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## Model of surprise has 'wow' factor built in

14 January 2009 by [Linda Geddes](#)  
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WE ALL know what surprise feels like, but a computer model has now defined the concept. It is the change in expectation caused by the arrival of new data, it says. The model uses an aptly named unit of measurement - the "wow".

[Pierre Baldi](#) at the University of California, Irvine, and [Laurent Itti](#) at the University of Southern California in Los Angeles devised the model while investigating human attention.

A dominant theory from the 1950s has it that the amount of attention we pay to an object or event is linked to the volume of information our brains need to form an understanding of it. For example, our attention should hover over intricate patterns longer than over a plain surface.

But this model did not consider that the majority of data is useless, says Itti, while only a little is of interest to you or might indicate a threat. Instead, he and Baldi reckon that we focus more on objects or movements that attract our attention by being surprising or unexpected. Surprise as they compute it may also explain what causes the "orienting reflex", whereby our attention is caught by novel stimuli.

To test their hypothesis, the pair developed a computer model which simulated a population of visual neurons "watching" video clips, just as your brain would watch it through the eye's retina. They used the model to analyse short video clips and mark which regions of the videos it considered the most surprising - which they rated in wows. "Something that is very surprising has a high wow content," says Baldi.

When they showed the videos to human volunteers, their eye movements correlated with what the computer had rated as being worthy of attention.

"We found that human observers did indeed look at surprising things while watching TV, much more than they looked at information-rich objects," says Itti (*Vision Research*, DOI: [10.1016/j.visres.2008.09.007](#)).

This study is a long-awaited "satisfactory theoretical account" for what holds our attention, says Aapo Hyvärinen, a computer scientist at the University of Helsinki in Finland. He adds that it formulates "a Bayesian theory of surprise in which an event is surprising if it changes our beliefs".

Itti says the model could have wide-ranging applications. For example, it could be used to rank websites for interest, as those providing more original content would stand out, while spammers, copycats and aggregator sites may be classified as boring. It could also be used to design more eye-catching advertisements, he says.

He and Baldi are now carrying out experiments in monkeys to see if individual

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### Bottlenose dolphin shows off her butchering skills



cuttlefish

14:00 28 January 2009  
 Though she can't wield a knife or cleaver, a bottlenose can do an impressive job of killing, gutting and boning a

retinal neurons compute surprise in the way their model predicts.



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### Woe Factor!

Wed Jan 14 22:11:19 GMT 2009 by **Boozer**

How boring!

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### So Did You See The Gorilla?

Thu Jan 15 11:17:07 GMT 2009 by **Barratt**

So how does this dovetail with findings of the video of the gorilla walking through the basketball players?

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### So Did You See The Gorilla?

Thu Jan 15 12:14:31 GMT 2009 by **JeffRelayer**

Remember that in that experiment, observers were asked to count something regularly occurring in the video (basket ball passes, or some such) - not just watch it and report anything surprising. So that implies (as one hypothesis) that predetermined intention is a conditioning factor for processing the incoming data.

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Thu Jan 15 19:01:03 GMT 2009 by **Black**

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There are some differences in breadth of the concept (the allusions to change in expectations or belief contain that), but it seems a lot like the information theory distinction between "data" and "information".

You can have a lot of data, but the amount of information associated with it depends on how much of it is actually "new" (in the sense of not being further support of existing information).

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**Sounds Like Information Theory**

Wed Jan 28 16:07:46 GMT 2009 by [InfoGeek](#)

Yes, this is pretty brilliant. The new thing I like here is how some data may contain a fixed amount of information according to Shannon yet variable amounts of surprise depending on the observer's internal state and beliefs, past experience, etc. So if I send you a 1.23MB email attachment, the number of bits it occupies is always 1.23MB no matter whether you like my attachment or not (that's fixed because of Shannon, objective). But it may contain a lot of surprise for you, little surprise for me, etc depending on our subjective beliefs, prior knowledge, etc. Very nice!

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