

UC Merced

Proceedings of the Annual Meeting of the Cognitive Science Society

Title

Diagrams to Augment Cognition

Permalink

<https://escholarship.org/uc/item/3dt63840>

Journal

Proceedings of the Annual Meeting of the Cognitive Science Society, 24(24)

ISSN

1069-7977

Authors

Tversky, Barbara

Heiser, Julie

Lee, Paul

et al.

Publication Date

2002

Peer reviewed

Diagrams to Augment Cognition

Barbara Tversky¹, Julie Heiser¹, Paul Lee¹, and Jeffrey M. Zacks²

¹{bt, jheiser, pauly@psych.stanford.edu

Department of Psychology
Stanford University
420 Jordan Hall
Stanford, CA 9435-2130

²{jzacks@artsci.wustl.edu}

Department of Psychology
Washington University
Campus Box 1125
One Brookings Drive
St. Louis, MO 63130-4899

Diagrams : A Cognitive Tool

Diagrams, such as maps, charts, graphs, and widely used as cognitive tools to promote memory and information processing, serving a variety of situated roles. They offload limited capacity working memory; they promote the use of space in inference and reasoning, they provide common ground for collaborative design (e. g., Kirsch, 1995; Larkin & Simon, 1987; Tversky, 2001).

One reason for the effectiveness of diagrams is that they map real or conceptual elements and relations to graphic elements and spatial relations in diagrammatic space. Diagrams have a rudimentary semantics and syntax. Diagrammatic elements, such as lines, blobs, crosses, and arrows have many possible interpretations derived from their geometric properties, but are disambiguated in context, much like the verbal concepts they approximate, such as relation and area. The elements can be combined in constrained ways to produce a multitude of meanings. This schematization has been a consequence of long term interactive situated use. Diagrams also use the spatial relations among elements to convey conceptual relations preserving varying levels of information, categorical, ordinal, interval.

Diagrams for Clarity

Diagrams can be used to organize and convey information and instructions, as in route maps and assembly directions. Here, the primary use is to instill prescribed information or linear actions. This will be exemplified by two projects on production and use of diagrams, one in route finding and the other in object assembly. In both cases, descriptions and depictions reveal the same underlying conceptual structure for traversing a route or assembling an object. These structures include both representations and procedures.

Diagrams for Creativity

Diagrams can also function to aid inference and promote creativity. Here, the goal is to come up with new ideas, ideas not anticipated by the designer of the diagram. This will be described by Suwa (2002; Suwa & Tversky, 2001) in a project on diagrams generated and used in design.

In both cases, diagrams are inevitably replete with ambiguity. In the former, context disambiguates, instilling clarity and avoiding confusion. In the latter, ambiguity is a resource for creativity.

Acknowledgments

We are grateful to Office of Naval Research, Grants Number N00014-PP-1-O649, N000140110717, and N000140210534 to Stanford University for support for this research.

References

- Kirsh, D. (1995). The intelligent use of space. *Artificial Intelligence*, 73, 31-68.
- Larkin, J. H. and Simon, H. A. (1987). Why a diagram is (sometimes) worth ten thousand words. *Cognitive Science*, 11, 65-99.
- Suwa, M. (2002, in press). Constructive perception: An expertise to use diagrams for dynamic interactivity. *Proceedings of the Cognitive Science Society*.
- Suwa, M., & Tversky, B. (2001). Constructive perception in design. In J. S. Gero & M. L. Maher (Eds.) *Computational and Cognitive Models of Creative Design V*, Sydney: University of Sydney.
- Tversky, B, Zacks, J., Lee, P. U., & Heiser, J. (2000). Lines, blobs, crosses, and arrows: Diagrammatic communication with schematic figures. In M. Anderson, P. Cheng, and V. Haarslev (Editors). *Theory and application of diagrams*. Pp. 221-230. Berlin: Springer.
- Tversky, B. (2001). Spatial schemas in depictions. In M. Gattis, (Ed.), *Spatial schemas and abstract thought*. Pp. 79-111. Cambridge: MIT Press.