"reasonable." The point to be made here is that each alternative eats up some menu space and potentially confuses the user by mode trapping (you never are in the mode you think you are). I am not aware of *any* data analytic problem where the first or third of the modes offers a substantial advantage over the second. What sometimes is required in addition is a *variant* of the first method, for moving one object (point cloud) as a rigid body relative to some other. In order to do this, one would have to control all six degrees of freedom of rigid body motion simultaneously (for which, incidentally, the mouse is a woefully inadequate interaction device).

As the authors stress, scatterplot matrices are nice because they provide a single integrated view of the data (Section 2.6). But I believe they understate the resolution problems, and that for all but the very smallest values of $p$ an alternagraphic solution is preferable. For example, show only two scatterplots at one time, keeping one fixed, and use the other space to flip through all the plots in one row or column of the scatterplot matrix.

Some shorter comments.

*End of Section* 3.1. The distributed processor model is not only at a design disadvantage, but it also creates a software maintenance nightmare.

*Section* 3.3: *Integer Arithmetic*. I believe these considerations are no longer relevant after the advent of coprocessors (8087, 68881, etc.).

*Section* 3.4. These sad comments on graphics standards, unfortunately, are even true for semistatic graphics (where the only interaction is the all important identification of labeled observations).

*Section* 3.5. Windows are great if there is enough screen resolution (800 by 1000 or better) and we immediately got hooked on them with our first Apollo in 1982. But just like the proverbial *goto* in programming, extensive use of windows may actually be harmful in data analysis. Data analysis is an experimental science, and a "laboratory journal" metaphor is more appropriate than a messy "desktop," especially since the electronic version can be messed up much more thoroughly than a real one, and in much less time!

Of course, no survey can cover everything in depth. Still, because of their importance, I believe the following topics would have deserved a more thorough treatment: techniques for identifying and isolating clusters (the letter I of the original PRIM-9) and the role and use of colors.

## ADDITIONAL REFERENCES

HUBER, P. J. (1987). Experiences with three-dimensional scatterplots. *J. Amer. Statist. Assoc.* **82** 448–453.

TUKEY, P. A. and TUKEY, J. W. (1981). Graphical display of data in three and higher dimensions. In *Interpreting Multivariate Data* (V. Barnett, ed.). Wiley, New York.

# Comment

**William F. Eddy**

The authors are to be thanked for their thorough review of the current state of interactive graphics (although I think I detected a certain bias in favor of methods they and their colleagues have developed). As I started careful reading of this paper I found myself repeatedly asking: What if Option 2 instead of Option 1? It seems obvious that there is considerable work yet to be done in deciding which choices should be made. I will resist the temptation to produce a long list of such questions but rather point in other directions.

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## 1. STATISTICAL ROOTS

Graphical techniques have always been a part of statistics. Nevertheless, I was very struck on reading this paper that graphical statistics is currently in very much the same state that mathematical statistics was about 100 years ago. In fact I went back and reread parts of some of Karl Pearson's long series of papers on the mathematical theory of evolution that was published in the *Philosophical Transactions of the Royal Society of London* between 1894 and 1916. In the very first paper, Pearson gives a graphical method for calculating the first five moments of a probability density function.