UNIVERSITY OF WATERLOO

Mental model updating depends on the salience of environmental change

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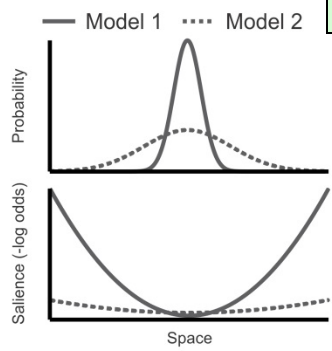
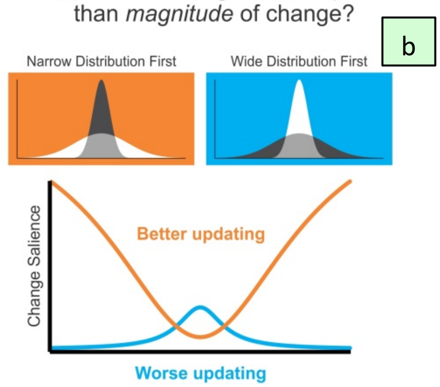
How do expectations influence the ability to detect change?

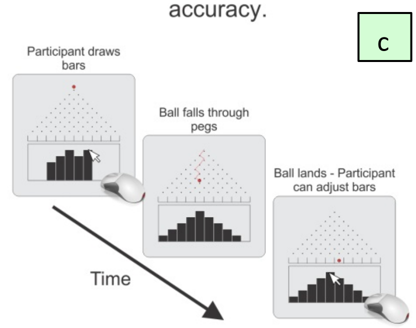
Salience depends on a mental model's expectations



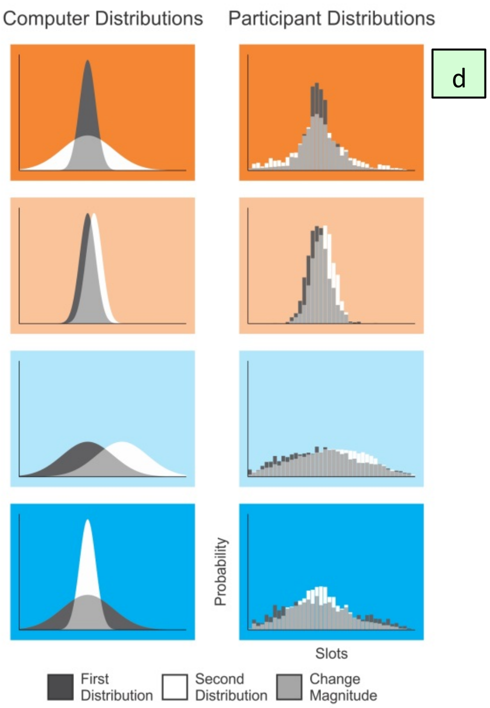
Is salience of change more important than *magnitude* of change?

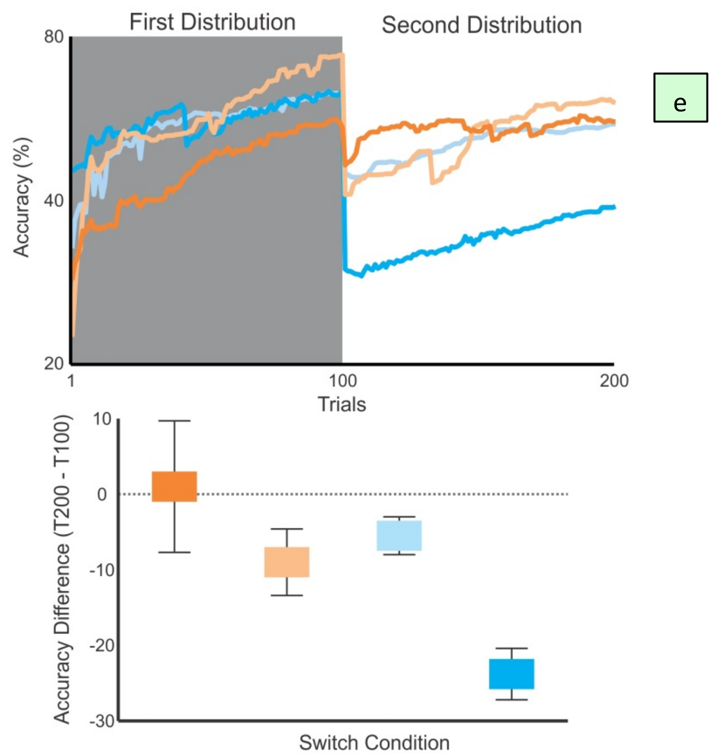


We used 'Plinko' to measure updating accuracy.



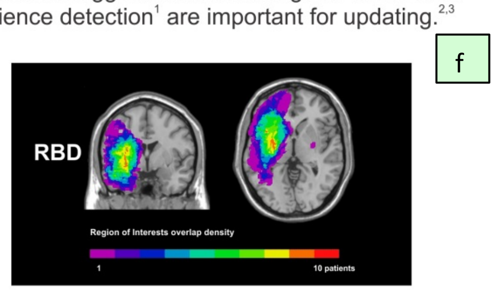
Changes in *salience* predict updating better than changes in *magnitude*.





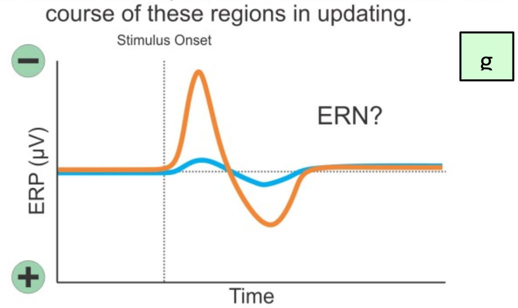
Updating may depend on brain regions involved in salience detection.

Research suggests that brain regions involved in salience detection[1] are important for updating.[2,3]



Stöttinger et al., 2014

Future studies will explore the role and functional time course of these regions in updating.



References
1. Menon, V., & Uddin, L. Q. (2010). Saliency, switching, attention and control: a network model of insula function. *Brain Structure and Function*, 214(5-6), 655-667.
2. Stöttinger, E., Filipowicz, A., Marandi, E., Quehl, N., Danckert, J., & Anderson, B. (2014). Statistical and perceptual updating: correlated impairments in right brain injury. *Experimental brain research*, 1-17.
3. Danckert, J., Stöttinger, E., Quehl, N., & Anderson, B. (2012). Right hemisphere brain damage impairs strategy updating. Cerebral Cortex, 22(12), 2745-2760.

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How do expectations influence the ability to detect change? (a) Different mental models make different predictions about the likelihood that certain events will occur. We hypothesized that salient changes (i.e., less expected) to an environment would lead people to more rapidly update their expectations of environmental contingencies. (b) We exposed participants to series of events that either followed a Gaussian distribution with small variance and switched to events following a Gaussian with the same mean but with larger variance (narrow distribution first), or vice versa (wide distribution first). Although the *magnitude* of change (i.e., the amount of overlap between the first and second distribution) is identical in both switch conditions, the change salience, calculated as the log odds ratio of the first distribution over the second distribution, is very different. We predicted that switches with higher change salience would lead to better updating than those with lower change salience. (c) To measure participant expectations we had them play 'Plinko', where participants saw a ball fall through pegs and land in slots. Their goal was to predict the likelihood that a ball would fall in any slot on a particular trial. Participants indicated their estimations by drawing bars under each slot using a computer mouse. They were told that taller bars represent a higher likelihood that a ball would fall in a particular slot and shorter bars represent a lower likelihood. These bars were set before participants observed any ball drops and could be adjusted at the start of each trial. These estimates provided a probability distribution to represent their expectations on any particular trial.

Changes in salience predict updating better than changes in magnitude. (d) Participants were exposed to one of four switches in ball distributions: narrow Gaussian to wide Gaussian with same mean (highest salience), narrow Gaussian to second narrow Gaussian with different mean, wide Gaussian to wide Gaussian with different mean, or wide Gaussian to narrow Gaussian with same mean (lowest salience). The overlap between the first distribution and the second distribution was identical in all four conditions. (e) Performance was calculated by measuring the % overlap between participant estimates and the computer's ball distribution on each trial. In all four conditions, participants were able to learn the first distribution they were exposed to with similar accuracy. When switched to a second distribution, participants in the high change salience condition were able to adapt their estimates and reach their maximum accuracy faster than the other groups. In contrast, participants in the low change salience condition were not able to represent the change as accurately and finished the task with the lowest accuracy among all four groups. These results suggest that the salience of a switch, rather than its magnitude, drive the updating process. Some unlikely events are more salient than others; our results suggest this salience depends more on the *presence* of unexpected events given a current model rather than the *absence* of expected events.

Updating may depend on brain regions involved in salience detection. (f) Previous research has demonstrated that regions involved in salience detection, most notably the right anterior insula[1], may play a crucial role in a person's ability to adapt to environmental change[2,3]. (g) We plan on using variants of the 'Plinko' task in future studies to measure the involvement of these regions in updating along with their functional time course.

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[1] Menon, V., & Uddin, L. Q. (2010). Saliency, switching, attention and control: a network model of insula function. *Brain Structure and Function*, *214*(5-6), 655-667.

[2] Danckert, J., Stöttinger, E., Quehl, N., & Anderson, B. (2012). Right hemisphere brain damage impairs strategy updating. *Cerebral Cortex*, *22*(12), 2745-2760.

[3] Stöttinger, E., Filipowicz, A., Marandi, E., Quehl, N., Danckert, J., & Anderson, B. (2014). Statistical and perceptual updating: correlated impairments in right brain injury. *Experimental brain research*, 1-17.