A picture among pictures: A classification system for instructional visualizations

Halszka Jarodzka, Birgit Imhof, & Peter Gerjets

Earli 2011

Different dimensions of visualizations

These visualizations depict the same *content* (fish locomotion patterns), have the same *function* (conveying knowledge on f.l.p.), but still differ dramatically! And hence, so did their effects:

Imhof, B., Scheiter, K., Edelmann, J., von Ulardt, J., & Gerjets, P. (2011). Is enriching static-simultaneous visualizations with motion-indicating arrows helpful for learning about locomotion patterns? In L. Carlson, C. Hölscher, & T. F. Shipley (Eds.), *Proceedings of the 33rd Annual Conference of the Cognitive Science Society* (pp. 1176-1181). Austin, TX: Cognitive Science Society.

Imhof, B., Scheiter, K., & Gerjets, P. (2011). Learning about locomotion patterns from visualizations: Effects of presentation format and realism. *Computers & Education, 57*, 1961-1970.

Jarodzka, H., Scheiter, K., Gerjets, P., Van Gog, T., & Dorr, M. (2009). How to convey perceptual skills by displaying experts' gaze data. In N. A. Taatgen, & H. van Rijn (Eds.), *Proceedings of the 31st Annual Conference of the Cognitive Science Society* (pp. 2920-2925). Austin, TX: Cognitive Science Society.

Kühl, T., Scheiter, K., Gerjets, P., & Edelmann, J. (2011). The influence of text modality on learning with static and dynamic visualizations. *Computers in Human Behavior, 27*, 29-35.

Kühl, T., Scheiter, K., Gerjets, P., & Gemballa, S. (2011). Can differences in learning strategies explain the benefits of learning from static and dynamic visualizations? *Computers & Education, 56*, 176-187.

Pfeiffer, V. D. I., Gemballa, S., Jarodzka, H., Scheiter, K., & Gerjets, P. (2009). Situated learning in the mobile age: Mobile devices on a field trip to the sea. *Association for Learning Technologies Journal, 17,* 187-199.

→ generic classification system is needed

Research questions

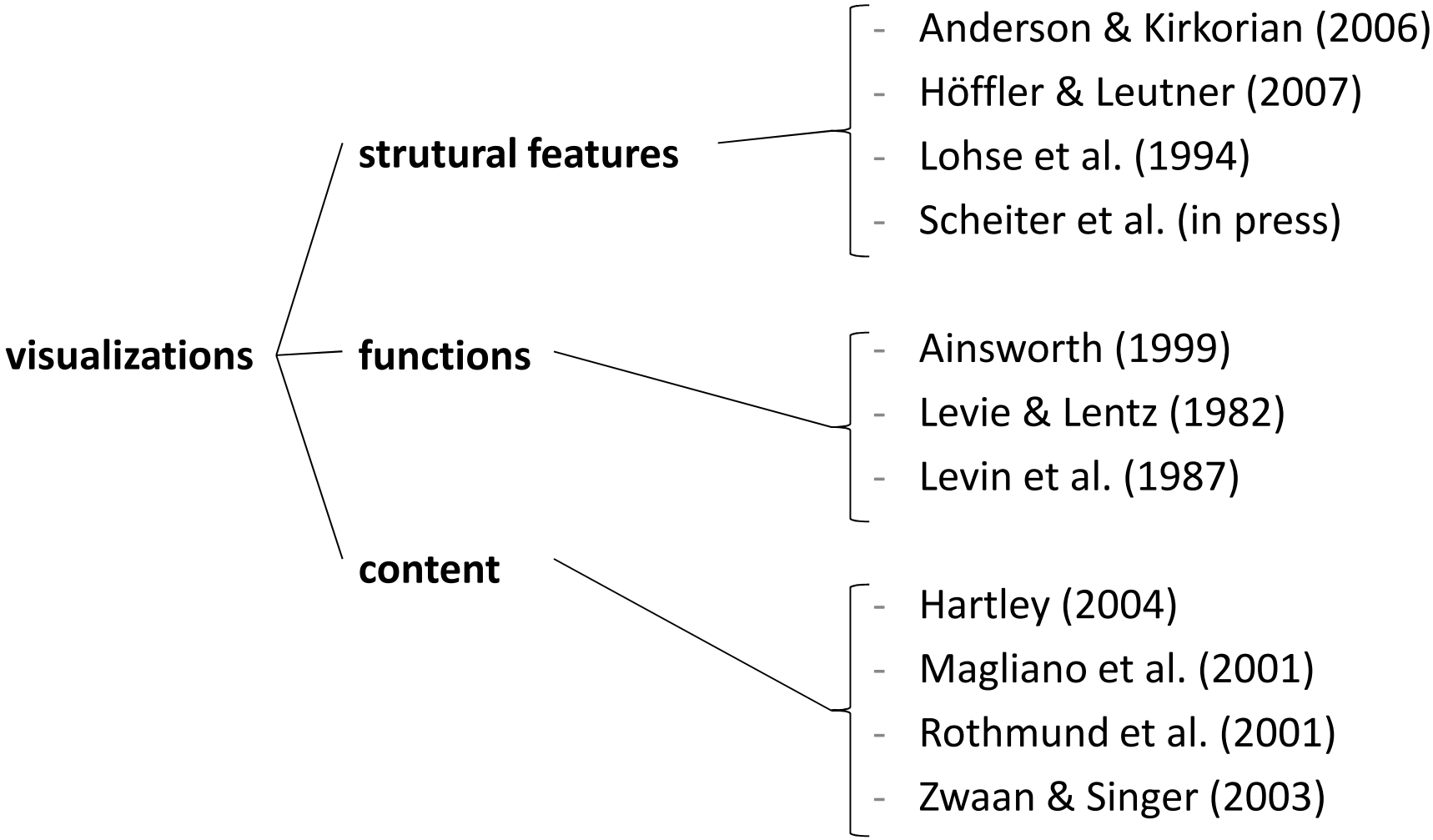
1. Which features are central for processing a visualization?
2. Which compentences are required to benefit from the use of certain visualizations?
3. To which degree can effects on the use of certain visualizations be generalized?
4. Which type of information or knoweldge can be best conveyed by means of which visualizations?
5. Are certain visualizations more similar, and thus more qualified to convey certain knowledge?

To answer these quesitons, you first need to objectively assess different types of visualizations.

→ Development of an classification schema

Which dimensions / features can be used to classify visualizations?

Theory-guided approach



1. Structural features

- **Visualization production**: photography, movie, animation, drawing, painting, comic strip, etc.
- **Visualization type**: iconic, indexical, symbolic familiar, symbolic unfamiliar
- **Recording or processing technique**: lighting, camera perspective, camera position, camera panning, change of scene
- **Dynamism**: degree, complexity
- **Realism**: time, colour, contours, texture, spatial relations, voice, sound
- **Accompanying text**: no, modality, text type, language
- **Accompanying audio**: no, music, noise / sound
- **Cueing** : no, auditive, visual, colour, motion
- **Interactivity**: no, basic, display, flow, manipulations

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1. Structural features	
1d) Dynamism	**Degree of Dynamism:** O single static O dynamic segmented O static-simultaneous O dynamic continuous O static-sequential O multiple dynamic O static-dynamic mixtures O miscellaneous **Complexity** (concurrent movements of several objects): O high O unobtrusive O low **Duration of the presentation:** O determined: _____ O not determined

2. Functional features

- **Affective**: influencing emotions, mood, motivation, attitudes
- **Complementary**: decorative, representational, organizing, interpreting, transforming, redundant vs. complementary vs. contrary, restricting
- **Attention controlling**: attracting, guiding, capturing
- **Working memory offloading**: perceptual chunking, off-loading, procedural fit
- **Long-term memory supporting**: facilitating recall, facilitating comprehension, fostering elaboration

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2. Functions	
2c) (Text-/picture-) complementary functions O yes O no O unclear	O decorative O representational O organisational O interpretational O transformational _____ O redundant O complementary O contrary O constraining

3. Depicted content

- **Genre**: expository, narrative, hybrid (inductive vs. deductive), visualization art
- **Striven target group**: age, expertise, specifity
- **Realism of content**: realistic vs. fictional, documentary vs. stage-managed, situation, event, plot
- **Object and degree of identification**: given vs. not given vs. changing vs. several, high vs. low
- **Coherence / continuity**: temporal, spatial, visual, content-wise, between representations
- **Difficulty of required inferences**: high vs. low
- **Detailedness of presentation in relation to complexity of content**: high vs. low
- **Type of conveyed knowledge**: facts vs. skills
- **Domain**: natural sciences, humanities, arts / culture, sports, politics / society, entertainment, ...

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3. Content	
3g) Domain	O natural sciences O sports O humanities O art / culture O politics / society O entertainment O advertisement / propaganda O „cultural techniques“ (e.g. reading, writing, calculating, cooking, knot tying, …) O miscellaneous

Evaluation of the new classification system

N = 10 independent raters

six different visualizations:

1. a computer animation about cancer
2. an impressionistic painting
3. a static text-picture combination
4. an animated cartoon
5. a section from a silent film
6. a section from a television movie

Conclusions and future directions

- First empirical testing of this classification system revealed good aggrement among different raters. Still, further evaluations with more visualizations needed!

For questions on this talk , please contact me:

Halszka.Jarodzka@OU.nl

Imhof, B., Jarodzka, H., & Gerjets, P. (2009). Classifying instructional visualizations: A psychological approach. ***IMAGE. Journal of Interdisciplinary Image Science, 10*****, 99-123.**

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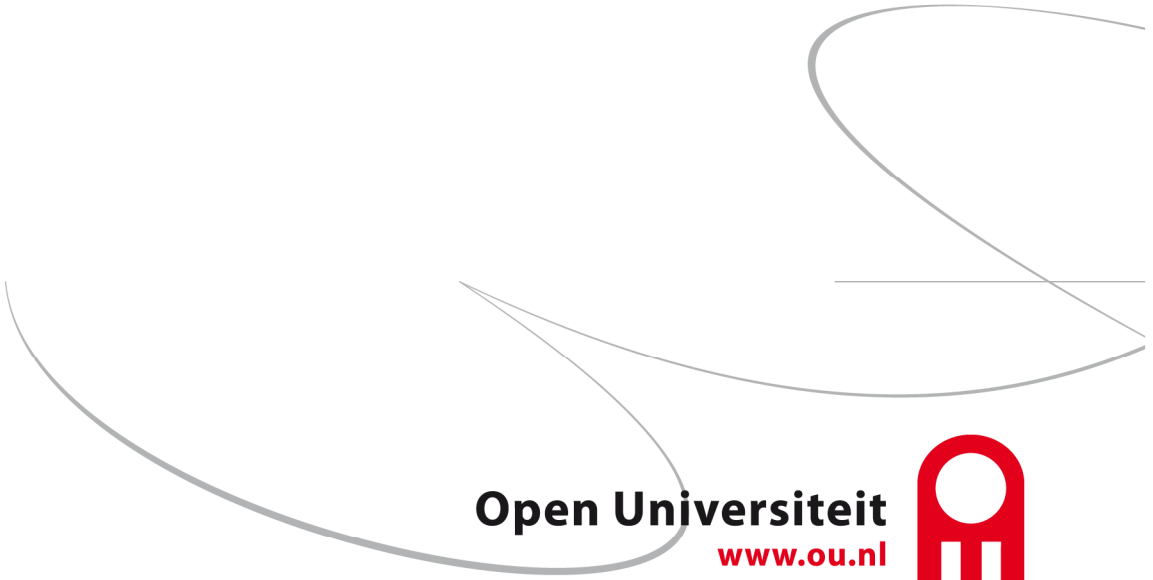
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