CONFLICTING GOALS IN CHOOSING COLORS FOR QUANTITATIVE MAPS

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In choosing colors for a map or series of maps it is essential to first identify the purpose of the color scheme, and second to be aware of the three dimensions of color (hue, darkness, and intensity) and how they can be used to accomplish that purpose.

An important distinction to make is between the use of colors for qualitative differences versus using colors to symbolize quantitative differences between map areas. This discussion will focus on colors used for quantitative differentiation — a task in which two separate major goals may be identified and seen to be in conflict. (*Minor goals may be identified tentatively as follows: equal-appearing intervals, hues appropriate to the theme being mapped, and variety in colors from one map to the next.)

1. One major goal is to have distinctive or distinguishable colors for each of the different classes or categories being mapped. Colors should be distinctive enough that a reader can easily identify an area's category by reference to the legend. On isarithmic maps, colors need not be quite so distinctive one from another because the orderly arrangement and labelled isolines make identification easier. On choropleth maps, however, with their complex patterns and changing settings for each color, there is need for more distinctive colors to satisfy this first goal.

2. The second, and conflicting, goal of a color scheme on a quantitative map is to provide a strong and unambiguous sense of quantitative change. The sequence must be a family of colors which appear related, and within which there is obvious progression that gives a reader the impression of — not one kind versus another — but rather of more and less of the same thing, i.e., the impression of changes in quantity only.

In order to satisfy the first goal, what sort of scheme and what color dimensions are useful? To achieve maximum distinguishability, especially with a large number of classes to map, we would select logically a series of colors widely

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* *Editor's Note: The graphics accompanying this presentation are not reproduced here. However, descriptions of the various slides are provided on page 288.*

spaced in hue, such as this sequence which encompasses much of the color circle from red through yellow and green to blue (Slide 1). Such a scheme is not suitable for quantitative maps because the colors are so widely separated in hue they suggest differences in quality, and also because the scheme puts yellow, with its unavoidable lightness, in the middle of the scheme, thereby making a sequence from darker through lighter to darker at the other end — very illogical in the darkness dimension and not conveying well the concept of quantitative differences.

If we were to be equally extreme in satisfying the second goal, i.e., providing a strong sense of quantity change, we would probably choose only one relatively dark ink and apply it at various strengths (Slides 2 and 3). This often is done, it certainly entails a logical progression of darkness and intensity, and it does give map readers the desired quantitative impression. Such schemes though, are limited with regard to the first goal since they allow only a few distinguishable classes.

To be less extreme in bowing toward either goal we might choose a series of colors spanning a part of the color circle; for example, a series through the warm side from red through orange to yellow, or through the cool side from blue through green to yellow (Slides 3 and 4). These are a great improvement, in regard to the second goal, over the red-orange-yellow-green-blue schemes, because there is much greater coherence and sense of relationship in the shorter range of hues: oranges seem intermediate between red and yellow because they are evidently mixtures of the two; and even greens are recognized as mixtures of blue and yellow. More important is the position of yellow in each of these two general schemes. Since it is at the end, there is logical progression of darkness from the inherently dark red hue to inherently light yellow in one case, and from inherently dark blue to yellow in the other case. Such schemes, therefore, make use of the darkness characteristics of the hues they employ.

The locical progression of darkness that depends on the character of hues would prevail even if inks were applied full strength with colors rendered at high intensity. But the logic of darkness change is not always enough to ensure that a scheme gives readers the intended quantitative message. In this case (Slide 5) the intense yellow at the intended low end of the scale is too often interpreted as representing large quantities; so it is necessary to screen the yellows and generally weaken or wash out the colors at the low end of the sequence as in this example (Slide 6) which does convey the impression of quantity changes but with some sacrifice in regard to the first goal. Undoubtedly a weak reddish-yellow like the second lowest in this series lacks a definite hue personality: it cannot readily be called a yellow, or any nameable hue, and that may impede the recognition and identification of map areas assigned that color.

So, the schemes that seem best for quantitative purposes, as seen in this brief exploration, are compromises that satisfy both major goals adequately: their colors are distinctive enough one from another, yet they all seem related and progress locically in darkness and intensity. A number of such schemes can be devised, but not a large number, I think, especially if the single-ink schemes are excluded. Often we may feel the need of a large number of schemes when designing a series of quantitative maps, preferring to use a different scheme for each new theme in the series. If that procedure is followed doggedly, there will likely be some unsuitable schemes, failing with regard to either the first or the second goal.

Another approach to a map series is to find one scheme that is effective and pleasing, and then to stick with it. The approach is used in the 1969 Census of

Agriculture by the U.S. Bureau of the Census, known for its automated production procedures, but at the same time an example of a series using well-chosen inks and screens. The color scheme may satisfy the second goal more completely than the first, i.e., sense of sequence is very strong, but distinguishability at the high end of the scale is rather uncertain — largely because county boundaries have been omitted for a most desireable clean and uncluttered look (Slides 8 and 9). This may be called monotonous by some designers; but I think map readers are likely to enjoy the repetition of color scheme — quickly adjusting to it, and then romping through the series, just absorbing information. If a scheme used in this repetitive way does promote transmission of information, then that is ample justification for its use.

The following slides accompanied "Conflicting Goals in Choosing Colors for Quantitative Maps"

Slide 1 A five-color sequence resembling that on Census Bureau G-50 Series, Map No. 7, with the following inks being applied full strength: red (PMS 184), orange (PMS 151), yellow (PMS 121), green (PMS 353), blue (PMS 312).

Slide 2 and Slide 3 Two single-ink sequences using red (PMS 185) at 100%, 60%, 40%, 20%, and 10%; and blue (cyan) at the same five strengths.

Slide 4 A five-color sequence like that used by the National Atlas of the United States, 1970, page 196, with these specifications.

PMS 185	100%	60%	40%	20%	—
Process Yellow	—	—	60%	60%	100%

Slide 5 A five-color sequence like that used on Census Bureau G-50 Series, Map No. 8, with these specifications.

Cyan	100%	100%	50%	20%	—
Process Yellow	—	30%	100%	100%	100%
Magenta	10%	—	—	—	—

Slide 6 A five-color sequence like that used by Goode's Atlas (14th Ed.) page 26, for Birth Rates, with these specifications.

PMS 179	80%	50%	30%	10%	—
Process Yellow	80%	70%	70%	40%	30%

Slides 7 8 and 9 Three maps from the atlas, 1969 Census of Agriculture.