

Seven, plus or minus two. What's the relevance for web design?

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I first confronted the 7+/-2 principle in 1990 when I was designing computer-based training. Like many of my training and writing colleagues, I accepted the application of 7+/-2 without ever reading the research paper on which it was based.

Why is the 7+/-2 principle applied so widely?

The research that produced the 7+/-2 principle was conducted in 1956 and, since that time, has been widely applied to the organisation of online information, the design of user interfaces and the development of web navigation.

Why? The answer may simply be that the 7+/-2 principle is being applied without any consideration of the relevance of the research to its real-time applications.

A quick historical recap

Almost 50 years ago, George A. Miller, a Princeton University psychologist, conducted specialised research to test the limits of short-term or, as it is now known, working memory.

Miller's results were published in 1956 as *The Magical Number Seven, Plus or Minus Two: Some Limits on Our Capacity for Processing Information* and aroused strong interest. In fact, many claim Miller as the father of cognitive psychology because of that paper and that research.

Miller's research was the primary basis for the chunking principle of Robert E. Horn's Information Mapping Methodology and is constantly quoted to justify recommendations for element groupings such as

- the number of chunks of information on a page
- the number of items in a list
- the number of items in an online menu
- the number of controls in forms and dialog boxes

What exactly did George Miller test in 1956?

He tested "absolute judgments" of what he called "unidimensional and multidimensional stimuli".

- A unidimensional stimulus requires the user to judge a single attribute such as the pitch of a musical tone.
- A multidimensional stimulus involves judging more than one attribute, such as the sweetness and saltiness of something you taste.

In one of his tests, Miller tested the human ability to correctly classify the pitch of the musical tones they heard. Was a new tone higher or lower than a previous tone? Was it the same as a previous tone?

"When only two or three tones were used, the listeners never confused them. With four different tones confusions were quite rare, but with five or more tones confusions were frequent. With fourteen different tones the listeners made many mistakes..." (Miller, 1956)

What is ignored when Miller's research is cited?

In his paper, Miller acknowledged that the span of working memory could be pushed beyond the 7 ± 2 limit by changing the conditions of the test.

"The three most important of these devices are (a) to make relative rather than absolute judgments; or, if that is not possible, (b) to increase the number of dimensions along which the stimuli can differ; or (c) to arrange the task in such a way that we make a sequence of several absolute judgments in a row."
(Miller, 1956)

George Miller himself has regularly protested at the blanket application of his research results to so many aspects of information design.

For example, in an email to the editor of a technical communication group, he wrote "... that 7 was a limit for the discrimination of unidimensional stimuli (pitches, loudness, brightness, etc.) and also a limit for immediate recall, neither of which has anything to do with a person's capacity to comprehend printed text."

Real-world support changes the equation

Those who cite Miller's research for information and web design decisions fail to understand that information processing tasks are enabled by prior experience and learning, by the performer's purpose and agenda, and by environmental support from visuals, words and sounds.

For example, how often is the mind called upon to produce output without tangible or physical environmental support? Would you attempt to add the THREE numbers, 1926, 4785 and 3072 without reaching for a piece of paper to order the numbers vertically and record interim totals?

And if you did the addition in your head, wouldn't you expect the task to be 'harder', that is, to impose a higher cognitive load than adding the items up on paper?

What we can readily acknowledge is that the nature of the processing task changes the demands on working memory.

Does the 7 ± 2 principle have any relevance for navigation design?

In 1998, Kevin Larson and Mary Czerwinski, two researchers from Microsoft Research, tested the relevance of 7 ± 2 to the design of navigation structures.

With the help of an editor, they took 512 information pages from the Encarta encyclopedia and set up three navigation structures.

- 8 primary navigation categories, each linked to another 8 categories that linked to a page of 8 links to information pages (8x8x8)
- 16 primary navigation categories, each linked to a page of 32 links to information pages (16x32)
- 32 primary navigation categories, each linked to a page of 16 links to information pages (32x16)

Larson and Czerwinski expected to find that users browsed more successfully when they had a smaller set of navigation choices because of the accepted 7 ± 2 limitation of short-term memory. Instead, they found that "that subjects performed best with the 16x32 hierarchy and worst with the 8x8x8 hierarchy."
(Larson & Czerwinski, 1998)

'Information scent' NOT memory capacity determines browse outcomes

Larson and Czerwinski noted that memory span had minimal effect on successful browsing. More important to their test subjects was the strength of 'information scent' provided by the category cues.

They noted that "the 16x32 and 32x16 information structures most likely afforded optimal performance because their category labels were more distinct at the top levels (better scent) than those of the 8x8x8 hierarchy. For the 8x8x8 hierarchy, the top-level category labels were more general, and hence subjects took longer to make a decision as to which category to choose." (Larson & Czerwinski, 1998)

They also noted that "The 8x8x8 structure also likely suffered from the fact that subjects had to make yet another categorical decision at the second level of the hierarchy." (Larson & Czerwinski, 1998)

Information scent is the key to navigation design

The term, information scent, is used to describe the ability of navigation labels and links to suggest the information or services that are located at the destination of the link.

Information scent is not an intrinsic quality of the navigation text. Scent is perceived by the user who reads and interprets the words. The user's learned associations with the words combine with the user's current context (purpose and agenda) to detect the 'scent' of the link.

Developing effective navigation labels and links involves selecting words that have appropriate user associations and will be interpreted correctly in the context of the user task.

Scent also influences content organisation

The ability to create 'scent' in navigation cues determines content organisation since the scent of the label or link sets implied boundaries for the content.

There is little point including content in an information area if the presence of the content cannot be suggested by the navigation label or link text.

And list items, dialog controls and page chunks?

The 7+/-2 limitation has no relevance to information or user interface design. What is important is the nature of the cognitive task that is presented to the user in combination with the agenda that the user brings to the task.

- A list of 3 items may overload working memory simply because the items themselves are difficult to understand.
- A navigation menu of 7 items may frustrate users because the items provide very poor indicators of destination content but a menu of 12 items may work very effectively because each item points to content that is clearly differentiated by the menu text.
- 2 chunks of information on a page may stress working memory because all the information must be processed to grasp meaning but multiple chunks running over several pages may work very well for situations where users are only scanning content to find and read a particular chunk.

The principle is simple. Design decisions are relative to the usage context and the nature of the information.

As George Miller commented at the end of his correspondence to the technical writing editor, Mike Halpern, "... nothing in my paper warrants asking Moses to discard any of the ten commandments."

Further reading

[George Miller's 1956 research paper](#), The Magical Number Seven, Plus or Minus Two: Some Limits on Our Capacity for Processing Information

An [amusing email exchange between George Miller and Mike Halpern](#), an editor within a technical writing group

Kevin Larson and Mary Czerwinski's paper, [Web Page Design: Implications of Memory, Structure and Scent for Information Retrieval](#)