到这些让其能清晰地展示给观众。

Legibility As A Function of Size 可读性

Legibility in a design means that different elements in that design can easily be distinguished by the viewer, and the viewer's ability to easily distinguish between different elements is related to the physical size and the viewers distance from those elements. This combination of physical size and distance influences the perceived size of the elements in a design by the viewer, and this correlation between the physical and perceived size of an object can be calculated using a number of mathematical calculations.

设计中的可读性意味着观看者可以轻松识别设计中的不同元素，并考虑到实际大小和距离的因素。实际大小和距离的组合会影响观看者在设计中对元素的感知，可以使用大量数学计算来计算对象的世纪大小和感知大小之间的相关性。

By working through these calculations you will develop an understanding as to why an objects size needs to be considered. Then, with a scientific understanding of the math that is involved in determining acceptable sizes for the different elements in a presentation you will be able to make informed generalizations that you can use in the future.

通过这些计算能了解为什么需要考虑大小的因素了。然后，通过对数学的科学理解，确定演示文稿中不同元素的可接受大小以便后期运用。

Stage 1 - Understanding Screen Sizes & Resolution 第1阶段-了解屏幕大小和分辨率

Although there is no one standardized computer screen size there are common sizes and aspect ratio's. Traditionally screens were in the 4:3 aspect ratio; however more and more computer screens are now adopting the 16:9 widescreen aspect ratio instead. Computer screens also have, for the most part, a standard resolution. A Typical computer screen has a resolution of 72 pixels per inch (72dpi), or in metric measurements that is 28.346 pixels per centimetre (28.346 pixels/cm). Some screens do offer higher resolutions then the industry standard 72dpi such as the Apple Retina Display, and these higher resolution screens will likely become the accepted standard in time; however the following examples will only use a standard resolution of 72 pixels per inch (72dpi).

虽然没有一个标准化的计算机屏幕尺寸，但有常用的尺寸和纵横比。一般来说，屏幕的纵横比为4:3；然而，现在越来越多的计算机屏幕采用16:9宽屏宽高比。计算机屏幕在很大程度上也具有标准分辨率。一个标准的计算机屏幕的分辨率为每英寸72像素（72dpi），或者以公制度量衡为每厘米28.346像素（28.346像素/cm）。一些屏幕的分辨率确实高于行业标准72dpi，如苹果视网膜显示器，这些更高分辨率的屏幕可能会随着发展越来越成为公认的标准；但是，以下示例仅使用每英寸72像素（72dpi）的标准分辨率。

When making mathematical calculations it is important to understand these different factors as they will affect the calculations that you make. For the following examples you will work with a resolution of 72dpi only.

在进行数学计算时，了解这些不同的因素很重要，因为它们会影响计算。对于以下示例，仅使用72dpi的分辨率。

Legibility As A Function of Size 可读性

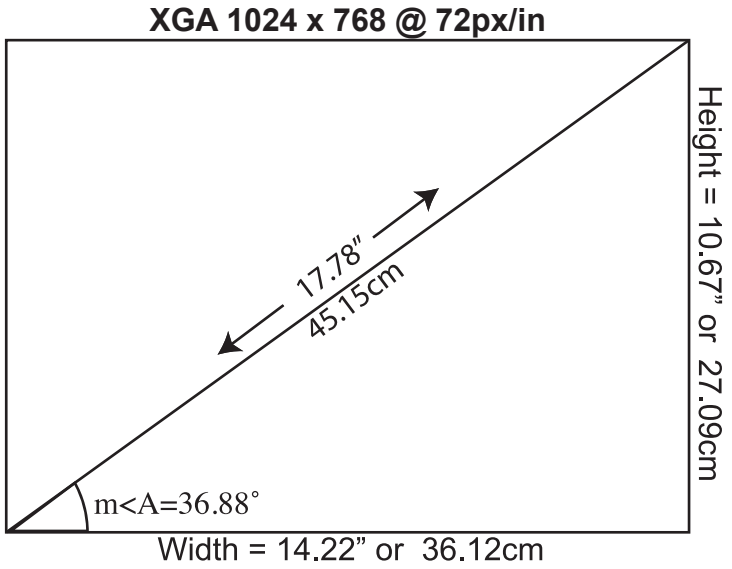
One of the most common screen resolutions currently in use is the XGA format which is 1024 pixels wide and 768 pixels high and is a standard 4:3 aspect ratio. This is also the aspect ratio and resolution that is used for most interactive white boards as well.

目前使用的最常见屏幕分辨率之一是XGA格式，宽1024像素，高768像素，宽高比为标准的4:3。这也是用于大多数交互式白板的纵横比和分辨率。

Example 1: XGA Screen Comparison 示例1:XGA屏幕比较

The image below shows the size of a computer monitor using the standard XGA format at a resolution of 72dpi. The width of a computer monitor using this standard is 14.22” or 36.12cm. The hight of the computer monitor is 10.67” or 27.09cm; however computer screens are not measured by their lengths and widths but are measured by the diagonal measurement from one corner to the other.

下图显示了使用标准XGA格式、分辨率为72dpi的计算机显示器的尺寸。使用本标准的计算机显示器的宽度为14.22英寸或36.12厘米。电脑显示器的高度为10.67英寸或27.09cm；然而，计算机屏幕不是通过其长度和宽度来测量的，而是通过从一个角到另一个角的对角线来测量的。



In order to determine the diagonal measurement of a screen you need to use trigonometry to find the measurement of the angle that is made when drawing a line from one corner of the screen to the other. With the measurement of angle A you can then calculate the diagonal measurement of the screen.

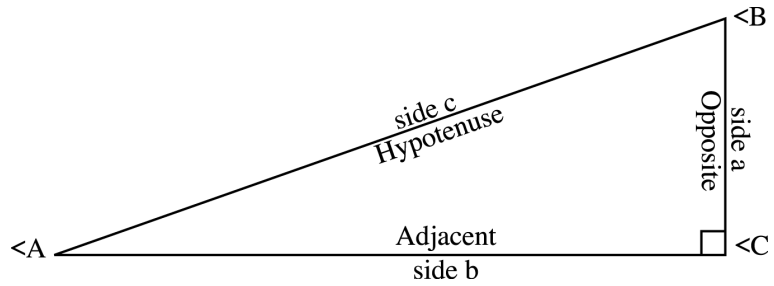
为了确定屏幕的对角线测量值，需要使用三角学来确定从屏幕的一个角到另一个角绘制直线时的角度测量值。通过测量角度A，可以计算屏幕的对角线测量值。

Legibility As A Function of Size 可读性

Trigonometry Review 三角学回顾

Angles are always measured with a large letter and the sides of a triangle are labeled using small letters only. Side (a) is always opposite to angle (A) and is the smallest side of the triangle. Side (b) is adjacent to angle (A) and is opposite to angle (B). Side (c) which is also known as the hypotenuse will always be the longest side of a triangle and is always opposite to angle (C). Please refer to the example below to see how a triangles are labeled in the study of trigonometry.

角度总是用大写字母表示，三角形的边用小写字母表示。边（a）始终与角（a）相对，是三角形的最小边。侧面（b）与角度（A）相邻且与角度（b）相对。边（c），也称为斜边，始终是三角形的最长边，并且与角（c）相对。请参考下面的例子，了解三角形在三角学研究中是如何标记的。



$sin(A) = \frac{Opposite}{Hypotenuse}$	$cos(A) = \frac{Adjacent}{Hypotenuse}$	$tan(A) = \frac{Opposite}{Adjacent}$

Just Remember: SOH - CAH - TOA

Since the width and height of the computer monitor are known you are able to calculate the measurement of angle (A). Since both the width (adjacent) and the height (opposite) are known, the formula for TAN needs to be used. This is because the TAN formula is the only formula that has two (2) of thee (3) known variables in it.

由于计算机显示器的宽度和高度已知，因此可以计算角度（A）的值。由于宽度（相邻）和高度（相反）都已知，因此需要使用TAN的公式。这是因为TAN公式是唯一一个包含两（2）个已知变量的公式。

Imperial Measurements

$$tan(A) = \frac{10.67”}{14.22”}$$

Metric Measurements

$$tan(A) = \frac{27.09cm}{36.12cm}$$

The formula for TAN has been shown with both the Imperial and Metric Measurements. Regardless of which values are used the result will be the same. The measure of angle (A) is equal to 36.88º. With the measurement of angle (A) the measurement for side (c) can now be calculated using either SIN or COS.

Legibility As A Function of Size 可读性

英制度量和公制度量中TAN的公式如图所示。无论使用哪个，结果都是相同的。角度（A）的测量值等于36.88º。通过测量角度（A），现在可以使用正弦或余弦计算侧（c）的值。

Imperial Mesutments

$$sin(36.88^o) = \frac{10.67”}{Hypotenuse}$$

Metric Measurements

$$sin(36.88^o) = \frac{27.09cm}{Hypotenuse}$$

The measurement for side (c) is equal to 17.78” or 45.15cm, but computer companies will often round numbers when advertising screen sizes to the public. The dimensions in provided example are the measurements for the standard 17” computer monitor.

侧面（c）是17.78英寸或45.15厘米，但计算机公司在向公众公布屏幕尺寸时，通常会将数字四舍五入。示例中提供的尺寸是标准17英寸计算机显示器的值。

Example 2: XUGA Screen Comparison 示例2：XUGA屏幕比较

The following diagram shows a scaled comparison between the 4:3 XGA screen format and the XUGA widescreen format which is capable of displaying FULL HD video content. From the diagram you may be able to quickly identify that the XUGA screen format is significantly larger and wider than the standard XGA format that is shown in the previous example.

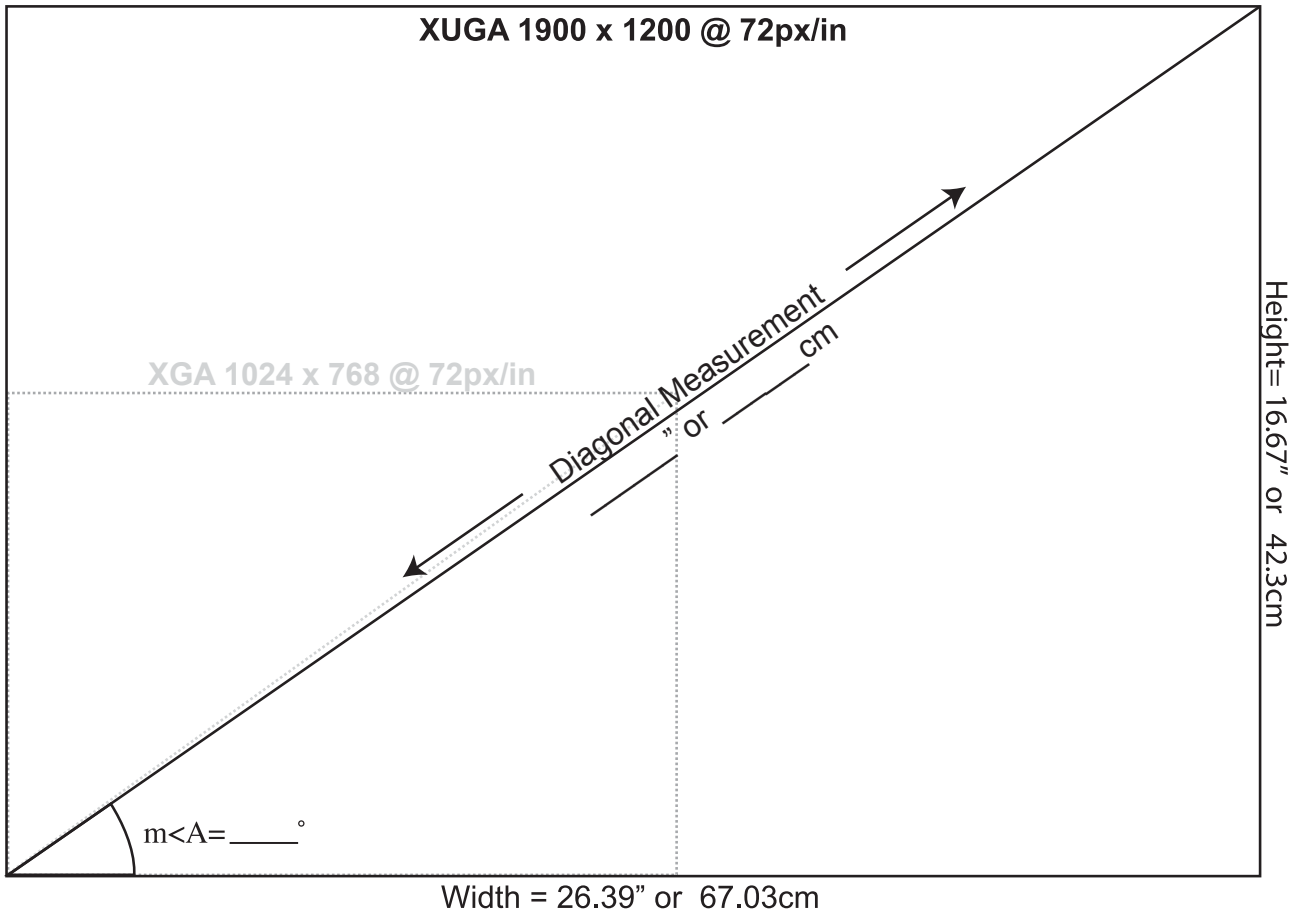
下图显示了4:3 XGA屏幕格式与能够显示全高清视频内容的XUGA宽屏格式之间的比较。从图中，可以观察到XUGA屏幕格式比上一个示例中显示的标准XGA格式大得多、宽得多。

Using trigonometry you are able to determine the measurement of angle (A) in degrees. Once you know the measurement of angle (A) you can then determine the diagonal measurement of the monitor. With all of the measurements known you will then be able to compare the physical difference in size between these two computer monitors.

使用三角学可以确定角度（A）的值（以度为单位）。一旦知道角度（A）的值，就可以确定显示器的对角线值。已知所有值后，就可以比较这两台计算机显示器之间的尺寸差异。

Space for Calculations 计算区

Legibility As A Function of Size 可读性



Stage 2 - Understanding Field of View 第2阶段-了解视野

The following diagram illustrates the standard field of view for a person with regular vision. Please note that there is a difference in the values for both the vertical and horizontal field of view. This is because humans have 2 eyes that are horizontally offset from one another. This results in a slightly wider field of view.

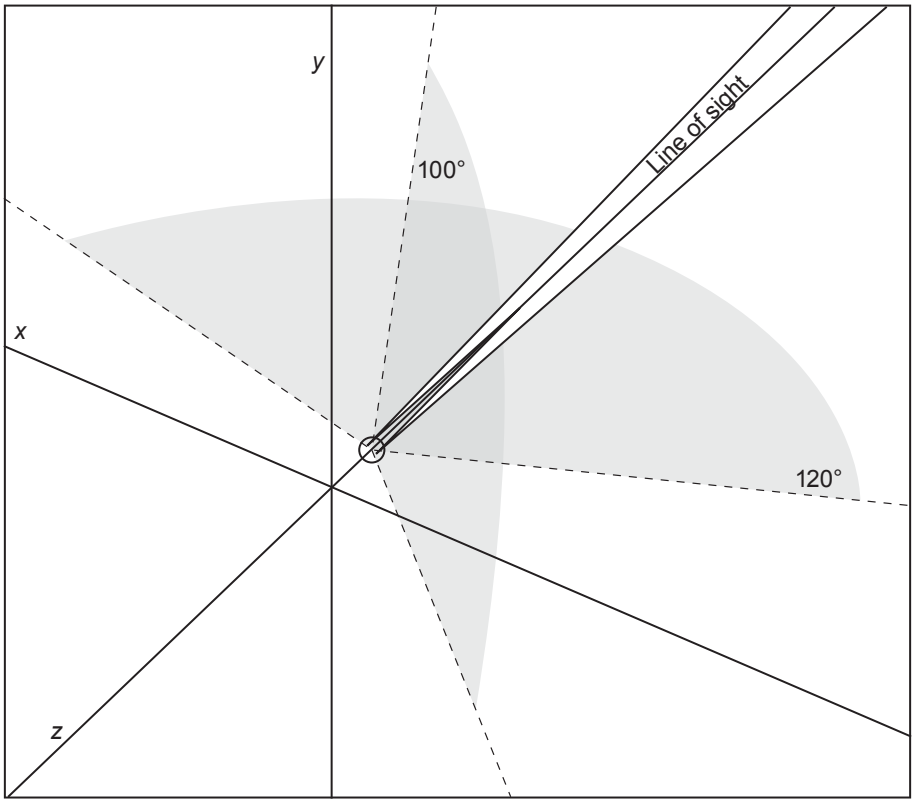
下图是具有正常视力人的标准视野。注意，垂直视野和水平视野的值都存在差异。这是因为人类有两只眼睛在水平方向上相互偏移。这会产生一个略宽的视野。

The area known as the “line of sight” is the area that is directly in-front of the viewer. This is an area of excellent vision. Your peripheral vision extends outwards from your primary line of sight. Although you can see things in your peripheral vision you will not see them as clearly as if they were directly in-front of you. A persons total field of view is equal to 120º horizontally and 100º vertically.

被称为“视线”的区域是观众正前方的区域，这是视野最佳的领域。周边视觉从主要视线向外延伸，虽然你可以看到周边视觉中的事物，但没有正前方的那么清楚。一个人的总视野水平方向为120º，垂直方向为100º。

Legibility As A Function of Size 可读性

3-Dimensional Field of View 三维视野图



The optical offset from having two (2) eyes is very important to human vision as it allows for the perception of depth in a 3-dimensional space. This optical offset allows your eyes to focus on objects at different distances, and depending on the distance between you and the object that you are looking at, your eyes line of sight will converge at different points in space.

两只眼睛的光学偏移对人类视觉非常重要，因为它允许在三维空间中感知深度。这种光学偏移允许你的眼睛聚焦在不同距离的物体上，并且根据你和所观察的物体之间的距离，你的视线将在空间中的不同点聚焦。

Try this experiment to help you understand the convergence in your line of sight. Hold a pen in front of you at arms length and look at the tip of the pen. Start moving the pen towards your nose while only looking at the tip of the pen. Move the pen back and forth several times while maintaining your focus on the tip of the pen only. You will notice that everything else will become blurry as you move the pen towards you. This is because of the point in space where your eyes line of sight is converging.

通过一个实验来理解视线的聚焦。将一支笔放在你面前，与手臂保持一定距离，并看着笔尖。开始朝鼻子方向移动笔，只看笔尖。将笔来回移动几次，只将焦点放在笔尖上。你会注意到，当你把笔移向你时，其他的一切都会变得模糊。这是因为你的视线在空间的某个点会聚。

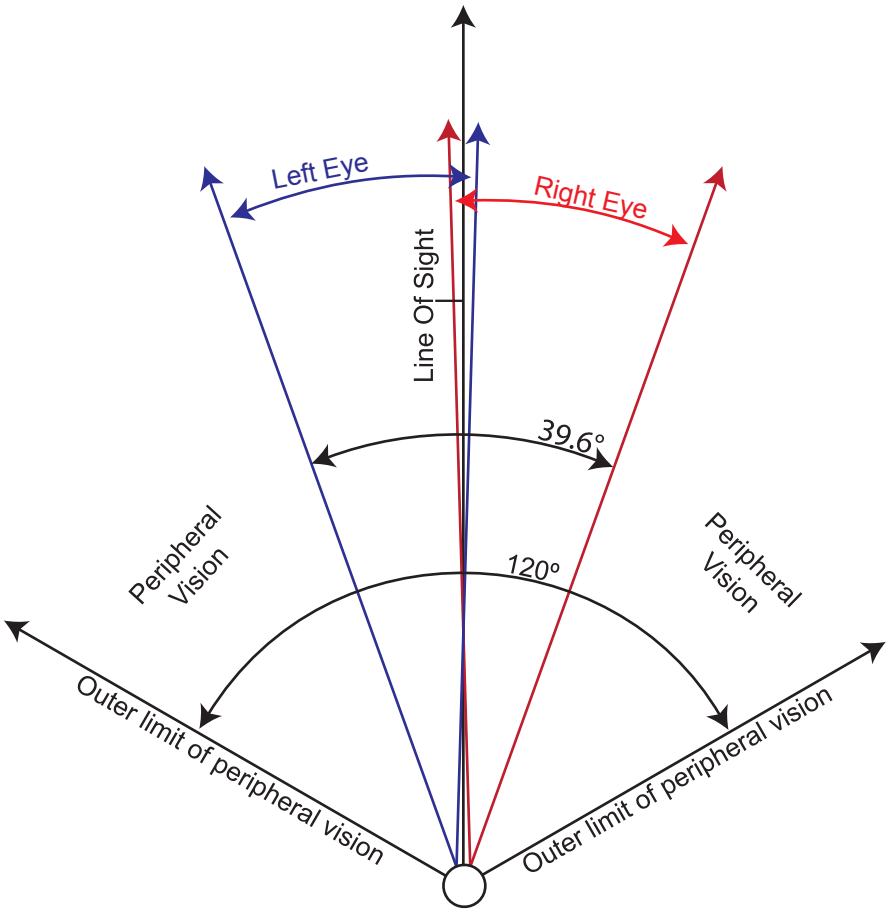
Legibility As A Function of Size 可读性

Stage 3 - Understanding Angles of View 第3阶段-理解视角

A person's field of view extends outward from their line of sight towards the outer limits of their peripheral vision. The central area of a persons field of view is the area which a person can see the clearest. A person is able to see more by moving their eyes around, but when looking strait ahead a normal angle of view exists. Just like a persons total field of view, a person's normal angle of view can be measured. This area of pristine vision can be measured as a horizontal, vertical, or diagonal angle of view. These three different measurements exist because a persons horizontal field of view is larger then their vertical field of view *(see the 3-Dimensional Field of View diagram)*. A persons normal angle of view, which is a small proportion of their total field of view, is 46.8º when measured diagonally, 27.0º vertically, and 39.6º horizontally.

人的视野从视线向外延伸到周围视觉的外部界限，视野的中心区域是一个人能看得最清楚的区域。通过四处移动眼睛可以看到更多的东西，当向正前方看时，是正常的视角范围。正常视角范围也是可以测量的。这视觉区域可以通过水平、垂直或对角来测量。存在这三种不同的测量是因为一个人的水平视野大于其垂直视野（参见三维视野图）。正常视角（占其总视野的一小部分）在对角测量时为46.8º，垂直测量为27.0º，水平测量为39.6º。

2-Dimensional Field of View:



Angle of Views Being Used in Context:

Legibility As A Function of Size 可读性

In order to produce natural looking images camera companies will use these values when creating optical formulas for different camera lenses. A lens with a 46.8º diagonal field of view is considered a normal lens, whereas an optical formula that has a wider angle of view is considered to be a wide angle lens, and any lens with a narrower angle of view is considered to be a telephoto lens.

为了产生看起来自然的图像，相机公司将在为不同的相机镜头创建光学公式时使用这些值。具有46.8º对角线视场的透镜被视为普通镜头，而具有较宽视角的光学公式被视为广角镜头，具有较窄视角的任何透镜被视为长焦镜头。

Stage 4 - Using Angles of View 第4阶段-使用视角

According to research conducted by Krueger in 1984, the normal point of convergence for a persons angle of view is at a distance of 31.5” or 80.0cm, and this is known as a persons optimal viewing distance. It is close enough that things can be clearly seen but far enough that it does not cause unnecessary eye strain; therefore to avoid eye fatigue the study concluded that the ideal distance to sit from a computer screen was 31.5” or 80cm.

根据Krueger在1984年进行的研究，人的视角的正常会聚点位于31.5英寸或80.0厘米的距离，这被称为人的最佳视距。这个距离不远也不近，可以清楚地看到事物但又不会造成不必要的眼睛疲劳；因此，为了避免视觉疲劳，该研究得出结论，坐在电脑屏幕前的理想距离为31.5英寸或80厘米。

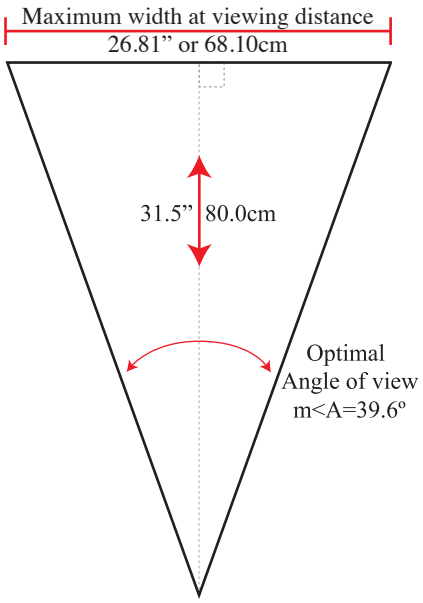
Using a person’s normal angle of view and the ideal viewing distance a maximum screen size can be calculated. Screens that are bigger then the maximum calculated screen size would exceed the persons optimal field of view at that distance; therefore the individual would be forced to move their head back and forth to look at different sections of the screen, or sit further away from the computer monitor.

利用人的正常视角范围和理想视距，可以计算出最大屏幕尺寸。超过最大屏幕尺寸的屏幕将不在最佳视野范围内，这种情况下不得不被迫前后移动头部以查看屏幕的不同部分，或坐得离计算机屏幕远一点。

The following example shows how to calculate the maximum dimensions that a person can comfortably see at their optimal viewing angle. This example uses a person’s optimal angle of view and the average resting point of convergence for their eyes.

下面的示例显示了如何计算一个人在其最佳视角下可以舒适地观看最大尺寸。此处采用了人的最佳视角和他们眼睛的平均休息点。

Legibility As A Function of Size 可读性



Calculations计算

$$tan(\frac{1}{2}39.6^o) = \frac{\frac{1}{2}opposite}{31.5”}$$

$$tan(\frac{1}{2}39.6^o) = \frac{\frac{1}{2}opposite}{31.5”}$$

$$tan(39.6^o) = \frac{opposite}{31.5”}$$

$$tan(39.6^o)31.5” = opposite$$

$$26.81” = opposite$$

Since the angle of view and the distance from the viewer are known it is possible to calculate the dimension for side (a) which is opposite to angle (A). However before you can calculate the measurement of side (a) several other calculations will be needed. The distance of 31.5” or 80cm is the height of the triangle, or the distance from angle (A) to side (a); however this is not a measurement that is standard for any of the three (3) Trig ratios. To solve this dilemma we can divide the triangle into two (2) equal halves. This will give you two right angle triangles. The hight of the triangle can then be used as an adjacent measurement, and the new measure of angle (A) will be half (1/2) of the original measurement of angle (A). The formula for tan can now be used to calculate the opposite side; however this will only calculate half (1/2) of the actual measurement needed. When writing the formula for Tan in this example you may notice that there is a fraction of one half (1/2) on both sides of the equation. These two fractions will eventually cancel each other out when solving the equation.

视角和与观察者的距离已知，可以计算与角（A）相对的侧面（a）的值。但是，在计算（a）侧的值之前，还需要进行一些其他计算。31.5”或80cm是三角形的高度，或从角（A）到侧面（a）的距离；然而，这不是三（3）个三角比中任何一个的标准测量。为了解决这个难题，我们可以把三角形分成两（2）等分，会得到两个直角三角形。然后，三角形的高度可以用作相邻测量值，角（A）的新测量值将是角（A）原始测量值的一半（1/2）。tan的公式现在可用于计算对侧；然而，这将仅计算所需实际测量值的一半（1/2）。在编写本例中的Tan公式时，你可能会注意到方程两侧各有一半（1/2）的分数。在解方程时，这两个分数最终会相互抵消。

Now that you have a better understanding of how to use the formula for Tan to calculate the measurement of side (a) you will be able to solve for the missing variables and complete the reference table below.

现在，通过计算并完成下表。

Legibility As A Function of Size 可读性

Maximum Viewing Dimensions
At The Normal Resting Point Of Visual Convergence

	Viewing Angle	Maximum Screen Dimension	
Horizontal Measurement	39.6º	26.81”	68.10cm
Vertical Measurement	27.0º		
Diagonal Measurement	46.8º		

Shortcut: *Although it is important to understand the steps in the previous example, and why each step was necessary, It can be very helpful to know different shortcuts that can be used in math. For example, the previous calculations are for an Isosceles triangle. Isosceles triangles have two angles and sides that are equal to one another, so if any angle is known then all three (3) angle measurements can be calculated, and if the hight of an Isosceles triangle is known then the measurement for the opposite side can be calculated. Therefore the formula for tan can be rewritten as follows:*

快捷方式：理解上例中的每个步骤是很重要的，但是数学中一些快捷运算也非常有帮助。例如，前面的计算是针对等腰三角形的。等腰三角形有两个彼此相等的角和边，因此如果已知任何角，则可以计算所有三（*3*）个角，如果已知等腰三角形的高度，则可以计算对侧的值。因此，*tan*的公式可以改写如下：

$$tan(m\angle A) = \frac{Opposite}{height}$$

Always check with your math teacher before using any math shortcuts. It is important to understand the shortcuts that you are using and that you understand how to use them properly to solve different types of math problems.

在使用任何数学快捷方式之前，请先咨询数学老师，正确使用快捷方来解决不同类型的数学问题。

Space for Calculations 计算区

Legibility As A Function of Size 可读性

Viewing Distance, Angles, Screen Size & Perception 观看距离、角度、屏幕大小和感知

The dimensions for both the XGA and XUGA screen sizes are both within the limits of the average optimal angle of view when sitting at the ideal viewing distance. This means both screens can be viewed from the same distance comfortably and a persons perspective of what they see on screen will be the same; however when a presentation is shown on a projector screen the size, magnification, and viewing distance will be different. This means that the persons perspective of what they are viewing will also be different.

XGA和XUGA屏幕尺寸均在理想视距下的平均最佳视角范围内。这意味着两个屏幕可以从相同的距离舒适地观看，人们在屏幕上看到的东西的视角将是相同的；但是，当演示文稿显示在投影仪屏幕上时，大小、放大率和观看距离会有所不同。这意味着人们对他们所看到东西的感知也会有所不同。

The following example displays an enlarged image that is viewed from further away but has the same angle of view as the closer image; therefore the perceived size of the elements in the design will be identical. In this example the XUGA screen size is shown from an optimal viewing distance of 31.5” or 80.0cm. A second screen that is double the width and height of the XUGA Screen size is placed further away. Despite the elements being shown on the larger screen are enlarged by a factor of 2X, the perceived size of elements are the exact same to the viewer because the relative angle of view has remained constant.

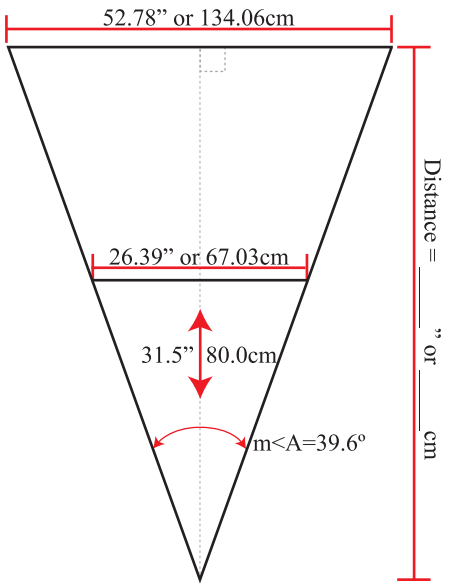
下面的示例显示从更远的地方观看的放大图像，但与更近的图像具有相同的视角；因此，设计中元素的感知尺寸将是相同的。在本例中，XUGA屏幕尺寸从31.5英寸或80.0厘米的最佳视距显示。第二个屏幕的宽度和高度是XUGA屏幕尺寸的两倍，放置在更远的地方。尽管在大屏幕上显示的元素被放大了2倍，但由于相对视角保持不变，元素的感知大小与观看者完全相同。

Using trigonometry determine the viewing distance from the larger screen in the example below.

在下面的示例中，使用三角比计算与大屏幕的观看距离。

Legibility As A Function of Size 可读性

Example例:



Space for Calculations计算区

Magnification & Surface Area放大率和表面积

Magnification and the increase in the surface area of an object are different from one another. If an objects dimensions are doubled in size, a magnification of 2X, then both the hight and width have both been doubled. This means that the surface area has actually increased by a factor of 4X (2x2=4) or 400%.

物体的放大率和表面积的增加是不同的。如果对象尺寸加倍，放大倍数为2X，则高度和宽度都加倍。这意味着表面积实际上增加了4倍（2x2=4）或400%。

Stage 5: Determining Magnification 第5阶段：确定放大率

In order to calculate the magnification factor of different elements in a design it is important to understand different units of measurement and how to convert these units back and forth. Although Standard International SI Units (SI units) are an important standard, many technological developments were based on the Imperial Measurement system. For this reason it is often easier to do some calculations using the Imperial Measurement system and then convert to SI units afterwards.

为了计算设计中不同元件的放大系数，了解不同的测量单位以及如何来回转换这些单位非常重要。尽管国际标准SI单位（SI Units）是一个重要的标准，但许多技术发展都是基于英制度量衡。因此，使用英制度量衡进行一些计算，然后再转换为国际单位制通常比较容易。

For example, font sizes on computers are measured in points (pt.) and 1” is equal to 72pt.; therefore 12pt. is equal to 0.167” or 0.42cm. When viewing a 12pt. font on your computer screen at 100%, or when viewing a computer print out, the size of the font will be

equal to 0.167” or 0.42cm; however when a presentation is projected on a large screen the image is magnified by a factor of (x) which you will calculate later on.

例如，计算机上的字体大小以号（pt.）为单位，1“等于72 pt。；因此12pt等于0.167英寸或0.42厘米。当查看12pt时。计算机屏幕上的字体为100%，或在查看计算机打印输出时，字体大小将等于0.167英寸或0.42cm；但是，当演示文稿投影到大屏幕上时，图像会放大（x），应根据这个进行计算。

The following calculations show the viewing angle of a 12pt. font when seen at 100% at the optimal viewing distance of 30.5” or 80cm. This measurement will be important once the enlargement factor of the presentation is calculated.

以下计算显示了12pt的视角。在30.5英寸或80厘米的最佳视距下100%看到时的字体。一旦计算了演示文稿的放大系数，此测量将非常重要。

Imperial Measurements:

$$tan(A) = \frac{12pt.}{31.5”}$$

$$tan(A) = \frac{0.167”}{31.5”}$$

$$m\measuredangle A = 0.304^o$$

Metric Measurements:

$$tan(A) = \frac{12pt.}{80cm}$$

$$tan(A) = \frac{0.42cm}{80cm}$$

$$m\measuredangle A = 0.304^o$$

To review, the standard 4:3 XGA screen size is 14.22” or 36.12cm wide and 10.67” or 27.09cm tall, and the interactive white board screen that your final presentation will be shown on also uses the 4:3 aspect ratio and the XGA resolution; however the interactive white board screen has the dimensions of 63” or 160cm wide and 46.45” or 118cm tall.

回顾一下，标准的4:3 XGA屏幕尺寸为14.22英寸或36.12厘米宽，10.67英寸或27.09厘米高，最终演示文稿将显示的交互式白板屏幕也使用4:3纵横比和XGA分辨率；然而，交互式白板屏幕的尺寸为63英寸或160厘米宽，46.45英寸或118厘米高。

With the size of both the computer monitor and projection known the enlargement factor can be calculated by dividing the size of the projection by the size of the computer monitor. In this example the magnification factor is equal to approximately 4.4; therefore a 12pt. font which is 0.167” or 0.42cm tall when viewed at 100% on a computer monitor will be enlarged to 0.734” or 1.86cm tall when displayed on the interactive white board. With the size of the magnification and angle of view known an equivalent viewing distance can be calculated.

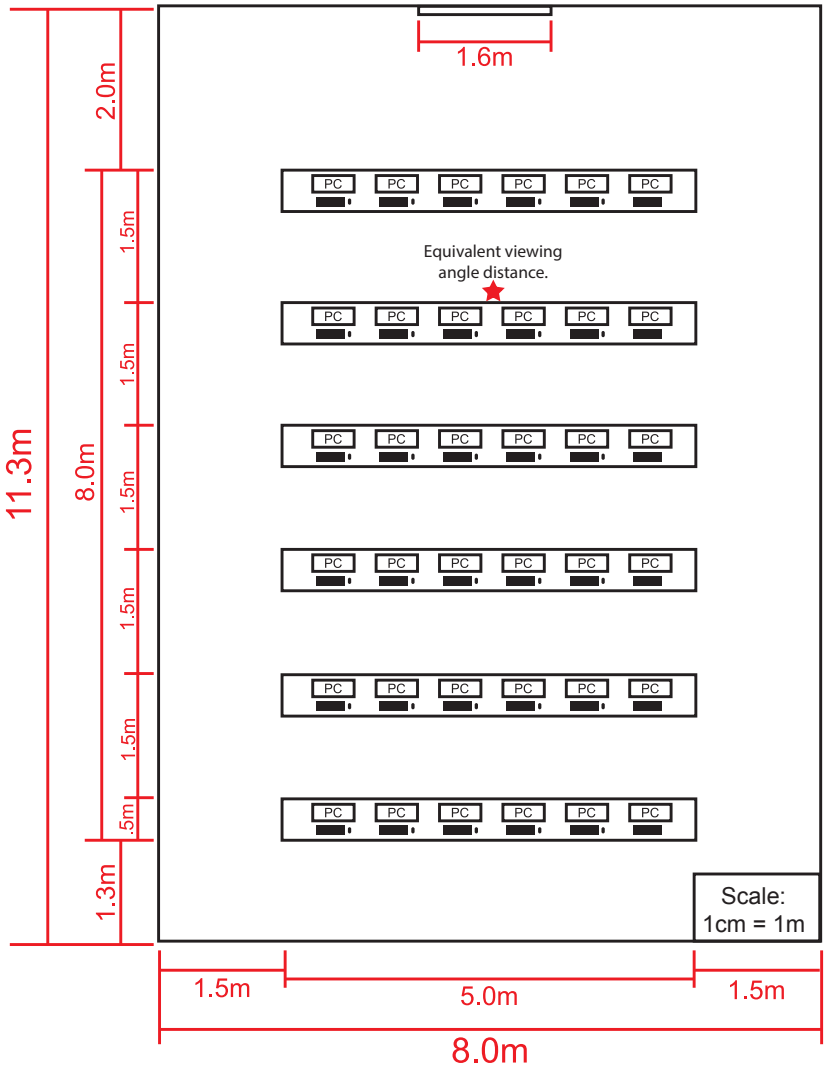
在计算机显示器和投影尺寸已知的情况下，可以通过将投影尺寸除以计算机显示器的尺寸来计算放大系数。在本例中，放大系数约等于4.4；因此是12pt。当在计算机显示器上100%观看时，高度为0.167英寸或0.42厘米的字体在交互式白板上显示时将放大至0.734英寸或1.86厘米。在已知放大率和视角的情况下，可以计算出等效视距。

Legibility As A Function of Size 可读性

Using the viewing angle of 0.304º and the magnified hight of the font which is 0.734” or 1.86cm, the equivalent viewing distance can be calculated. In this example the equivalent viewing distance is 138.34” or 3.51m away from the interactive white board. A schematic for a computer class is shown on the next page, and the equivalent viewing distance has been marked. Any student sitting behind this point would perceive objects in the presentation smaller then they would see on their computer screens.

使用0.304º的视角和字体的放大高度（0.734英寸或1.86cm），可以计算等效视距。在本例中，与交互式白板的等效视距为138.34“或3.51米。下一页显示了计算机类的示意图，并标记了等效的可视距离。坐在这一点后面的任何学生都会感觉到演示文稿中的物体比他们在电脑屏幕上看到的要小。

Classroom Example: Layout 1
课堂示例：布局1



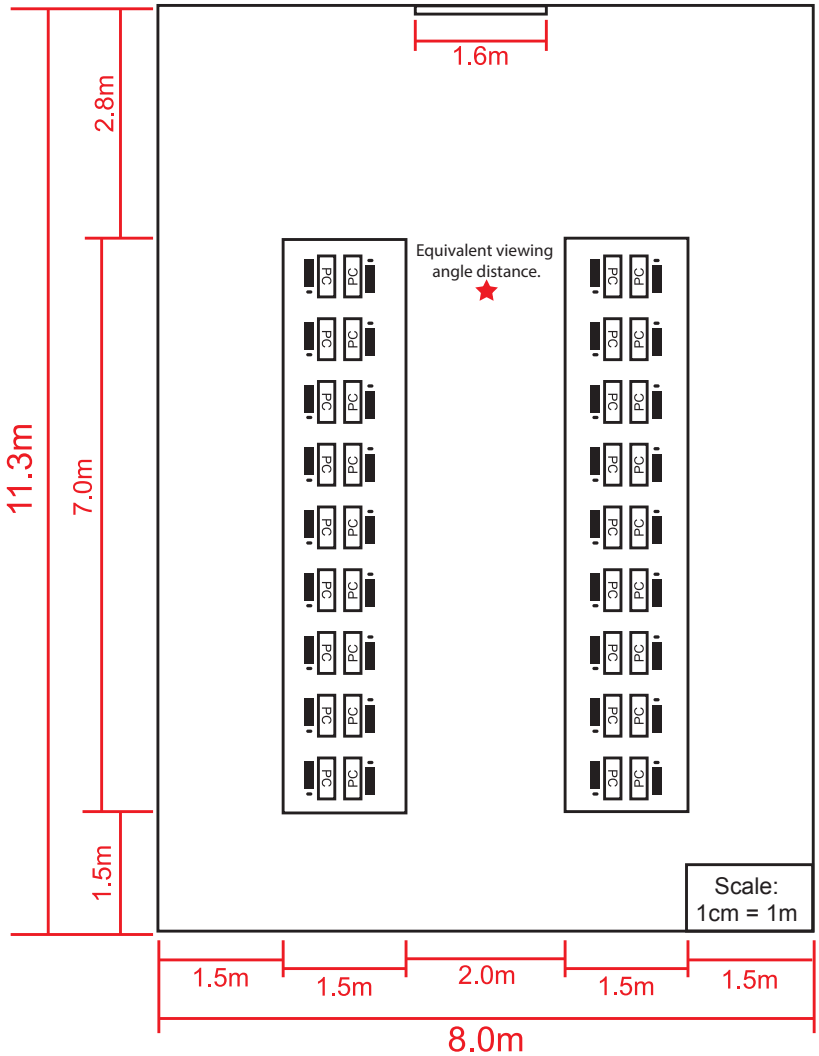
Legibility As A Function of Size 可读性

In this example a standard classroom layout is shown at a scale of 1:100. This means that one (1) centimetre in the schematic drawing is equal to one (1) meter in real life. Using a ruler you can determine the viewing distance from the projector screen at different locations in the classroom by using the scale ratio provided in the lower right corner of the schematic. Alternatively you can use the measurements shown on the schematic to calculate distances along both the horizontal and vertical axis of the schematic. Then Using trigonometry you can calculate the diagonal angle of view of students who are siting towards the outer edges of the classroom.

在本例中，标准教室布局以1:100的比例显示。这意味着示意图中的一（1）厘米等于现实生活中的一（1）米。使用标尺，通过示意图右下角的比例来确定教室中不同位置的投影仪屏幕的观看距离。或者，使用示意图上显示的测量值来计算沿示意图水平轴和垂直轴的距离。然后，使用三角函数计算出坐在教室外边缘的学生的对角线视角。

Space for Calculations计算区

Classroom Example: Layout 2
课堂示例：布局2



Legibility As A Function of Size 可读性

In this example the same classroom is shown but the computer work stations have been laid out in a different configuration. The dimensions of the room and the number of computers in the class are identical to the first example; however this layout has more desk space at each computer workstation and has more open floorspace. In this example the maximum viewing distance between the students and projector screen can be reduced slightly from the previous example; however there will still be students who will be sitting toward the far corners of the classroom in this layout as well.

在本例中，显示了相同的教室，但计算机工作站的布局不同。教室的尺寸和课堂上的计算机数量与第一个例子相同；然而，这种布局在每个计算机工作站上有更多的办公桌空间，并且有更多的开放式占地空间。在本示例中，学生与投影仪屏幕之间的最大观看距离可以比前一示例稍微缩短；但是这种布局中，仍然会有学生坐在教室的远角。

Do you think this change will have much effect on the relative viewing angle of students in the back of the classroom? Discuss this idea with your peers and support your answer with evidence from the reading.

你认为这种变化会对教室后面学生的相对视角产生很大影响吗？与你同伴进行讨论，并用阅读中的证据支持你的答案。

Stage 6: Determining What Size To Use 第6阶段：尺寸的选择

In the first classroom example the back row of desks is located 11m away from the projector screen; however students sitting towards the outer edge of the class would be viewing the projector screen from an angle. This means they would be viewing the screen from a slightly greater distance than the students sitting in the centre of the row. Using either a scale measurement or trigonometry it can be determined that students sitting in the back corner of the provided classroom example will be viewing the computer screen from a distance of 11.28 meters and at an angle 12.8º.

在第一个教室示例中，后排课桌距离投影仪屏幕11米；然而，坐在教室外边缘的学生会从一个角度观看投影仪屏幕。这意味着他们将从比坐在前排中间的学生稍远的距离观看屏幕。使用刻度测量或三角函数，可以得出坐在所提供教室示例后角的学生将从11.28米的距离和12.8º的角度观看计算机屏幕。

From the viewing distance of 11.28m and an equivalent viewing angle of 0.304º the equivalent perceived size for a 12pt. font can be calculated.

从11.28m的观察距离和0.304º的等效观察角度来看，可以计算出12pt的等效感知尺寸。

$$sin(0.304^o) = \frac{Opposite}{11.28m}$$

Legibility As A Function of Size 可读性

The size of the magnified font on the projector screen would need to be 5.98cm 2.34” tall in order to be perceived as the same size as 12pt. font on a standard XGA computer monitor. However this size is still magnified by a factor of 4.4X which was determined earlier in this document. In order to get determine the font size that needs to be selected when working at a scale of 100% on the computer, the magnified size of the font needs to be divided by the magnification factor of 4.4; therefore the revised size of the font at a scale of 100% would be equal to 1.36cm or .54”. Since one half of an inch is equivalent to a 36pt. font size the closest equivalent font size that could be used in the presentation would be a font size of 36pt.

投影仪屏幕上放大字体的大小需要为5.98厘米2.34英寸高，才能被视为与12pt相同的大小。标准XGA计算机显示器上的字体。然而，该尺寸仍然被放大了4.4倍。为了确定在计算机上以100%的比例工作时需要选择的字体大小，需要将字体的放大大小除以放大系数4.4；因此，100%比例下字体的修订大小将等于1.36cm或0.54”。因为半英寸等于36pt。字体大小演示文稿中可使用的最接近的等效字体大小为36pt。

Conclusion 总结

Always think of how far away your audience will be away from the presentation screen in your classroom. Select a font size large enough for the audience to read. Most people cannot read a font size smaller than 24pt. from more than 3.5 meters away. The minimum safe font size you should use in a presentation is 36pt.; however a font size of 48pt. is better for bulleted lists or descriptions in your presentations. Titles should be even larger and use a font size of such as 72pt. or even 96pt.

始终考虑观众离屏幕的距离，选择一个足够大的字体供其观看。大多数人从3.5米以外无法阅读小于24pt的字体。演示文稿中应使用的最小安全字体大小为36pt。48pt的字体最好在演示文稿中使用项目符号列表或描述。标题应更大，并使用72pt甚至96pt。