

## Is mindset awareness the key to unlocking your research potential?

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Within the scientific community as a whole and more specifically within the preclinical research sector there has been growing discussion for many years now about the need for change. A cultural change to improve the rigour of how research is conducted and the reproducibility of results, analyses, and interpretation<sup>1,2,3</sup>. Best practices have rapidly evolved during this time to facilitate the fulfilment of revised expectations. But awareness and implementation of this evolution in responsible research practices is not always seen as a top priority by individuals or organisations. Mindset, ambition, and belief are reported to be common barriers that need to be overcome when it comes to delivering cultural change<sup>4</sup>. Thus, this article will focus on mindsets and the research culture. It seeks to shed light on how an individual's mindset can affect their ability to implement change and influence others working around them.

For over 30 years researchers have investigated how the way someone views themselves influences their mindset and affects their reaction to different experiences as well as the decisions they make. Evidence suggests it can be enlightening for individuals to have an awareness of mindsets so that they can identify personal mindset traits and triggers, as well as to understand the behaviour of others working around them<sup>5</sup>. For educators, mentors, and supervisors an ability to identify and support individuals to change, develop or maintain mindset characteristics can contribute to the achievement of learning outcomes<sup>5</sup>. For research groups, institutes and organisations, an awareness of mindsets and the impact they have on research culture can inform discussions and decisions regarding how behaviours are encouraged or discouraged, developed, and supported or rewarded to facilitate change<sup>5</sup>. This article will discuss current thinking regarding human mindsets and illustrative examples to provide insights in the context of laboratory-based research. It is hoped that this information will help scientists to reflect upon their own mindset, how this impacts the quality and conduct of their research, and the conduct of others working around them. Such insights could contribute to the success of initiatives seeking to tackle the reproducibility crisis and efforts seeking to deliver cultural change within the preclinical research sector.

### The idea of two mindsets

Central to the work of Dr Carol Dweck and other researchers is the concept that human behaviour is shaped by two different mindsets – a *fixed mindset* and a *growth mindset*<sup>5</sup>. Most individuals irrespective of age will exhibit a mixture of *growth* and *fixed mindset* characteristics linked with different aspects of their personal and professional lives. For example, parents and teachers will often encourage and support their children or students to develop a *growth mindset* to try new things, develop resilience and problem solve. Yet the same people can have quite a *fixed mindset* in terms of their own professional conduct at work. For example, choosing to return to the same sources of information, follow the same procedures or repeat the same experimental design or protocol without tweaks or refinement for many years. Following such a 'fixed' approach can seem logical if a method of working is productive and generating results. But the concepts of best practice and refinement in research are by their very nature constantly evolving and require individuals to have the ability to learn and adapt to implement change. So, let's explore the different mindsets in a little more detail.

A *fixed mindset* is linked to a person’s belief that abilities, or personal qualities are in some way pre-determined and cannot be changed<sup>5</sup>. Put simply, you either have what it takes (such as intelligence, knowledge, or skills), or you do not. For example, John McEnroe the tennis player had a *fixed mindset*<sup>5</sup>. His ability to play tennis was sufficient to enable him to become world number one, but because he didn’t like to learn and didn’t see the point in practicing, he struggled and ultimately failed to retain his title when other players challenged him<sup>7</sup>. In contrast, a *growth mindset* is built upon an individual’s belief that it doesn’t matter where you are starting from because with effort, help and support you can develop your skills, increase your knowledge, and learn to be successful at anything<sup>5</sup>. The golfer Tiger Woods is a great example of what an individual can achieve with a *growth mindset*. From a young age Tiger loved golf, he practiced regularly and was encouraged by his father to grow and learn<sup>5</sup>. It is his knowledge about all aspects of the game that Tiger has used to experiment throughout his career and achieve long-term success<sup>8</sup>.

Also worth noting are the differences in how individuals with a *fixed* and a *growth mindset* assess their own abilities. Studies by David Dunning<sup>9</sup> and Justin Kruger have shown that people are not good at estimating their abilities (the Dunning-Kruger effect)<sup>10</sup>. But research conducted with university psychology students by Joyce Ehrlinger has shown that it is individuals with a *fixed mindset* that account for most of the inaccuracy<sup>11</sup>. People with a *fixed mindset* emphasize what they can do well and play down their weaknesses. This distortion introduces bias and reduces the accuracy of individuals estimates. In contrast individuals with a *growth mindset* are more accepting of accurate information about their strengths and weaknesses. Furthermore, teaching a *growth mindset* made individuals more open to identifying their weaknesses and less likely to over-estimate their abilities. Thus, a *growth mindset* enabled individuals to use the more accurate estimate of their abilities to direct their learning to address their weaknesses. There are of course many other differences between individuals with a *fixed* versus a *growth mindset* (summarised in Figure 1). To explore the differences between *fixed* and *growth mindsets* plus the impact on individuals and others working around them in greater depth, I have created the following five fictional scenarios.

**Figure 1. Differences between fixed and growth mindsets based upon a diagram by Nigel Holmes<sup>6</sup>.**

	Fixed Mindset	Growth Mindset
Belief	Intelligence is static.	Intelligence can be developed.
Challenges (practical or theoretical)	Avoid challenges.	Embrace challenges.
Obstacles (unexpected events)	Get defensive or give up easily.	Persist in the face of setbacks.
Effort	See effort as pointless or worse.	See effort as the path to mastery.
Criticism	Ignore useful negative feedback.	Learn from criticism.
Success of others	Feel threatened by the success of others.	Find lessons and inspiration in the success of others.
Result	They may plateau early and achieve less than their full potential.	They reach ever higher levels of achievement.

**Scenario 1 – response to challenge**

A member of your team tells you about a new experimental approach, or methodology that they would like to try. Maybe it has huge potential to refine a 'gold standard' animal model or could become a valuable alternative/non-animal model generating reproducible data with enhanced translational value and/or clinical relevance. It is not something that you are familiar with, but they assure you it is a modified version of a technique they have previous experience of using. There is nothing similar already in use within your lab so it will require time and money for your team member to set up. The idea has potential, but all the literature is from a different field of research than the one you are currently working in.

*The fixed mindset reaction.* Your gut reaction is one of interest, but you are also annoyed and fearful. The idea has potential, but you are annoyed that you didn't think of it first and that this individual has thought to research different approaches to the one you currently use. The experimental protocols used by members of your lab are all well established and proven to be successful. There is risk involved if you agree to let them try this new approach. What if the technique it is not as transferable as first thought, and this individual's efforts are not successful? You will have wasted time and resources on this individual who will have made little or no contribution to the productivity of the whole team during this time. If they are successful, then they will have greater knowledge and skills regarding this technique than you. After careful consideration you tell the individual that you are not convinced that the new technique will work but that you will review your decision if more studies using the technique are published. You reassure the individual that they are a valuable member of your team and ask them to focus on their existing research commitments.

*The growth mindset reaction.* Your gut reaction is one of interest and excitement, but you are nervous also. It is great that a member of your team has felt able to share with you a new and interesting idea. They have some experience from a previous lab that could help them get the new technique set up and running quite efficiently. You love the idea of bringing an innovative approach to your field of research but recognise that it will require some effort on your part also. The individual will likely need some support to help them trouble shoot issues as they arise, and you will need consider how best to manage their ongoing research commitments. You decide to support this individual to try and develop the new technique. Even if they are unsuccessful, you will both have learnt something from the process.

*General mindset differences.* It is clear in this scenario that individuals with a *fixed mindset* are more cautious and risk adverse than those with a *growth mindset*. The chance of success or failure are equal for both mindsets, but by not agreeing the *fixed mindset* individual is potentially limiting both the team member and them from achieving their full potential. From a management perspective awareness of such a reaction can provide useful insight into individual's self-belief, career aspirations plus willingness and ability to adapt to changing circumstances. If not identified and offered appropriate support, successful individuals with a *fixed mindset* can inhibit the potential of others around them as they become fearful of no longer being successful. They can also develop behaviours (such as boasting) to manage and reiterate their perceived superiority over others working around them. This can be a major cause of stress for the individual concerned but also for others working around them.

**Scenario 2 – response to unexpected events**

You are just a few months into a new research project. The equipment and assay you are using is set up and working well. Your plan is to run a series of experiments, analyse the data generated and then decide whether you need to run any more experiments to confirm the results, or whether you will move on to a different set of experiments. You completed the initial series of experiments and have analysed the data, but the results are not as you expected. You are happy that the experiments went to plan, but there is large variability within the data that may impact the reproducibility and translational value of your research. You have not seen this variability previously, and the results of the analysis are not statistically significant.

*The fixed mindset reaction.* Your gut reaction is frustration and disappointment. You have set up the equipment and assay well and carefully planned this series of experiments. You do not understand why the data is unexpectedly showing such a high level of variation and you need a statistically significant result before you can move on to your next series of experiments. You may find negative thoughts creeping into your head so to make yourself feel better and deflect blame away from yourself you consider if “there is a problem with the reagents”, “someone has fiddled with my equipment”, “this equipment is out of date and needs replacing”. You decide to repeat the experiments and hope that the new data generated will display less variability and give a statistically significant result.

*The growth mindset reaction.* Your gut reaction is to be curious about the cause of the high level of variability in your data. You ask peers and colleagues within your facility who run similar assays whether they have ever experienced such high variability within their data and with their input you generate a list of potential causes. Using this information, you redesign your experiments to allow you to control for different sources of variation and investigate which, if any, are factors of interest. This work was not within your original research project plan, but you believe the experience and knowledge you will gain from conducting this study will be beneficial to you and your future research.

*General mindset differences.* What this scenario illustrates is that individuals with a *fixed mindset* will often seek to ignore unexpected events and simply hope that they will not happen again. Their reputation is everything to them, so they will do anything to avoid the risk of appearing as if they are not perfect and in control. Such individuals can react badly if notified of issues by others and become tricky to manage as they attempt to save face. They can refuse to discuss issues and/or actively avoid similar activities involving the individual(s) that have notified them of a problem. This is because they perceive unexpected events as a direct and critical assessment of them as an individual. If not spotted this can be highly damaging to an individual’s self-worth whether working independently or as part of a team because the achievement of results becomes all about them.

In contrast, individuals with a *growth mindset* do not perceive unexpected events as a threat to their professional reputation. Instead, they view them as opportunities to gain experience and will often reflect upon questions such as - what happened? Why did it happen? Could it have been foreseen? Is there anything that can be done to prevent it happening again or identifying it at an earlier timepoint? Individuals with a *growth mindset* recognise the value of hard work, good planning and embody the phrase ‘practice makes perfect’. They are often more resilient, actively seek opportunities to challenge themselves, to gain experience, improve their knowledge or depth of understanding and develop their skills. They understand that no one is expected to be an expert in everything and so are not afraid to seek training or support to improve their research practices. Such individuals are also not afraid of failure, but this does not make them immune to the negative emotions that can be triggered by failure or adverse events. This enables them to empathise and support others through similar situations, leading by example and always being accountable for their own actions.

### Scenario 3 – perception of effort and success

The organisation you work for is committed to providing opportunities for continued professional development (CPD) for all staff. This has become increasingly important over recent years and a proactive approach to lifelong learning is now expected. During a recent appraisal it was noted that you are good at updating your publication record but have not recorded details of any CPD activities over the last few years. In a follow up email, you have been asked as an action point to ensure that your training records are up to date before your next appraisal.

*The fixed mindset reaction.* Your gut reaction is anger. You believe it is obvious to everyone working around you that you are a highly intelligent, skilled, and competent individual. Your growing publication record demonstrates how successful you are, and you consider training courses a waste of your time that is more effectively spent conducting research. You feel resentful of the implication that your research conduct could be improved and do not believe that you would benefit from additional training. You decide to ignore this request and argue your case during your next appraisal.

*The growth mindset reaction.* Your gut reaction is one of disappointment at this oversight. It is not always easy to find the time, but you try to undertake CPD at regular intervals throughout the year. You decide to diarise some time to update your training record, reflect upon your current training needs and identify upcoming CPD events that are of interest to discuss at your next appraisal. You recognise that best practice in all aspects of research and professional conduct is a constantly evolving concept, and you pride yourself on keeping up to date with new developments. This requires effort on your part, but you feel it is important to keep up to date and like to lead by example.

*General mindset differences.* The important thing to note here is that individuals with either mindset can be successful. Thus, whether an individual has a *fixed* or *growth mindset* does not determine if they will be successful or not, but it does influence how success is defined by the individual. It can also influence the journey an individual takes to achieve and maintain success. For individuals with a *fixed mindset* success is about being the best or recognised as better than anyone else around them. They will work hard to get the success and recognition they believe they deserve but once externally validated as successful they simply want to repeat and repeat and repeat. Such individuals are not interested in personal development or growth, and they do not want to change. They do not understand the benefit of training and they see no reason to practice or develop their skills. For individuals with a *growth mindset* success is more a measure of personal achievement that does not require external validation. As such individuals with a *growth mindset* may strive to be the best and are willing to work hard, but they can also recognise and take some comfort if unsuccessful from knowing that they have done the best that they can.

### Scenario 4 – response to criticism

Imagine you are presenting your work to your peers and colleagues. It may be during a lab group meeting, a lunchtime seminar, or as an oral or poster presentation at a conference. You have conducted your research using a well-established model and common approach within your field. You follow a standard protocol that is also used by others conducting similar procedures within your research facility or organisation. You have presented your work many times before and are confident

in your data, but then someone in the audience questions the reproducibility of the study and/or translational value of your findings.

*The fixed mindset reaction.* Your gut reaction is to feel threatened or defensive. Your work is well regarded with your field, and you conduct your research to the best of your abilities, so who is this person questioning you? And why do they think that they know better than you? You are smart and believe that they are wrong, and you are right. So, you play for more time to think of a suitable rebuttal by asking them to expand upon their critique, or to validate their comments. You then challenge the evidence base underpinning their enquiry and the validity of their question before dismissing it without answer and move on to take a question from someone else within the audience.

*The growth mindset reaction.* Your gut reaction is to be inquisitive. You may or may not be able to answer the concerns put to you, but you are interested to explore these concerns further. You are human and not infallible so whilst you have confidence in your approach you do not assume that you are right. You are aware of issues relating to the reproducibility and translational value of research findings across the scientific community as a whole and so attempt to answer the persons questions to the best of your ability. You know that you are not an expert on reproducibility issues and the translation value of different models so you ask the person to meet with you to discuss what they think you could do differently. You view their interest in your work positively and are open to suggestions regarding how you might improve the reproducibility and/or translational value of your findings.

*General mindset differences.* In this scenario individuals with a *fixed mindset* perceive challenge of any level (curious to robust) as harmful. Their response may involve justifying their actions by boasting of their successes or dismissing an individual's right to question them. If this is insufficient to see off the challenge, *fixed mindset* individuals can also seek to blame others around them to divert attention or discredit alternative approaches. This contrasts sharply with individuals displaying a *growth mindset* who perceive challenge as an opportunity for learning. From a management perspective the distinction is quite clear. Individuals with a *fixed mindset* will make little or no attempt to answer questions put to them and respond negatively to challenges relating to their research practices or personal conduct. They may seek to dismiss questions as irrelevant or not applicable, or they may attempt to demonstrate or imply a level of superiority (reputational, intellectual, practical, physical, or professional) over the person they perceive as challenging them. This can be particularly harmful to research cultures if the person asking questions is belittle or ridiculed in front of their peers or colleagues. Such behaviour can discourage others present from asking questions and challenging the status quo, two qualities that drive forward scientific progress. Individuals with a *growth mindset* will seek to maximise the benefits from the challenge they receive. This may involve the transfer of knowledge between individuals, it may initiate a new a collaboration, or it may simply enable the individual being questioned to identify an area of weakness that they can then reflect upon how they can best address.

#### **Scenario 5 – response to the success of others**

Every year the scientific society that you are a member of awards a prize to recognise the research achievements of an individual member during the annual conference. This year you have been short-listed for this award along with four others. During the conference all five short-listed nominees give a presentation describing their work and most recent findings. After all nominees have presented their



work, the conference attendees (all members of the scientific society) are asked to cast their vote to determine the award winner. The award is won by another nominee.

*The fixed mindset reaction.* Your gut reaction is to feel disappointed and resentful. You believe that your work is clearly superior to that of the other nominees, and you cannot understand why the conference attendees did not vote you the winner. You consider whether the vote may have been rigged in some way to favour another nominee, or perhaps you were disadvantaged by the order in which each nominee spoke. You cannot wait to leave the conference and hope that news does not get back to your peers and colleagues.

*The growth mindset reaction.* Your gut reaction is to feel disappointed, but you are also grateful for the opportunity to present and showcase your work as a nominee. You are proud of your nomination despite not winning and have found it inspiring to hear more about the other nominee's work. Being nominated for this award has increased general interest in your work and may result in new opportunities to collaborate. You have lots of ideas you want to investigate, and this experience has given you renewed confidence in your abilities.

*General mindset differences.* Individuals with a *fixed mindset* will do anything to ensure that others are not perceived in any capacity to be better than them. For such individuals' competition can bring out the worst in them. Encouraging them to take shortcuts, develop poor practices and become hyper critical of others working around them. Whether the expectation to exceed is real or perceived often does not matter. The desire for external validation of their superiority can trigger or reinforce *fixed mindset* behaviours such as the development of fixed ways of doing things. This behaviour is intended to replicate past successes, but often has the opposite effect. From a management perspective unless such individuals are identified for support their behaviour can quickly escalate. This can have a negative impact on the research culture and others working around them. Such individuals can become increasingly critical or dismissive of others' opinions (including their own team members) and/or resistant to change, refusing to recognise that there may be alternative ways of working. A fear of others becoming more successful can also lead such individuals to act to prevent others from accessing or undertaking CPD activities. They want staff and students to do as they say and follow their lead rather than become more experienced, develop skills, or enhance their knowledge and understanding to gain independence.

### **Mindset and group processes**

In practice, scientific research is reliant upon individuals working effectively, sometimes in isolation, sometimes in teams, but ultimately for the benefit of others. So, what do we know about the impact of mindset on group dynamics? Carmen Tabernero and Robert E Wood<sup>12</sup> conducted a study of thirty management groups, each comprising of three members. Half the groups had individuals with a *fixed mindset*, the other half were made up of individuals with a *growth mindset*. All groups worked together for several weeks before each group was given the same complex management task – to run a simulated organisation (furniture company). All groups started with the same ability, but the longer the task went on for the more the *growth mindset* groups outperformed the *fixed mindset* groups. The *fixed mindset* groups were seen to develop 'groupthink' – a term meaning "when everyone in a group starts thinking alike"<sup>5</sup>. In some circumstances it is helpful for groups to reach consensus so that progress can be made. But in this case the *fixed mindset* stifled discussion. A group member put forward an idea, and the other members agree because they do not want to risk looking stupid by

disagreeing or being wrong by proposing an alternative idea that may not gain approval. Thus, the whole group learns one idea at a time. The *growth mindset* group on the other hand are willing to make mistakes, ask questions, disagree with each other, and propose other solutions. This enables them to work through different ideas and learn as a group much more quickly than the *fixed mindset* groups.

### What can you do?

Hopefully this article has raised your awareness of both *fixed* and *growth mindset* characteristics. Perhaps it has triggered you to reflect upon your own mindset & behaviours. Maybe it has provided some insight into the actions of your peers and colleagues or others working around you. The key question for you now is - which mindset do you believe is more beneficial and therefore desirable to support and work towards achieving within the preclinical research community? Every single one of us has the same potential to develop *fixed* or *growth mindset* characteristics. We also have the capability to change if we choose to. Dweck chooses to teach about mindset in her undergraduate course each year because she has found that “*just learning about the growth mindset can cause a big shift in the way people think about themselves and their lives*”<sup>5</sup>. If you too believe there is a benefit to developing or maintaining a *growth mindset*, then take care not to fall into the “*false growth mindset*”<sup>5</sup> trap. “*A growth mindset is about believing that people can develop their abilities. It’s that simple*”<sup>5</sup>. It is not about taking something that we like about ourselves, such as being open-minded or flexible, and calling it *growth mindset*<sup>5</sup>. It is not solely about praising effort because a *growth mindset* is a lifelong journey rather than a destination that you do or don’t arrive at. This journey requires effort but also an ability to devise and test different strategies as we come across new challenges<sup>5</sup>. And it is not about simply telling people they can achieve anything and setting goals. To progress, individuals require access to resources and appropriate support to learn and develop key knowledge and skills<sup>5</sup>. So, if you are wondering how to get started or what to do next, I have written some potential ‘mindset awareness’ action points for you to consider, share and discuss as you see fit (see Table 1).

**Table 1 – List of potential ‘mindset awareness’ action points**

<b>Individuals</b>
<ul style="list-style-type: none"> <li>• Use the references provided to learn more about <i>fixed</i> and <i>growth mindset</i> characteristics.</li> <li>• Reflect upon your own mindset. Does it vary with different personal and professional roles and responsibilities? Are there any aspects relating to your mindset at work that you would like to change?</li> <li>• If you recognise that you exhibit some <i>fixed mindset</i> characteristics that is ok, if we are honest with ourselves most of us do. The first step on your mindset journey is thus to acknowledge and accept it. You will then be ready to start exploring your <i>fixed mindset</i> triggers.</li> <li>• Think about your personal strengths and weaknesses in the context of your professional roles and responsibilities. Are there any aspects that you would appreciate additional training, mentoring or support to develop further?</li> <li>• Consider requesting and/or researching mindset awareness training and/or support, especially if you are in a staff development, management, and training, supervisory or mentoring role.</li> </ul>
<b>Trainers</b>



- Take the time in advance of training sessions to find out individual's reasons for attending. Individuals stating that attendance is compulsory, or they have been told to attend may have a *fixed mindset*. They are not indicating that they are engaged and ready to learn. Unless this is addressed at the start of the session the likelihood of achieving learning outcomes is low. Individuals that state a learning outcome that they wish to achieve are more likely to have a *growth mindset* and are ready to learn.
- In advance of each training session establish 1:1 contact with all attendees to identify if they have any specific learning needs or may benefit from additional support. This will ensure that the training you provide is as inclusive as possible, and that every attendee feels safe and secure in the learning environment. Note – individuals with a *fixed mindset* can benefit greatly from this initial contact to discuss any fears or assumptions they may have.
- It is good practice as early on as possible during a training session to include an individual or group activity that enables attendees to identify gaps in their knowledge, experience or skill set that they can address during the training session. This can encourage a growth mindset.

#### Organisations

- Be clear what behaviours you wish to encourage or discourage and review your local research framework (policies, procedures, guidance, and recommendations) to ensure they are consistent with this.
- As part of the application or recruitment process for management, training, supervisory and mentoring roles consider including mindset assessments.
- Identify individuals with a *growth mindset* and discuss how they can be recognised and/or rewarded to inspire others working within the organisation. Seek advice or support with this if required.
- Ensure individuals have multiple routes for accessing CPD (internally & externally, in person & on-demand) to minimise the risk that they are prevented from accessing training or support because of restrictions placed upon them by others whose permission or approval they may require.
- Consider sourcing mindset awareness training for all staff and/or students but especially those in staff development, management, and training, supervising or mentoring roles.

#### Data Availability

This work is entirely theoretical, there is no new or unpublished data underpinning it.

#### Declaration of conflicting interests

The author is the founding director and lead tutor for a company that provides training and consultancy services to individuals and organisations within the life science and preclinical research sector.

#### Ethical Statement

The work reported does not require approval from a human or animal ethics committee.

#### Funding

The author received no financial support for the research, authorship, and/or publication of this article.

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