"*If the mind were Bayesian alone, it could hardly survive, It could not conceive of new ideas, would suffer from overfitting when making predictions with scarce data but many variables, and would be lost when faced with intractable problems.*"

Gerd Gigerenzer

Memory, Emotions and Heuristics: How brain functions can affect data journalism perception

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The split-brain patients of Gazzaniga

Patients that were treated by a dissection of the 2 parts of the brain => left and right hemisphere could no longer communicate.

In the laboratory: researchers showed them a photo of **chicken claw to the left hemisphere** that controls speaking & a photo of a **wintery scene was shown to the right hemisphere**.

The 2 stimuli entered the brain but they never connected. Then, researchers showed them an array of objects and asked them to choose one object that relates to what they have seen.

Their left hand pointed to the shovel which is logical given the fact that the image was presented to the right hemisphere which controls the left hand..

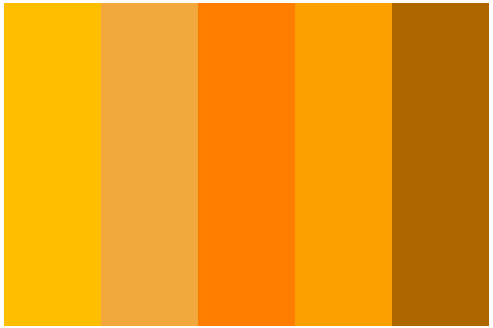
consciously or subconsciously humans try to build a story in order to make their observations complete or explain them.

‘hollow-face illusion’

An optical illusion of a face we assume is popping out at us because that is what we are used to see faces in our lives

...Our brain is doing a lot of interpretative work even just to understand a scene.

A lot of visual information is ambiguous but our brain makes a decision about it (think of colors…)



Memory is a construction

-It changes every time we remember something.

-“When humans recall memories, it is a reconstruction, never a literal reproduction of the original data”

Think of memory as a clay…

Lost in the mall!

Researchers told 4 stories to the participants, from their childhood, 1 was false.

In the false story the participants were told that they had been lost in a mall as a 6 year-old. The researchers provided a lot of details such as the store they were lost in and how eventually they were found and returned to their parents.

After being interviewed in the weeks that followed, **25 percent of the participants reported clear memories of the fictional incident**. Loftus said that a lot of participants put a lot of sensory detail on to this creative memory: "*They started telling us details about the appearance of the people that rescued them and other details that we never mentioned to them*."

Loftus demonstrated experimentally how false memories could be implanted to some people.

The eye witness experiment

Researchers presented participants with a crime scene involving an automobile accident in which a car stopped at a stop sign.

Some participants were later asked what the car did after it passed the yield sign.

Compared with a control group that did not receive any misleading questions, participants in the misleading information group more often mistakenly claimed that they had seen a yield sign.

The experiment proved that by suggestively asking for certain information, we can implement memories that are basically not there.

The way we ask a question can create a memory!

“The technique is quite known from the police and psychologists and was / is ***used to lead people to have false memories and this has also been important in court cases.*** *For instance, some children in the Netherlands were interrogated by policemen and judges when caretakers were accused of children sexual abuse or violence and the policemen and psychologists interviewed the children but the* ***children were amenable to false memories****.* ***You can lead them with the right words to imagine some bad situation****. It makes it possible that children will testify at some point and say “yes, I was abused’ or something bad “.*

Cyriel Pennartz, Professor of Cognitive and Systems Neuroscience at the University of Amsterdam

-People remember very well when events happen at a certain place or in a certain part of the house or an area they know. In that case, they are able to remember sometimes a hundred items in succession .

Having a logical storyline also helps to remember, such as a string of events that follow each other logically as if walking in a landscape.

This is how **Australian Aboriginals**, among the oldest known continuous human cultures in the world that have survived for over 50,000 years without written (alphabetic) transmission of information, remember all walks through the bushes by songlines.

“They make it like a song. When they are travelling through a desert landscape and a particular hill looks like a turtle, the turtle becomes part of their song and that helps them to remember the sequence: ‘ I was a turtle rock I had to go left, toward the East and in the sunset I would see the sun and there was a forest...’

"Student responses to learning the Australian Aboriginal memory technique ***in the context of biomedical science education*** *were overwhelmingly favourable, and students found both the training and the technique enjoyable, interesting, and more useful than rote memorization.* ***Our data indicate that this method has genuine utility and efficacy for study of biomedical sciences and in the foundation years of medical training*****."**

Deese, Roediger and McDermott (DRM) task where participants are presented with lists of semantically related words, e.g. *shiny, house, glass*…

…..Did I say '*window*'?

Can emotions overshadow (storytelling with) data / numbers?

"*The mark of a civilized human is the ability to look at a column of numbers, and weep*."

Bertrand Russell

Emotions:

They are a *relevance detector.* They allow us to determine what is or is not important in a given situation, in order to generate an adaptive response (Cosmides and Tooby 2000).

Emotions are essential for storytelling.

Emotions are undismissable for storytelling. They are such a powerful driver for any story, in order to make it exciting, to relate it to the self, to elicit empathy with the protagonist.

*"**There is no storytelling without emotions. There are no movies without emotions"**.*

“Numeracy as a precursor to pro-social behavior: The impact of numeracy and presentation format on the cognitive mechanisms underlying donation decisions”

Stephan Dickert, Janet Kleber, Ellen Peters, Paul Slovic

The participants in the experiment were asked to imagine that they could contribute to a humanitarian aid organization with the aim of reducing hunger in Africa among poor children in danger of starvation.

Participants' numeracy was measured.

The authors explained that donation requests typically confront people with numerical information related to the needs of others:

"*Whether it is the number of victims of a natural disaster, a proportion of lives affected by a disease, or the number of individuals benefiting from a specific charitable cause, this kind of information is conveyed with numbers.* ***People's ability to comprehend those numbers and derive meaningful interpretations from them likely influences their decisions to help.***"

In the 1st study researchers examined whether numeracy influences the mechanisms underlying donation decisions when **presentation formats varied**:

Describing the number of affected victims in a frequency format (e.g., 10 out of 100) **or** in a probability format (e.g.,10% out of 100). Only the presentation format changed while the numeric information was identical.

- Donation amounts among less numerate individuals were influenced by the presentation format (less numerate individuals were willing to donate more money in the frequency format)
- whereas individuals with higher numeracy were not influenced by presentation format.

Recommendation

- When communicating numbers, better choose a way that is transparent for the human mind.

- Percentages tend to cloud the mind of the audience.

- Better use natural frequencies. Natural frequencies represent the way humans encoded information before mathematical probabilities were invented in mid-17th century and are easy to ‘digest’ by the human brain. (‘*Helping doctors and patients make sense of health statistics*’, Gigerenzer, Gaissmaier et al.)

In the 2nd study, researchers wanted to test whether identifying the victims with mental images led to higher donations.

From the study, it was clear that the mental image of the victim influenced donation decisions of less numerate people.

Among the crucial findings:

The **significant relationship between mental images and donation amounts emerged for less numerate individuals whereas donation amounts for highly numerate individuals were not associated with mental images.**

Among highly numerate participants, donation amounts were more strongly related to the estimated impact of a donation rather than the mental image of the victim. As researchers pointed out: "***These results are consistent with prior findings of highly numerate individuals drawing more affective meaning from numbers*** *(Peters et al., 2006) and further buttress the notion that the role of mental images in donation decisions depends on people's numeracy"*.

“Numeracy and Decision Making”

Ellen Peters, Daniel Va¨stfja¨ll, Paul Slovic, C.K. Mertz, Ketti Mazzocco and Stephan Dickert

… when there was risk involved (a small financial loss beside the reward), less numerate individuals opted for the safer option while the highly numerate made a less ‘‘rational’’ option “precisely because they focus on the detail of numbers and draw **more affective meaning from numerical comparisons**. The highly numerate tend to derive more affective meaning (generally stronger or more precise affective meaning) from probabilities and numerical comparisons.

Participants high in numeracy opted for the choice that entailed a small financial loss (numerical comparison) and they had a more clear and less negative affect for the option that included a loss condition.

Low in numeracy participants did not opt for the option that included a financial loss besides the reward.

A ROLE FOR HEURISTICS IN DATA JOURNALISM?

A heuristic is **a strategy that ignores part of the information, with the goal of making decisions more quickly, frugally, and / or accurately than more complex methods.**

Other strategies include regression, Bayesian models etc.

-**Recognition heuristic**: If one of two alternatives is recognized and the other is not, then infer that the recognized alternative has the higher value with respect to the criterion.

-**Take-the-first heuristic**: Choose the first alternative that comes to mind.

-**One-reason decisions:** A class of heuristics that bases judgments on one good reason only, ignoring other cues, e.g., take-the-best and hiatus heuristic.

-**Hiatus heuristic** (especially for managers): If a customer has not purchased within a certain number of months (the hiatus), the customer is classified as inactive; otherwise the customer is classified as active.

-**Social heuristics**: A class of heuristics especially necessary for social information when knowledge about a specific environment is scarce (eg. imitation heuristics, the social-circle heuristic and default heuristics).

(Gigerenzer, Gaissmaier, 2011).

The Keys to the White House is a historical-based index system for predicting the results of American presidential elections that has been successful since 1984.

Unlike other forecasting models, the Keys are not based on a fixed numerical relationship between the percentage of votes won by candidates and factors such as economic growth rates and presidential approval ratings in public opinion polls (Britannica).

“Big data failed to predict. There is a simple heuristic that predicted Trump will win and that is a simple tallying system by Allan Lichtman, that looks only at 13 keys to the White House (the Keys to the White House model), for instance: is the candidate of the ruling party, the sitting president? He was not, this was a point against the victory of Hilary Clinton. There were 13 questions and the result was that Trump would win”.

“This is very different from Big Data as Nate Silver does it. Silver is very open about the contingencies of these big data predictions, if I assume a normal distribution or a heavy-tailed distribution, the results are different. The differences that the Big Data people think about statistical assumptions. ***If you do heuristics, you think about the content, what is important for the American people.*** *And that according to Lichtman are the 13 keys that are important.*

In situations that are highly volatile and uncertain, simple models, do mostly better*. And all the complexity is just for show*”.

Gerd Gigerenzer, psychologist and leading expert in heuristic research

Predicting elections in Germany

Gaissmaier and Marewski (2010) put the recognition heuristic to a test in predicting federal and state elections in Germany:

"*Forecasts based on name recognition were as accurate as interviewing voters about their voting intentions especially when predicting the success of small parties, for which no polls are usually available. In contrast to surveys of voting intentions, recognition-based forecasts can be computed from small, "lousy" samples*" (Gigerenzer and Gaissmaier 2011).

"Heuristic Decision Making" Gerd Gigerenzer & Wolfgang Gaissmaier

Geographic profiling

Geographical profiling is performed by sophisticated statistical software programs, such as CrimeStat, which provides statistical tools to aid law enforcement agencies and criminal justice researchers in their crime mapping efforts. CrimeStat calculates a probability distribution across possible locations.

Snook and colleagues (2005) challenged the idea that actuarial methods are better than human cognitive shortcuts: They taught two heuristics, the Circle and Decay heuristic to laypeople in criminology and reported that after a single session, laypeople became about as accurate in predicting offender locations as the algorithm.

Circle heuristic

Circle heuristic predicts the criminal's most likely location in the center of a circle drawn through the two most distant sites of crime.

Participants trained in **simple cognitive heuristics can perform as accurately as a leading actuarial technique** when predicting the location of an offenders' residence based on the locations of their crimes (Snook et al. 2004).

Emergency medicine

Green and Mehr (1997) tried two solutions: (*a*) a logistic regression, the Heart Disease Predictive Instrument (HDPI), and (*b*) a fast-and-frugal tree. To use the HDPI, doctors received a chart with some 50 probabilities, checked the presence and absence of symptoms, and inserted the relevant probabilities into a pocket calculator.

The fast-and-frugal tree ignored all probabilities and asked only a few yes-or-no questions. Ultimately, the tree was more accurate in predicting actual heart attacks than the HDPI: It sent fewer patients who suffered from a heart attack wrongly into a regular bed and also nearly halved physicians' high false-alarm rate (Gigerenzer and Gaissmaier 2011).

Researchers concluded that teaching simple decision-making strategies might effectively reduce unnecessary ICU utilization (Green and Mehr 1997).

"Heuristic Decision Making" Gerd Gigerenzer & Wolfgang Gaissmaier

A story about wolves!

How to calculate the population of wolves?

Who has the data?

State, scientists, shepherds

Methods:

-Occupancy modelling / detection probability,

-Heuristics (direction of the traces, distribution of the herds in the mountains).

- Do we start a story from the data or / and from a source that has a experiential knowledge / relationship with a situation, topic..

- We need to have basic knowledge in the way the human brain 'digests' numbers. As there is a psychology of the vision, there is a way for humans to encode numerical information.

- The way we ask questions, can give us back wrong data.

“*If the mind were Bayesian alone, it could hardly survive*, *It could not conceive of new ideas, would suffer from overfitting when making predictions with scarce data but many variables, and would be lost when faced with intractable problems.*”

Gerd Gigerenzer