

Displays versus viewer: The simpler, the better

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D.G. Bouwhuis. Displays versus viewer: The simpler, the better. Gerontechnology 2010; 9(3):397-399; doi:10.4017/gt.2010.09.03.011.00 Many different display technologies have been designed to present visible messages and information. Though most display products feature an adequate image quality, the images often fall short of optimality. How images and information should be displayed for optimal visual processing is more science than art, but in actual practice it is more art than science. Much graphical design therefore handicaps the aging visual system.

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At first sight the expression 'less is more', sometimes employed by James Fozard¹, entails at least a paradox, if not a clear contradiction. There are situations, however, in which this can be turned into an actual truth that because of the description above will continue to evoke disbelief, notwithstanding contrary empirical evidence.

THE VISUAL DISPLAY

One such situation is that of graphical information presented on a visual display unit. If the screen is totally blank and only one element, for instance, the letter E is shown for a short time in the centre, all observers with even cursory alphabetic proficiency, will recognize that letter with certainty. If now another letter is added next to it, recognition will also be unproblematic, but this will become more problematic if ever more letters are added. Difficulties will already start at four letters, while twenty letters will be recognized by no one; the total number of correctly reported letters will hover around 4.5^2 .

This means that whenever more letters are added, and information is correspondingly increased the actual information received will correspondingly drop.

INFORMATION AS A CROWD

An interesting analogue is a crowd on one side of a wall that contains a door that only lets pass one person at a time. If everyone in the crowd tries to pass the door, irrespective of other people, simulations show, (and this is corroborated by actual observations in emergency situations), that progress is excruciatingly slow and frequently held up by obstructions occurring in the doorway³.

If, however, people would be arranged in a single row and march through the door in sequential fashion, the total time taken for a complete traversal is only a fraction of that. Now the crowd can be thought of as the visual information fighting for attention, represented by the narrow doorway. It is clear that when the crowd is growing in size, less of them will get through, while what is getting through is an ever-decreasing proportion of what is actually there.

VISUAL ATTENTION

What visual attention does is not only enhancing the piece of information that is there, but also reducing those parts that have to remain outside of the field of attention⁴. Attention is therefore rather more a suppression mechanism than an enhancing mecha-

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nism. Inasmuch as any type of processing requires processing effort, one may imagine that when the neural processing system is aging some mechanisms will show a drop in effectiveness. That it should be the attentional suppression mechanism comes as something of a surprise, as few people think of attention in terms of suppression. Nevertheless extensive studies at our lab showed conclusively that suppression is strongly affected by aging of the visual and/or cognitive system⁵.

STIMULI VERSUS DISTRACTORS

In one study we used a distractor paradigm, where a stimulus had to be recognized in a small centrally located field, while it could be surrounded by a varying number of similarly shaped distractors. The exposure time of the stimulus field was between 100 and 150 ms, which is amply sufficient to recognize single letters. The higher the number of distractors, the lower the recognition became, until it practically reduced to zero for older observers. Younger observers, of student age, were hardly affected by the number of distractors, which made the effect quite dramatic. The phenomenon can be described as: 'when more is presented less is perceived' which gives the expression 'less is more' at least some empirical support.

What happens when the exposure time is increased? The influx of visual information will reinforce the visual image and in due time the attentional mechanism can indeed select the intended stimulus and suppress the distractive information. Mobilizing the attentional resources and structuring the visual lay-out to recognize the stimulus takes time, making also time a precious resource.

Yet, again the effect of this time increase may be jeopardized by other types of distractors, one of the most damaging of which is movement, especially movement in the periphery of the visual field.

MOVEMENT AND EXPECTATION

If the displayed information would be visible for a longer time, but the peripheral elements in it would start to move, the attentional mechanism would be unable to suppress that interfering information, as it simply lacks the time needed to mobilize the right type and location of suppression. Such effects become gradually well-known from our experiences on the Internet where commercial parties try to draw our attention to the unavoidable flicker in the corner of our eyes. Evolution has not prepared us for avoiding sudden physical movement in our periphery, which might either represent something to eat, still fresh as it is moving, or something that might eat us, that is unfortunately moving. On the contrary, evolution has prepared us to interpret the peripheral movement as something that is so important for our survival that its identity need not be explicitly recognized to realize how vital it is⁶.

In our visual perception the great majority of things that we perceive is redundant, perhaps to varying degrees, but very often highly redundant. Especially artifacts are designed such that they are clearly recognizable, highlight their function, and frequently stand out from their environment. In our lab Bondarenko and Janssen⁷ performed studies on what features office workers used to recognize and categorize objects on their desks. It turned out that people can specify extended series of hierarchically organized parallel features that link basic visual features to semantic interpretations. If one of the intermediate features should be absent, or invisible, this would not impair recognition as there is sufficient information available for unambiguous recognition. Take the printed word 'Yes' which can be specified in various ways, but even in the digital world it would be hard to get a description that goes below 30 bits. Yet in the context of a yes-no decision the information is only 1 bit, implying that 'more' ultimately becomes 'less'. So, this conspicuous property of peripheral movement is exactly the reverse of that. It is another unexpected example of 'less is

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more'; the minute visual information that we extract from a movement in the periphery of the visual field, is interpreted by our cognitive organization as something decidedly more that deserves immediate attention.

CONCLUSION

Both cases of 'less is more' should constitute a guideline for webpage designers who want to bring the right information to purposeful users.

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