

## Help! My Brain is Out of Control!

### Impact from Irrelevant and Misleading Information in Software Effort Estimation

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## “Clouds Make Nerds Look Better”



- Study of university applicants:
  - Nerds had significantly higher chance compared to non-nerds on cloudy days.
    - Nerd-factor measured as academic rating divided by social rating (e.g., leadership).
  - 12% higher chance when sunshine compared to worst cloudcover.

## **Irrelevant and misleading information in requirement specifications ...**

- There are good (and not so good) reasons for this, e.g.,
  - Information added for pricing purposes, or other purposes than effort estimation,
  - "copy-paste" of general information about the clients' processes and organization from previous specifications, and,
  - lack of competence in how to write a good requirement specification.

## **The impact of the # of pages**

- Computer science students estimated the effort of the same programming task.
  - Group A: Received the original specification, which was one page long.
  - Group B: Received a version of the specification that had exactly the same text, but was seven pages long. The increased length was achieved through double line space, wide margins, larger font size and more space between paragraphs.
- Group A and B's estimates were, on average, 117 and 173 work-hours, respectively.
  - Longer specification → higher estimates.

## Adding irrelevant information ...

- Group A software professionals received the original programming task specification.
- Group B software professionals received the same specification, with clearly estimation irrelevant information included.
- Results:
  - Group A average: 20 work-hours
  - Group B average: 39 work-hours

## Misleading information ...

- HIGH (LOW) group: *"The customer has indicated that he believes that **1000 (50)** work-hours is a reasonable effort estimate for the specified system. However, the customer knows very little about the implications of his specification on the development effort and you shall not let the customer's expectations impact your estimate. Your task is to provide a realistic effort estimate of a system that meets the requirements specification and has a sufficient quality."*
- Results:
  - HIGH anchor group average: 555 work-hours
  - CONTROL group (no anchor) average: 456 work-hours
  - LOW anchor group average: 99 work-hours
- *None felt they had been much impacted, and most of the software professionals claimed that they had not been impacted at all.*

## Impact from “future opportunities”

- Group-WISHFUL:
  - “[the client] has invited many providers (more than 10) to implement these extensions and will use the providers’ efficiency on this project as important input in the selection of a provider for the development of the new ticketing system ... Estimate the work effort you think you MOST LIKELY will use to complete the described extension to the existing ticketing system. The estimate will not be presented to [the client] and should be the effort you most likely will need.
- Results:
  - Group-WISHFUL: 40 work-hours
  - Group-CONTROL: 100 work-hours

## Why does this happen?

- Hot topic among researchers. We do not know much.
- The main reason is that brain activity when estimating effort is mainly unconscious, i.e., we are not in control of most of our thought processes and attention.

## Example: The Cocktail Party Effect



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## HELP! My brain is out of control ...



- The lack of brain control implies that it is hard to defend positions like:
  - “*I know why I like what I like*”
  - “*My expert judgment-based estimate is based on information X, by not by information Y.*”
  - “*I will not be impacted in my judgment by a dinner with a potential provider*”
- This is, however, what most people seem to do.
- The reason for our unwillingness to accept the lack of control may be a strong desire to believe that we are rational individuals.
  - The rational reaction to our lack of control is to admit irrationality and learn how to live with and avoid it.

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## We cannot be that irrational, or we would have been extinct ...



- The effect of irrelevant information is a consequence of high performance tailored (evolved) to other, much more important, situations (survival and reproduction) combined with the relatively slow speed of mental activities:
  - Information received: ~ 10 Mbit/sec
  - Information processed consciously (working memory): ~ 40 “bit”/sec?
- If the working memory (the conscious part of our brain) should do all processing work, we would not be able to walk and talk at the same time - probably not even walk or talk.

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## There are individual differences ...



Evidence suggest that people more affected by irrelevant and misleading information have:

- Poorer memory.
- A higher disposition towards absorption.
- Higher level of depression.
- Stronger emotional self-focus.
- A tendency to be more easily bored.
- A more external locus of control.
- Better imagery vividness.

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## Theory: Threshold of belief updating ...

- An underlying theory for stronger impact from information is the a theory related to connection between the brain hemispheres.
  - Possibly related to differences in size of *corpus callosum* and activation of right brain hemisphere.
- Handedness may be a (far from perfect) measure of the belief updating threshold.
  - Supported by several of our studies in software engineering contexts.
- Example: Anchoring experiment on estimated time to read and answer mail the following day:

Table 1: Median Estimated Time

Group	Mixed-handed	Strong-handed
A (5 min)	7,5 min (n=12)	10 min (n=12)
B (4 h)	15 min (n=17)	10 min (n=8)
C (10 h)	15 min (n=13)	10 min (n=8)
D (22 h)	30 min (n=14)	7,5 min (n=8)

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## Is it better to have a high or low update threshold?

It depends ....

- We need a certain degree of stability in our beliefs (consistency) to benefit from our past experience.
  - There is a substantial lack of consistency in software development effort estimation.
  - In an experiment with software professionals Stein Grimstad found that the mean difference of the effort estimates **of the same task by the same estimator** on different occasions was as much as 71%.
- We also need a certain degree of flexibility (belief updating) to benefit from new experiences.
  - Mixed-handers (lower threshold for updating?) had systematically higher (and more realistic?) software development effort estimates when there were no irrelevant information.
- There is consequently a fine balance between being consistent (and less impacted from irrelevant and misleading information) and being flexible.

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## What we definitely should avoid ...

- Exposure to obviously irrelevant information, e.g., customer expectations that will have the role as anchors in effort estimation situations.
- A belief that the impact from irrelevant information only happens to other than yourself.
  - This will effectively prevent actions to take place.
- Information that “dilutes” the impact from the most essential information.
  - Much evidence to support the claim that more information of lesser quality or relevance typically leads to too little emphasis on the most relevant information.

## Example: The “dilution” effect

Software professionals were asked to weight the importance of estimation model selection factors. A 20% weight meant, for example, that the score of model on that factor would count 20% of the evaluation. The sum should be 100%.

### The factors were:

1. Accuracy of the estimates
2. Ease of understanding the model
3. Ease in use of the model
4. The model uses only easy available data
5. The method is flexible and possible to use when not all input data are available
6. The method provides minimum-maximum intervals
7. Other factors

**Group A** had a reduced list of factors (Factors 1-3 + 7), while **Group B** had all seven factors.

**The most important factor (Factor 1) had the weight 40% in Group A, while “diluted” to only 24% in Group B.**



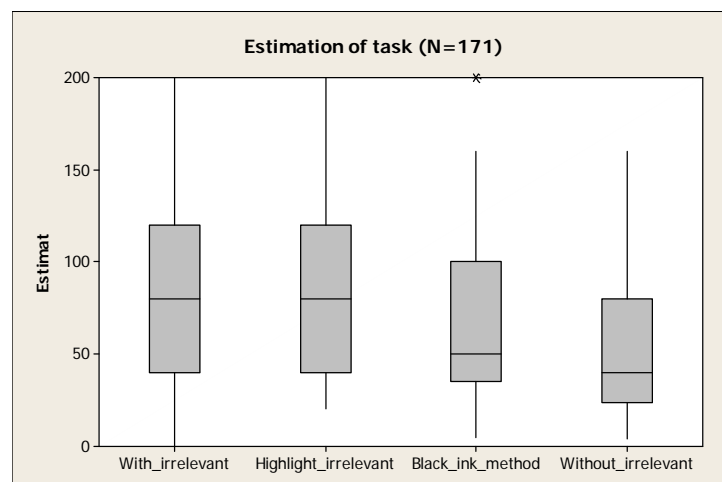
## Debiasing techniques ...

- Awareness of own biases does not help directly, but indirectly in that other less vulnerable judgment processes are chosen.
- Analytic, as opposed to intuition-based, estimation processes may help, e.g., estimation models and use of historical data.
  - But, as long as they are not mechanical, there is room for impact from irrelevant and misleading information.
- The “black-ink method” (see next slide) may help.
- The only really effective method is to remove the irrelevant and misleading information. Our recommendation is based on this finding.
  - Debiasing techniques are typically the second best option.

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## The “Black Ink”-method (experiment at JavaZone 2006)



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## **What to Do? Recommendations**

### **Element 1: Filter Estimation Information**

- People other than those estimating the effort should prepare a filtered estimation information package that includes relevant and neutral estimation information only.

## **What to Do? Recommendations**

### **Element 2: Less Vulnerable Estimation Work**

- Exclude estimators that deliberately or accidentally gain access to misleading or irrelevant information that can bias the estimates. In particular, the estimator should not know the “desired” outcome of the estimation process, because this probably will induce wishful thinking.
- Exclude estimators with vested interests in the outcome of the estimation process, e.g., estimators that are very keen on starting the project and may easily fall prey to wishful thinking.

## What to Do? Recommendations

### Element 3: Adjustments

- When the estimation work has been completed, there may be a need for adjustments and re-estimation.
- This situation may be highly vulnerable to wishful thinking and should be treated very carefully.
- We recommend that the software professional in charge of producing the filtered estimation information package, and not the estimators, updates the information to include less functionality, lower quality, simplified design, or apply other means of reducing the required effort.
- The estimators should then be asked to re-estimate the effort based on the updated estimation information package. Under no circumstances should the estimators know the desired outcome or receive information that suggests that they need to estimate more optimistically.