The Visual Presentation of Information: Part 2

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Informational graphics are useful tools for the presentation and analysis of information. Not only do such graphics allow us to see patterns in the data that might otherwise remain hidden, but they also permit the presentation of a lot of information in a relatively small space. Ultimately, well-designed informational graphics promote the understanding of extremely complex or potentially confusing information. This has been especially true with the data from our research on diamond cut. In particular, for the published articles, we developed a series of contour maps to illustrate the effect of different proportions on brilliance and fire in a round brilliant cut (RBC) diamond. An understanding of the development of these contour maps should help the reader understand the graphics themselves — and the very valuable results they communicate.

In our previous article, "The Visual Presentation of Information: Part 1," we examined informational graphics in terms of their *dimensionality* — both the *dimension of their information* and the *dimension of their presentation*. We also examined informational graphics in terms of the number of *variables*, both *independent* and *dependent*, they represented. The total number of variables was shown to correspond to the dimensionality of the information (e.g., three independent variables and one dependent variable constitute four-dimensional information). We also briefly explored the difference between *discrete* and *continuous* data space, and explained that devising a graphic to present continuous data of more than three variables (i.e., more than three dimensions of information) created interesting challenges.

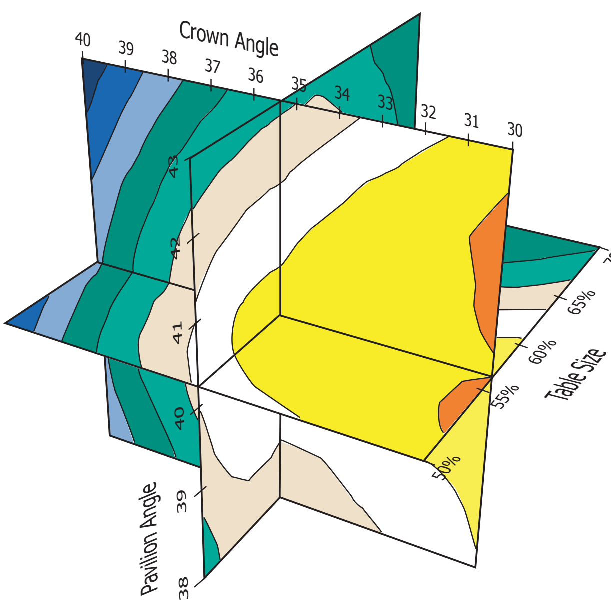

Figure 1. Visually displaying information with three (or more) independent variables creates interesting graphical challenges.

Unfortunately, much of our research data on diamond cut present just such challenges. This is because the appearance of an RBC diamond is affected by a complicated and intricate relationship of at least eight proportions that all can vary independently (i.e., act as independent variables)[1]. It would be convenient if we only needed to consider two or three independent variables (proportions) to understand the appearance of an RBC diamond, but — at least with regard to brilliance and fire — we have found that this is inadequate. For these reasons, we use informational graphics of four and five dimensions to better portray our findings. This article will examine how to "read" and understand this type of multi-dimensional visual information.

FROM A WHOLE TO SLICES

As we saw in the previous article in this series, the visual presentation of information with four or more variables creates interesting graphical challenges. This is especially true when presenting a continuous data space. An example we previously examined from GIA's 1998 article on diamond cut[2] is the graphic that displays the change in WLR (one of GIA's metrics for calculated brilliance)[3] across changes in crown angle, table size, and pavilion angle (figure 1).

Although this graphic attempts to display three-dimensional space, in reality it is only two-dimensional (limited by the two dimensions of your computer monitor or the printed page). Consequently, many areas of data space are hidden or are difficult to analyze accurately. An alternative presentation format is needed to address these hidden areas.

One solution is to take the "whole" or complete space that is depicted in this graphic and divide it into many slices. This method allows us to use a combination of discrete and continuous space mapping to present the information in a more usable format. That is, we can examine one of the independent variables as discrete data slices, while we continue to examine the other variables as continuous data.

For example, we can examine the change in WLR as table size increases in discrete increments from 50% to 59%. If we continue to present the graphic as a "whole," this does not necessarily increase the usefulness or readability of the information (figure 2).

However, once we separate those slices, and examine them individually, or side-by-side, a wide range of "new" information becomes available to us (figure 3; adapted from Hemphill et al., 1998, p. 176).

By presenting the information in this new format, we can better understand and analyze it. In this case, we can explore the changes in WLR values over a continuous range of crown and pavilion angles at predetermined table sizes. The smaller the increments between table size slices (i.e., the closer the slices are to each other in the "whole" graphic), the more closely table size approaches acting as a continuous variable. We could display separate slices for every 0.5% increase in table size, but at some point the number of slices we would need to examine would become prohibitively large.

This method of slicing the data space into discrete slices can be done for crown angle and pavilion angle as well as table size. For example, we could look at the change in WLR values over a continuous range of crown angles and table sizes while pavilion angle increases at discrete intervals (figure 4; taken from Hemphill et al., 1998, p. 177).

Remember that there are several uses for these slices (which can also be thought of as contour maps). First, if you know the specific crown angle,

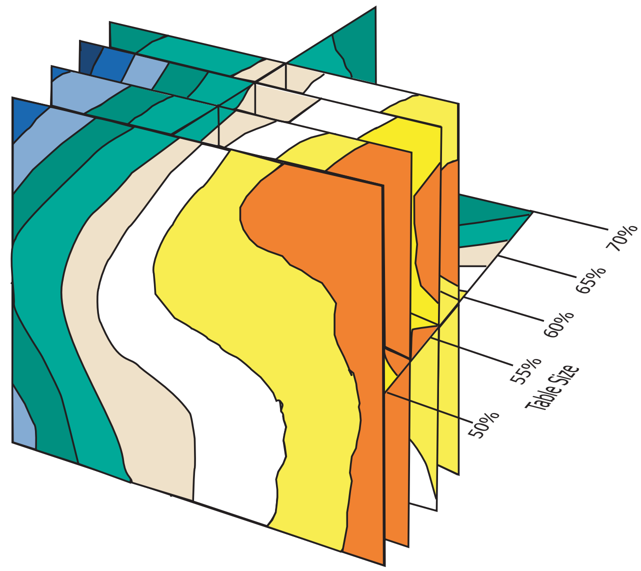

Figure 2. This graphic displays "discrete slices" of table size values intersecting the graphic from figure 1. Notice how much of the information stills remains "hidden" in this format.

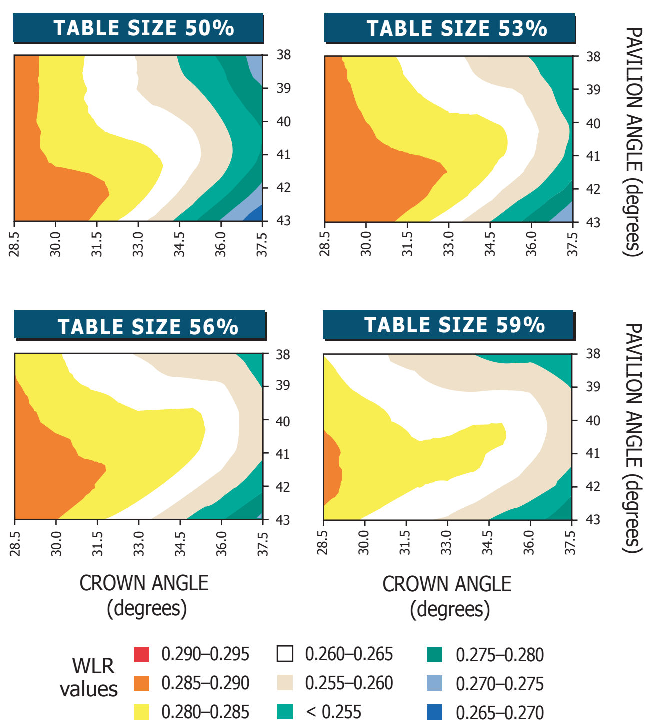

Figure 3. When the "slices" of information are placed side-by-side, more areas of data space become available for analysis.

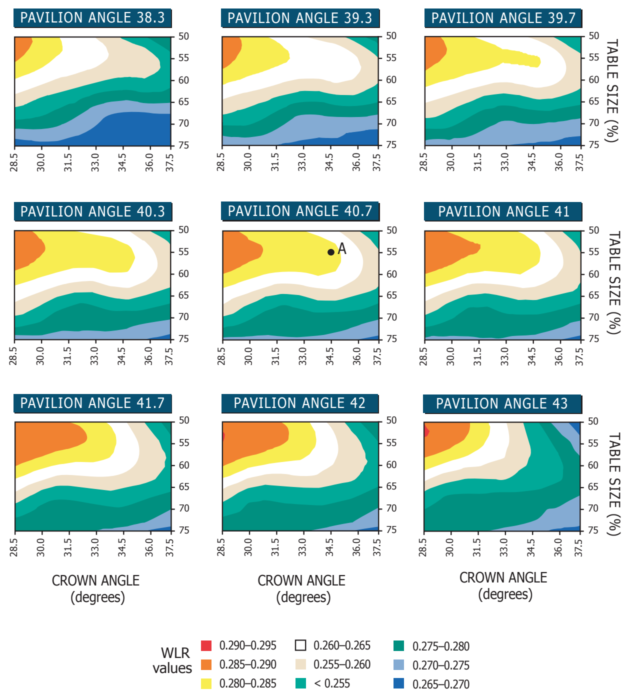

Figure 4. It is possible to analyze other aspects of the same data space by choosing to present different independent variables as "discrete slices." In this case, we have presented pavilion angles as discrete values, while leaving table sizes and crown angles as continuous data.

table size, and pavilion angle of an RBC diamond, then you can use these maps to determine the corresponding WLR value. In the above example, this would be done by first locating the data slice with the correct pavilion angle (e.g., 40.7 degrees) and then determining the WLR value at the intersection of crown angle and table size that you are interested in (e.g., crown = 34.5 degrees, table = 55%). This spot is marked in figure 4 with an "A," and has a WLR value in the range of 0.280 – 0.285. Second, you can analyze which ranges of crown angle, table size, and pavilion angle produce, in combination, a desired WLR value. In the above figure, this would be done by determining which variables (proportions) result in a certain color (i.e., a specific WLR range). Third, you can use the *contour edges* (the edges of the colored areas) to determine exactly where — that is, at which change in proportion values — WLR increases or decreases. As we can see, this is a large amount of information that can be made available in a relatively condensed visual format.

MOVING INTO THE FIFTH DIMENSION, AND BEYOND

In GIA's Fall 2001 article on diamond cut (in which we report our results from our research on fire)[4], we found it necessary to analyze six-dimensional information; that is, information consisting of five independent variables and one dependent variable. Unfortunately, we were still limited to the two-dimensional space of paper (or, as here, the two-dimensional space of a computer monitor). First, we held one variable (table size) constant, to reduce the number of variables to 5. Then, as with our previous examples of WLR graphics, we were able to use discrete-value data slices to present this information in a usable format.

The five-dimensional information from that article illustrates the change in dispersed colored light return (DCLR), GIA's new metric for calculated fire[5], across continuous changes in crown and pavilion

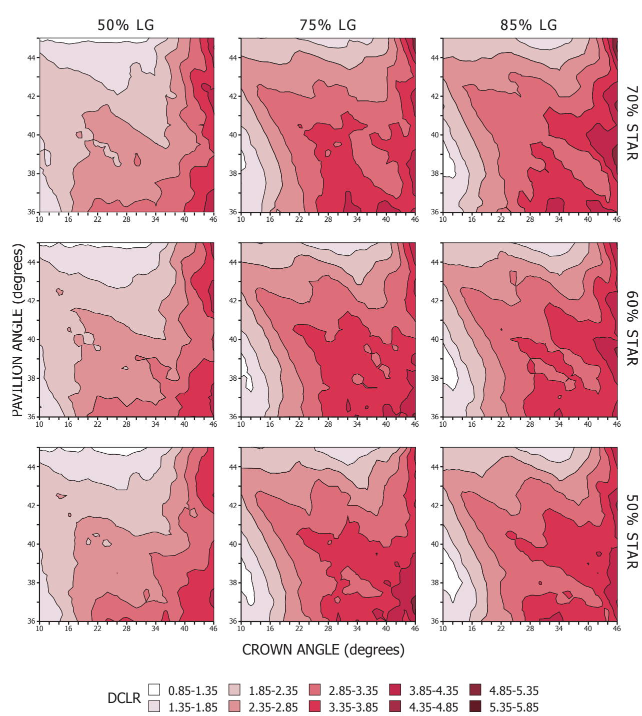

Figure 5. This illustration condenses many variables into one graphic. Some variables (crown and pavilion angles) are presented as continuous information, while other variables (star and lower-girdle facet lengths) are presented as discrete values. Including the DCLR values, there are a total of five dimensions presented in this graphic.

angles, and discrete changes in star facet length and lower-girdle facet length for a predetermined table size (figure 5; taken from Reinitz et al., 2001, p. 188).

In this figure, the continuous data spaces of crown and pavilion angles are graphed as the two axes of each individual contour map. The discrete values of lower-girdle facet length (50%, 75%, 85%) are represented as columns, of three contour maps each, from left to right. And the discrete values of star facet length (70%, 60%, 50%) are represented as rows, also of three contour maps each, from top to bottom. In this figure, the table size for all maps is set, or held constant, at 60%. The DCLR values (the dependent variable) are then graphed as different intensities of red in each contour map.

Depending on the available space for visually presenting this information, different new data slices could be added. For example, more columns could be added to provide other options for lower-girdle facet lengths, and more rows could be added to increase the number of options for star facet lengths.

In addition, the whole grid of contour maps could be re-created for different table sizes (e.g., 53%, 58%, or 64%). Placed side-by-side (imagine a sheet of paper for each discrete table size taped onto a large wall), the totality of all the contour maps now available to you would constitute six-dimensional information. (This is because table size would shift from being a constant to being an independent variable.)

Although this approach can make a lot of information visually available, it also can make that information increasingly difficult to understand and use. That is why it is sometimes easier to examine different contour maps where the independent variables that are held constant are switched. An example of this from the same article illustrates the change in DCLR across changes in crown angle (continuous), pavilion angle (continuous), and table size (discrete), while star and lower-girdle facet lengths are held constant (figure 6; taken from Reinitz et al., 2001, p. 189).

These contour maps represent the same data (proportion) space as figure 5, yet allow us to view the information in a slightly different manner. This method of switching various independent variables

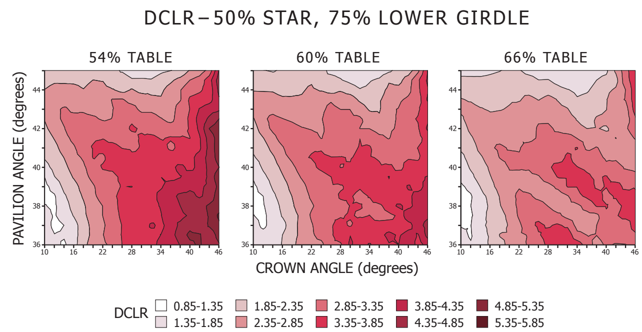

Figure 6. These contour maps display a different view of the data (proportion) space of the previous figure. The variables of star and lower-girdle facet length have been made constants, and three discrete values of table size have been used.

to constants is an important and useful way to analyze data from different directions, to examine specific "targets of interest."

CONCLUSION

We hope this and the preceding article have given you some idea of the power and usefulness of informational graphics. The visual presentation of information is everywhere in our daily lives. Whether we read newspapers and magazines or watch television, informational graphics form a large part of how we learn about the world. Certain situations, such as our research on diamond cut, demand ever more creative methods of visual presentation. However, the methods for analyzing this visual information are the same as those used for their simpler counterparts. Whether they are one-dimensional or five-dimensional, informational graphics allow us to view, understand, and analyze large amounts of data in a clear and condensed manner.

We received great inspiration for this article from Edward Tufte's three-volume set of books that explore visual information. We have provided the full references for these volumes in our references.

We hope that you found this article useful, and invite any feedback or comments that you may have. You may contact us by e-mail at DiamondCut@gia.edu. ■

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[1]Although we will be focusing on diamond proportions in the graphs that follow, it should be noted that research into diamond appearance includes many more possible variables (such as lighting, panorama, viewing angle, and human visual systems).

[2]Hemphill T.S., Reinitz I.R., Johnson M.L., Shigley J.E. (1998) Modeling the appearance of the round brilliant cut diamond: An analysis of brilliance. *Gems & Gemology*, Vol. 34, No. 3, pp. 158-183.

[3]WLR is a measure of brilliance that was calculated using computer ray tracing to follow millions of light rays (each with a specified source, direction, and wavelength) as they interacted with a modeled ("virtual") round brilliant cut (RBC) diamond. The WLR value depends on the specific proportions of the modeled RBC diamond (as well as the modeled lighting and viewing conditions) for which it is calculated.

[4]Reinitz I.R., Johnson M.L., Hemphill T.S., Gilbertson A.M., Geurts R.H., Green B.D., Shigley J.E. (2001) Modeling the appearance of the round brilliant cut diamond: An analysis of fire, and more about brilliance. *Gems & Gemology*, Vol. 37, No. 3, pp. 174-197.

[5]As with WLR, DCLR (Dispersed Colored Light Return) was calculated using computer ray tracing to follow millions of light rays (each with a specified source, direction, and wavelength) as they interacted with a modeled ("virtual") round brilliant cut (RBC) diamond. The DCLR value is a measure of fire which depends on the specific proportions of the modeled RBC diamond for which it is calculated.

