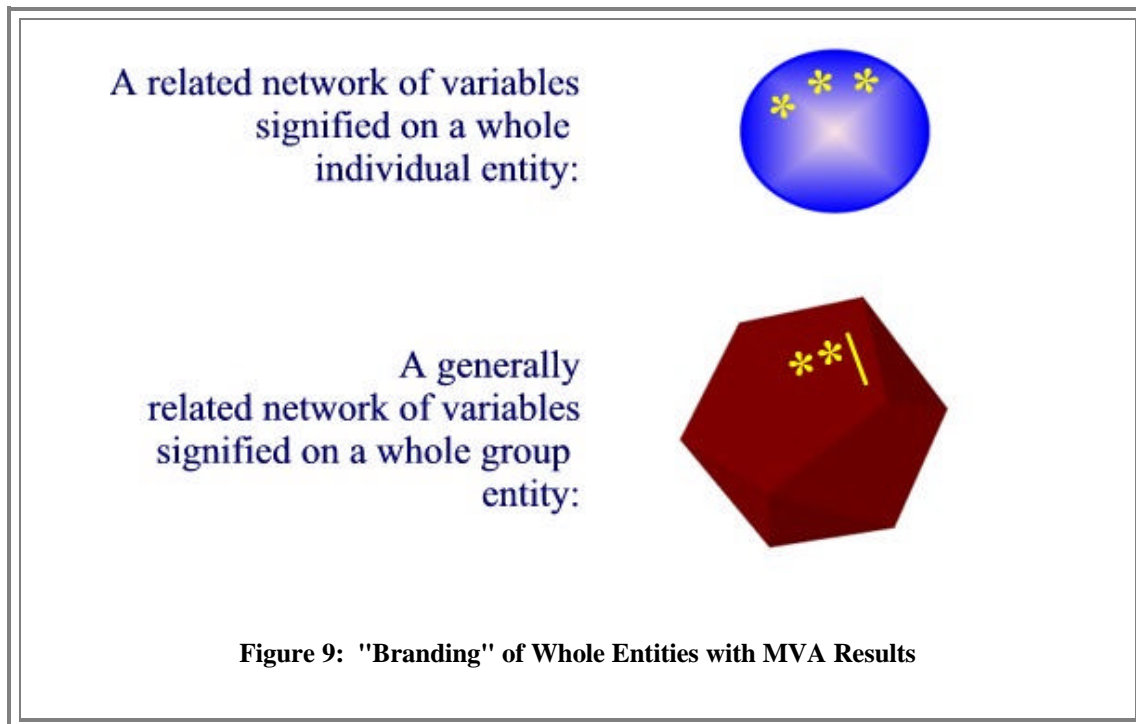


Because the relationships amongst variables does not take place independent of entities, we can envision a scenario much like that of blood histology when antigens were first discovered. Specifically, just as red blood cells carry an Rh factor, so also does an entity carry a similar “brand” as shown in Figure 9.



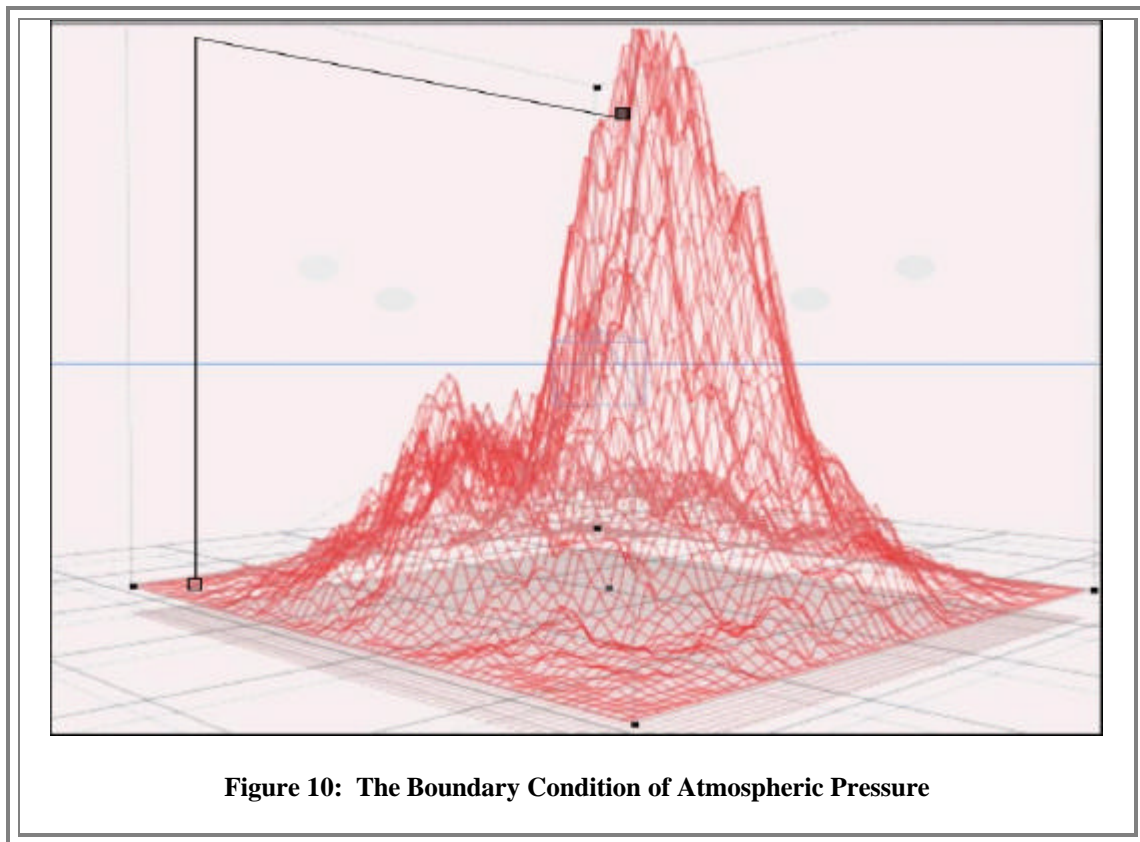
Thus, it is possible to simultaneously show specific variables tied to specific entities. More important, additional attributes such as a marker to indicate which entities are high, medium, or low on the variables in question, can be overlaid as another surface feature. Indeed, it is possible to show enough entity-specific information so as to require large mainframes to graphically display the results.

The Fourth Inferential Component: MRA - Multiple Relationship Analysis

The final inferential component, MRA, or Multiple Relationship Analysis, is perhaps the most often overlooked of the four, but it is possibly the one that offers the greatest assistance for modeling complex systems. MRA adds an important tool to the multilevel toolkit by enhancing our ability to test for and detect boundary conditions.

Why are boundary conditions important? At a very abstract and theoretical level, there has been a long standing debate in the scientific communities regarding theories that are either universally applicable under all conditions (termed multiplexed) versus those theories that are contingent, that is, they are predicted to occur only under certain conditions. Likewise, at a very detailed, operational level, there also has been a great deal of discussion in the organizational sciences about how to deal with the notion of contingency, and how to operationalize it, especially using moderated regression. MRA offers an alternative view to moderated regression that combines inferences about predictions for both variables and entities.

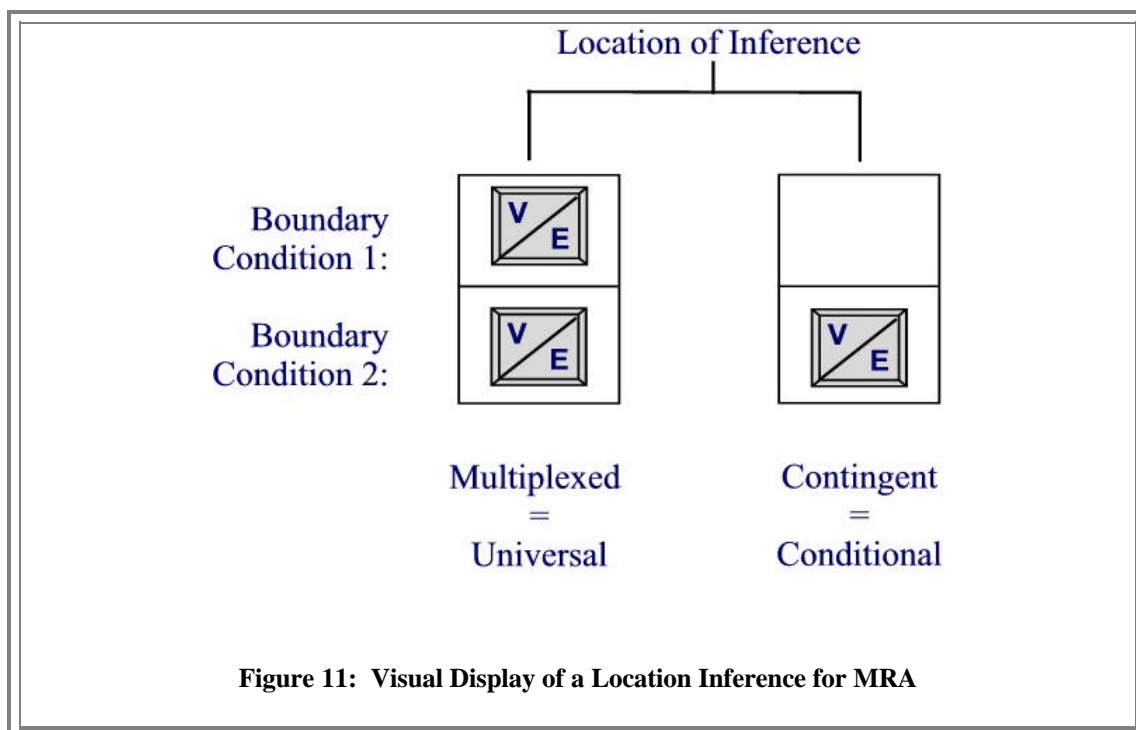
To explain the visual glyph for MRA, let us first imagine, as shown Figure 10, a camper who has lived all summer at 12,000 feet in Summit County, Colorado.



She knows that burning two 8 oz. sticks of pine in the morning will boil enough water for her coffee and breakfast. She plans accordingly. Months later when she descends to her

fall camp near Colorado Springs at 4,900 feet, she finds that she has badly underestimated the amount of fuel that she now needs. Why? She did not account for an important boundary condition: atmospheric pressure. At 12,000 feet, water boils at a much lower temperature and requires far less wood than at 4,900 feet. In Figure 10, the small square at 12,000 feet is darkened, indicating that the relation between the wood, fire, water and boiling holds true. The open square at the base camp indicates that the relationships between the same variables and entities do not hold.

A more formal way of visualizing this conditional inference is shown in Figure 11. When both vertically aligned flags are darkened, it indicates that the relationship in question holds across both values of the boundary condition. It is multiplexed. (Notice that the boundary condition in this example, altitude, in its raw form is continuous, but it has been reduced to a dichotomous form: high and low.) In contrast to the left side of the figure, the right side, with one unshaded box shows that a contingent theory has been formulated or found.



Notice that the shading within each “locator” box has a notation “E” for entities, which indicates that some type of SLA or MLA inference has been found.

Summary

This short exercise in visualization has attempted to assist in developing a visual notation for explaining the types of results generated by the DETECT program and the WABA rationale behind these tests. It is by no means a complete explanation of the WABA inferential system. As a starting point, it might serve as a bridge to other types of application areas such as information systems or simulation where the display of both variables and entities is required.

The following table summarizes the four major inferential components of WABA and the scientific analogs for their visual glyphs.

Table 1: Summary of Visual Glyphs for the Four Inferential Components of WABA

WABA Component:	Issue:	Visual Glyph:	Scientific Analog:
SLA	Detecting effects of a single grouping entity on texturing	SLA Inference Dial	Deep space astronomical observations
MLA	Detecting the simultaneous effects of multiple entities	MLA Lenses	Cellular microbiology
MVA	Describing the relationship of a network of variables	MVA Branding	Blood histology
MRA	Identifying the conditions under which relationships hold true	MRA Locator Flags	Meteorology

In conclusion, future efforts in visualization can direct both at extending WABA into other fields and to refining the visual applications for each of the components listed above. Much work remains in creating a visual nomenclature for explaining the complex findings from multilevel organizational research.

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