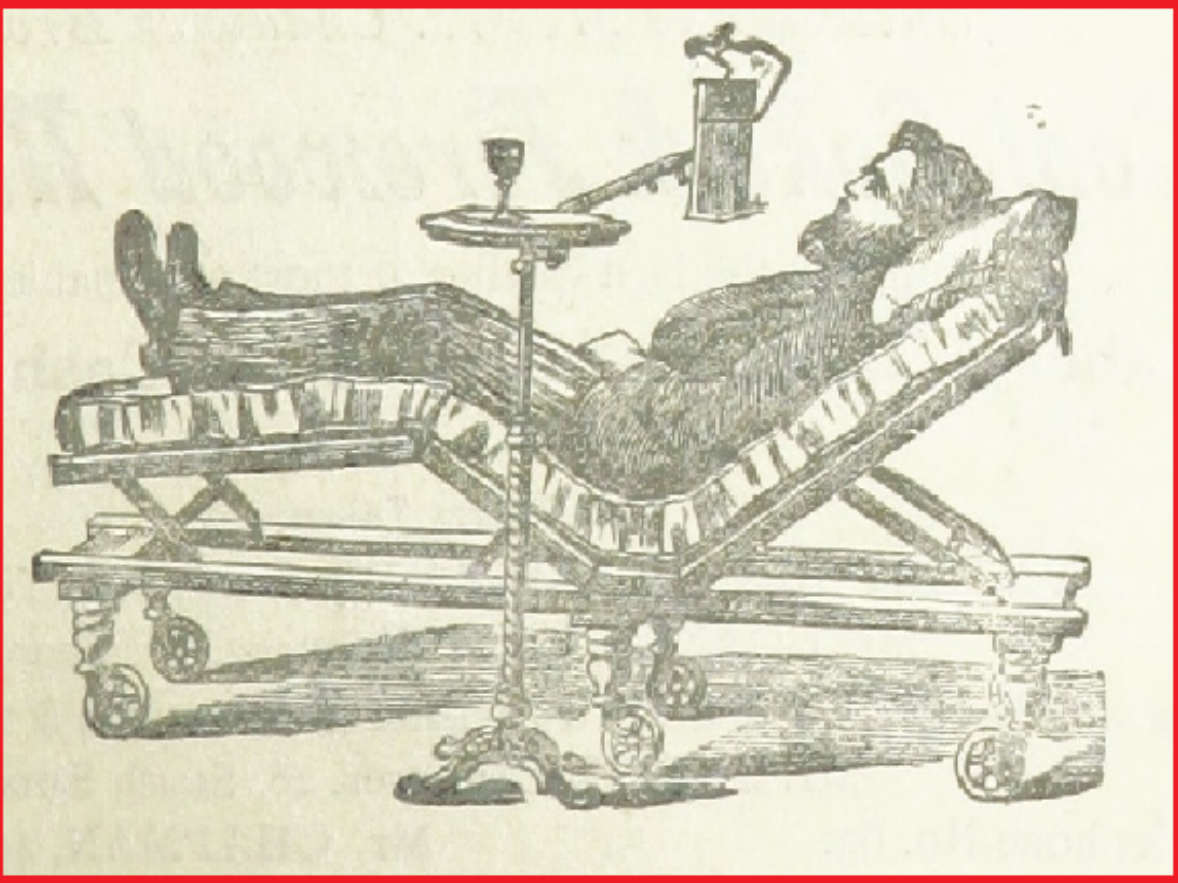
The Psychology of Software #Testing



John Stevenson

The Psychology of Software #Testing

A look at psychology and its connection with software testing. (Ver: 0.9 beta)

John Stevenson

This book is for sale at http://leanpub.com/thepsychologyofsoftwaretesting

This version was published on 2016-02-02

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This book is dedicated to my wife Tracy Stevenson who has always supported me in everything I do. She is the one person who grounds me and acts as my sounding board for my sometimes strange thoughts and ideas. Without her I would not be the person I am nor would I have found the courage to even think about writing this book.

Tracy's favourite phrase when discussing my ideas about software testing is:

"That is obvious...."

Welcome to the world of Software Testing.

x x x x

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Acknowledgements

First and foremost I would like to thank my wife Tracy. She has always supported me in all I do or try to achieve.

There are many people who have influenced me in my career none more so than Michael Bolton, who, over the years has given his time freely to help me improve myself as a tester. Michael was the one who persuaded me to start blogging and encouraged me to talk about my interests and passions. If you get the chance to meet Michael you will find him a warm and friendly person who will encourage you. Thank you Michael.

There have also been others who have had an impact on me such as Jerry Weinberg and James Bach, who I admire and respect as one of the greatest testers in our craft, even if sometimes we may not agree. Cem Kaner, to me the godfather of exploratory testing as an approach. If you have not read any of the material by these people I highly recommend you do so.

I would like to extend my thanks to those who have offered to help review this book for me:

- Rob Lambert
- Dorothy Graham
- Patrick Prill
- Lisa Crispin
- Andrew Patterson
- Huib Schoots

Last but no means least I would like to thank you, the reader, for giving up your time to read this book. If you get only one useful idea, thought or tip from it, then it is worth the late nights and effort taken to put this together.

John Stevenson 2015

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Introduction

Writing a book has been one of those items on my list of things to do for a number of years, and, after seeing what Robert Lambert has done by just going ahead and doing it, I thought I would follow his wonderful example and get around to writing my own.

Why This Book

There are a variety of books available about software testing that inform *'how to do testing'* or offer advice, tips and techniques to help you with all aspects of software testing. I have not seen nor am I aware of any books related to how you, the reader, can be influenced by your 'human behaviour' and the impact this can have on how, or what you do whilst testing software. Jerry Weinberg wrote a book called 'The Psychology of Computer Programming' over 25 years ago. This influenced me and inspired me to write this book with a focus on the psychology of software testing. I have no formal qualifications in psychology or social science, I am a human being and suffer the same biases and fallacies that befall us all. I have spent a great deal of time researching and learning about many aspects of social science, particularly psychology, to grasp various connections this could have with software testing.

Software is invariably created by humans, tested by humans and in the majority of cases used and abused by humans. Many ways in which software testing is being taught or sold, is on the premise of simplicity and the ability to repeat the same actions over and over again. I find this extremely disheartening and over the years have seen the light of passion regarding the craft diminish from so many talented people. They are expected to tick boxes thereby creating wasteful reams of unread documentation. Software development is unlike any other manufacturing processes in which the same way of producing a product can be repeated over again and whereby similar results are expected.

Software is a humanistic approach which requires a great deal of context to be able to deal with the fact that we are fallible. The reason for writing this book is to hopefully highlight how we need to be always thinking about "*how we think*" and "*why we are thinking*".

This is not a book to teach you how to accomplish software testing nor will it make you into a 'expert' on psychology. It takes two of my passions, psychology and software testing, and brings them together. It uses examples that you can take away and use in your daily life, not just your testing profession. This book is not only for testers, it is useful for anyone involved in software development or also has an interest in how our minds work.

Many of the articles on my blog are about the relationship between psychology and software testing. I have included and expanded on some of these article within this book.

I hope you enjoy reading this book and if you have any feedback please get in touch either via twitter @steveo1967 or using the feedback form on the Leanpub page.

Chapter 1: Software Testing Biases

> *"You should work to reduce your biases, but to say you have none is a sign that you have many"* - Nate Silver, author of The Signal and the Noise

This chapter introduces the many cognitive biases that we as humans encounter each and every day, and how they relate to software testing. Many of the examples used within this chapter can be found on my blog, hence the reason that this chapter is available to download for free, before deciding if you would be interested in purchasing the full book.

It is useful to start by considering what do we mean by bias in the context of human beings and their thinking. In psychology terms this is referred to as cognitive bias, that is what this chapter will be mainly focusing on. It is how we form our views, beliefs, opinions, and how we see the world, therefore it has an enormous effect on how we think and act.

Princeton University has the following definition for cognitive bias:

> *"Cognitive bias is a general term that is used to describe many observer effects in the human mind, some of which can lead to perceptual distortion, inaccurate judgement, or illogical interpretation. It is a phenomenon studied in cognitive science and social psychology."*

One bias that many testers appear to be aware or heard of is *'Confirmation Bias'*.

DANGER - Confirmation Bias

Confirmation bias is an extremely powerful bias which we are very susceptible to.

The Skepdic website defines confirmation bias as:

> *"Confirmation bias refers to a type of selective thinking whereby one tends to notice and to look for what confirms one's beliefs, and to ignore, not look for, or undervalue the relevance of what contradicts one's beliefs"*

I started to research more about confirmation bias after reading an article in Ars Technica on 'How to Avoid Confirmation Bias.'

A good example of this is if you are thinking of buying a new car and all of a sudden you seem to notice many more of the same model car you were thinking of purchasing. Your mind is conditioning

itself to notice this make and model of car and making you notice them more, even if there are actually no more of this type of car around before you began seeing it everywhere. Dorothy Graham gave me another example of how prams and playgrounds seemed to appear from nowhere once her daughter had been born.

Another example is if you start talking to a friend about a certain film and actor and then suddenly notice lots of coincidences, the actor is in an advert, the film is being shown again on TV, a support actor is in another film you just started to watch.

David McRaney on his website gives a great example of confirmation bias - A sample of this is shown below:

> *"Confirmation bias is a filter through which you see a reality that matches your expectations. It causes you to think selectively, but the real trouble begins when confirmation bias distorts your active pursuit of facts. - David McRaney"*

If there was no such thing as confirmation bias there would be no conspiracy theories. Conspiracy theories are based upon information which proves the theory correct; those who believe in the theory ignore the evidence that debunks that theory. As a tester have you ever been in a situation where you have found an interesting problem but when you approach the developer they provide you with lots of evidence that says what you see is not a problem? This could be an indication of confirmation bias with the developer.

So why is there any concern for testers?

Let me start with an example.

You are working closely with the development team and you start to ask them questions about the release you are about to test. You ask for their viewpoint on which areas they feel are the most risky and which they feel are the most important, so you can adjust your priorities as required. This is a typical exchange between developers and testers that happens each and every day. You now start testing beginning with the area of high risk and work your way to the low risk areas.

You find a few serious bugs in the high risk areas (as expected) and you find no problems in the low risk areas.

After release a major bug is reported in the low risk area you tested. How did you miss the bug? Did you see the bug, but your thinking was that everything was working correctly? Did confirmation bias play a part? Did your subconscious hide the bug from you? Now this gets very scary, most people who work in software testing know that some bugs try to hide from you, we expect them to hide in the software. What happens if they decide to hide in your brain?

How can we try and prevent confirmation bias?

The quick and easy way to try and prevent confirmation bias is to ensure that more than one tester tests the same feature. They may bring in their own confirmation bias but hopefully it will be different from the previous tester's bias. There is more chance that it will be different if the testers have not discussed the area under test beforehand.

Another way to try and prevent confirmation bias is to do 'paired testing' either with a developer, another tester, or ideally a user. That way you can question each other with regards to what is true and what is false. There is a chance that you could cross contaminate each other with your own confirmation bias, but the risk should be less than if your are working on your own.

It is not easy to remove confirmation bias since it is infectious. Working on a software development project requires testers to communicate more and more with other areas of the business, and at each stage. With each conversation confirmation bias could be introduced.

Should we lock ourselves away in a dark room with no communication with anyone else on the team? I think I would get out of testing as a career if that happened. The Social Tester would now be the anti-social tester, time to get him an ASBO (For our non UK readers see - Anti-Social Behaviour Order - Wikipedia.)

My view is that there is no realistic way to prevent confirmation bias due to the way in which our minds easily fool us. It is vital that when working in software development projects, everyone needs to be able to clearly communicate with each other. However, if testers are aware that there is such a thing as confirmation bias then they can try and take steps to ensure it does not creep into their tests. The point of this section is to help raise awareness of confirmation bias and how it can affect your testing.

Cognitive dissonance

There have been many studies on Cognitive Dissonance and what it really means, Wikipedia describes it as follows:

> *"Cognitive dissonance is an uncomfortable feeling caused by holding conflicting ideas simultaneously."*

The history of Cognitive Dissonance is accredited to Aesop's tale of the Fox and the Grapes. The fox who wants to eat the grapes but cannot reach them. To remedy the conflict he feels within himself, he makes himself think that he really does not want the grapes and decides that the grapes are either not ripe enough or too sour.

My thoughts on this conflict of beliefs and how we try to adjust our minds to resolve the conflict is something that I feel could benefit testers especially when carrying out exploratory testing.

As testers it is important we recognise when we are experiencing Cognitive Dissonance and learn to ask questions before we make a decision to resolve our internal conflict. The problem with experiencing cognitive dissonance is that it is very easy to change our opinion and belief and suddenly we are drawn into the trap of confirmation bias.

As humans we do not like the feeling of conflict within our minds and we try to make a decision to resolve this conflict. Once we have made that decision we will try to justify the reasoning for making the choice we did.

If you had two areas to test and each area had the same level of importance and you choose area A instead of B, you may now subconsciously favour choice A more than choice B. If a colleague says Area B is more important you have a conflict, and your mind needs to give reasons as to why you would choose to test A rather than B. You may make statements such as:

Area A has been tested, it was important for me to test it.

"Or"

Area A is more closely tied to user concerns, so I think it's more important.

You will try to justify the reason for making the choice that has now had some doubt raised about it.

Dorothy Graham makes the following points regarding this subject:

1. the same piece of information can be made to fit into two very different cognitive structures - take a look at what politicians do with the same set of unemployment statistics!

2. If the new item of information is dissonant with your existing cognitive structure, then in order to be absorbed, that structure will need to change, and this takes energy and effort. This additional effort creates a barrier - the "cognitive dissonance barrier". The new item needs to overcome this barrier in order to be merged in to existing cognitive structure/beliefs. It is easier to reject the information than to change what you think! The phrase "My mind is made up, do not confuse me with the facts" - is a typical response.

When testing if we get two conflicting oracles and you need to make a decision on what is correct or the product owner needs to make a decision, cognitive dissonance could come into play. A decision could be made which is wrong. The problem now comes at a later date when you need to justify why you made that decision. You will change your opinion or belief to make sure that the decision you made was the correct one. This can have catastrophic consequences on peoples lives. For example with the use of juries and their view that they are guilty at the beginning of the trial based upon their own biases and prejudices.

It can become worse if you use a rating system to rate identical items. Imagine you are in a team and the team is given the task to rate features to be tested or developed. These ratings are then used to determine the order in which features for the product are developed. You then make a choice to test/develop your most highly rated feature, and at a later date you get to rate the list again. The item that you rated as next best has suddenly become of low importance even though it had the same value as the previous highly rated item. Making a choice after rating affects your value/belief/opinion of the item of same identical value. You start to score it lower to stop your uneasy feeling or cognitive dissonance. Project managers and team leads need to be aware of this since items/tasks of high importance could be downgraded by a team because of the issues of cognitive dissonance.

Take a look at Agile planning and the use of story points.

We begin by rating each story based upon business value and priority, this is normally done by the agile team with input from the scrum master and the product owner. The team develop the story with the highest business priority and value. Once this has been developed the team revisit the planning

board and re-rate the tasks in the backlog adding any new tasks. If a new task comes along that is felt to be the same value and priority as the currently top rated task in the backlog the team may give the current high rated task task a lower rating. This is cognitive dissonance in actions, the team gives the existing highly rated task a lower priority than would normally be expected. The team experience a conflict in what they felt was the highest ranking task against the new information and downgrade the current task to resolve the internal conflict they are feeling.

It may be useful to remove all value and priority values before engaging in a agile planning sessions to help remove this type of bias.

So how else can cognitive dissonance affect testing?

I believe cognitive dissonance can actually harm what we are testing. If the expectations we have for the software we are testing, contradicts with what it is actually doing and we adjust our expectations to justify what the software is doing there is a danger we could miss an important bug. From my own experiences this happens a great deal when testers are following requirements and ensuring they are being met. When the software does not behave in the way that the requirements are written this could cause the tester to ignore what the software is doing (even if this is correct) and report it as an error.

There are many situations in which this can happen especially if the mindset of the development team is that the requirements are all that matter. I have come across cases where defects have been rejected with a reason that it is not in the requirements. This leads to even more insight into the way we behave as humans. Since requirements are written in natural language, their interpretation can have numerous solutions, so to state that the way the software is behaving does not meet a requirement can be ambiguous at the very least.

Michel de Montaigne sums this ambiguous nature of language very well:

> *"When I pick up books, I will have perceived in such-and-such a passage surpassing charms which will have struck my soul; let me come upon it another time, in vain I turn it over and over, in vain I twist it and manipulate it, to me it is a shapeless and unrecognizable mass."* The Complete Essays of Montaigne by Michel de Montaigne p. 425

How many times has this happened to you? You read a passage in a book and think WOW! this resonates with me, then you read the passage again at a later date and wonder why you felt the way you did the last time you read it.

Useful reading for Cognitive dissonance:

- Cognitive Dissonance - Instructional Design
- Cognitive Dissonance Beyond Intractability
- Cognitive Dissonance: Additional Resources - Beyond Intractability
- This is your brain undergoing cognitive dissonance- Ars Technica

What you believe might not be true

When I started to look at how the human mind works and the traps that it continually falls into I did not realise what a huge area of psychology this is. The subject of bias and the human mind is fascinating and every tester should be aware that every decision we make when testing a product will be subjected to our cognitive biases.

Within the psychology field of cognitive biases there are many different types of biases, some of which I have previously discussed. Within this section I will look at a few more biases which could have an impact on your testing. Since the whole area of cognitive bias is huge I may not go into great detail about each type of bias but will provide enough information for people reading this book to be aware of the failings of our human minds.

One bias that intrigues me is called the conjunction effect.

A definition of this bias taken from the changing minds website is shown below:

> *When two events can occur separately or together, the conjunction, where they overlap, cannot be more likely than the likelihood of either of the two individual events. However, people forget this and ascribe a higher likelihood to combination events, erroneously associating quantity of events with quantity of probability.*

An example of this can be seen when using the experiment that Amos Tversky and Daniel Kahneman carried out:

> *Linda is 31 years old, single, outspoken, and very bright. She majored in philosophy. As a student, she was deeply concerned with issues of discrimination and social justice, and also participated in anti-nuclear demonstrations.*
>
> *Which is more probable?*
>
> *A. Linda is a bank teller.*
>
> *B. Linda is a bank teller and is active in the feminist movement.*
>
> Bank teller experiment from - Judgment Under Uncertainty: Heuristics and Biases

In the experiment 86% of people answered B even when using mathematics it can be proven than A is more probable. This is conjunction fallacy in action, your mind tricks you into believing something is more probable than it is.

Tversky and Kahneman carried out further psychological experiments including the following one:

During 1983 two different experimental groups were asked to rate the probability of two different statements, each group seeing only one statement:

- *A complete suspension of diplomatic relations between the USA and the Soviet Union, sometime in 1983.*
- *A Russian invasion of Poland, and a complete suspension of diplomatic relations between the USA and the Soviet Union, sometime in 1983.*

Even though the probability of each happening was low there was a significantly higher probability of people choosing that the second statement was more likely.

The moral? Adding more detail or extra assumptions can make an event seem more plausible, even though the event could become less probable.

How does this all relate to testing?

Within testing we have to look at statements and judge what is most probable to happen.

For example we see the following requirements:

> *Req1* :If the user is a software engineer then screen 'is engineer' must be shown.

> *Req2*: If the user is a software engineer and likes to listen to classical music then screen 'music engineer' must be shown.

Let us look at the following user story.

David went to university to train as a classical violinist. Once leaving university David retrained as a software engineer and started to write code for a major software house.

Which is more likely to be true?

Most people will see *Req2* as the most likely to be true, and ignore *Req1*. However the probability that *Req2* is more likely in the given user story is far less than *Req1*.

With these two requirements you can see the conjunction effect, where one of the statements appears to be more likely than the other and as testers we should be aware of this. However our minds might not notice that there is a conjunction and our human biases take over so when we test we assume that only *req2* is valid and ignore *req1*. The probability of *req2* is less than *req1*. We need to be aware of this bias and try to eliminate it. This is why context is important, we need to apply context to the situation and to the test to ensure it is valid, correct and nothing is being missed.

The issue we face as testers is that some requirements and the resulting test ideas we come up with could be subjected to the conjunction effect where upon our minds are telling us that the probability of event 'x' happening is greater than the probability of event 'y'. When we look at the mathematics the probability between each event is the same, or event 'x' actually has a lower probability.

How can we prevent this bias?

> *"Experiments that have tried to repeat the Tversky and Kahneman bank teller fallacy noted that if before the decision was made people were allowed to discuss and communicate their thoughts with others then conjunction fallacy occurrence was significantly lower."* Conjunction Fallacy:- Gary Charness, Edi Karni, Dan Levin: 2009

This indicates that it is possible to reduce the chance of conjunction fallacy occurring just by simply communicating and talking with other people.

Framing

When researching this area I found that there are many links to cognitive framing such as the following: The Power of Framing.

The way something is worded (framed) can lead people to be subjective to conjunction fallacy, this in itself can lead to problems. Maybe this is an area that architects and technical authors need to be aware of when creating design and requirement documents? How a requirement is framed could influence a developer to write code in certain way and become subjected to the conjunction fallacy giving more probability to some event or requirement than is actually true. This is important for developers to be aware of and put in place thinking exercises to reduce the fallacy.

What fascinates me on this particular area is the idea that the way things are worded (framed) and how our mind understands these words (conjunction fallacy) could be the reason that a lot of bugs are created in code. I am looking to collect data on this and see if there is some correlation.

If we look at framing and how it can influence our thought process and cause bias, the problem with framing is that it can be subjective. If we frame a sentence in such a way as to force people to believe that a certain fact is true then there will be some people in which it will have no influence. Framing is used extensively within politics and advertising to encourage people to believe in a certain policy or product. It can be very powerful as a tool.

Michael Bolton ran a workshop at Eurostar Testing Conference in 2010 on test framing and this was extremely useful to help testers think if a test needs to be run, or why it was not run. However, it was only after Eurostar that I thought more about how framing can be used in the opposite direction and become dangerous as a tool. It could be used to force people to think that the wrong view is the correct view.

An example of this is to have a list within a test plan of thousands of test cases, and to frame it in such a way that to the casual reader every single test case must be run and think they are of high value. This is before the tester has actually touched or used the product to be tested. The framing in this context can be used to justify wasted effort and work time.

Look at the following statement:

> I prefer to code using Java than C++ because it is easier with the development suite I have installed and C++ does not work within the development environment I have set up.

The framing bias here is that the person thinks Java is superior to C++ because of how they have set up their environment. It maybe that using C++ would make it easier for the developer on the project they are working on but they are trying to give reasons why they are working in Java instead of C++.

There are many more examples in the world of software development. I prefer OS x to OS y because of z. Machine type 'a' is far better than machine type 'b' because it does 'xyz'. It does not matter that the person making the statement has never used OS y or machine type 'b'. They are forming a bias viewpoint and using framing to justify it. In my opinion this is why the context driven way of testing is so important. When looking at requirements and statements it is easier to think of 'in which context' to verify if the requirement is just and sound.

As testers we need to be aware of this and when we report our findings during testing be aware of how we frame the words.

The next part of this chapter investigates other forms of bias and how they influence our decisions and thought processes. One of the first I will touch upon in this article is belief bias.

Belief bias has many similarities to confirmation bias and in some ways both are closely linked. If someone has very strong beliefs they can use arguments that back up their beliefs in such a way that only evidence that supports their beliefs are used giving a confirmation bias to their beliefs. There are many examples of this in the world from the belief in the existence of aliens to the range of conspiracy theories that are abundant on the internet.

So what is belief bias?

> *"People will tend to accept any and all conclusions that fit in with their systems of belief, without challenge or any deep consideration of what they are actually agreeing with."*
> Belief Bias

Belief bias is the conflict a person incurs when their beliefs do not match the logic of what is presented to them

The danger with belief bias is that it can quickly turn to Belief Projection:

> *"Psychological projection is a form of defence mechanism in which someone attributes thoughts, feelings, and ideas which are perceived as undesirable to someone else."*

The problem now is that the beliefs of someone on a team could become fostered on other team members using belief projection even if what they believe is unfounded. Within software development we all have our own views and beliefs on what a piece of software is expected to do.

How does this have an impact on software development and especially testing?

Imagine a situation in which a tester has a very firm belief on how an interface should interact. They then test that interface and find it is not behaving as they believe it should be. A bug report is

now raised and passed back to the development team. It is found that the bug was raised in error . The interface interacts as designed and described in the requirements. This is a simple case in which regardless of what requirements, design specifications and others are saying, the testers strong belief bias is saying everyone is wrong and what they believe in is correct.

In the world in which we as testers operate I doubt that the above would happen since we are now in situations in which developers and testers communicate and there is no more "throwing it over the wall" way of releasing. However if you still work in teams in which there is a lack of communication and talking then belief bias can have a large negative affect on testing.

Another issue is when you do work in a team and belief projection comes into the equation. If someone on your team subconsciously has a belief that the developers think the testers are a waste and not necessary (negative personality trait) this could project on to other members of the team and start to cause a barrier of resentment to build up between teams.

It is impossible to prevent people having opinions and thoughts about other members of a team but having an environment in which everyone is allowed to express their views and thoughts in an open discussion can help to remove this type of bias. Within one company in which I worked as a team lead, I would have an open session in which nothing was recorded or written down but people could express views and thoughts on what was really happening within the project. Sometimes it would be heated and people would get emotional but it managed to clear the air. One important part of this method was that a mediator was always in charge to prevent it getting into a naming calling situation.

Another bias which could have an impact on testing is illusory correlation in which people form a connection between two events even when all evidence shows that there is no such connection or relationship.

A good example of this bias can be seen with people who have arthritis and believe that their condition worsens depending on the weather. Redelmeier and Tversky conducted an experiment in which they took measurements based upon the patient's view of their condition and at the same time noted details of meteorological data. Even though nearly all the patients believed that their condition got worse during bad weather the actual results showed that there was a near zero correlation between the two.

Wikipedia defines illusory correlation as:

> *"Illusory correlation is the phenomenon of seeing the relationship one expects in a set of data even when no such relationship exist."*

It is easy to see the effect this can have on software development. Imagine if a developer creates an illusory correlation between two variables that do not have any real correlation, therefore introducing bugs into the project. There has been a study on the reasons for software errors and it has been found that illusory correlation does play a part. Details of this study can be found in the article A framework and methodology for studying the causes of software errors in programming systems by Andrew J. Ko, Brad A. Myers

Stereotypes are normally defined by the use of illusory correlation. A person who grew up in a small town where everyone was kind makes an assumption that everyone from a small town is kind therefore when they go out into the world and meet a kind person they correlate that the person will be from a small town.

How does this help or hinder with regards to software testing?

The problem occurs when testers work in isolation and form their own methods and create their own hypotheses of what should happen when they test the product under certain conditions. The danger is that the testing becomes one sided searching for evidence that matches their current hypothesis of how the product should react. The resulting factor of this bias within testing is that conditions are tested which meets the illusory correlation of the tester but conditions which do not meet the expected assumptions are not tested. This could then cause significant bugs to be missed due to flows not meeting the expected correlation being tested.

It is very difficult to avoid falling into the illusory correlation trap since the human mind tries to take the easiest path and group' objects together for easier recall, hence the existence of stereotypes. To help to avoid cognitive bias it is important to not work in isolation and ensure you involve others in both your planning for testing (kick offs), the execution of your testing (pairing), and the result of your testing (debriefs).

There are many fallacies and biases that can affect testers and the fallacyfiles.org website gives many more that you can research.

Exercise:

Take a look at http://www.fallacyfiles.org/taxonomy.html and note down how many of these fallacies could impact your day to day testing?

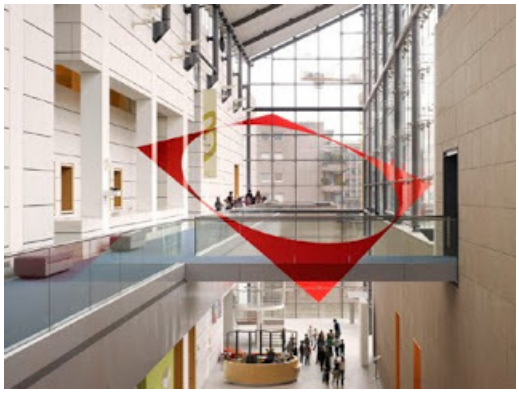
On a positive note since developers will also suffer from these fallacies when coding, there will always be a need for testers!

Cognitive Illusions *(or how your mind plays tricks on you)*

In the book Bad Science by Ben Goldacre, there is a chapter entitled *Why Clever People Believe Stupid Things*

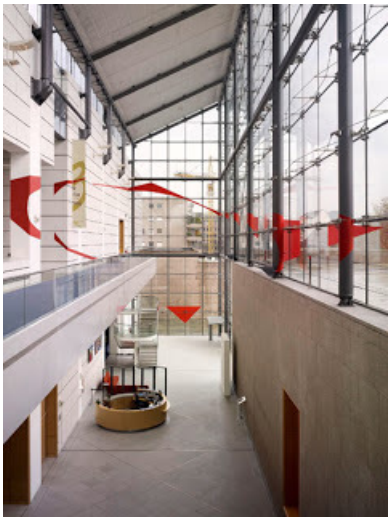
The chapter is very interesting from a tester perspective and it made me re-think about the need to be careful when we are testing especially about reporting what we believe happened. The human mind is a tricky beast and there are various methods it uses to try and trick us into believing things which are not true.

For example take a look at the following picture by French artist Felice Varini (*the site is in French*) This is a fantastic anamorphic illusion in which our mind joins all the pieces together to make us see something that in reality is not real.



Original Image Link | Website Location

Looking at it from a different perspective shows us this.



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An important lesson in testing is not to look at things from only one point of view. See how our mind tricks us in to thinking something is real when it is not.

Ben Goldacre manages to breakdown some of the common tricks our mind plays into the following:

- Randomness
- Regression to the Mean
- The bias towards positive evidence
- Biased by our prior beliefs
- Availability
- Social influences

He concludes with the following statements:

- We see patterns where there is only random noise.
- We see causal relationships where there are none
- We overvalue confirmatory information for any given hypothesis.
- We seek out confirmatory information for any given hypothesis.
- Our assessment of the quality of new evidence is biased by our previous beliefs.

I added the following:

- Our assessment of the quality of new evidence is biased by our social influences.

Once we become aware of these illusions that our mind plays upon us we can start to put practices in place that help to try and remove them. I should warn you, it is impossible to remove them entirely since we are only human after all, but being aware that they exist is a good start.

Patterns from Nothing

This section investigates the ability we have as humans to be fooled into seeing patterns from nothing. It is common for people to find shapes or objects when staring at the clouds or to think that there is a pattern of luck associated with the game we are playing. We can look at a random set of data and without doubt we will naturally make a pattern. Ben Goldacre talks about this in his book Bad Science.

It is in our nature, and we are over sensitive to making patterns where there are none. Look at the following example of the toss of a coin.

H = Heads, T = Tails

H H H H H H H H H H H T H H H H H H H H H H H H

What conclusion would you infer from this set of results?

Have you come up with any?

Maybe you have come to a conclusion. It is natural instinct and intuition to create a pattern and a cognitive illusion. Given that the coin is true the chances that the sequence above would happen is the same as for any other sequence. Take this one step further and ask yourself what the result will be on the next coin toss.

- What would your answer be?
- Why would this be your answer?

Using statistics the possibility of it being H or T is 50/50 or equal chance. This is one of the reasons that casinos make so much money. They understand we are all fallible and use that against us. We make the mistake that there is a pattern and that our luck must change. I am sad to inform you but there is no luck involved the chances are still the same and within a casino the odds will always be against you. Casinos have spent large amounts of money on studying human behaviour and how to ensure that we remain and therefore spend more. Those that are interested in learning more about this may find the following articles enlightening.

- Biases in casino betting: The hot hand and the gambler's fallacy
- (Making the Gambler's Fallacy disappear: The role of experience
- The Psychology Of Casinos
- Effects of Casino Design on Gambling Tendencies

The same can be applied to those who follow sport and come across the phrase "someone is on a lucky streak"; this again is our natural bias to create a pattern when one does not exist. Another example: A soccer player has the following goal scoring record.

X means scored in the game – O – means did not score.

X X X X X O O X X X X X X X X X X O O O O O O O O

Our tendency to create a pattern means that we will take that data and say the player has had 2 lucky streaks of scoring and is currently having a dip in form. With such simple data it is so easy to create and formulate assumptions and make patterns where there is no pattern. This is especially easy to do if there is no context. The simple example above proves the need to have some context. If I gave some more information that the player above has for the last ten games been playing in the senior side instead of the juniors, would that make a difference to your conclusion?

How does this apply to testing?

There is a talk within testing that we should trust our intuition (I am one of these people to talk about this) and go with our gut feelings. Malcolm Gladwell in his book Blink describes this to great effect. However we need to be aware that our intuition can try and fool us and try to create patterns when we are carrying out our testing. The problems come when we start to see these patterns and this causes us to miss other information that may be important.

For an example of this watch the following video:

Invisible Gorilla

Have you watched the video?

No?

Please go and watch it, it will help you understand the rest of this article.

Did you see the Gorilla?

No?

This might be due to being distracted and focused on a task. Noticing patterns and forming inconclusive assumptions when there are none can cause the same impact and as such it does show the point that our minds can be easily distracted and miss important information.

It is important when we are testing that we do not spend too much of our time looking and investigating patterns since our natural instinct is to see patterns. We could end up missing a lot more vital information.

This is vital when we are testing using the exploratory testing approach where it is very easy to go off track and away from our mission to investigate what we think is a pattern of behaviour within the system under test. It is best in these situations to make a note of it and continue on track.

Sometimes it is difficult to go against what is natural and some find it near impossible. This could be one of the reasons why the exploratory testing approach may not be suitable for them or they find it too difficult. I hope this chapter will encourage those who have struggled, to have another go knowing that sometimes they could be fighting against is their own instincts and as such making it appear more difficult for them.

Are there any techniques that can be used to help resolve this bias?

The problem we face is that since this is a natural instinct, and we are made aware of it, it does not necessarily mean we can resolve it or even wish to.

> *"Knowing that it exists does not remove it"* The Deceptive Nature of Intuition - Gordon Pitz (2010)

There are few techniques that could help. One previous described when using session based testing is to keep to your mission and make a note of interesting patterns that you think are emerging. Later when you do a feedback session to others explain your thoughts about the pattern and see if others notice the same pattern. If they do not, it could be a case that you see a pattern where there is none.

Another way which may help to prevent this bias is to use paired testing. There is gathering evidence that social facilitationcan help to reduce cognitive bias and paired testing is one way to make use of social facilitation. We seem to be more attentive and aware when we are being observed. It should be used with caution since if the task is complex and difficult, people will perform badly. This can only really be used when the task is not overly complex.

One more technique I have found invaluable is the use of testing framing as mentioned by Michael Bolton. I attended a course explaining this and I do recommend that people read the article on his website. Using this approach helps the tester to focus on the purpose of the test but it also has a useful side effect that it can help to remove this bias to see patterns when there are none. It works especially well when you have to justify your reasoning.

Randomness

Within the book 'The Drunkard's Walk: How Randomness Rules Our Lives by Leonard Mlodinow there are lots of useful pieces of information that could relate to what we could experience when

testing. The premise of the book (_spoiler alert …..) is that randomness affects our lives all of the time. It talks about why do some people become very successful when others who have similar talents are not as successful? It explains about our natural ability to form patterns where no pattern exists. It gives examples of how we form mental relationships between independent events where there is no relationship, better known as regression towards the mean. It is an extremely interesting book and ties in with my previous posts on how our cognitive biases can easily fool us and the connection to testing.

One of the best lessons I obtained from the book was when we have formed a theory how do we prove that theory to be correct or not.

The exercise used is as follows:

Exercise

"Suppose I tell you that I have made up a rule for the construction of a sequence of three numbers and that the sequence 2, 4, 6 satisfies my rule. Can you guess the rule? A single set of three numbers is not a lot to go on, so let's pretend that if you present me with other sequences of three numbers, I will tell you whether or not they satisfy my rule. x> Take a moment to think up some three-number sequences to test.

Now that you have pondered your strategy, I can say that if you are like most people, the sequences you present will look something like 4, 6, 8 or 8, 10, 12 or 20, 24, 30. Yes, those sequences obey my rule. So what is the rule? Most people, after presenting a handful of such test cases, will grow confident and conclude that the rule is that the sequence must consist of increasing even numbers. However, my rule was simply that the series must consist of increasing numbers. The sequence 1, 2, 3, for example, would fit; there was no need for the numbers to be even.

Taken from The Drunkard's Walk by Leonard Mlodinow

Did you note that the author used the term "test case" – these are like little test cases to prove a theory or idea you have. The author talks in great depth about why people get this wrong most of the time. The reason being that once we form an idea or theory we search for ways to prove our idea is correct rather than prove the idea is wrong. There are many more ways to prove a theory is wrong rather than it is right.

Does this sound familiar to what we do in testing? We do so much to prove the requirements are correct when really we should be trying to prove that the requirements are wrong. Within the world of software testing there is a great deal of trying to confirm (validate) what we already know about the software rather than try to 'test' what we do not know. Having read the book by Mlodinow I can see why it is so easy to fall into this trap. In most cases our natural instinct is to look for positive ways to prove our theory correct, rather than try and disprove them.

When we test, it appears as if we are fighting our natural instincts and we can get feelings of uneasiness. Hence why some people to struggle to adopt a more exploratory testing approach. Some find it difficult to move from a confirmation style of testing (checking) towards a more

questioning approach where the answer is unknown style. This feeling is commonly known as Cognitive Dissonance.

If we can understand that we as testers should feel uneasy and that it is part of our remit to fight our natural instincts we can then use it as a tool when testing to improve how we test.

Great Expectations

Two books by Dan Ariely I have read that appear connected to the subject of psychology and software testing are Predictably Irrational and The Upside of Irrationality.

Within these books there are some great insights into how we think we behave and how we actually behave. Dan calls this behavioural economics. There are many interesting articles he talks about in the books and most of them I can relate to software testing. The one I want to pick up on for this section is how we can be easily influenced into following a certain path and making us act in a predictable way by manipulating our expectations.

The world of advertising and marketing have very clever ways in manipulating us into buying their products. One of the ways they can do this is to 'Prime' us. Doing this they make us think of a subject or a product so that we unconsciously act in a way that makes us want that product and only that product.

For example if right now I asked you to think of words that are associated with being elderly, what words would you come up with? Think about this and you come up with a list of positive and negative words for the 'elderly'. After you have thought about this I then ask you to perform a few tasks. When you perform these tasks you will be slower, take more time and notice little aches and pains you have. This is from just thinking about the term elderly. The use of association has a very powerful effect on our unconsciousness. Taking this a stage further if you have been primed your expectations have been manipulated so that you tend to have a bias towards the initial priming.

If you are told beforehand that a certain type of coffee is unique, expensive, has a secret ingredient and tastes wonderful, you will at some point have to try it and once you do because of all the priming your subconscious tries to make you like it. If you like coffee that is, replace coffee with chocolate, beer or whatever your favourite product is. Your expectations have forced you to enjoy it. Even if your taste buds are saying it tastes vile, you have paid a lot of money for it and have been told many times how wonderful it is it. You will tell yourself it is wonderful and amazing. Priming your conscious is a powerful bias that can override many other indicators.

Now what if I tell you that the secret ingredient is elephant dung now you have this knowledge your mind will be changed, what if I told you this before you decided to buy the product, would you still buy the product?

So how does this relate to testing?

Imagine if all you are doing when 'testing' is validating the requirements, your expectations have been primed and managed. You keep hearing that the software is bad by the development teams,

the model being used is poor. All of these force you to be primed and you automatically assume the product is poor and that the requirements are what we should expect the product to match.

*Can you see how dangerous this could be? *

You are priming yourself to only confirm what the requirements are or what people are saying.

One of the ways to help resolve this is by using an exploratory testing approach, which can help to reduce your expectations and assumptions of the product under test. It tries to achieve this by the use of models, oracles, and heuristics to ensure that your beliefs, biases and expectations are constantly being challenged as you are testing.

Michael Bolton at Developsense wrote some articles about oracles and heuristics which you may find interesting.

Beware of your own beliefs, assumptions and that of others on your team. Critical thinking skills can help to reduce biases.

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