WHAT IS THE VALUE AS DESCRIBED BY SENIOR LEADERS OF UNDERSTANDING INDIVIDUAL BRAIN SEX DIFFERENCES IN THE WORKPLACE – AN EXPLORATION.

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DECLARATION SHEET

STATEMENT 1

This thesis is the result of my own investigations, except where otherwise stated. Where correction services have been used the extent and nature of the correction is clearly marked in a footnote(s). Other sources are acknowledged by footnotes giving explicit references. A bibliography is appended.

Signed:

Date: 10/12/2023

STATEMENT 2

I hereby give my consent that the thesis, if successful, may be made available for inter-library loan (subject to the law of copyright), after expiry on access approved by the university of two years (see PG 27)

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Abstract

The primary purpose of this research was to explore the value to senior leaders of understanding individual brain sex differences in the workplace, particularly in the context of the limited representation of women at the highest executive levels in modern corporations. While there is evidence supporting the positive impact of male/female differences on business performance, research addressing the challenges of understanding brain function differences, both in men and women, remains limited. This study addresses this gap by conducting a phenomenological exploration of leaders' lived experiences who participated in a workshop on brain sex differences at work.

The workshop involved ten semi-structured interviews with both female and male leaders, sharing insights from neuroscience and practical tools developed by the researcher. Topics covered included basic brain function, neurochemistry affecting performance states, key neurobiological sex differences, and the influence of nature and nurture on individual brain development.

Five key findings emerged from the study: A demonstrable gap exists in awareness and knowledge of brain sex differences at work; participants applied acquired knowledge effectively in three domains: Self, Teams, and Clients; the application of new knowledge induced a profound mindset shift among many leaders; improved relationships resulting from the application of knowledge contributed to better self-awareness, enhanced understanding of others, and more effective approaches to business tasks; extracting full organizational value from this knowledge posed a significant challenge.

These findings not only contribute to existing research but also provide innovative perspectives on addressing persistent business challenges. The research fills an academic void by offering new approaches to understanding differences within an organization and presents insights applicable at both individual and organizational scales.

Key words: Business value, brain sex, inclusivity

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Chapter 1: Introduction

1.0 Thesis context and background

I have been a senior female leader in business and a leadership coach for a total of forty years. It is my experience that the differences in thinking styles and behaviour of female and male leaders in the workplace is not well understood or utilised as a source of performance enhancement. To better understand why, I became interested in the neurobiology of brain sex and how differences based in neurobiology impact in the workplace. My observations have been that brain sex differences at work are largely overlooked, misunderstood, and ignored.

The brain has been described as 'the chief administrative and emotional organ of life' (Moir and Jessel, 1991) and what is meant by brain sex differences are the variety of ways in which the brain is differently constructed in men and women and the differences in the way the sexes process information with these sex differences causing, on average, a variety of perceptual and behavioural diversity between the sexes (Baron-Cohen, 2004). Very recent research demonstrates that these structural sex differences are readily detected in scans read by deep learning models with accuracy of over 90 per cent (Ryali et al., 2024). This new data clearly confirms observable brain sex differences. The new data was not released at the time of initial writing of this research thesis and has been included in this post viva iteration of the project. The replicable and generalizable nature of the latest brain sex differences evidence (Ryali et al., 2024) refutes many of the feminist arguments which suggest that sex differences are socially constructed (Rippon, 2019). These feminist arguments against brain sex differences are explored later in this thesis. Moir in her much earlier work defines brain sex differences as revealing 'startling sexual asymmetry'(Moir and Jessel, 1991) and it transpires now that the most recent evidence from cognitive neuroscience supports this view (Ryali et al., 2024). This research project focuses in particular on the value to leaders of understanding these neurobiological sex differences in the brain and the potential differences in perception that can result from them in the workplace (Brizendine and Shoffner, 2008; Brizendine, 2010).

In this Introduction I will look first at the evolution of leadership and inclusion over recent decades and why it is important. Then I look at my own particular perspective on including brain sex differences in modern business.

1.1 The evolution of leadership and inclusion

The history of leadership in business and management can be thought of as one of increasing awareness of the individual and the value of individual inclusion to business performance and employee well-being (Herring, 2009). Leadership in business is a phenomenon that has been

studied over many decades (Bennis, 2009) . There is no unified theory of leadership (Bennis, 2007) and many definitions of leadership have been proposed since leadership research first started in the early nineteenth century (Hunt and Fedynich, 2019). These definitions are wide-ranging reflecting the lack of consensus of the nature of effective leadership. A small selection of these definitions range from leadership is 'an influencing process aimed at goal achievement' (Stogdill, 1950)to 'the art of mobilising others to want to struggle for shared aspirations' (Kouzes, 1997) through to a style of leadership where the leaders "exhibit visibility, accessibility and availability in their interactions with followers" (Carmeli et al., 2010).

The literature reveals over two hundred theories about leadership and how to define it (McCleskey, 2014). These theories can, to an extent, be situated in identifiable historical phases (Middlehurst, 2008). These start with the 'Great Man' theory that occurred during the industrial revolution in the 18th to 20th centuries (Hunt and Fedynich, 2019) with an exploration of leaders who led directly as individuals (Bennett and Murakami, 2016). This theory presupposes that some men are born to lead with innate characteristics that fit them to leadership. At the time women were not part of the research due to the gender discrimination and social structures of the day (Johns and Moser, 1989). The theory had a number of problems such as no empirical data to prove the validity of the Great Man. In addition, there is bias involved as to who chooses, who is and who is not, a great leader (Hunt and Fedynich, 2019).

Trait theory grew out of the Great Man theory as an attempt at a framework for research into leadership (Malakyan, 2014). Trait theory proposed that particular qualities were needed to lead, such as integrity, energy, faith and intelligence amongst others. There were problems with the theory such as its implication that one was born a great leader with these traits or not. It did not allow for the possibility of becoming a leader (Malakyan, 2014). Nor did this theory account for the situation/circumstances that the leader was in at the time and there was no empirical evidence for the theory (Johns and Moser, 1989).

There is no specific timeline when one theory of leadership gives way to the next (Hunt and Fedynich, 2019), there are, however, clear phases (Malakyan, 2014). The limitations of the Great Man and Trait theory gave rise to the study of power and how a leader both acquired and used power to influence others (King, 1990) . Some research suggests there is a limit of around 150 subordinates that can be led using the Great Man or power approach (Vugt and Ronay, 2014). Beyond this number of people research suggested that leaders resorted to coercion in a way that is not acceptable in many cultures (Vugt and Ronay, 2014). This theory was developed in the World War II years and linked to the events at the time.

Post the Second World War there was a significant expansion of leadership research and new theories (Middlehurst, 2008). The economic potency of the USA at this time and the rise of multinational organisations with large workforces was responsible in part for the driving

of this leadership research since the existing theories could not support an understanding of this now more complex corporate leadership environment (Hunt and Fedynich, 2019). Behaviourist theories that focused on the actions of the leader rather than their personality traits came into being. The most well-known of these is the Theory X and Theory Y view of leadership (Hunt and Fedynich, 2019). Theory X proposed that people disliked work, needed to be controlled to do it and sought job security rather than responsibility. Theory Y proposed the opposite; that individuals mostly enjoyed their work, were motivated, and did not require any forcing to work hard (Northouse, 2021). This stage in leadership research did engender the use of data analysis of actual behaviours to support the understanding in ways which previous theories had not/could not (Northouse, 2021). However, the studies ignored important aspects of leadership such as the environment of the leader and the subordinates and their roles (Malakyan, 2014).

Situational theory developed in recognition of these missing elements (Hunt and Fedynich, 2019). This considered the task itself and the nature of the working environment. This was all happening at a time in organisational history where very few women were in positions of seniority in leadership (Lanz and Brown, 2020). The situational theories did, however, involve the attempt to look at broader factors such as personality, behaviour, influence and the situational environment (Hunt and Fedynich, 2019). The style of leadership was given more importance, and during this phase the leader was still seen as directing subordinates to accomplish goals (Malakyan, 2014).

In the second half of the 20th Century and into the 21st Century organisations have continued to become increasingly complex and less rigid compared with the hierarchical post war corporations (Hunt and Fedynich, 2019). This can mean flatter structures or matrix structures (Vugt and Ronay, 2014) and these more complex structures have led to new leadership theories evolving. Amongst these are Authentic Leadership (A. Duignan, 2014) and Servant Leadership (Malakyan, 2014). These theories show the leader focusing more on the needs of the followers than in previous leadership approaches (Northouse, 2021). Some research indicates that followers are enabled to rise to the leader's level (Malakyan, 2014). Follower based leadership led to the concept Leader Follower Trade (LFT) (Malakyan, 2014). This approach demonstrates a circular flow where ideas are exchanged between the leader and the followers (Malakyan, 2014). This phase of leadership research is one of the underpinnings of the concept of inclusivity in leadership (Hunt and Fedynich, 2019).

The research into inclusive leadership has recently been identified as a 'burgeoning field' (Korkmaz et al., 2022). A systematic review of this literature highlighted recent meta research that seeks to synthesize the conceptualisation of inclusive behaviours by leaders and propose a multi-level model of inclusive leadership (Korkmaz et al., 2022). Of 280 studies into the differences in leadership styles, 107 went into a synthesis of a proposed multi-level model, consisting of four dimensions:

- Fostering employee uniqueness

- Strengthening belonging

- Showing appreciation

- Supporting organisational efforts

(Korkmaz et al., 2022)

These four leadership behaviours appear in the literature on three dimensions: individual, team and organisational. These dimensions are of particular interest since they reflect three of the four dimensions highlighted in the findings of this research project (discussed in Chapters 4 and 5). Research reported in this literature began to investigate, in the early part of this century, sources of differences in leadership style (Eagly and Johnson, 1990). The concept of 'fostering uniqueness' emerged which refers to recognising employee's individual differences (Bradley, 2020). The research into 'fostering uniqueness' looked at understanding male and female leadership differences (Shen and Joseph, 2021). Early research into gender differences in leadership focused on external behavioural differences initially rather than neurobiological and brain sex differences (Eagly et al., 1992).The beginnings of interest in brain sex differences and leadership arose later (Annis and Merron, 2014). This emergence of interest in brain sex differences is discussed below.

What literature there is on male/female leadership differences reveals one of the persistent challenges in modern leadership with the proportion of women in CEO roles having remained at a limited 5% for a significant period of time and showing little sign of increasing (Catalyst, 2023). Scholars from many different disciplines have sought to understand what the differences are between male and female leaders and why there are so few women in the very top roles (Shen and Joseph, 2021). The research is complex (Paustian-Underdahl et al., 2014) and covers a wide range of areas that impact women in leadership. One key area of this research highlights a discrepancy in the numbers of women lower down the executive ranks compared with the small percentage that make it into the very top jobs. A large PwC study identified what it called a 'leaky pipeline' with 25% of women in senior roles dropping to 2-3% making it into senior leadership executive positions (Churchman and Thompson, 2008). These studies have developed in approach since the 1990s and show a change in research methods. Earlier research focused more on social constructs and behavioural observations (Eagly et al., 1992), while the more recent research focuses on the including of some understanding of neurobiological evidence for brain sex differences (Case and Oetama-Paul, 2015).

These earlier studies look at differences in leadership styles, traits and behaviours as well as investigating the impact of gender stereotypes, role theory and the gender spill over effects of these stereotypes within the business context (Eagly et al., 1992). Studies found that women leaders demonstrated a more democratic leadership style, less autocratic style than

their male counterparts (Eagly and Johnson, 1990). Earlier studies into gender stereotypes revealed that the 'carry over into workplace of gender-based expectations for behaviour' (Gutek and Morasch, 1982) evidenced a dilemma facing women but not men as female leaders tended to violate the expectations of them as women once in a leadership role (Stogdill and Bass, 1981). For male leaders their behaviours matched more closely the expectations of others (Heilman et al., 1989). Such findings contributed to a body of literature into what causes the specific barriers for female leaders and what might be done about barriers in order to support greater inclusion of engagement. These barriers include what the literature generally calls gender bias discrimination, implicit bias, unfair performance management and sexual harassment. Meta analytic evidence demonstrates that discrimination at work increases stress and job dissatisfaction (Dhanani et al., 2018). Some of this research suggests that female leadership experiences resulting from these forms of bias cause lower career equality for women (Kossek et al., 2017) and may prevent women from accessing senior leadership roles internationally (Sidani et al., 2015). Whilst much of this body of research has found that male and female leaders also have much in common (Offermann and Foley, 2020), meta studies nonetheless consistently evidence differences in leadership styles and behaviours with women rating more highly on characteristics such as influence, inspiration, individual consideration and a democratic style (Eagly et al., 2003).

As organisations have become increasingly complex and connected across a global trading environment and collaboration, teamwork and communication have become more necessary, Offerman sought to establish whether there is a female leadership advantage given style and behavioural differences (Offermann and Foley, 2020). Studies into the business case for better inclusion of female leadership support the view that there is such an advantage (Offermann and Foley, 2020). The literature on the business case is explored in depth in Chapter 2 of this thesis so is not covered here.

Given the growing evidence of the benefits of female leadership in modern business (Offermann and Foley, 2020) yet the persistence in low numbers of women going into CEO level roles (Catalyst, 2004) there is the beginning of a literature that considers brain biology as a 'mediating link in women's differing organisational experience' (Case and Oetama-Paul, 2015). This literature argues that there is 'too much biological evidence for sociological arguments to prevail' (Case and Oetama-Paul, 2015). As yet this literature is largely not based on primary research in the workplace but rather seeks to develop conceptual frameworks that link new empirical evidence from neuroscience to observed workplace behaviours (Case and Oetama-Paul, 2015). Evidence from this literature suggests that part of the reason women do not advance at the same rate as men in the business environment is not because they will not 'lean in' (meaning being assertive within existing organisational structures) (Sandberg and Scovell, 2014) but because businesses are still inherently male systems (Annis and Merron, 2014).

The body of literature investigating the challenges and opportunities for greater female

involvement from a brain biology perspective is currently scarce. This project seeks to move the literature forward by investigating what happens in practice for senior leaders when new knowledge about brain sex differences is shared and they have the opportunity to apply it in their workplaces. My own experience as a senior leader in business and as a leadership coach over many years resonates with the assertion from the literature above that many of the challenges for female leaders lie in the inherently male systems that make the nuanced and specific inclusion of brain sex differences a difficulty in business environments where they are little understood. In colloquial terms much of the literature and my own lived professional experience is that women leaders in business need to become the 'best men they can be' in order to succeed within the current 'inherently male systems' (Annis and Merron, 2014). Systems that demand the differences in brains - male as well as female- to function out of their optimal way risk missing out on the benefits of enabling brains to perform according to their diverse natures. Exploring what might be possible for organisations to better include all the brains in the business is the basis for this project. It is true for me personally that in my corporate professional existence I did indeed have to be the 'best man I could be' in order to succeed in my roles at the time.

Section 1.2 explores the context of my professional coaching practice and how this further generated interest in undertaking this research.

1.2 Significance of this project and its genesis

Given my interest in understanding how organisations could optimise creating the conditions for brains to perform at their best I began to investigate the literature on the topic as described above. The lack of literature on brain differences sex led me to set up an action learning group (Stringer, 2020) consisting of a coaching group of four senior women leaders to investigate their experience of corporate leadership cultures and ways of working. They came from four different organisations and were very different individuals. This group met over five months and there were three meetings. I wanted to understand where and how they felt that they were able, or not, to bring their leadership skills as women to the workplace in a meaningful way. The female leadership skills in question refer to what these women described as a focus on relationship just as much as on work task, on collaborating rather than competing, on active inclusion of all opinions (rather than just those who speak up) and on the individual and their needs at quite a personal level. They consistently reported their perception of a difference between male and female ways of leadership (put very simply this was a more transactional task focus vs. a more relational task focus) and that there were systemic processes and ways of working that were not well suited to their more 'female' ways of leading. They also revealed that they knew little or nothing about brain sex differences.

These senior female leaders encouraged me to share the insights from my research more widely. This led to me designing a workshop to inform leaders about brain sex differences and

developing tools for applying this knowledge in a fast-paced, challenging work environment. These workshops ran in various formats over several years and I developed and shaped the content with the aim of sharing the maximum amount of information in the most effective way in a half-day session. I developed the tools for applying the knowledge about brain diversity and brain sex differences. Feedback from clients over time was an important part of this development. I was curious to see what happens if one raises awareness such that leaders, and the systems they develop and operate in, can reduce their brain sex 'blindness' and increase their awareness of brain differences and diversity. Full details of the workshop content are given at the end of the Chapter 2 (which covers the specific literature review into brain sex).

Over time clients who had attended the workshop reported that the content had significant positive impact for them and their teams. This was true across a number of different companies. This feedback from clients heightened my interest in understanding more deeply the specific impact and value to leaders of the workshop content. I also wanted to establish how the experiences of participants fitted in to the current thinking on inclusion in the workplace. This desire to understand what was actually happening in a more granular way, led to pursuing this Professional Doctorate. A Professional Doctorate (D. Prof) provides the structure, discipline and challenge to understand more deeply, capture and document the value that leaders were taking from the workshop in an academically rigorous manner. Importantly a Professional Doctorate is a recognised means to expand the literature on the topic of brain sex inclusion at work.

As I embarked on the Doctoral journey and my curiosity and experience in this subject developed over the months and years, I felt that it was important to share what I was discovering and thinking more widely within the business community. I also felt that business leaders would appreciate being able to digest the information and tools for application in an easy access format. Thus, this blend of experience from the workshops, the senior women's coaching group and the beginnings of this research became the underpinning of a book I co-wrote on the subject with a male colleague. The book is entitled "All the Brains in the Business: the engendered brain in the 21st Century organisation" (Lanz and Brown, 2020).

So, this research project explores and documents the value to a group of senior leaders (from three different organisations) derived from learning about the neuroscience of individual brain sex differences. It reports those leader's actual lived experience, sense-making, usage and reported added value and organisational impact from the new knowledge acquired.

In short, the research question posed is:

"What is the value as described by senior leaders of understanding individual brain sex differences in the workplace – an exploration"

At the time of writing an influential point of view in feminism is that there is little or no difference between men and women in the workplace, and that equality is what is sought. (Rippon, 2019). But this risks defining women as being necessarily like men so this point of view limits the progress of women and men alike by preventing access to the many important individual brain differences that do exist. This research report explicitly refers to brain sex as a biological distinction as opposed to a gender distinction which is a social expression. Gender and the non-binary movement (Davi and Spelman, 2021) are a current topic of activism in the workplace and beyond. This movement highlights that individual gender choices matter but that is not what is being considered in this research. It has previously been argued that accessing individual brain difference is a potent source of competitive advantage (Muthukrishna and Henrich, 2016). This project seeks to document the reported value to leaders of improving their understanding of brain sex differences and applying the new knowledge.

To my knowledge this is the first study of its kind, so it also provides a starting point for more extensive explorations for brain sex differences at work as well as providing a new basis for organisational change programmes. The study identifies key areas of focus and highlights their importance for individuals and organisations.

This research, then, takes a phenomenological approach, focusing on the details of the reported experiences of the leaders and identifying the common themes that arose. The outcomes of this research are, I believe new insights into how individual leaders, and at a collective level their organisations might better access individual brain differences at work. The outcomes provide the basis for a diagnostic and educational framework that could support business leaders to access brain sex differences effectively.

1.3 Professional and personal context and background

This research has emerged from my experience during three important phases of my life, both professional and personal:

Phase One: General Management in the international corporate sector
Phase Two: Bringing up two neurodiverse sons
Phase Three: A career in leadership coaching globally

1.3.1 Phase one: Corporate general management

As an international General Manager (GM) in Eastern Europe and Latin America for Diageo, setting up and running businesses to sell whisky and Guinness beer, into the market place for 12 years from the early 1990s, I became very interested in understanding what motivated people so that it was possible for me to hire individuals who could 'team' effectively with others. I enjoyed the then understood psychological aspect of leadership very much. I

became certain that understanding personal motivation was critical in being able to allow people to perform their best work. I seemed to acquire a natural talent in this area and built upon it by reading about psychology and developed a consistent track record in hiring and developing people and creating teams that worked well, even when some of the personalities involved did not find each other easy.

As a GM at the time, I was the only female GM in the organisation internationally, and the youngest. This was quite challenging as the dominant culture was male. There was overt sexism and it was expected that this was accepted and put up with as part of the job. The ways of working were highly competitive and often adversarial. One had to be able to 'win' in these ways of working to survive in the culture. Although tough, it was a fun as well. It would not be unreasonable to say, however, that I had to work at being the 'best man' I could be in order to survive in this work environment. At this time, I was not aware of much of the science behind brain sex differences but I was conscious that I had to learn to act in ways that were not natural for me. It was only in later years, through my personal reading and active research, that I uncovered some of the underlying reasons for feeling that I was being forced to act out of my natural way of being.

1.3.2 Phase two: Bringing up two neurodiverse sons

I was brought up as a feminist in the schools of home-grown feminist thought from the sixties through the eighties. I believed as a university student that the vast majority of differences between men and women were socially engineered and that biological differences were incidental. That was until I had two sons. Having grown up in a family of three girls, including myself, and being brought up largely by my mother, I had a good understanding of an all-female environment. As the mother of boys, it became apparent to me very quickly that there are profound differences between the sexes from birth and that these are biological, from nature and not largely nurture. I began to learn about these biological differences, at the same time as paying careful attention to individual differences between my sons so that I could be an effective mother to my children. It was fascinating both to read the works of and talk to different professionals. This included colleagues who were child psychiatrists and reading the literature of the day (Biddulph and Stanish, 2013). This increased my curiosity about sex differences and how they impact behaviour.

My sons are very different individuals with very different brain sex scores. Details on brain sex scores are elaborated in Section 2.7.5. However, in short, brain sex can be measured on a spectrum from 1 which is a very male brain to 20 which is a very female brain (Moir and Jessel, 1991) . One of my sons has a very male brain (2/20) and the other a more female brain (12/20). I do not believe in any way that a simplistic binary way of looking at maleness and femaleness in the brain should be a standard approach (Baron-Cohen, 2004). Each brain is an individual structure and set of connections, as unique to the person as their fingerprint (Moir and Jessel, 1991). Yet by biological definition, there are sex differences

in every single cell in the body (XY or XX in every single cell) and this influences how the nurture part of our lives shapes what nature has given us. As a mother of two very different males, this has been an immensely important part of my understanding, learning and curiosity feeding into this eventual research project.

1.3.3 Phase three: Global leadership coaching

As I stepped out of the corporate world in 1999, I undertook a BSc. in Psychology with a view to becoming a clinical therapist and pursuing my interest in the psychological arena. Upon completion of the BSc. I chose, however, to stay in the business side of psychology and apply my education and business experience as a leadership coach.

Spending twenty-five years as an international leadership coach has involved running my business in Latin America, mainland Europe and London. I have also spent nearly twenty years working as part of the global leadership centre at INSEAD (Institut Européen d'Administration des Affaires), one of the world's leading business schools. My experience as a leadership coach is that most organisational cultures and measures are blind to these brain sex differences . For example, many female leaders have been sent to me in coaching because they are not deemed 'confident' enough. Upon investigation, the question is not one of confidence but one of how one 'shows up' as confident. Many of these women were being expected to demonstrate confidence in the way that a certain type of organisational man would.

There was one particular experience that led me into starting this research project. I was asked to work with a client who had been brought over from Spain to London to undertake a challenging role for a bank. He was paid a considerable sum to do this. However, he was made very unwelcome by the people around him in London at the time. In the coaching sessions, it was apparent that he was unable to think at his best in the hostile environment he found himself in. At one point he exclaimed, 'I have to switch myself off in the mornings to survive the day in this place and I switch myself back on when I see my children's faces when I get home at night.'

I found myself thinking, 'Why would you pay that brain that much money and then render it useless?' It struck me that this was both bad for this man's well-being and a poor return on investment for the business. I decided to find out what it took for an organisation to create the conditions for optimal individual brain function. The early phases of my reading into the subject revealed that, in order to create optimal conditions for the brain to function well, knowing that there are brain sex differences and using that knowledge is key. This was the starting point of my research activity, ultimately leading to this project. Section 1.4 outlines the scope of the thesis followed by an overview of each Chapter.

1.4 Scope of thesis

As stated by Bloomberg there must be 'conscious inclusions and exclusions in the framing and design of the investigation' (Bloomberg and Volpe, 2018,p90). These are elucidated below:

- Both male and female business leaders have the capacity for creating positive change for valuing each other at the greatest scale. This is what drove my interest in the experience of business leaders rather than their advisors (e.g., trainers, coaches etc.).

- Most business leaders currently know little or nothing about brain sex differences and how to include them at work. In a workshop I shared information about neurophysi- ological brain sex differences. The design of the workshop was based on preliminary investigations with a group of five female leaders, including myself, who initially reported an absence knowledge about brain sex differences.

- I also highlighted how these brain sex differences exist on a spectrum which ranges from very male to very female and that brains are influenced by both nature and nurture (there is further detail on the Brain Sex Spectrum in the Chapter 2). Each individual brain is different. I also shared models on how to apply brain sex knowledge so that all brains might feel included. In the interviews of ten business leaders, that form the basis of my first-hand research, I listened for the level of brain sex knowledge and application.

- Current ways of working in most business cultures are more suited to the natu- ral/authentic function of a brain at the more male end of the brain sex spectrum. Based on my own experience in business and coaching and on the preliminary studies I assumed that existing business cultures and performance measures are likely to suit leaders at the more male end of the brain sex spectrum.

1.5 Thesis outline

1.5.1 Chapter 2: Literature review

This Chapter includes a review of the main schools of thought in respect of the literature on brain sex, a major challenge being that the current literature on applied neurosciences is a combination of being both limited yet broad.

The Chapter identifies three dominant areas of investigation and explores each in depth. These are:

Area 1   Scientific/empirical evidence of neurophysiological brain sex differences from research in medicine and the life sciences.

Area 2   Perspectives on and responses to that evidence, which fall into three dominant perspectives:

  a) The evolutionary biology model of the genetic evolution of brain sex difference driven by adaptation.

  b) The view that there are important differences between a male and female brain that should be paid attention to and utilised because, despite existing on a spectrum of maleness to femaleness, their nature and type make a significant difference in society and at work.

  c) The feminist view that male/female brains have more in common than in difference: that such differences should be discounted and therefore that the sexes should be considered 'equal' in terms of brain function.

Area 3   Business literature in respect of male female differences and their impact on business performance.

The workshop content highlighted what was missing in the current literature on brain sex differences in the workplace.

1.5.2 Chapter 3: Methodology

This Chapter details the research aims and objectives and the design process for the final choices in research methodology. The Chapter looks in detail at the epistemology and theoretical perspectives that led to the overall methodology chosen and ultimately how all these informed the specific methods utilised. The final research strategy of phenomenology focuses on an individual's conscious experience of events (Menon et al., 2014), so the ultimate research method employed was thematic analysis; looking for patterns within the phenomenological data in full interview transcripts.

The Chapter also considered ethical issues in respect of this research.

1.5.3 Chapter 4: Project findings

Based on the ten interviews with the business leaders from which the data for my research is derived, this Chapter opens with a summary of the analysis process, an overview of the key thematic outputs that appeared from the ten interviews and includes a theme table as a guide to understanding all the data.

There then follows a summary of the five key themes and their related subthemes. The balance of the Chapter provides a more detailed analysis of each of the themes and their subordinate themes. These are illustrated using quotes from the interviews.

1.5.4 Chapter 5: Discussion of findings

This Chapter focuses on the insights into and observations about what participants identified as value-add from the workshop and its application, relating the findings directly to my research question. It also analyses and discusses how the data from the leaders' lived experience of using new awareness and tools from the workshop translated into the five key themes and their related subthemes.

A notable outcome was that the outputs from the interviews with senior leaders about their experience of the content from the workshops had little to do with the content of my initial literature review. This Chapter, therefore, includes a further review of a wider literature that was relevant to themes that came up in the interviews.

1.5.5 Chapter 6: Conclusions, recommendations, and reflections

This Chapter draws five key conclusions arising from the main research project, together with recommendations in relation to each of the key conclusions. The recommendations form the basis of a simple framework that could be used by leaders to think about what they would need to consider and how they might approach accessing the value from brain differences in their businesses.

The Chapter also considers how the findings from this project might be further disseminated; recommendations for further research; and the changes arising in my own practice from having undertaken a Professional Doctorate.

Chapter 2: Literature Review

2.0 Literature review process and parameters

The leadership literature on applied neuroscience is in the very early stages of development with respect to appreciating neurobiological brain sex differences and getting the value out of these within a business environment. This Chapter undertakes a thorough investigation of this literature and its relevance to the main research investigation of this thesis. The available literature ranges from rigorous academic research to popular press articles in a wide variety of subject areas related to sex differences. Only academic papers and books are considered in this thesis. There is detail below on the criteria for selection.

The review process began with looking at the empirical evidence for neurobiological sex differences in the brain. This included empirical studies that both identified and failed to identify brain sex differences. It also included meta research reviews that aimed to look at the latest status on the empirical research. There was no specific year range used in the searches. Surprisingly some of the early work on understanding hormonal impact on behaviour (in animals) started in the 1800s despite hormones not having been scientifically named or categorized at the time (see Section 2.2.1). Most of the recent research into brain activity developed with the advent of the fMRI scanner in the 1980s and, the extensive technological developments of being able to see the brain working in real time that have been a huge part of neuroscientific research in this century.

All non-academic/popular press literature was excluded from the search. The search terms highlighted below were the terms used within each body of literature that was reviewed.

Given the potential range of literature involved in this research question, from educational psychology, social psychology, business psychology, medical research and into business research on diversity inclusion and performance, to name a few of the disciplines that the topic touches upon, it was felt important at the outset to frame the search with some parameters to guide the review process. The following guiding questions were considered the most relevant and focused after lengthy discussion and reflection on the research question and its range:

a) What is the primary empirical evidence base for sex differences in the human brain?

b) How and where has this evidence been interpreted and discussed in the literature beyond the primary research community? What are the main perspectives outside the primary research community?

c) Where and how has this evidence and interpretation been used in business literature in relation to brain inclusivity in the workplace?

The primary search terms used to facilitate investigating these questions were:

- Neuroscience male/female brains
- Sex differences in the brain
- Workplace gender diversity and neuroscience
- Brain sex differences in the workplace
- Brain gender
- Male/female brain differences
- Neurodiversity
- Science of sex and gender
- Gendered brain
- Male brain
- Female brain
- Brain sex

The review provided is constrained to evidence-based research obtained from searching the following databases:

- Sage Journals Online
- Wiley Online Library
- Elsevier Online Library
- APA PsychArticle
- ProQuest
- Web of Science
- Muse Knowledge Search
- Inspec Direct

A number of books from other publisher's lists were also consulted and are appropriately referenced.

2.1 Classification of the literature

Even within the parameters of the guiding questions there was a large amount of information to synthesize from the review. Discussions, reflection and review of the information finally resulted in identifying three main areas in respect the main research question These are:

Area 1   Empirical data from research in medicine and the life sciences that evidences physiological brain sex differences.

Area 2   Interpretations of and perspectives on the neurophysiological evidence of brain sex difference. There are three dominant interpretations in this second area:

     a) The evolutionary biology model in which brain sex differences are seen to be driven by adaptation for natural selection.

     b) Literature that acknowledges that there are important neuro-biological differences between male and female brains and that these should be paid attention to and utilised. This often involves an acceptance that individual brain differences sex exist on a continuum from maleness to femaleness and asserts that the nature and type of the differences has a significant impact in society and at work.

     c) Literature that adopts the traditional feminist view that male/female brains have more in common than in difference and as such any differences should be discounted and the sexes considered 'equal' in terms of brain function.

Area 3   In respect of male female differences, as reviewed in the business literature, there is an impact of brain sex differences on business performance.

In the following sections an in-depth summary of the relevant literature in each of the three areas is presented.

2.2 Physiological brain sex differences: the empirical evidence

Brain differences can be characterised in terms of the three metrics, or dimensions, of brain chemistry, brain structure, and neural connectivity (Brizendine and Shoffner, 2008). This facilitates the identification of brain sex differences, their understanding in terms of genetic and developmental influences and their effects on behaviour. In what follows the current understanding of brain chemistry, structure and connectivity is reviewed.

2.2.1 Brain chemistry

The awareness of brain sex differences dates from the mid-1800s with the removal of the testes of some roosters by Arnold Berthold. The birds became less aggressive and their sexual interest in hens diminished. Berthold noted: 'The testis acts on the blood, and the blood acts on the whole organism' (Berthold, 1829) It was not, however, until over one

hundred years later that the study of the impact of hormones on the brain really became established (Tata, 2005).

The hypothesis of hormone influence on the human organism was pioneered by Frank A. Beach in the late 1930s (Beach Jr, 1938). However, the major advance, heralding modern endocrinology, came in 1959 with a report by Phoenix, Goy, Gerall and Young (Phoenix et al., 1959) that set out the organisational and activational impact that hormones have on the organism. This established a new and rapidly expanding research field encompassing all aspects of the study of hormones and their effect on the brain and body (McCarthy et al., 2012). In 2004, a seminal review of this research provided a meta-analysis of the hormonal and neural impact on reproductive physiology and behaviour revealing that the organisation of the brain is significantly different in males and females (Arnold et al., 2004). In particular, these differences were in relation to social recognition, human development at different life stages, aggression responses, anxiety reduction, stress responses, analgesia and the lordosis response (this is the reflex mating action in non-primate mammals) (Pfaff and Joels, 2016).

2.2.2 Hormones and sex differences in brain development

Females have the double XX chromosome and males have the XY chromosome in the last pair of the 46 chromosomes (half supplied by the mother and half by the father). This means that every cell in the bodies of women and men is different (in normal development). In utero, the basic biological template of the embryonic brain is female (Gorski, 1998).

In normal foetal development, if the baby is male with the XY chromosome, at about six to eight weeks the male embryo will start to develop the cells that produce male hormones, otherwise known as androgens (Arnold and Burgoyne, 2004). The main male hormone is testosterone. This instructs the body to stimulate development of, for example, male sex organs. The developing sex organs in turn stimulate the release of large quantities of testosterone into the growing foetus. As a result, the developing brain of the male embryo is radically changed (Arnold and Burgoyne, 2004). The areas of the brain associated with sex and aggression grow more cells, and the cells in the communication centres of the brain are pruned back (Sur and Rubenstein, 2005). If the embryo has the XX chromosome, the female brain continues to develop unchanged by testosterone and keeps it communication centres intact (Hines, 2002). The male sexing of the brain happens during a well-defined 'activational period'. Exposure to male or female hormones outside this activational period produces negligible changes in brain structure (Rossi, 2018). In short, 'hormonal influence at this critical stage is important for gender difference since brain cells acquire a 'set' structure which is highly resistant to change after birth. It is this organisational effect of the hormones on neural circuitry that has led neuroscientists to speak of a 'male' or 'female' brain at birth' (Bixo et al., 1995; Rossi, 2018). Although the structure of the brain is 'set' during this early development, there are two other periods in which brain development is

affected by hormones. The second is at three to four months and the third is at adolescent puberty (Bixo et al., 1995). It is at adolescent puberty that both the male and female hormones are most influential in activating the brain networks that have been laid down in utero (Arnold et al., 2004). However, both these periods of hormonal impact on the brain are fundamentally and essentially promoting the brain's development in preparation for reproduction (Grumbach, 2002; Soldin et al., 2005) – the basis upon which we are here at all.

2.2.3 Impact of hormones on behaviour

In addition to affecting the structure and connectivity of the brain during development, hormones also directly influence brain function and thus behaviour (Hines, 2002).

Testosterone levels and aggressive behaviours

One of the most prominent and studied behavioural differences between men and women is that men are, on average, more aggressive than women (Moyer, 1974, 1987). Human babies that have been exposed in utero to high levels of androgens (of which testosterone is the most significant) show increased aggression postnatally (Reinisch, 1981). A variety of studies show that from an early age, boys are six times more likely than girls to seek play fighting, competition and games that enable social ranking to be established (Archer, 1976; DiPietro, 1981). Research has also suggested that this way of playing gives the developing male brain a dopamine rush- the wish to have more of the same. (Becker and Taylor, 2008). Controlled studies in animals also confirm this behavioural impact of hormones and that it can be transferred in utero. For example, daughters of a female monkey injected with testosterone display much more aggressive male-style play (Reinisch, 1981). Conversely, virgin female monkeys injected with oestrogen and progesterone showed more maternal behaviours and interest in babies (Reinisch, 1977).

Testosterone levels and social skills

Testosterone levels have also been shown to relate to the particular social skills of eye contact and verbal fluency through a command of vocabulary. Research has shown that, on average, toddlers exposed to lower levels of foetal testosterone, tested at both 12 and 24 months, demonstrated higher levels of eye contact and a superior vocabulary than other babies with higher foetal testosterone. Those toddlers with higher prenatal testosterone exposure were significantly less effective at eye contact and lower vocabulary when tested at the same ages (Lutchmaya et al., 2001).

Testosterone and spatial awareness

Hormonal differences between males and females have been shown to have an impact on spatial awareness. A laboratory test known as the Mental Rotation Test has shown that

testosterone is linked with superior ability at rotating 3D shapes in the mind's eye (Janowsky et al., 1994). Males born with a condition known as IHH (small testes) are measurably worse at spatial tasks than typical males. In addition, animal studies show that female rats injected with testosterone at birth show faster maze learning ability than female rats without (Williams et al., 1990).

Girls born with a condition known as congenital adrenal hyperplasia (CAH), in which they generate abnormally high levels of androgens, have above average spatial navigation skills compared with the average levels for the majority of girls (Baron-Cohen, 2004). Using eye-scanning technology, into how men and women read maps, together with an analysis of the way directions are given, demonstrates that females tend to navigate using landmarks and visual cues rather than spatial awareness and cardinal and distance information, which are more often used by men (Rahman et al., 2005).

Emotional sensitivity

At 24 months-old, during a period called infantile puberty, the levels of oestrogen in an infant girl's body and brain increase significantly. This is enhanced at puberty and continues into adulthood. The female brain contains oestrogen in far higher quantities than the male brain (Grumbach, 2002), and directly linked to females feeling more 'emotional', (Grumbach, 2002; Baron-Cohen, 2004) it is also linked to the observation that in young girls, behaviour is more focused on preserving harmonious relationships and forming social bonds (Sánchez-Martın et al., 2000). Furthermore, this literature demonstrates that connecting through talking stimulates the pleasure centres in a girl's brain through the release of dopamine (Dluzen, 2005). Dopamine is the reward neurotransmitter. In addition to promoting the release of dopamine, oestrogen also activates the production of oxytocin- the attachment hormone (Glazer, 1992). On average oxytocin levels are significantly higher in female brains (Marazziti et al., 2019).

Hormonal changes during the female monthly cycle have also been shown to have significant behavioural effects. During the female mid-cycle, dopamine and oxytocin levels increase. This in turn increases verbal fluency and desire for relationship connection through conversation. It is often stated in the literature that the typical female brain gets more pleasure from bonding through relationship, conversation and connection than the typical male brain (Dunbar, 1996).

2.2.4 Summary of brain chemistry differences

The impact of sex hormones on behavioural variations is well established. In addition, the neurobiological facts are that at a cellular level the brain is sexed. The evidence for the impact of sex hormones on the development of structure and connectivity within the brain is also compelling. In Section 2.3 the structure of the brain is reviewed.

2.3 Brain structure

Prior to examining the findings about the second physiological difference in the brain identified for this investigation, that of brain structure, it is helpful to briefly situate the knowledge into the context of brain scanning developments.

2.3.1 Imaging technologies

In addition to the primary literature dedicated to the theme of brain sex differences, a contextual literature was also consulted which it is essential to include in order to interpret the primary sources. For example, an understanding of the development, capabilities and limitations of brain scanning technologies is necessary in order to interpret the literature on applied neuroscience in leadership and to situate it within its historical technical context. A broader review of the contextual literature is therefore also provided, where it is essential to the understanding of the primary literature on applied neuroscience within business.

Figure 2.1 gives a brief overview of the chronology of human brain imaging. The direct imaging of the brain began in 1981 at the University of Aberdeen with contrast enhanced images of brain function using MRI (magnetic resonance imaging) (Raichle, 2009). A detailed review of the underlying science and technology is beyond the scope of the current work. However, it is helpful to briefly situate the research evidence within the technological developments. This section gives a very short summary of the main scanning techniques.
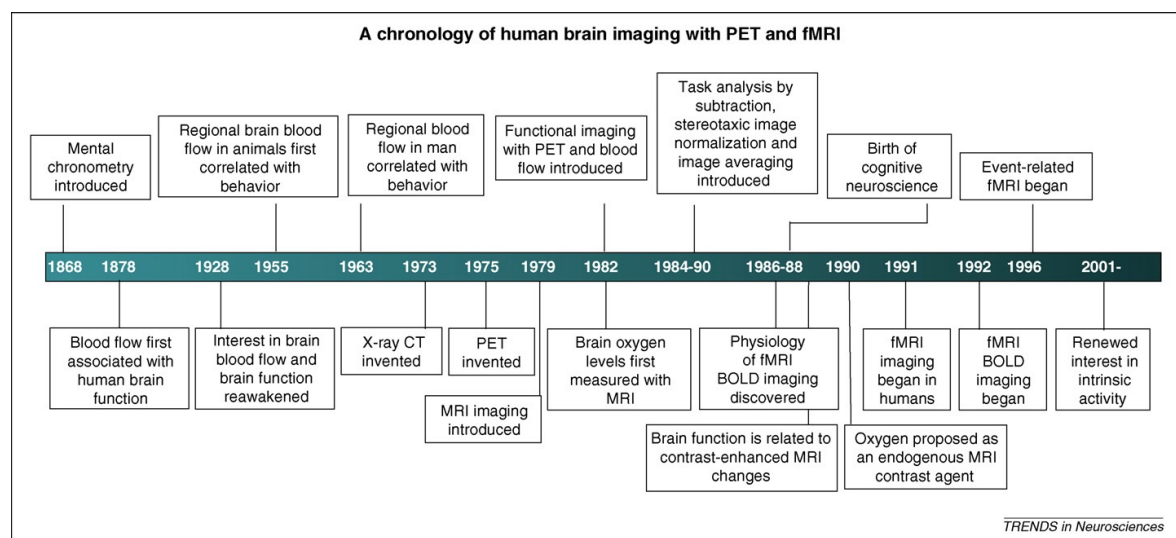
Figure 2.1: A chronology of major events associated with the development of human brain imaging with PET and fMRI. (Trends in Neurosciences Vol 32 No 2)

Positron emission tomography (PET) scans can be used to image in three dimensions (3D) the distribution of a small amount of radioactively labelled glucose introduced as a tracer. Functional magnetic resonance imaging (fMRI) uses the chemical contrast of nuclear magnetic resonance in an external magnetic field to provide time resolved 3D imaging on a sub mm length scale of, for instance, minute changes in blood flow in an active part of the brain. The development of these two technologies alone, (though within the limits of

imaging technology available at the time) revolutionised our capacity to begin to see inside the brain and measure real time brain activity whilst it was working under any normal or experimental conditions.

fMRI enables live images to be measured that are related directly to brain activity. The technology continues to develop rapidly in terms of scan rates, resolution and the power of the image reconstruction algorithms (Pinho et al., 2020). These advances in fMRI brain scanning, in particular, are enabling researchers to understand sex differences in brain structure and neural connectivity supporting and expanding upon the evidence of biological brain sex differences gained from those possible via the study of endocrinology (Phoenix et al., 1959).

2.3.2 Brain structure and processing

Sex differences in brain structure result from the interaction between those determined by our genetics (nature) and those that result from life experiences (nurture) (McCarthy and Arnold, 2011). Determining the impact of life experience on the underlying genetic expression is at the forefront of much of the ongoing research (Ngun et al., 2011). The current evidence suggests that nature is always dominant in determining brain structure with nurture playing a powerful role in creating the patterns of the brain (De Loof, 2019; Ristori et al., 2020).

The research in this field is often motivated by the need to understand brain illness in order to develop therapies and treatments. This has led to it being well established that there are clear sex differences in many diseases and dysfunctions of the brain (Baron-Cohen, 2004). For example, occurrence statistics show that Alzheimer's, autism, schizophrenia and dyslexia are up to four times more likely in men and that depression, anxiety disorders and anorexia are three times more likely in women (McCarthy and Arnold, 2011). There is a large body of research aimed at determining to what extent brain structural differences have a part to play in the differential occurrence of these diseases and disorders (Chiarello et al., 2009; Cheng et al., 2010). The following section outlines what has so far been established about the main areas of structural difference between male and female brains and their behavioural implications.

Structures involved in processing language and emotion

In the first meta-analysis of global brain volume and density, Ruigrok et al found statistically significant structural sex differences in the brain regions of the amygdala, hippocampus, insula and cingulate gyri (Ruigrok et al., 2014). These brain areas are involved in the processing of language (Sommer et al., 2008; Chiarello et al., 2009) and emotion (Stevens and Hamann, 2012). The brain is symmetric left-right; structures are replicated in both hemispheres. However, observed differences show that there are distinct differences between

certain neurophysiological structures in each hemisphere – where neural functions are specialised to one or other side of the brain. Structural differences between both distribution and size of regions in the left and right hemispheres of men's and women's brains have been found (Goldstein et al., 2001). On average, males have higher neuronal density and volume in the amygdala, hippocampus (Ystad et al., 2009), insular cortex and posterior cingulate gyri (Ruigrok et al., 2014). In contrast, females tend to show higher densities of neurons in the left frontal pole and higher volumes in the right frontal pole, (Sowell et al., 2007) middle and inferior frontal gyri, pars triangularis, anterior cingulate gyrus, and insular cortex (Ruigrok et al., 2014). A review of the interpretations of this neurophysiological data and its impact on behaviour is undertaken in the following sections. However, it is useful to highlight here the overarching behavioural analysis from the literature of the findings concerning the structural differences. One such example is in relation to the processing and articulation of emotions. While, in general, linking sex-related brain structural differences directly to behavioural differences is a complex and a disputed area of debate in the literature (Kimura, 2000), one unambiguous result , is that men and women process emotional information differently between the hemispheres (Witelson et al., 1995; Kimura, 2000).

One fMRI-based study, investigating where emotion is processed in children's brains revealed that in young children negatively experienced emotions are processed in the phylogenetically (ancient inherited) primitive area of the brain, notably the amygdala (Sax, 2017) This research identified that young children cannot easily explain difficult emotions. This is due to the fact that the pre-frontal cortex, where complex spoken language is produced, has few direct connections to the amygdala in the limbic system. During adolescence, the brain's processing of what the child experiences as difficult emotions move up to the cortex for girls (Sax, 2017).This is directly linked to the observation that teenage girls demonstrate a far greater capacity to explain difficult emotions. The same is, on average, not true of the teenage boy. The emotional processing of more challenging painful emotion remains in the amygdala (Sax, 2017) These differences remain into adulthood (Brizendine and Shoffner, 2008).

Structural differences related to vision

Detailed analysis of human tissue samples from the retina reveal sex-related differences in the rods and cones in the eye (Wickham et al., 2000). There are two types of cells that translate visual signals in the eye. These are P cells that detect texture and colour and M cells that detect movement and direction (Murray et al., 2012). The female retina is relatively rich in P cells and the male retina in M cells. The male brain sees colours differently to the female brain due to differences in receptor cells (Koscik et al., 2009; McGivern et al., 2019). Numerous behavioural studies have found that on average boys perform better in tasks involving object location (Abramov et al., 2012) and girls in those involving object colour discrimination (Abramov et al., 2012).

Structural differences related to spatial awareness

Early experiments (pre fMRI) measuring electrical activity in the brain of boys and girls as they perform tasks of rotating shapes in their mind's eye show that boys performed on average significantly better than girls (Kimura, 2000). It was not possible at the time to interpret this observation in terms of structural differences in the brain. Subsequently a large body of data has been gathered demonstrating that men consistently perform better than women on spatial tests. With the advent of imaging technologies, it has been possible to show that the larger surface area and thinner cortex of the parietal lobe found in men is correlated to the capacity to imagine the rotation of 3D shapes (Gorski, 1998; Koscik et al., 2009).

The 'mosaic' of brain structure differences

Despite the very clear correlations between structure and behaviours discussed above, the lack of a working model for understanding the link between brain structure and function hampers the development of a genuinely predictive model that reveals the specific role of sex based structural differences. Both the structural differences and behavioural characteristics exist on a continuum between the 'extreme male' and 'extreme female' and so differences are always between average behaviours of broad distributions (Moir and Jessel, 1991). This, perhaps coupled with the significant political sensitivity of documenting difference, has led to the concept of the 'mosaic' brain. To quote the work of Joel et al., 'each brain is a unique mosaic of features, some of which may be more common in females compared with males, others may be more common in males compared with females, and still others may be common in both females and males.' (Joel et al., 2015)

2.3.3 Summary of structures in the brain related to dimorphic sex difference

There is substantial evidence for there being significant differences in the brain structure of males and females, and where detailed investigations have been performed, these differences correlate strongly with differences in performance or behaviour in suitably constructed tests. Further research is required to establish the mechanisms underpinning these correlations.

2.4 Neural connectivity

The third dimension of brain sex difference is neural connectivity. It is relatively recently that it has been possible to document in detail the role of connectivity in the brain through the use of modern imaging and data analysis.

2.4.1 Differences in brain connectivity and organisation

Prior to the 1990s, the role of brain connectivity in behaviour was inferred through studies of brain-damaged patients. This early research demonstrated that, on average, the male brain is more 'specialised' in the sense that specific activities are performed in particular parts of the brain (Inglis and Lawson, 1981). Women's brains were described in these pre fMRI days as more 'diffuse' (Gordon and Galatzer, 1980; Hines, 1982). Table 2.1 summarises the conclusions of this early research and highlights the functions and locations in the brain that showed differences in specialisation and performance between women and men. Many of the findings are consistent with the conclusions drawn from evolutionary biology, this is discussed later in Section 2.5.1.

These observed sex differences occur in:

- Language

- Spatial awareness

- Processing emotion

Table 2.1: Brain organisation differences (Moir and Jessel, 1991)

Function		Brain location	Summary
Mechanics of language, e.g. speech, grammar	Men	Left hemisphere, front and back	More diffuse
	Women	Left hemisphere, front	More specific
Vocabulary defining words	Men	Left hemisphere, front and back	More specific
	Women	Left and right hemispheres, front and back	More diffuse
Visuo-spatial perception	Men	Right hemisphere	More specific
	Women	Left and right hemispheres	More diffuse
Emotion	Men	Right hemisphere	More specific
	Women	Left and right hemispheres	More diffuse

In 2014, there was a ground-breaking neuroimaging study, (Ingalhalikar et al., 2014) using Diffusion Tensor Imaging (DTI). Findings from the study are shown in Figure 2.2. The study looked at the human brain connectome. The human connectome can be defined as the mapping of the 'matrix of the human brain' (Sporns et al., 2005). Given the importance of this particular study, it will be considered in some detail here.

Inter- and intra-hemisphere

DTI works by tracking the diffusion of water molecules across the brain network and thus provides insights into the organisation and integration of whole-brain networks. It does this by applying magnetic field gradients which are able to generate an image that is sensitive to water diffusion in a particular direction. A three-dimensional diffusion model is subsequently estimated by repeating this process in multiple different directions. This 2014 study revealed significant sex differences. The dominant finding was that male brains showed stronger intra-hemispheric connectivity with the connections running front to back inside each hemisphere independently. A very different neural connectivity patterning was shown in the female connectome. Females showed much stronger inter-hemispheric connectivity with the dominant patterns running between hemispheres. Figure 2.2 (reproduced with permission) shows the key findings:
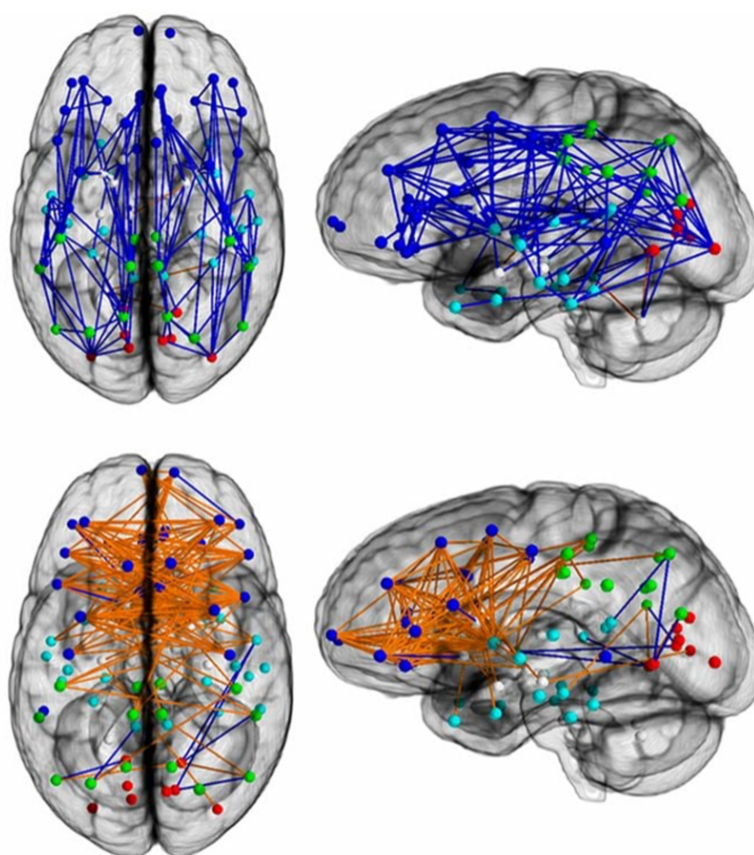
Figure 2.2: Intra and Inter connectivity brain sex differences. The intra-connectivity patterns in the male (blue) and inter-connectivity patterns in the female (orange) brains (Source Ingalhalikar et al., PNAS 2014 January, 111 (2), 823–828. https://doi.org/10.1073/pnas.1316909110)

The study also revealed a distinct progression in the development of these brain sex differences over time. The connectomes in the youngest age group studied (8 to 13 years) displaying a relatively small difference which diverges to become pronounced in the adolescent group, and even more distinct in adults (Ingalhalikar et al., 2014). The suggested interpretation of this remarkable difference was that it influences the way in which male and female brains pay attention. This will be discussed in detail below.

Sex differences in the functional connectivity during foetal brain development

A recent ground-breaking study at Washington University, using fMRI scans and subsequent statistical analysis of the image data, has accessed the development of functional brain connectivity in utero (Wheelock et al., 2019). It was observed that there are distinct sex differences in the connectivity for brain function during foetal development. These sexually dimorphic differences were observed both within and between brain networks (Wheelock et al., 2019). This study was the first to demonstrate that genetics (nature rather than nurture) plays an important role in laying down a neural connectivity blueprint that is different between the sexes. It suggests strongly that life experience (nurture) builds upon this blueprint that is already differently functionally connected.

So, sex differences in functional connectivity during foetal brain development as outlined above represent the early stages of a significant shift in our understanding of the brain. Neuroscience is moving rapidly from an era in which mechanisms are inferred from dysfunction due to damage and macroscopic measurements of electrical activity, to one in which they can be inferred from time-resolved imaging of functions operating at the sub-mm length scale real time in a healthy human brain.

Having looked at the neurophysiological evidence to date from the empirical research I now move on to exploring the perspectives on this, starting with the bio-evolutionary perspective in Section 2.5.

2.5 Three main perspectives on the physiological evidence

2.5.1 Perspective one: The evolutionary biological perspective of brain sex difference

The evolutionary biology view that brain sex differences are best interpreted by the advantage they yield in natural selection.

Evolutionary biology seeks to understand and explain how brain sex differences might have been selected in our genetic evolution. The evolutionary history of all species, not just humans, favours the selection and adaptation of traits that have helped to support access to, and sufficient control of, the resources that enable reproduction and survival (Geary, 2005). Darwin's finches are a classic example in which beak size and shape had evolved to take best advantage of different types of food (Grant and Grant, 2002). A widely adopted framework that facilitates understanding how brain sex differences have developed has been introduced by Geary (Geary, 2005).

Figure 2.3 illustrates the framework from Geary (2005). It proposes that human behaviour is driven by the motivation to control the social, biological, and physical resources that have tended to covary with survival and reproductive outcomes during human evolution.

This is called the 'Control Motivation' framework and defines the resources required for reproduction and survival. These are: social (humans survive in groups/tribes), biological (selection of suitable mates), and physical (food/land vital for physical survival) (Geary, 2005). This is the bottom layer of the pyramid in the framework in Figure 2.3 and these 3 elements underpin the layer above which describes the supporting mechanisms to sustain evolutionary success. These 3 are explained below.
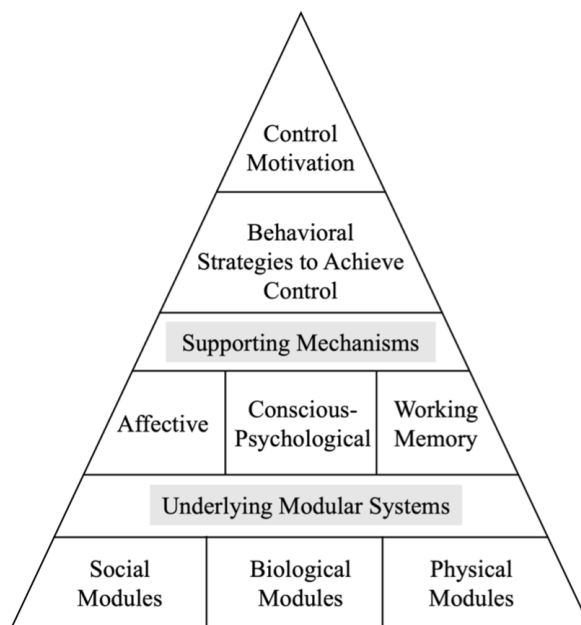
Figure 2.3: Evolutionary biology Control Motivation Framework. From The Origin of Mind: Evolution of Brain, Cognition, and General Intelligence (p. 74), by D. G. Geary, 2005, Washington, DC: American Psychological Association. Copyright 2005 by the American Psychological Association. (Geary, 2005).

Once the basic survival requirements have been met then the three 'mechanisms' that drive evolutionary success are introduced: the capacity for 'self-awareness' (conscious-psychologically-supporting awareness of oneself in the group); 'emotional responses' (affective, to support relationship); 'working memory' (to facilitate relationship/group membership) (Geary, 2005). The argument here is that these 'mechanisms' (as Geary calls them) enable the self and social awareness to allow humans to belong effectively to the groups that facilitate reproductive opportunity and survival (Gaulin, 1995). Below, I explore each of these elements of the 'Control Motivation' framework and link them to the physiological empirical evidence in the brain that has been set out in Section 2.2 on neurophysiological brain differences.

Self and social awareness for group belonging and interrelationship

The evolutionary biological literature holds that humans had to belong successfully to groups for their survival and reproductive success and that self and social awareness was critical to achieve this. One consequence is the development of the capacity to imagine events in the future in a way that differs from other animals (Suddendorf and Busby, 2003). In the Geary framework, this capacity to imagine future events is denoted 'conscious psychological'

(Geary, 2005). This type of awareness exists in relation to the Self, other individuals and the social fluidity of group dynamics. This allows humans to imagine and predict future scenarios and their own potential place in them, which involves a type of mental time travel that can appear in language, visual images (Suddendorf and Busby, 2003; Corballis and Suddendorf, 1997), or memories (Tulving, 2002). Working memory is thus considered important for group membership and effective emotional (affective) connection as set out by Geary (Geary, 2005).

Evolutionary biology also suggests that sex-differentiated reproductive needs impact the way in which men and women interact with their social groups. Evolutionary theory says that these different relational needs have in turn resulted in sex differences in adaptive traits appearing in our modern brains (Gaulin, 1995). It is proposed that women's reproductive needs have focused more on cultivating equality and safety in relationships (Bowlby, 1969), while men have had greater reproductive success through social competition and dominance. In consequence the female relies more on relationship for her safety and reproductive success and the male relies more on competing with other potential mates to reproduce successfully. In the section below, I have explored the physiological evidence from the literature that women's brains evolved with a bias for relationship and men's brain with a bias to compete.

Relationship v.competition sex differences theory – the physiological evidence

The following brain sex differences support the bio evolutionary theory that the female brain has evolved to support relationship and that the male brain has evolved more for competition:

Processing sound in the brain

In tests of how sensitive a person is to sound, women demonstrate a superior capacity for hearing and, in particular, distinguishing different tones (Sagi et al., 2007). It has been suggested that this capacity for nuance in hearing conferred an advantage both in terms of being able to connect with preverbal babies and to detect the mood of the alpha males who could protect or kill the female's offspring (Brizendine and Shoffner, 2008). This may also be connected to the fact that females have, on average, a higher density of neurons in areas of the brain that process sounds in language (Witelson et al., 1995): (Sagi et al., 2007) Baby girls and female toddlers have been shown to respond to tiny changes in vocal tone (Plante et al., 2006). Girls can hear a wider range of sound frequencies in the human voice than boys (Plante et al., 2006). Research found differences in the way the male and female brain process voice: women process voices with both hemispheres while men process voices in the auditory section of the right hemisphere, especially used for melody (Hunter et al., 2018). This suggests that both brain structure and connectivity have evolved to females an advantage in responding rapidly to the mood of their caregivers and mates (Gaulin, 1995).

Managing emotional responses

As evidenced in the Sections 2.2 and 2.3 on structural differences in the brain, there is evidence of sex differences in the areas of the brain involved with processing emotional responses. These differences are particularly notable in relation to the amygdala. Research into the aggression response, and managing it suggests that the female brain has evolved with a greater capacity to manage direct aggression. The female brain's capacity to inhibit amygdala activation response is superior to men's (Campbell, 2005).

The amygdala sits deep in the centre of the limbic (mammalian) brain and acts as the continuous observer of everything that is happening. Among its many functions and extensive connectivity, it continuously scans the environment for threat receiving information directly from the five senses. It is connected to all the brain systems associated with emotional reactivity (Johansen et al., 2011). Thus, the amygdala enables the brain to respond emotionally to any threats activating the primal survival emotions: fear, anger, disgust, shame and sadness (Lanz and Brown, 2020). Once activated, the amygdala triggers other parts of the brain and body to respond appropriately to the threat. It does this through initiating neurochemical responses that drive escape/avoidance behaviours. The dominant neurotransmitters in such responses are adrenaline and cortisol. In women under stress there is neuroendocrine evidence that the hormone oxytocin can also be released (Taylor et al., 2006). So, these neurotransmitters drive the 'fight, flight, freeze' responses or, in females, the additional response of 'tend and befriend' responses, oxytocin being the bonding hormone. Bio-evolutionary theory suggests that females protected themselves and their offspring by bonding into communities/groups as they did not have the same physical powers as men. The increased amounts of oxytocin triggered by the stress response in females (Taylor et al., 2006) could be physiological evidence to support this theory of 'tend and befriend'.

Memory experiments investigating lesions to the amygdala and experiments that inhibit amygdala activation during memory training demonstrate that the amygdala plays a significant role in taking emotionally-laden information from sensory experience and encoding it for memory (McGaugh et al., 1996). These are structural and functional differences with regard to the amygdala in men and women (Goldstein et al., 2001; Kilpatrick et al., 2006). The amygdala is larger in men and connects differently with the prefrontal cortex (Tranel et al., 2005). Measurements taken at different ages show that this larger amygdala is related to hormonal changes during puberty (Wood et al., 2008). In men, the connections between the amygdala and the mid/lower parts of the prefrontal cortex are stronger with the right hemisphere. Evidence suggests that the right hemisphere plays a larger role in males of modulating the male response in emotional and sexual contexts (Gur et al., 2002). The central and bottom areas of the prefrontal cortex (the rational part of the brain) that are involved in the response to socio-emotional information are larger in women than in men (Goldstein et al., 2001) (Gur et al., 2002). In addition, the ventromedial (middle

and bottom) parts of the prefrontal cortex, along with the anterior cingulate cortex, are more intricately inter-connected in women, coordinating a balance between the emotional and supposedly rational components of social decision making and behavioural responses. (Adolphs, 1999). The evidence adds up to females typically having a superior capacity to inhibit aggressive responses than do male brains. (Campbell, 2005). The bio-evolutionary literature holds that both responses have adaptive function for each sex (Geary, 2005).

Reading emotional cues

On average, women are physically smaller and weaker than men, and so evolutionary biologists have proposed that women have needed to be faster and more effective at processing emotional and social information to ensure their own and their offspring's survival (Silk, 2001). Sustaining effective relationships and knowing when to get out of the way before anything bad happens are behaviours that protect offspring (Wrangham, 1980) . This reading of emotional cues also links to the 'tend and befriend' defence response prompted by secretion of oxytocin under stress as described by Brizendine and Shoffner (2008).

In experiments that measure the capacity to read non-verbal cues of emotion, girls and women outperform boys and men (Buck et al., 1972). The best known of this type of test is the Profile of Nonverbal Sensitivity (or PONS) text where participants judge the emotions displayed by an actor. Other studies have also demonstrated more accurate reading by women of facial expression and other emotional cues based in tonality, body posture and facial expression (Rosenthal et al., 1979). The superior performance by women compared with men in these tests have been found to be consistent across a wide variety of cultures (Hall et al., 2000).

When it comes to reading the non-verbal signals in relation to contempt or disgust, however, neural activation tests show that male brains are faster at reading and responding to dominance signals in facial expression and body language than women (Aleman and Swart, 2008). The male brain reacts less strongly to aggression on the face of a female face than it does to aggression on a male face (Wager et al., 2003).

Conclusions from evolutionary biology

The conclusion from the evolutionary biology literature can be summarised briefly as natural selection has optimised men to seek 'social dominance' and women to seek 'social equality' (Geary, 2005). It is inferred that the measured brain sex differences in relation to language and the reading of emotional signals by women and the more dominant, faster, aggression responses in men are a result of this selection mechanism.

2.5.2 Perspective two: Brain sex differences matter

The second key perspective about the neurophysiological data is the view that there are important neuropsychological differences between a male and female brain that should be paid attention to and utilised because, despite existing on a continuum of maleness to femaleness, their nature and type make a significant difference in society and at work.

This perspective on the evidence of physiological brain sex difference starts from the point of view that whilst there is commonality between male/female brains, the differences are a biological reality and significant in their impact. It is exemplified by the view that acknowledging the differences will mean that both sexes can be 'liberated by honesty rather than imprisoned by self-deception' (Moir and Jessel, 1991). This 'liberation by honesty' is based on actual biological differences and is considered completely distinct from the concept of equality which is a social precept (Restak, 1979). It is proposed that brain sex differences should be measured, allowed for, understood and enabled such that all brains are authentically supported to perform well and are accepted in their own right. This next section explores what the literature has shown to me in relation to the degree of maleness/femaleness of the brain (e.g., brain sex exists on a spectrum of very male to very female); views about female empowerment or vulnerability in relation to brain sex differences; and the impact of brain sex differences on educating the developing young brain.

Brain sex spectrum from very male to very female and its impact at work and in society

An often-cited concept from the literature that seeks to explain the key differences between a very male brain compared with a very female brain is the systematising – empathising spectrum (Baron-Cohen, 2004). This framework holds that 'The female brain is predominantly hard wired for empathy. The male brain is predominantly hard wired for understanding and building systems' (Baron-Cohen, 2004). The elements of this systematising/empathising spectrum are explored below:

Empathising

Two components of empathy put forward are highlighted in Figure 2.4 (Baron-Cohen, 2004).
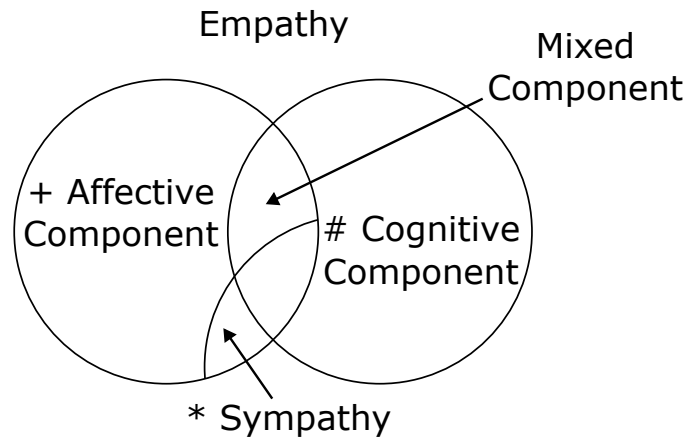
Figure 2.4: Empathy components. What is Empathy? Baron-Cohen (2004) uses the following definitions: [+] feeling an appropriate emotion triggered by seeing/learning of another's emotion; [#] understanding and/or predicting what someone else might think feel or do; [*] feeling an emotion triggered by seeing/learning of someone else's distress which moves you to want to alleviate their suffering.

The cognitive element of empathy is the capacity that Jean Piaget (Piaget and Inhelder, 1956) called 'de-centering', which is otherwise known as 'Theory of Mind' or in modern-day terminology the ability to put yourself in the other person's shoes. The affective part is the ability to subsequently react appropriately to the other person's emotional state. This framework posits that women's brains are typically better adapted by nature for empathy than the average male brain. The supporting evidence for this theory is drawn from the scientific evidence on brain sex physiological differences outlined in Section 2.2 (physiological brain sex differences: the empirical evidence) so will not be repeated here.

Systematising

Systematising is described as 'a system which is governed by rules specifying input/output relationships' (Baron-Cohen, 2004). Systematising is an inductive process, based in empirical evidence and requires an 'exact mind'. Six different kinds of system are highlighted in this framework:

- Technical (computers/vehicles),
- Natural (ecology/biology),
- Abstract (maths/mortgages)
- Social (law/economics)
- Organisable (creating taxonomies)
- Motoric (a golf swing)

The proposition is that despite big differences in the systems mentioned there exist underpinning similarities whereby the 'systematiser' 'explores how a particular input produces a particular output following a particular operation' ,which Baron-Cohen (Baron-Cohen, 2004) suggests a particular way in which the systematising brain pays attention, thinks and relates to any set of circumstances in which it finds itself. In this view there are significant sex differences in the way that a systematising brain functions in comparison with an empathising brain. The proposition from research carried out by Richler and Bisarya (Baron-Cohen et al., 2003) is that there is a 'male superiority in systematising' and 'female superiority in empathising'. However, one of Baron-Cohen's particular area of research interest in his research is understanding the autistic brain.
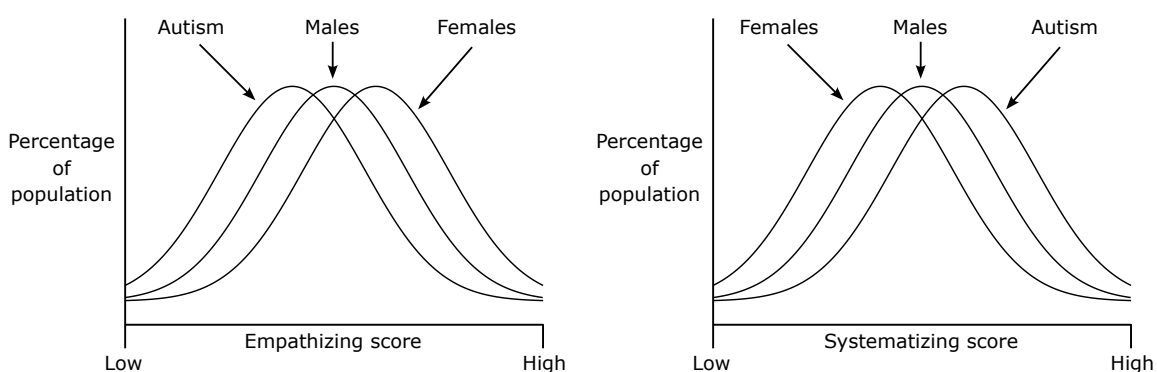
Figure 2.5: Empathising and systematising brain sex scores male, female and autism scores in empathizing and systematizing (Baron-Cohen et al., 2003)

Systematising and empathising questionnaires were developed by Baron-Cohen and his research teams, in part to build understanding of autism and Asperger's Syndrome (Baron-Cohen et al., 2003). The researchers involved in this work point out that there is an over- representation of Asperger's brains and more male brains in occupations that are heavily systematising in their requirements. The examples include engineering, computer programming and careers connected with physics. The researchers equally point out that there is an over representation of brains that are naturally better empathisers in professions such as nursing and certain types of teaching (Baron-Cohen, 2004). Some more recent cross-cultural research supports Baron-Cohen's argument and is reviewed below.

The Patriarchy Paradox

Recent cross-cultural research from 22 countries has demonstrated that even in countries where there is significant gender equality the sexes tend to choose from the currently available work roles those that are in line with what would be considered traditional work roles (Mac Giolla and Kajonius, 2019). Men and women nevertheless 'It seems that as gender equality increases, as countries become more progressive, men and women gravitate towards traditional gender norms.' (Mac Giolla and Kajonius, 2019)

This pattern is viewed as counter-intuitive but has also been found in other areas such as attachment styles, choices of academic speciality, happiness and interest in casual sex (Stewart-Williams et al., 2017). One of the hypotheses is that for people living in more gender equal societies there is greater personal freedom to pursue individual choices and that this ends up magnifying natural differences (Stewart-Williams et al., 2017). This is referred to as the Patriarchy Paradox in which the systematising/empathising spectrum supports the Patriarchy Paradox description.

A significant omission in the literature was any analysis of the way certain work roles are structured and measured. Could it be the case that engineering attracts a brain that is more male on the brain sex spectrum because of the way it is currently taught and structured? Job structure, design and performance measurement emerge from this research project as important issues for future research and investigation. The evidence suggests that certain types of roles are designed to suit certain types of brain better than others, though there is an inevitable circularity of cause and effect in such evidence but they go beyond the range of this thesis. The focus of this theme within the literature is on providing the evidence that, and explanation for, why certain types of brain prefer certain types of work roles over others and are better at them. It does not explore the consequences of this analysis in detail: for instance, how the workplace could be restructured to make better use of all types of brain.

Neural connectivity patterning in the brain evidences that women and men pay attention differently (Ingalhalikar et al., 2014). The differences are that the male brain has greater 'intra- 'or 'within-hemispheric' connectivity while, by contrast, the female brain has enhanced 'inter-hemispheric' connectivity. The impact of this difference in connectivity patterning showed differences in attention and subsequent action taking. The results revealed that male brains facilitate connectivity between perception and coordinated action and female brains facilitate communication between analytical and intuitive processing modes (Ingalhalikar et al., 2014). These different forms of paying attention often result in a more iterative, emergent way of thinking and problem solving for women. The male neural patterning results in a more direct and typically narrower approach to problem solving. Speculatively it may be that men tend to prefer either/or answers to any situation whilst women prefer 'both/and' solutions. The implications of this research are far-reaching and only beginning to be explored in the literature (Lanz and Brown, 2020).

The perspective that brain sex difference generate different workplace experiences and preferences highlighted another theme in this literature to do with female vulnerability versus female empowerment. This is linked in particular with the conundrum of motherhood and the workplace. It is discussed below.

Female vulnerability or informed female empowerment?

The literature demonstrated an interesting split in the consideration of this. It was less about the impact of knowledge of brain sex along a spectrum of very male to very female but it was more about the impact of the biological fact that women are the bearers of the children and this has an impact on their role at work and in society more broadly. On the one hand, the literature introduced the concept of 'female vulnerability', meaning that women are by nature more vulnerable than men and that society should protect women and enable them to 'mother' and take their place in respect of child-rearing before they take their place as professionals in the workplace (Hakim, 2000). On the other hand, a quite distinct stance arose about choice and empowerment. This stance does not disagree about some of the challenges for women being able both to mother and work successfully. It does, however, suggest that by women understanding their own neurobiology and brain changes over the life cycle they can choose how best to blend mothering with the workplace (Brizendine and Shoffner, 2008). The literature explores the links between the neurophysiology of the brain and the impact for women at work and in wider society. These links are discussed here:

Female vulnerability; the theory and the empirical evidence

The argument about female vulnerability is based on the view that female attachment to their offspring, friends and family make women more dependent on others (especially as mothers) and as such more naturally vulnerable to loss (Frank, 2008). Pregnancy, birth and nursing are draining activities that mean women are left in a more vulnerable position, needing to nurture themselves in order to successfully raise children (Rhoads, 2005).

Live scans from PET (Positron Emission Tomography) that asked women and men to recall memories of serious loss showed the limbic (emotional) brain light up for both sexes. The area that lit up in the female limbic systems was eight times bigger for the women than the men (Frank, 2008).

'Women are genetically pre-programmed to be more affiliative. Interpersonal attachment is a bigger deal for women than men and that's true in all cultures and times. It has an adaptive significance for the survival of the species. If women did not attach, babies would not survive... if we have one half of the human race more pre-programmed for attachment, then that's the half that's going to be more vulnerable.' (Frank, 2008)

This vulnerability argument contradicts the feminist view, that believes that brain gender is socially constructed (Rippon, 2019). This view of women as having an 'outsized love of their children' argues that the feminists are denying the 'idea of deep-seated female vulnerability' (Rhoads, 2005).

Female empowerment through informed choice

The alternative view demonstrated in this review, of the scientific facts about brain differences has shown me that these facts can act as a powerful stimulus for renegotiating the woman's social contract in modern society (Moir and Jessel, 1991). The argument goes that women now have greater control over their fertility and greater access to economic freedom in a networked economy, giving women the opportunity to create a new paradigm for how and when they manage motherhood in combination with their professional identities and wider personal lives.

'Understanding our innate biology empowers us to better plan our future' (Brizendine and Shoffner, 2008).

This viewpoint is reflected through a summary that looks at the 'Phases of a Female Life' from a brain-based point of view and is summarised in Table 2.2 (Brizendine and Shoffner, 2008). This supports the modern view that the knowledge of how brains develop over the female lifetime will support women to make successful choices in their lives personally, as mothers, and professionally.

Table 2.2: Phases of a female's life (Brizendine and Shoffner, 2008)

	Major hormone changes	What females have that males don't	Female specific brain changes	Reality change
Fetal	Brain growth and development left unperturbed by the high testosterone of a male brain	Brain cells are XX, which means more genes for fast brain development and female-specific circuits	Female brain circuits for communication, gut feelings, emotional memory, and anger suppression grow unabated - there is no high testosterone of the male around to kill all those cells	More brain circuits for communication, reading emotions, social nuance, nurturing skills, able to use both sides of the brain
Girlhood	Estrogen is secreted in massive amounts from age 6 to 24 months, then the juvenile pause turns off hormones	High estrogen for up to 2 years after birth	Verbal and emotional circuits are enhanced	Major interest in playing and having fun in connection with other girls, not boys
Puberty	Estrogen, progesterone, and testosterone increase and begin to cycle monthly	More estrogen and less testosterone, girls' brains develop 2 years earlier than boys'	Increased sensitivity and growth of stress, verbal, emotion and sex circuits	Major interest in sexual attractiveness, desperate love interests, avoidance of parents
Sexual maturity, single woman	Estrogen, progesterone, and testosterone change every day of the month	More focus on relationships, finding a lifelong mate, and choosing a career or job compatible with raising a family	Earlier maturation of decision-making and emotional control circuits	Major interests in finding a mate, love, career development
Pregnancy	Huge increase in progesterone, estrogen	Focus more on nesting, how the family will be provided for, less on career competition	Stress circuits suppressed, brain calmed by progesterone, brain shrinks, hormones from the fetus and placenta take over brain and body	Major interest in own physical well-being, coping with fatigue, nausea, and hunger, and not damaging the fetus; surviving in the workplace, and planning maternity leave
Breast feeding	Oxytocin, prolactin	Focus more exclusively on the baby	Stress circuits still suppressed, sex and emotion circuits hijacked by infant care	Major focus on coping with fatigue, sore nipples, breast milk production, making it through the next 24 hours
Child rearing	Oxytocin, cycling estrogen, progesterone, and testosterone	Less interest in sex, more worry about kids	Increased function of stress, worry, and emotional bonding circuits	Major interest in well-being, development, education, and safety of kids, coping with increased stress and work
Pre-menopause	Erratically cycling estrogen, progesterone, and testosterone	Fluctuating interest in sex, erratic sleep, more fatigue, worry, moods, hot flashes and irritability	Decreasing sensitivity to estrogen in certain brain circuits	Major interest in surviving day to day and coping with the physical and emotional ups and downs
Menopause	Low estrogen and no progesterone, high FSH/LH	The last precipitous brain change caused by hormones	Circuits fueled by estrogen, oxytocin, and progesterone decline	Major interest in staying healthy, improving well-being and embracing new challenges
Post-menopause	Low, steady estrogen and testosterone, lower oxytocin	More calmness	Circuits less reactive to stress, less emotional	Major interest in doing what you want to do, less interest in taking care of others

A conundrum nevertheless

The female vulnerability argument puts women in a more passive place and argues that society should protect and support women in their vulnerability, while the informed choice argument puts women themselves more in charge of their choices. Regardless of either stand-point, one of the problems confronting women in organisations is that the structure and promotional laddering at work remains largely better suited to those who do not have to take a break to give birth, bearing the largest part of the burden of childcare (Slaughter, 2015; Lanz and Brown, 2020). A detailed and thorough exploration of the structure of work from a brain-based point of view is not evident in the literature yet (Lanz and Brown, 2020).

Nevertheless, the conundrum remains in modern work structures. Slaughter (2015) discusses the challenges working mothers face in balancing career fulfilment with motherhood, in 2023 this remains a challenge for professional women. On the other hand also in 2023, there are some recent examples of women who are taking their power as women, not as 'the best men they can be', the literature emerging on female leadership during the COVID 19 pandemic is beginning to investigate this (Lanz and Brown, 2020). Jacinda Ardern, voted back in as Prime Minister of New Zealand in 2020, is a case in point of a more authentic show of female power. Her capacity to bind her society during the pandemic won her a landslide victory. She was a good example of a working mother in a 'top job'. Her subsequent resignation as Prime Minister was said to be in part to do with wanting to step back and have more balanced time with her young family. It is noteworthy, however, that Ardern's was a position of power as judged by current society. Should more recognition and value be given to other more crucial roles such as child-rearing, teaching or nursing? Is it possible that all the key worker roles that were so valued in the pandemic will have their value overlooked once again as soon as 'normality' is restored? A related but separate strand emerged in relation to the education of children. This is noted next as part of the proposition that brain sex differences are important as they impact many important areas of life, such as education. Sex differences in way the brain pays attention and learns is discussed below.

Differences in attention and learning styles

The literature looks at the impact of brain sex differences in attention and learning styles, and how these differences might impact teaching methods, especially at all schooling levels. The following quote sums up one of the core arguments succinctly.

'There are no differences in what girls and boys can learn. But there are big differences in the best ways to teach them' (Sax, 2017).

This is based on the concept that the brain makes sense of the world through the five senses and that there are sufficient differences between the way male and female brains process sensory information such that learning differences between the sexes are a biological fact (Gur et al., 2002). Many of the neurophysiological brain differences discussed earlier are cited in this aspect of the literature to support the view that single sex-education works better for both male and female brains. There remains a strong counter-argument being strongly debated in the current literature, coming from the feminist view that it is' social constructionism' is what underpins differences between boys and girls. This view disagrees with the single sex education idea, arguing that differences in teaching methods are not important (Eliot, 2013). The definition of social constructionism is that the aspect of life in question is not real but rather only exists through the social agreements we have co-engineered in society.

There is evidence from the literature on understanding brain sex difference in education is that behavioural improvements and learning outcomes can be positively impacted by using brain-based knowledge effectively (Gur et al., 2002). It revealed some prominent advocates of single-sex learning within a community of writers. Nevertheless, the proponents of single-sex education attract strong criticism. The criticism is that a small number of studies about differing pedagogical needs are misconstrued and overstated (Eliot, 2013). However, I do not propose to explore or expand on this aspect of the literature here since the literature is focused on school learning which is not a main focus of this research.

Finally, within the interpretations of the neurophysiological evidence of brain sex differences, the literature has a strong feminist thread. The feminist perspective was the third major interpretation in the literature. It is explored in depth in Section 2.5.3.

2.5.3 Perspective three: The feminist perspective

This section considers the feminist perspective that male/female brains have more in common than in difference and that such differences should be discounted and therefore that the sexes should be considered 'equal' in terms of brain function.

The feminist scientific community have critically examined the output from neuroscience investigating its impact on gender roles and relations. This scholarly investigation of bias in neuroscientific research has been going on for some thirty years (Schmitz and Höppner, 2014). The reviewers of the science from the feminist community coined the phrase 'neuro-sexism' (Fine, 2010). Neuro-sexism is the notion that neuroscientific research is actively being used to promote a sexist agenda.

Distinct from neuro-sexism, the 'neuro-feminism' approach looks at the actual practices of knowledge production within neuroscience (Bluhm, 2013). Neuro-feminism, it is claimed, highlights the complex relationship between biological matter, in this case the brain, and

its social influences. (Bowlby, 1969; Anna, 2023)

There is third branch of the feminist study of neuroscience and this is 'feminist neuroscience'. This branch engages itself with looking for more gender appropriate research methodologies and participation in the investigation of sex differences (Joel et al., 2015).

How the feminist interpreters of neuroscience have responded

In 2010, a network called the NeuroGender Network was set up to bring together these three different groups in relation to the feminist stance and interpretation of the neuroscience (Dussauge and Kaiser, 2012). The platform was interdisciplinary, and its aim was to share knowledge from the humanities, cultural studies, homosexual studies, feminist science studies and science and technology. The purpose was to evaluate the current research methods and findings and develop ideas about how to develop more reflective debate in the field.

These combined groupings within the feminist interpretation express three major criticisms about the data on brain sex differences:

a) **Stereotypical interpretations assume a binary view of brain sex:** The concerns of this group were that deterministic ideas about a 'sexed brain' were being brought into the wider public discourse but that the evidence brought forward did not consider the biases that had been built into the design of the empirical work (Schmitz and Höppner, 2014). The argument presented has been that the act of studying brain sex differences assumes that men's and women's brains are uniform within each sex. This is clearly not the case in the majority of research papers which measure and document variations within and between the sexes (Moir and Jessel, 1991).

b) **Research design bias:** One of the major criticisms from the NeuroGender Network is that the basic research design of many experiments has a built-in male bias as a starting point (Gumy, 2014). These show up in the forms of biased data selection, statistical analysis and tomographic calculations (Schmitz and Höppner, 2014) It is also claimed that studies that do not find differences do not get published (Fine, 2010) and so are not being represented in either the scientific or public debate.

In addition, feminist scientists and reviewers' express concerns that some of the evidence of brain sex difference has become 'over identified' with one sex. For example, oxytocin – a hormone found in higher levels in women than men – was seen as being treated as the biological basis for pair bonding and trust (Matusall, 2014). There is evidence that articles in the press picked up selective facts such as this and only presented one side of the argument without relaying any inconsistencies in the research (Fillod, 2014). Another key argument is that any representation of brain imaging is, by definition, a metaphor of what is going on in the brain rather than a direct portrayal of the interior of a brain. As such, any metaphor is subject to social con-

structionism and must to some extent represent the conscious and non-conscious bias of the researchers (Beaulieu, 2001).

Another finding from the feminist analysis of brain imaging has been that, due to the selection of certain calculation processes, gender differences – or lack of them – can appear in the same experimental group (Kaiser et al., 2007; Maibom and Bluhm, 2014). The call from the feminist analysts is for total transparency about the methods used for calculation, and for rigour in using the information in the full and correct context, as often, partial information gets taken up by the popular press and quoted out of context with over-simplification. These become absorbed, they argue, into the wider social discourse and confirm rigid sex differences (Vidal, 2012; Fillod, 2014). The popular press can legitimately be accused of presenting more sensationalist viewpoints without any commentary on the nuance, or missing detail from a particular piece of research.

c) **Neuroplasticity and the feminist view:** The final area where neuro-feminism takes issue is with much of the research into brain sex difference in relation to brain plasticity. Neural networks learn – they demonstrate 'plasticity' whereby repeated patterns become embedded structurally and functionally into the functioning networks of the brain. Studies into brain plasticity have looked at what changes in the brain when for instance learning languages (Bloch et al., 2009), studying navigation (Maguire, 2001) and acquiring new physical skills, such as juggling (Draganski et al., 2004). Concepts from the study of neuroplasticity have led to a redefinition of the cause-and-effect relationship with regard to how the brain 'wires up'. The proposition is that neural connectivity must be seen and understood as the 'continuous entanglements' between the internal and external world (Schmitz, 2010; Jordan-Young and Rumiati, 2012). Neural plasticity means that the whole structure of the environment surrounding the child growing up is the main source of influence in the way in which the brain develops its own connectivity; and so social gender stereotypes have a more dominant impact on brain function than innate biological gender; so that all brain function from day one as a baby arriving in the world would not be possible in any way at all without the inherited biology of DNA (nature) (Rippon, 2019). Cutting edge research into foetal brain development counters this view. It is actually the case that sexual dimorphism begins during gestation (Wheelock et al., 2019). The extent to which plasticity at any stage of life is induced by life experience remains an open topic of active research, but sex differences in functional connectivity between brain networks begin in utero (Wheelock et al., 2019) .

Summary of the feminist perspective

One of the striking aspects of the feminist interpretation of the literature is that much of what is written is focused on trying to prove that there are or are not significant brain sex differences. The debate between those who believe that brain sex differences should be understood, accepted and accommodated versus the feminist view that men and women's brains have so much in common that there is no difference and that the sexes are 'equal' continues to dominate the literature. There is comparatively little on what understanding differences might mean in practice and how this knowledge could be used in terms of frameworks and models of deployment. Given the gains in awareness and rights in law that the feminist movement has had great success in creating, this omission in the literature represents a very interesting gap. This gap in the deeper exploration and application of the brain sex differences is also becoming visible in the business literature as reviewed in Section 2.6.

2.6 Business and management perspective

Here I examine the third and final main area identified which is the business literature in respect of gender differences and awareness of their potential impact on business performance.

Legislation that heralded the first modern equal employment opportunities in law was introduced in the US Congress in 1943. Subsequently in 1948, President Truman signed an order to desegregate the armed forces. This is seen by some scholars as the first diversity initiative in the workplace (McCormick, 2007). The sixties saw social and political change increasing the legislation that prohibited discrimination on the basis of ethnicity, religion or sex. Diversity and Inclusion (D&I) in organisations became a widespread phenomenon during this period of the 1960s (McCormick, 2007).

One of the early movers in respect of women in the workplace at this time was an organisation called Catalyst. Catalyst was founded in 1962 by the feminist writer and advocate Felice Schwartz. The stated mission of the organisation was to 'accelerate the progress of women through workplace inclusion' (Schwartz, 1989). For the last sixty years, Catalyst has been a key player in research into women in the workplace and a provider of evidence of the business impact that women make to the net earnings of a business.

2.6.1 The business case for diversity

The literature demonstrates that companies that achieve gender awareness and manage it well attain better financial results, on average, than the companies that do not. Catalyst (2004) used three measures to examine financial performance:

a) Return on sales (ROS)

b) Return on invested capital (ROIC)

c) Return on equity (ROE)

The Catalyst findings include:

- Companies with the most women board directors (WBD) outperform those with the least on ROS by 16 percent.

- Companies with the most WBD outperform those with the least on ROIC by 26 percent.

- Companies with sustained high representation of WBD, defined as those with three or more WBD in at least four of five years, significantly outperformed those with sustained low representation by 84 percent on ROS, by 60 percent on ROIC, and by 46 percent on ROE.

(Catalyst, 2004)

The literature calls for the need to be careful not to confuse cause and effect. It is pointed out that it may be that the higher performing companies were doing all kinds of innovative things to drive performance of which the close involvement of women at senior levels was but one. Companies at their best are complex adaptive systems, so the presence of women may be evidence of that fact, not cause. However, the evidence suggests that companies that have every appearance of being chaotic, with maladaptive systems are unlikely to involve women as senior board level. Such organisations might be part of the male high-end spectrum that confuses action with direction and that demands only performance, not the quality of relationship that inspires performance (Lanz and Brown, 2020).

Analysis of government policy literature on the topic of male/female differences shows that the efforts of FTSE companies are beginning to generate better gender diversity at board level, but while progress has been made, there is still more to be done (Davies, 2015).

'The business case is even stronger today as Chairs report on the positive impact women are having at the top table, the changing nature of the discussion, level of challenge and improved all round performance of the Board.' (Davies, 2015).

More recently McKinsey's 2019 research (Hunt and Fedynich, 2019) into delivering growth through diversity in the workplace reported that 'Gender diversity is correlated with both profitability and value creation'.

It demonstrated a positive correlation between gender diversity on executive teams and key measures of financial performance such as earnings before interest and tax (EBIT). Their study also revealed that companies with gender diverse senior teams were also more likely

to maintain longer-term value creation than companies without a critical mass of women at executive level. Research from MIT suggests the critical mass is gender parity (Woolley et al., 2011).

In short, the literature reveals that businesses that are competent at harnessing the best of what women have to bring, by welcoming and valuing those differences at executive level and at sufficient scale, perform sustainably better than companies that fail to do this (Lanz and Brown, 2020).

2.6.2 Neuroscience of brain sex in the business literature

Business journals

Compared to the amount of research literature which supports brain sex difference, there is comparatively little in the business literature about brain sex and its application in practice. I reviewed the leading western business magazines (setting no date parameters), with a focus on The Harvard Business Review (HBR), Fortune and The Economist, since these top the rankings in the business/leadership sector. The search revealed two articles in the HBR that were indirectly related to the topic. One article investigated evolutionary biology (Nicholson, 1998). A second article made the case for businesses to enable women to be excellent mothers and excellent professionals (Schwartz, 1989). It alludes to innate differences between the sexes but does not look at brain sex. The Economist has a 2006 article about innate differences. The article evidences the inborn differences (drawing on some of the data cited above) but suggests that this does not make these differences immutable and wonders why the higher echelons of business and academe have proved harder for women to occupy (Economist, 2006).

Business books

There were more business books than business journals (again I set no date parameters on my search) that dealt with the topic of applied neuroscience in the workplace but very few that dealt directly with brain sex differences. Of those that did explore the application of an understanding of brain sex differences at work, there was a lack of depth on neuroscientific evidence.

This part of the literature included an examination of male/female behaviours at work through the lens of evolutionary biology (Brown et al., 2007). The argument put forward being that women's biological desire to input their time and attention into their offspring has meant that they tend to focus more on relationships than competition compared with men and that this focus also plays out in the workplace. This has meant over time that women are on average more risk averse and are more nurturing compared with their male colleagues. The argument in respect of men in the workplace is that evolutionary history

has rewarded risk taking, competition and status acquisition. As such in the workplace where more of the measurement systems have been designed by more competitive men, men tend to fare better.

Simply removing barriers to inequality in such a system will not achieve gender equality, as women and men typically value different things in the workplace and will make different workplace choices based on their different preferences. (Browne, 2002)

Putting forward a different point of view based more concretely in the neurobiology of brain sex differences Leadership and the Sexes (Gurian, 2008) Gurian and Annis actively apply the scientific evidence to the workplace and seek to measure its impact. Their work highlights 'equal but different intelligence', drawing upon subsets of the literature previously identified. Although not in itself an empirical study it complements the author's experience, identifying a spectrum of maleness to femaleness and making some link with leadership styles.

Their main hypothesis in this book is 'equal but different intelligence' between the sexes in business. It explains the state-of-the-art knowledge (at the time in 2008) on brain sex differences and draws upon a subset of the scientific literature cited in this Chapter. It looks at case study examples from the authors' business practice and how these might link to brain gender differences and considers the tools of how to apply these in the workplace. Gurian and Annis are the first in the literature to offer a series of guidelines to help leaders use brain differences within business environments as in meetings, negotiations and communication skills (Gurian, 2008).

2.6.3 Summary of the business literature

Overall, with the possible exception of the Gurian and Annis work, the business literature is sparse in its exploration of brain sex differences at work, given the large quantity of physiological evidence of brain sex difference and the latest studies showing replicable, generalizable and behaviourally significant sex differences in functional brain organisation (Ryali et al., 2024). Business leaders frequently seek to improve productivity. As such I had anticipated greater evidence in the literature of attempts to apply this knowledge to improving business performance. Since the time of writing Leadership and the Sexes, significant new scientific evidence regarding brain sex differences and their impact has come to light, notably the research on brain sex connectivity differences in utero and at key developmental life stages (Ingalhalikar et al., 2014; Wheelock et al., 2019) discussed earlier.

In Section 2.7 below I outline the key content from the Neurosmart™ workshop. This is included as part of the Literature Review as it demonstrates how as researcher, I attempted to close some of the gaps identified in Sections 2.5 and 2.6, through the content and design of the workshop. This project was borne of the desire to understand the value (or not) to participants of the new knowledge from neuroscience in the business environment.

The overarching principle of the Neurosmart^{TM} workshop was to inform participants about the most recent knowledge from neuroscience, relevant to business regarding how the brain works and importantly how this knowledge might be applied. A core principle of the workshop, within this, was to highlight the difference between brain function in a survive state (suboptimal functioning) compared with a thrive state (potentially optimal functioning) and the potential impact that understanding sex differences might make to inducing these different states (Arnsten,2009). The details about what is meant by thrive and survive brain states is set out in detail below in sections 2.9.1 up to and including 2.9.4. Another core principle of the workshop was to enable participants to understand how supporting a thrive state in the brain is preferable for well-being and productivity (Lanz and Brown, 2020). The final major principle of the Neurosmart^{TM} workshop was to share practical tools to support the enabling of a thrive brain state. The content from neuroscience and its potential relevance to leadership was built up and tested during the development and design and testing of the workshop. This design and build process is described in depth in the Methodology Chapter.

In relation to the core principle of practical applications to enable a thrive brain state the Neurosmart^{TM} workshop also introduced two new tools developed specifically as part of this research. The tools that I developed are designed to help leaders apply the neuroscience in simple and practical ways. They are described in detail below in section 2.8. Finally, the Chapter concludes with an overview of what this project adds to the current state of including knowledge on the topic of brain sex differences in the workplace.

2.7 Workshop content

In summary, the Neurosmart^{TM} workshop provides the following information for executives:

- A model about how the brain evolved.
- A model for the brain in its 'Survive' (suboptimal brain performance) and 'Thrive' (optimal brain performance) states and the basic emotions associated with these states.
- A framework for describing the associated neurochemistry of the 'Survive' states and 'Thrive' states.
- Information about the neurobiological differences (on average) between the female and male brain and how these (on average) impact behavioural preferences. In particular, in relation to communication, how power is taken at work, how attention is focused, how stress manifests and how problem solving is approached.
- A discussion about the neuropsychological elements of how nature and nurture interact to inform our individual differences.
- A brain-sex questionnaire to establish on a scale the relative sex of the participant's brains.

- The two work-practice tools for creating the conditions for optimal brain function that are central to this research: the RICH^{TM} Communications Model and the 4 C's^{TM} Meetings Model for brain aware meetings. Both tools are informed by an understanding of brain sex.
- Examples of how to apply the work-practice tools for communication and meetings.

The data gathered for this project was based on ten interviews from workshop participants' experience of using the new information and the two tools in their work practice.

The content and tools are described in more detail Section 2.8. To clarify, the term 'model' I use this term in the workshop context as this is the language with which business leaders are most familiar. For this report I use the term 'tools' as this represents what RICH^{TM} and 4 C's^{TM} are within the academic context.

2.7.1 Workshop Curriculum

The overall workshop objective was to enable participants to explore how they might use the new knowledge about brain differences in their daily work to better access individual functional differences. The workshop curriculum covers the content areas highlighted in the summary above, each of the main content areas being described in more detail in Sections 2.7.2 to 2.7.5.

2.7.2 Duration and Format

The workshop was designed to cover either a half or full day depending on client requirements and was designed to be highly interactive. As concepts were shared with participants they were immediately invited to apply them to their own work situations and discuss this with other participating members.

2.7.3 Desired Outcomes

The desired outcomes from the workshop were designed to be:

- Embed new knowledge about the neurochemistry of survive and thrive and the impact this has on brain performance.
- Embed new knowledge about sex differences in the brain.
- Enable participants to use both the RICH^{TM} and 4 C's^{TM} tools in the service of better accessing brain sex and brain diversity differences.

2.7.4 Basics about the Evolution of the brain and Survive and Thrive

The key ideas in this section of the workshop demonstrated that, due to the evolution of the brain we all respond emotionally before appearing to respond rationally/cognitively. The brain has developed to trigger quickly into a survive state (producing cortisol and adrenaline with higher cognitive functions less active) faster than it will move into a thrive state (producing dopamine, oxytocin, serotonin and the possibility of 'flow').

2.7.5 Brain Sex Differences

The workshop explains how these occur along three dimensions: Structure, connectivity and hormones. There are about 100 known sex differences in the human brain. The workshop highlights a small number of these do to with differences in how brain sex impacts the way the brain pays attention; potential communication differences; how brain sex difference can show up in relationships; and different sex-based stress responses. It is made clear in the workshop that one's own brain sex is always a combination of nature and nurture and so encourages participants to find out their personal brain sex score and discuss the impact of this at work with their colleagues or in their personal lives, the brain sex score existing on a spectrum from very male to very female. Scoring their personal brain sex, they then have an opportunity to discuss this with colleagues and reflect upon the interplay of nature and nurture.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20

Very male   Very female
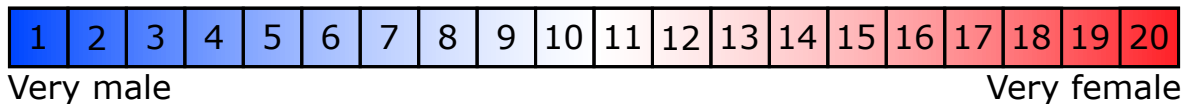
Figure 2.6: Brain sex questionnaire scores on a scale of 1 (very male) to 20 (very female). (Moir and Jessel, 1991)

The brain sex questionnaire and score sheet are available in Appendix C page 168.

2.8 Workshop tools

2.8.1 The RICH^TM Model

The RICH^TM model, shown in Figure 2.7, is a communications tool designed to help leaders access the best of all the diverse brains in their business. Since the brain responds emotionally before it can respond cognitively it is important in the first instance to have the emotional limbic system as settled as is possible, first to allow more effective communication to occur. The first two steps defined in RICH^TM are:

2.8.2 Recognition and Intention

Together these two steps enable the person communicating to help influence the limbic system (emotional brain) of the other. In the Recognition step it is a question of what is there to recognise or acknowledge positively about the other person's position or point of view.

The Intention step is designed to sign-post to the other person's emotional brain what the communication is about. The idea is to provide clarity and direction for the communication such that they do not feel taken by surprise. These two steps provide a solid means of settling the emotional response in the other person.

2.8.3 Challenge and Hope

The powerful 'rational' part of the brain, prefrontal cortex, is highly adept at generating solutions to complex problems. By setting out the challenge plus a solution this moves the communication forward into a collaborative problem-solving mode. This is intended to actively engage the cortex of both communicators.

Finally, the model suggests painting a verbal picture of what a positive outcome for all parties could look like. This painting of a positive future aims to trigger the production of dopamine- the reward neurotransmitter.

Used sensitively, bearing brain sex differences in mind, RICH^{TM} is expected to enable communication that activates a thrive state in all parties in the communication.
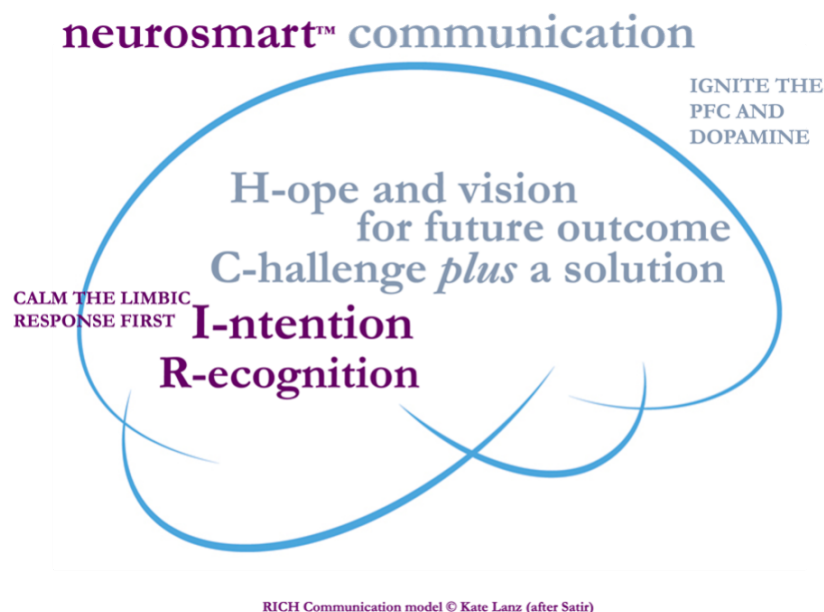
Figure 2.7: The R.I.C.H^{TM} Model (Lanz and Brown, 2020)

2.8.4 The 4 C's^{TM} Model

The 4 C's tool was designed as part of this research for running meetings. It also became apparent during the course of that work that the model has wider applications than are detailed here, but for the purposes of the workshop and this research its application was for meetings. The 4 C's Model^{TM} is shown in Figure 2.8.
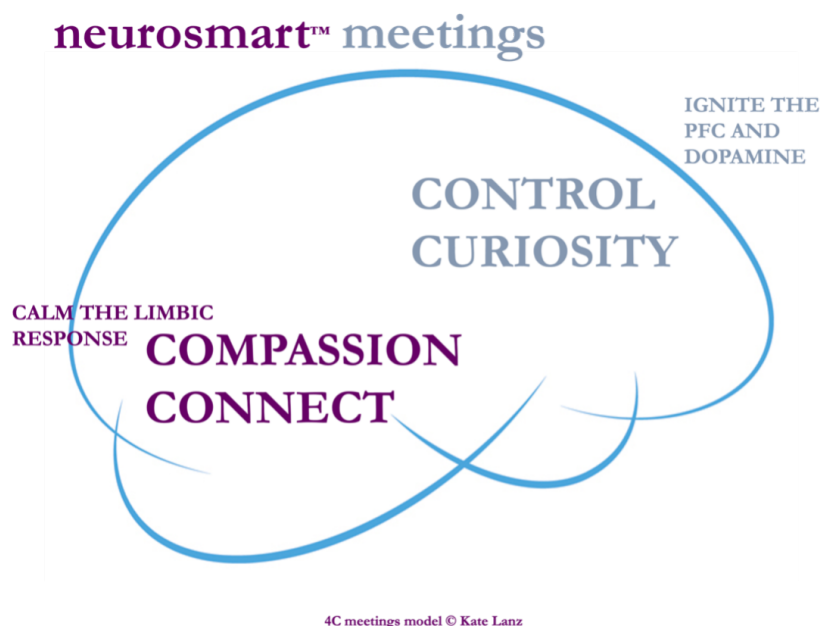
Figure 2.8: The 4 C's^{TM} Model (Lanz and Brown, 2020)

The 4 C's^{TM} consists of:

Step one: Connect. This means taking time at the outset of a meeting to find ways to connect at an interpersonal rather than work-task level. This enables the limbic brain to be welcoming. How this is done is dependent on context.

Step two: Compassion. Neuroscience (Eagleman, 2015) demonstrates that the brain judges others as part of an in group or out group without our conscious awareness. This Compassion Step seeks to acknowledge that such judgement will bring it into consciousness, compassion or suspension of judgement towards others present. When others are not judging us, our limbic system can detect that we are in a safe welcoming space.

Taken together these two steps allow all the limbic systems in the meeting a good chance to encourage the higher brain functions of individual participants to perform at their best.

Step three: Curiosity. This step involves actively using curiosity in the meeting to find out what all the brains in the meeting are focused on with regard to any particular subject. Active curiosity is a very potent way of engaging the prefrontal cortex.

Step four: Control. This means making sure the person contributing knows he/she has airtime in which express themselves without interruption. It is very common in meetings that the flow of ideas and waves of thought get interrupted. Knowing that one has time and space to speak enables higher quality thinking to occur.

Both of these models were explained and explored in the workshop, with participants given time in small groups to apply them to real work situations. The feedback was shared with the larger group. Handouts were given to participants of both RICH™ and 4 C's™ to act as aide memoires.

2.9 Conclusions to the literature review

The main research seeks to expand existing knowledge in understanding and using the value to leaders of including brain sex differences in their workplaces. Currently there are key omissions in the literature on certain aspects of the applied neuroscience of brain sex differences. In Section 2.9.1, I set out these omissions in the literature to date in relation to my research question.

2.9.1 An explanation of basic brain function

The brain responds emotionally before it can respond apparently rationally (Lanz and Brown, 2020) This is how the brain has evolved (Mac Giolla and Kajonius, 2019). This understanding of brain function exists within the wider literature in relation to the workplace application of neuroscience (Brown and Brown, 2012). It is, however, largely missing from the business literature on the subject of brain sex differences in the workplace. Understanding that we respond emotionally (approximately three times faster than the supposedly rational part of the brain can begin to make sense of a situation) (Mac Giolla and Kajonius, 2019) is important for business leaders to understand before they can make sense of how they might apply knowledge of brain sex differences. This awareness enables leaders to make sense of situations at work that might previously have appeared incomprehensible (see Findings and Discussion, Chapters 5 and 6). This understanding is a key element in supporting leaders to use applied neuroscience of brain sex differences successfully. This 'emotional before rational' (Lanz and Brown, 2020) reaction is significant and important, but not directly related to brain sex.

2.9.2 Survive and thrive responses in the brain

A simple metaphor to support people to understand some of the key responses in the brain is the distinction of Survive and Thrive (Lanz and Brown, 2020). Put simply, there are two dominant modes of brain response. Firstly, a survive response whereby the limbic (emotional) system remains active and the prefrontal cortex is not permitted to operate optimally (Arnsten, 2009). The second dominant but much slower response within this

metaphor is 'Thrive', where the limbic system has effectively 'stood down' and the cortex is thus enabled to function freely. There are different neurochemical responses to survive and thrive states which are detectable in the body (Dfarhud et al., 2014) and leaders can learn about these different neurochemical and physiological responses quite quickly through some exercises that I developed.

In my view, this simple Survive/Thrive metaphor to explain the brain's dominant responses and the associated neurochemistry, and how these impact learning in the brain, is vital. It was not present in the current literature on brain sex in the workplace. It is an integral part of the Neurosmart^{TM} workshops.

2.9.3 Connections between the amygdala and prefrontal cortex

Another omission in the business literature that pertains to this awareness of Survive and Thrive is a detailed explanation of the sex differences in the connections between the amygdala and the prefrontal cortex (as described in Section 2.5: managing emotional responses). This knowledge is important to further advance the understanding of the, on average, differing emotional responses between men and women. The proposition that more male-brained people might be more likely to respond more competitively and aggressively and want clear cut answers to problems than more female-brained people in the same situation (Brizendine and Shoffner, 2008) is helpful information for executives in stressful work situations. An awareness of potential sex differences might serve to deepen the understanding and handling of difficult or conflict situations. This level of education and raising of awareness is part of the programme that is the basis of this research project.

2.9.4 Brain sex and the link to an individual's personal life experiences

The literature into the application of the neuroscience seems to be dominated by the arguments about typical brain sex differences between men and women and does not focus on the individual brain within the context of neurobiological differences, making the individual the unique person that s/he is.

One's brain sex is a function of the mix of both nature and nurture (McCarthy et al., 2012) and is therefore, highly individual. The brain sex score used in the workshop and my book is used with the permission of Dr Ann Moir. Scores run from 1 which represents a very male brain to 20 which represents a very female brain (Moir and Jessel, 1991) It is possible to be a woman with a more male brain and vice versa. The mix of personal experience, as well as complex in utero neurochemical events, is what shapes the brain connectivity. An understanding of individual experience and how it impacts relationship patterning, based in attachment theory, is central to the Neurosmart^{TM} workshop. It is important to leave participants clear that whilst there are typical neurobiological differences that exist each individual brain is different based in the unique experiences and combination of nature and

nurture for any given individual. This individual imprinting of every unique brain is not a concept that is clearly communicated in the literature on the application of neuroscience in business.

This individual element of one's brain sex is also linked to another application that I developed as part of my wider research. It looks at individual leader's attachment patterning called Trustprint[TM]. Although TrustPrint[TM] is not part of this research project (since it is an individual interview) the concept is described to workshop participants at the workshop. This informs the participants clearly about the blended role of nature and nurture, which in turn informs the brain sex score[1] line-up which is an integral part of the Neurosmart[TM] workshop.

At the workshop, all of the information shared with participants feeds in to helping them think about how they might use the RICH[TM] and 4 C's[TM]-though they are referred to as models in the business environment. Headline details of the RICH[TM] and 4 C's[TM] tools are set out in detail in Section 2.9.5.

2.9.5 Neurosmart[TM] tools compared with guidelines

Simple tools that encompass brain sex differences and how to apply them is another area of key difference between what was uncovered in the existing literature that I looked at for this research project. The gender tools put forward in the existing literature are a series of checklists/guidelines. I found them difficult to remember and therefore not easy to apply. As checklists, they only make sense if the user is immersed in the reading of the wider content of the particular book from which they have been drawn. Furthermore, they are focused purely on sex differences rather than focusing on accessing the thrive neurochemical states (See Section 2.9.2) in all the brains in a given situation.

As mentioned, my work and research include two simple tools – RICH[TM] and the 4 C's[TM]. These are simple to use, easy to remember and do not require users to have a deep understanding of applied neuroscience to apply them.

The sparsity of literature on what an understanding of individual brain differences might mean and how this knowledge could be used in the service of brain inclusivity in business, alongside significant omissions in the literature are the inspiration for this main research project. I was curious about the possible reasons for this sparsity. One possible hypothesis is that the backdrop of the post-war feminist movement, seeking equal opportunities for women at work and beyond, has historically made it challenging to write about brain sex differences. As the brain sciences have been developing over the last 30 years a large element of the feminist movement focused on women being equal, not different to or from men (Rippon, 2019) though it defines 'women' as like 'men'. In 2004, Baron-Cohen de-

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[1]This is physical line up and discussion by participants once they all have their own brain sex score.

scribed how writing about essential brain sex differences was felt to be 'politically dangerous' (Baron-Cohen, 2004). However, to shy away from examining whether there are brain sex differences that have an impact in the workplace if there are, does a disservice to both men and women. This research project seeks to understand the actual lived experience of the participants in applying the new knowledge and what (if any) value they took from it. Phenomenology[2] presented itself as the best way forward as a methodology for this project. The detail of the research design is set out in the next Chapter.

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[2]Phenomenology is a **philosophy of experience**. For phenomenology the ultimate source of all meaning and value is the lived experience of human beings.

Chapter 3: Methodology

3.0 Introduction

This Chapter sets out the methodology finally chosen for this research. The choice and consistent use of a research philosophy is essential if robust conclusions are to be drawn from primary research (Crotty, 1998). The choices made for this project are explored and compared to alternative approaches. The specific choice of qualitative design (phenomenologically informed with thematic analysis), the methods of data collection (semi-structured interviews) and data analysis (using the brand named NVIVO thematic analysis software) are described and discussed with respect to the generalisability and authenticity of the conclusions drawn. The Chapter incorporates a discussion of ethical considerations arising from this research and closes with a simple summary of the research design.

3.1 Project research aims

The overall aim of this project has been to explore the value to senior leaders of understanding brain sex differences and their inclusion in the workplace. As already discussed Chapter 2: Literature review, there is a limited body of published research into how modern neuroscience can be applied in business, and what impact it might have. Prior to this research project I developed two tools (I call them 'models' within the workshop context and they are described in detail in Chapter 2 above) which allowed senior business leaders to adapt and refine their working practices to better include the variety of brains in their teams and wider groups. So, the main research explores leaders' experience of using the workshop content and tools and how subsequent behavioural and structural changes (to meetings, team structures and with individual colleagues for example) influenced their work experience and its effectiveness. This was achieved firstly by introducing them to the latest applied research in brain sex science in the Neurosmart^{TM} workshop that has been discussed in Section 2.7. Specifically enabling leaders to use two work-practice tools: the RICH^{TM} Communications Model and the 4 C's^{TM} Meetings Model (©Kate Lanz, 2017).

3.2 Project objectives

The overall project objectives were to gain deep insights into the lived experiences of participants in the research.

Specific objectives were to:

a) Explore the individual reflections and experiences of leaders as they applied the knowledge gained from the workshop in their workplaces.

b) Understand the leaders' lived experience of using the RICH^{TM} Communications Model and the 4 C's^{TM} Meetings Model in their own business environments.

c) Gain insight into the value (if any) that senior leaders gained in their work environment from their understanding of basic brain function and brain sex differences in using both models.

Research question:

"What is the value as described by senior leaders of understanding individual brain sex differences in the workplace – an exploration". Choosing an overall research design consistent with this question has presented several challenges and issues. These are considered in Section 3.3 below, along with details about the chosen research design.

3.3 Methodology

3.3.1 Determining a research philosophy

Having enabled leaders to use the two work-practice tools the aim of the research was to understand the actual lived experiences of the individual participants and to establish the value (if any) to senior leaders of the content and tools as applied to their leadership practices. Through analysing the senior leaders' descriptions of their experiences, I wanted to investigate whether there might be common themes arising in relation to the research question. The underpinning philosophical stance therefore assumes a high level of subjectivity.

I explored a broad literature in respect of research methodology in the social sciences (Gray, 2021), coaching (Jackson et al., 2019) and business (Saunders et al., 2012) to find the most useful approach for this project. Given that the audience of specific interest to me were business leaders, I chose a research philosophy from the business research literature which posits four philosophies to inform business-based research. These are:

- Pragmatism
- Realism
- Positivism
- Interpretivism

(Saunders et al., 2012)

3.3.2 Pragmatism

Pragmatism is a research philosophy that has its roots at the beginning of the twentieth century in America and has undergone a more recent revival (Sundin and Johannisson, 2005). The pragmatic research philosophy holds that the research question is the most important determinant of how the research is undertaken and as such accepts any concept as relevant, provided that it supports action. In pragmatism what matters is that the outcome generates practical consequences in society (Gray, 2021) and causes actual action in the world (Rorty, 1991).The pragmatist notion that there may be 'multiple realities' (Saunders et al., 2012) and acceptance of multiple data collection methods could be helpful at a future point in time to further investigate findings in relation to applied neuroscience in business. However, the aim in this project was to understand in depth the actual experience participants had of applying the new knowledge about brain sex differences. So, the research based on pragmatism; looking to support action, rather than simply understand it, seemed not best-suited for this research project.

3.3.3 Realism

Realism starts from the idea that science provides an accurate picture of the world (Chia, 2002) The subjects being researched are thought to exist and be available for analysis, advancing knowledge and building on what is already known (Gray, 2021). Given this view in realism that reality is somehow independent from the human mind and is thus based on the assumption of a scientific approach to acquiring knowledge, also seemed not appropriate for this research question. Even critical realism with its recognition that reflections and images of the real world may be deceptive (Novikov and Novikov, 2013) and human senses may get in the way between the researcher and the research, does not lend itself to an early stage of investigating the lived experiences of individuals and their reactions to/use of the new knowledge they are acquiring.

3.3.4 Positivism

Positivism was a dominant philosophy in social science research from the 1930s through to the 1960s (Gray, 2021). A core belief of positivism is that reality consists of what the senses can perceive and that through observation reality can be empirically tested (Gray, 2021). There have however, been a variety of different versions of positivism which, despite having some aspects in common, have rarely agreed on the core components (Bryman, 2003). Positivism aims to provide a dispassionate view of social affairs often based in the analysis of available empirical data such as statistics. In relation to applied neuroscience in business, the review of the literature suggests that at this stage we do not understand enough, nor have the appropriate data set to adopt any form of positivist philosophy. We may not yet even understand the questions that would be relevant to ask from a positivist standpoint.

3.3.5 Interpretivism

Interpretivism is the philosophy that 'tends to focus on exactly those aspects that are unique, individual and qualitative' (Crotty, 1998). Myers talks about how 'interpretative researchers assume that access to reality (given or socially constructed) is only through social constructions such as language, consciousness, shared meanings and instruments' (Myers, 2019). As such, interpretivism appeared to be the best fit as an overarching philosophy for this research given the nature of its enquiry. This philosophy emphasises a qualitative approach over a quantitative one. Crotty (1998) describes how an interpretivist philosophy sits within constructionism, where there is no objective truth waiting to be discovered, the notion being that meaning comes into existence as it becomes constructed in the conversations and reflections of the different people involved.

"There is no meaning without a mind" (Crotty, 1998)

So, interpretivism assumes that practically all meaningful reality is generated between human beings and their world and exchanged in an essentially social context (Crotty, 1998).

3.4 Interpretivism – the chosen research philosophy

At this stage, the individual's sense-making was of most interest to me. The focus of the research question is aimed less at the social dimension of meaning (Schwandt et al., 1994) and more at the individualistic understanding of the constructionist position. Thus, the knowledge base that this research is calling upon is interpretivism. The work-based paradigm situates interpretivism within a constructivist epistemology[1].

3.4.1 Epistemology of Interpretivism: Strategies within Interpretivism

An interpretivist philosophy bases itself in naturalistic data collection such as interviews and observation. Making meaning of the data emerges towards the end of the research process when all the data is to hand. And Crotty has suggested some key strategies within the interpretivist philosophy as the basis of research (Crotty, 1998). These key strategies are:

- **Phenomenology:** 'the philosophical tradition that seeks to understand the world through directly experiencing the phenomena' (Littlejohn and Foss, 2009).
- **Symbolic interactionism:** which holds that socially constructed symbols are culturally derived and are how meaning is made in a shared way. Associated methodologies are ethnography, which involves observation rather than conversation to make meaning: and grounded theory which develops assumptions based on sense-making of data from observations in practice (Gray, 2021).

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[1]Epistemology is the theory of knowledge. It is concerned with the mind's relation to reality. What is it for this relation to be one of knowledge? Do we know things? And if we do, how and when do we know things?

- **Hermeneutics:** originally oriented to historical and relative meanings, (often focused on historical and biblical texts and wisdom literature),in its more contemporary terms considers shared meanings between people and communities (Gray, 2021).

Of the three strategies within interpretivism, phenomenology appeared best to lend itself to the question under investigation, and so became the chosen research strategy for this thesis. But before going into more detail about the phenomenological strategy that was deployed it seems helpful to review the sources of knowledge that have informed this as an interpretivist study and the approach used for making sense of the data.

There are four sources that constitute relevant knowledge (Hallebone and Priest, 2017) in relation to this applied business research style.

These are:

a) **Intuitive knowledge** – based on human feelings versus a reliance on facts
b) **Authoritarian knowledge** – taking its source from information from experts, research papers, books and such authoritative sources
c) **Logical knowledge** – the creation of new insights built on the application of logical reasoning
d) **Empirical knowledge** – objective facts that can be demonstrated.

During the research process, all of these forms of knowledge have been integrated into the study. Intuitive knowledge led to the discovery of the research area which ultimately defined the question. The literature review drew heavily upon authoritarian knowledge. Logical knowledge was used in the data analysis. Empiricism accepts personal experiences connected with observations and feelings as a valid source of knowledge. This is summarised in Table 3.1 adapted from Saunders et al. (2012).

Table 3.1: Epistemology of popular research philosophies

Epistemology: the researcher's view regarding what constitutes acceptable knowledge	Research Philosophy
Either or both observable phenomena and subjective meanings can provide acceptable knowledge dependent upon the research question. Focus on practical applied research, integrating perspectives to help interpret the data.	Pragmatism
Only observable phenomena can provide credible data, facts. Focus on causality and law-like generations, reducing phenomena to simplest elements.	Positivism
Observable phenomena provide credible facts, data. Insufficient data means inaccuracies in sensations (direct realism) Alternatively phenomena create sensations which are open to misinterpretation (critical realism). Focus on explaining within a context/contexts	Realism
Subjective meanings and social phenomena. Focus upon details of a situation and reality behind these details, subjective meanings, motivating actions	Interpretivism

The chosen design being interpretivist means that the epistemology is subjective meaning, with focus on the conscious experiences of participants and getting inside these experiences, whilst, to the very best of one's ability, putting aside one's judgements and interpretations.

3.4.2 Inductive approach

The inductive approach proposes the meanings, and sense making come towards the end of the research process based on observations (Goddard and Melville, 2004). Induction starts from the point of view that no theories or patterns exist at the beginning of the research and that as a researcher, one is free in terms of the direction taken once the study has begun (Bernard, 2017). Inductive reasoning is based on learning from experience. Patterns and any regularities in experience emerge from an immersion in the data set.

3.5 Phenomenology – the chosen research strategy

Phenomenology was ultimately the chosen research methodology for this project. The choice was 'ulitmately' since the original methodology choice was action research (Stringer,2020). Before describing the detail of the phenomenological approach adopted it is helpful to set out why the pilot tests of an action research approach were abandoned as a suitable methodology. Action research focuses on both the action and researching the action (Coghlan, 2019) and given that this project was based in both designing a workshop on applied neuroscience in business and understanding the value of the content for participants, action research was a very well suited methodology (McNiff, 2013). However, the three pilot group meetings of four female leaders described earlier demonstrated the difficulty of getting busy executives to commit to meeting up on a regular basis. It proved impossible to keep the group going.

These four female leaders were well known to me and they were invested in supporting such research. Yet it still proved too difficult for them to commit to regular meetings and discussion. The ultimate participants in this research were more senior than the original pilot group participants and they had more demanding schedules to manage. As such, after reflection and discussion in supervision, it was decided that the project risked being set up to fail and that data capture could be seriously compromised if action research were attempted at the point of actual data collection. This was disappointing but based on the pilot experience it was clear that a methodology that involved repeat meetings would not be practical. As such a phenomenological approach lent itself best under the circumstances to gathering 'thick descriptions' (Ponterotto,2006)of the perspectives of leaders and their lived experiences of the value (or not) of the workshop content.

Phenomenology posits that we 'can never know the real world, only the interpreted world' (Spinelli, 2005). This world emerges through our reflections and generates an openness which can induce new thinking and possibilities in the world. This new thinking can help cause positive change impacting issues such as decision-making analysis and social change policy, for example. This research project sought to find out what the value is to leaders of understanding something of brain sex differences and whether this does create change in relation to work practices.

Phenomenological research assumes an interrelationship between the researcher and the participants in the research. The researcher's beliefs, from within the interpretative role, are up to a point considered as a necessary part of making sense of the data (Fade, 2004). Phenomenological research is very concerned with consciousness and the conscious experience of the participant. This involves an in-depth analysis of the individual experiences within the unique contexts of the participants (Pietkiewicz and Smith, 2014).

The ambition to allow the phenomena under investigation to 'speak for themselves' (Gray, 2021) by definition, requires that any researcher suspends their own assumptions. This is a difficult task. As humans we are always making judgements in any situation in which we find ourselves and as we know from applied neuroscience our judgments are often arising non-consciously and faster than we can become aware of them from the cognitive, so-called rational part of the brain, the pre- frontal cortex (Brown and Brown, 2012). Therefore, it is an important part of the process of phenomenological research to be able to consistently reflect upon the assumptions that are emerging in the mind of the researcher. This process of reflecting upon and setting aside one's assumptions as researcher is known as 'bracketing' (Carpenter et al., 2011). Bracketing is ongoing throughout the research. The bracketing process itself acknowledges that the research takes place 'within co- constitutionality' (Spinelli, 2005). Zaner (Zaner, 1970) describes this as 'just as it is by consciousness that objects are made present, equally, it is by objects that consciousness is revealed and elucidated'.

In general, the aim of phenomenological research is to provide 'increasingly adequate meaning statements rather than final laws or incontestable truths'. Farber (1966) states that phenomenology concerns itself with 'speaking truthfully' about experience and does not have as its focus the aim of achieving an 'arrived at' final truth.

It is nonetheless important to note that there are clear variations within the philosophy of phenomenology (Bachkirova et al., 2020). These mean that there are plural approaches to phenomenological research (Vagle, 2018). These variations exist on a spectrum based in differences of opinion between the Husserlian view that one can put aside ("bracket") foreknowledge almost to a transcendent extent to arrive at the essential nature of a phenomenon (Husserl, 1958) compared with Heidigger's view that we are inevitably bound up in our interpretation (Bachkirova et al., 2020). This view of phenomenology suggests that we are 'thrown into a pre-existing world of people and objects, language and culture and cannot be meaningfully detached from it' (Smith et al., 2012). The tensions within phenomenology are explored in more depth in Section 3.5.1 and throughout this Chapter given its importance to my study. Table 3.2 provides a useful summary of a comparison of the plural approaches within phenomenology (Jackson and Cox, 2020). My chosen approach was the phenomenological psychology method which best fits the nature of this research given the early stage of developing knowledge of brain sex inclusivity in the workplace. The main purpose of my research was to look for an integrated picture (if any) of the common experience. As researcher the aim was to establish a general structure of the phenomena (Giorgi, 2013).

Table 3.2: Comparison of phenomenological research methodologies.

	Phenomenological psychology method	Interpretative phenomenological analysis	Heuristic research	Conceptual encounter
Theoretical underpinning/ associations	Transcendental phenomenology, idiography	Idiography, Phenomenology, Hermeneutics, Symbolic Interactionism	Phenomenology, Idiography, Humanism, Constructivism	Phenomenological psychology, Humanism, Idiography, Interactionism
Main proponents	Giorgi (2013)	Smith et al. (2012)	Moustakas (1994)	De Rivera and Kreilkamp (1981)
Dimensions of differences				
Role of the researcher	Bracketing foreknowledge, comparing accounts, establishing a general structure of the phenomenon	Micro-analysing and interpreting with reflexivity the convergence and divergence in accounts to interpret the meaning of experiences	Researcher as an instrument for data collection, self-inquiry as well as the inquiry into the phenomenon	Gatekeeper of concept development, foreknowledge of researcher is included in the dialogue and analysis
Main purpose	The integrated picture (essence) of the phenomenon	A picture of similarity and variability of human experience	Personal change of the researcher and essence of the phenomenon	Elucidation of the structure that exists within psychological events
Role of theory	Theoretical assumptions bracketed. Only description is offered	Theoretical propositions are explored and compared with existing literature alongside emerged themes at the final stage	Theoretical propositions are secondary to creating synthesis that could be seen as theory	Concept is gradually developed and can be seen as theoretical proposition
Balance of text and visual means	Analysis of the observations or text	Analysis of text and own memos - other data collection methods are encouraged but not often used	Any means of data collection, creative approach to final synthesis	Concept can appear as a map or an 'elegant' model

Despite these variations it is fair to say that phenomenology does not accept the notion of causality in any linear form. The meaning of past and present occurrences may be noted but the research stance is not to assume that the first event caused the second. This creates a particular mindset for the researcher of deep curiosity about the 'natural attitude' (Husserl, 1958) under investigation.

Due in part to this neutral deeply curious stance that the researcher holds as the context for the enquiry there is a partnering that occurs between the researcher and the participant which is 'foundationally collaborative' (Spinelli, 2005). This requires completely engaged active listening on the part of the researcher, continuing to create contact and openness with the co-researcher. As such the researcher's quest is to explore the individual's experience of the phenomena focusing on gaining insights of 'increasing adequacy' regarding the structure

of the co-researcher's experience. In its essence phenomenological research is seeking to understand qualitative variables.

Phenomenology focuses on the individual's conscious experience of events with only minimum regard for external reality (Menon et al., 2014). As an approach, it argues that an interpretatively focused activity has to 'get inside the forms of life... in which the person's activity has taken shape' (Gillett, 1995), requiring the researcher to achieve 'an empathic and imaginative identification with the subject' (Gillett, 1995) but without any over identification leading to bias. This process is known as 'bracketing' as previously described, which actively seeks to come at the exploration with fresh eyes and ears (Carpenter et al., 2011). Further detail is provided in Section 3.9.3 on my specific use of bracketing in this project.

Valle and King (1978) describe the phenomenology approach as:

'[seeking] to understand the events of human experience in a way which is free of the presuppositions of our cultural heritage ... as much as possible. When applied more specifically to human psychological phenomena, [phenomenology] has become that psychological discipline which seeks to explicate the essence, structure or form of human experience and human behaviour as revealed through essentially descriptive techniques including disciplined reflection'.

3.5.1 The pros and cons of phenomenology

One of the major advantages of phenomenology as a research strategy is its capacity to explore as far as it is able to the meanings attached by people to whatever is under consideration and through this its potential to contribute to the early stage of ideas for the development of new theories (Paley, 2016).

A key disadvantage is the potential difficulty with bias (Williams et al., 2019). Given the nature of the approach, data collection and interpretation thereof as the researcher is taking care to keep their own assumptions and preconceptions out of the act of interpretation as best as possible throughout the process. This can slow down several stages of the research process compared with other methods (Paley, 2016).

In addition, the approach can lead to questions over generalisability given the highly contextual nature of the data being collected and the interpretivist nature of the thematic analysis. There is a potential risk of the 'dead end' that could arise whereby 'all positions are to be treated as equal value and merit' (Spinelli, 2005). The challenge is that this 'extreme form of relativism' is not actually a risk with phenomenology as the 'inter-relational reality' which occurs as the analysis of experiences is undertaken makes it possible to 'arrive at positions of judgement regarding the relative adequacy of one stance in contrast to another' (Spinelli, 2005).

3.6 The methodology of phenomenological research

Prior to going into the details of the data collection and data analysis, I reviewed the more specific principles required by a phenomenological research strategy, since these were my guidelines. The literature revealed a helpful framework for handling phenomenological findings (Ritchie et al., 2003). This framework analysis was used as the approach in reviewing the interview outputs (Ritchie et al., 2003). This method supports the exploration of the qualitative data in a systematic, phased way starting with organising the data, to summarising, and finally to interpretation within a thematic framework. Framework analysis has the following benefits in making sense of the research data (Roberts and Newton, 2001):

a) It offers a level of coherence and structure to handling large amounts of potentially cumbersome, qualitative data such as full interview transcripts of meetings that may have been of up to an hour's duration.

b) It enables a more organised systematic analysis, supporting the research process to be explicit as well as replicable.

c) The researcher is enabled to reflect and think creatively about the data supported by the process of abstraction and conceptualisation.

There are four key phases in the analysis process as described by Ritchie et al. (2003) explored in Section 3.6.1.

3.6.1 Four phases of the analysis process

Phase One: The first element is familiarisation with the data to get a deep 'feel' for the content. This stage requires revisiting the research aims and reengaging with the sampling strategy to better understand the diversity of the data. This stage involves re reading the transcripts carefully to get an idea of any recurring themes. Upon identification of recurring themes, a conceptual framework can be developed. This framework continues to be refined as the data analysis goes on. A hierarchy of groupings begins to emerge within the main headings of broad themes.

Phase Two: Labelling the raw data from interview transcripts by indexing it systematically. The indexing is based on the initial thematic framework. Ritchie et al. (2003) make a distinction between this indexing and actually coding the data– 'when applying an index, it simply shows which theme or concept is being mentioned or referred to within a particular section of the data...' (Ritchie et al., 2003). At this indexing phase there is still the opportunity to refine the conceptual framework that is emerging from the data.

Phase Three: This stage is where the data actually gets collated into similar themes or content. This can either be done manually or using computer software such as NVIVO.

Phase Four: Summarise and synthesize; this phase helps to get the data into a more manageable format. Richie and Lewis stress that it is important at this stage that the language and key phrases of the participants is retained. This matters because it enables easy access to referring back to the original data. It is also important at this stage not to discard any data and especially that which does not fall into any clear themes/categories.

This Framework approach is not a linear process. Revisiting earlier stages in the analysis is an important feature. Three years earlier from Ritchie's work Mays and Pope (Pope et al., 2000) expressed the view that using such a Framework approach supports the maintaining of high standards of analysis as it provides a clear account of the conceptual process leading to the interpretation of the data. As the researcher attempts to look at the essence of the experience from the point of view of the person having the experience (whilst 'bracketing' their own assumptions) they are at some level partnering in the co-creation of the understanding that is emerging. Thus, it is impossible to bring forth data that is 'undistorted by human interpretation' (Polkinghorne, 1989). The understanding that will emerge is based in interpretation of the phenomena under investigation and not on a description of them (Bradberry and Greaves, 2009). A detailed review of the bracketing process used in this project is discussed in Section 3.9.3.

3.7 Methods for data gathering

3.7.1 Qualitative Interviews

Interviews are integral to a qualitative interpretivist approach. Qualitative interviews are widely used in business research and help capture the dynamic aspects of the phenomena being studied in order to understand what people do, believe and think (Britten, 1995). In day-to-day business activities interviews have been described as a form of communication that are 'initiated by the interviewer for the specific purpose of obtaining research relevant information and focused on content specified research objectives of systematic description, prediction or explanation' (Cohen et al., 2013).

In the case of this research, the purpose is the 'systematic description' rather than prediction or explanation. (Creswell, 1998; Davies, 2015) suggests that the main benefit of interviews is that they allow the researcher to 'elicit the participant's perspective of an experience'. It seemed important to consider the type of interview technique that was most relevant given the epistemology within an interpretivist philosophy. Interviews accessed the intuitive and empirical sources of participant's knowledge mentioned in Section 3.4.1

The interview type used in this research was semi-structured. Roulston (Roulston, 2010) points out that structured and semi-structured interviews are linked to a constructivist epistemology where meaning is co-created between the researcher and the participant. This fits with the philosophy (interpretivist), approach (inductive) and strategy (phenomenology)

that are best suited to this research question.

The participants were intelligent, educated, experienced individuals who had shown themselves to be fascinated by the topic. It is in part in honour of their intelligence and respecting them as having agency within their organisations that a semi-structured interview technique was chosen to allow sufficient freedom for them along with the researcher to probe their own experiences.

Interviews open up the opportunity to explore ideas that cannot be directly observed (Patton et al., 1980) from the interviewee's point of view rather than how they may be perceived by the researcher (Marshall and Rossman, 2014). Robson (2002) argues that semi-structured interviews allow for the generation of 'rich and illuminating data' (Robson, 2002). In such semi-structured interviews, a schedule setting out the open questions to be explored is utilised. The semi-structured approach allows the interviewer to use their own judgement and perceptions and modify the order in which questions might be asked, rephrase the way they are worded and add additional questions to probe the emerging thinking more deeply. Robson (2002) posits that the benefits of such interviews are strengthened by conducting them face to face so as to have access to visual cues. Britten (1995) emphasised the importance of staying with the participant's own views and meanings, saying:

'In a qualitative interview the aim is to discover the interviewee's own framework of meanings and the research task is to avoid imposing the researcher's structures and assumptions as far as possible. The researcher needs to remain very open to the possibility that the concepts and variables that emerge may be very different from those that might have been predicted at the outset' (p251)

Seidman (Seidman, 2006) concurs with this view commenting that seeking to understand the experiences of the interviewee should be at the root of interviewing. Standardised interviews run the risk of and have been criticised for not sufficiently acknowledging participant's views (Mishler, 1979; Murphy et al., 1998). The semi-structured approach helps to avoid some of these risks and it is also important to the practice of effective interview techniques to be continuously reflective. Lofland et al. (2022) also suggested that interviews should be recorded to allow a full and in-depth analysis to be conducted. Recording also means that it is easier for the researcher to be more responsive during the interview with less concern for taking notes.

Hence semi-structured interviews were chosen based upon the questions set out in Section 3.8.1. Interviews were recorded to reduce the interference of note taking and for the purposes of having a complete record of each session.

3.7.2 Transcription

One of the most common ways to prepare interview content for analysis is transcription (Bazeley, 2009). For the purposes of this thesis, a transcriber was used due to time constraints. The choice of transcriber was carefully undertaken in order that the transcriptions were standardised in line with the accepted rules of transcription (Waitzkin, 1990) and to ensure that pauses, slang usage, notations of emotional content and such matters were all conserved. Ensuring such standardisation allows participants to speak for themselves (Schegloff, 1997). By way of quality-control, a sample of transcripts were spot-checked, to make sure there are no quality assurance issues (MacLean et al., 2004).

3.7.3 Computer assisted qualitative data analysis

The amount of transcript data is significant and to manage large amounts of qualitative data in a systematic way, ensuring efficient retrieval of key content, a computer software package was used. Such packages help to assist with the data analysis process but are not an alternative to researchers' time, effort and skills. They are considered as a means of enhancing the rigour of qualitative studies (Bazeley, 2009) and can encourage proximity of the researcher with the data (Pope et al., 2000). For these reasons, following the transcription of interviews into Microsoft Word, data was stored and managed using the specialist software for qualitative data NVIVO.

3.7.4 Thematic analysis as a research analysis technique

Thematic analysis is a method for identifying, analysing and reporting patterns (themes) within data. It organises the data into themes as efficiently as possible and describes the data set in rich detail. Thematic analysis then goes on to interpret various aspects of the research topic (Boyatzis, 1998) and to extract the implicit meanings, moving towards 'an ever-increasing adequate description of any given phenomenon as it presents itself, to one's experience' (Spinelli, 2005).

Owing to the rich thematic descriptions that emerged from the semi-structured interviews, it appeared to lend itself well to under-researched areas, such as this. Phenomenological research requires a careful analysis of the data set to see whether there are patterns in the essence and structures of the experiences arising. Thematic analysis supports this process by providing clear links between the research question and the aims of the study, and as such can guide the development of the analytical findings.

3.8 Participant selection

The selection of participants is important, and their characteristics determine to what extent and to whom the results of the study can be generalised. The nature of this type of study means that a sample size might be relatively small, so threats to validity needed holding in mind while planning sampling procedures (Campbell and Riecken, 1968).

Purposive sampling was used to select participants as this research project is qualitative (Patton, 2014). This type of sampling is also known as judgement or selective sampling. It is a non-probability method and is used when 'elements selected for the sample are chosen by the judgement of the researcher'; though researchers often believe that they can obtain a representative sample by using a sound judgment' (Black, 2023), it being an effective sampling method when there are only limited numbers of people who can act as primary data sources. This was the case for my research project.

Participants were selected from 3 different client organisations, which were themselves from three different sectors. These were: an international academic institution; a large consulting firm; and a global legal partnership. By selecting from different sectors in this way, the study aimed to minimise, as far as possible, the threat to validity of a small sample size and explore more roundly whether there were generalizable themes emerging across different business sectors (or not).

The selection variables relevant for this project were:

- Leaders from within a selection of my client organisations that have requested/undertaken workshops with me. These leaders were self-selected in terms of already being interested in the topic of brain inclusivity
- Seniority levels – leaders were either be at the top level within their division or reporting into the top level
- Executives with senior sponsorship authority to enable attendance

3.8.1 Interview specifics for this research

The interview aimed to explore each participant's reflections about, and lived experience of, using the new knowledge that they had gained from the Neurosmart^{TM} workshop. The participants consisted of six men and four women. They were all senior leaders within their sectors coming from three different organisations already briefly described. They had all been at their organisations for over ten years and up to $20+$ in some cases. They were each from different departments within their organisation, with levels as partner, executive board member, or Head of an Academic Department. The aim was to interview as diverse a group as possible. In respect of the gender split, there was a slightly higher percentage of women as part of the interview group (40%) than had been typically represented at the workshops, which was usually 25 to 30%.

The interviews were semi-structured using four guiding questions, supplementary questions being built in around these guiding questions. The four questions were:

1) What have your reflections been about the information we shared about the neuroscience of brain function and brain sex?
2) What have you found useful from what we covered in the workshop and how specifically have you used it? A supplementary question asked to explore what they did not find useful/what was useless?
3) What has your experience been of working with the knowledge in practice?
4) What has your experience been of working with the models – notably the RICH^{TM} Communication Model and the 4 C's^{TM} Model?

Before the interview a short email was sent to participants, including the questions above. The purpose was to promote reflection and allow preparation for all participants. These were designed as a prompt only. This is considered good practice and meant that leaders arrived settled and ready to discuss their experience.

In addition to the four guiding questions above, further questions were asked during the interview to probe and understand more detail of participant's responses to obtain specific examples and evidence from their experience. The aim of the process from the researcher's perspective was, however, to listen carefully to the actual lived experiences and real reflections of the leaders, aiming not to influence the participant.

The interviews were all virtual due to the public health requirements during the COVID pandemic and lasted approximately an hour each. They were recorded with participant permission and transcribed. Participants were invited to take part in the research within a month of attending a Neurosmart^{TM} workshop. They were invited by email. Initially there were a number who were willing to take part, but those finally involved were the ten who were able to put aside the time for the hours interview.

The email opened with:

'To complete the research, I now need to understand how this knowledge is being used in practice by senior, experienced leaders like you and it would be splendid to be able to capture your valuable insights and reflections.'

Participants came to the interview with plenty to say and well prepared, in the sense that they had clearly reflected on the content of the workshop and what they had done with their new knowledge, or what they thought about it.

3.9 The position as researcher

As a qualitative researcher there will always be direct personal contact with participants at most stages of the process. As the person, having designed, delivered the workshops myself and conducting the interviews I was thus 'co-constituting' the rich data emerging from this research. As a phenomenological researcher there is 'no way in which we can escape the world in order to study it' (Hammersley and Atkinson, 2019). It is important, therefore, that any biases arising from this level of involvement are evaluated and critically assessed (Altheide and Johnson, 1994) to the best of one's ability at all stages of the research. This required a high level of reflexivity given the design of the whole. This is discussed in further detail below.

3.9.1 Reflexivity

The issues of researcher bias along with participant bias are the most significant potential limitations of this research project. As such holding a solid reflexive stance at all phases of the project was of particular importance so as to ensure that it was possible to have enough distance to be able to assess any actual value reported by participants. Reflexivity was actively built in at all phases of the research in order to best assess actual value of the workshop outputs as neutrally as possible from a phenomenological perspective. This reflexive effort can be usefully divided into three main stages; before, during and after/the analysis phase of the research activity.

At the workshop design phase, the before stage, the pilot group of senior women leaders were used as the main element of this reflexive effort. As researcher designing a workshop I was keen to test the potential workshop content on these female leaders. Participant bias was a possible risk/limitation at this phase given that all the women leaders were giving their time to support me as researcher so could be considered professional 'friends' in that regard. That said these pilot group participants are also very busy leaders who would not waste their time. There had to be some value add for them to make space in their calendars. In addition they were also prepared to be very frank about what aspects of the potential workshop content were practically valuable to them and which not. There was a level of honesty from them as senior leaders not given to time wasting that was important to reducing researcher bias at this pre-design stage of the workshop development. I kept careful notes of these sessions and as I built the workshop I discussed in my coaching supervision sessions what elements I was planning to include and why. These conversations with my coaching supervisor were also part of my commitment to reflexivity and keeping out my own personal bias as to what could be included as interesting and useful. Justifying the workshop content and explaining it in the supervision space was helpful at this pre-delivery phase of design.

The workshop delivery phase took place predominantly over two years. The client com-

panies and the cohorts of participants where the workshop was delivered represented very demanding audiences. Given the demanding nature of the participants content for the whole programme was reviewed by an internal pilot groups from the clients on an on going basis. This involved multiple feedback sessions on the content and actual delivery of the workshop. This pre workshop pilot group occurred before each set of workshops as the audiences varied with each cohort. This provided a useful element of reflexivity as I was forced by the process to take distance from the content and mode of delivery and was also getting a lot of information about what senior leaders were interested in and found valuable. This along with continuous external supervision from my personal supervisor and the support from the coaching group involved with the Professional Doctorate process provided reflexive space at the delivery/during phase of this research. The reflexive conversations with my academic supervisor, colleagues from the Professional Doctorate were important as part of this stage of the reflexive process. These groups provided a reflexive sounding board going forward and one which I added to for the later stages of bracketing too. The support of these groups of critical friends is discussed further in the bracketing section below.

At the stage of actual data gathering I did consider having the interviews undertaken by a neutral third party, who would be more impartial to any conflicting evidence (Seidman, 2006) which would therefore mean the outputs could potentially be more valued (Robson, 2002). After lengthy consideration and discussion with my academic supervisor, I chose not to do this since an outsider not familiar with the topic of brain gender differences would inevitably be limited in their capacity to ask additional probing questions and explore some of the nuances and richness that could arise during interview. The final judgement was that the phenomenological methodology with bracketing interviews throughout would support the mitigation of some of the personal bias on the part of the researcher to an extent that would outweigh the risk of not obtaining sufficiently rich and textured data during the interviews. However, given that I both designed and delivered the workshop the risk of bias and the need for a very high level of reflexivity to mitigate bias as well as possible was very important. A very thorough bracketing process involving different groups as reflexive sounding boards was carried out. Details of the bracketing process are set out below. The groups of people I called upon to support the post/analysis phase of the project were the group of colleagues also undertaking the Professional Doctorate, my internal supervisor, my external supervisor and two critical friends who understood the academic endeavour but were not directly involved in any way. The aim of involving these critical friends at this stage was to have some completely fresh perspectives on the project.

The aim was to to strengthen my self reflexive criticality through repetitive checking of my own interpretations at all stages of the research (Whittemore et al., 2001).The next sections examines in more depth some of the issues in relation to participant bias as a separate issue from researcher bias.

3.9.2 Influence of power distribution in interviews

Power dynamics is an important consideration in relation to these interviews and links to some of the quality and reliability issues discussed in Section 3.10. Power in an interview exchange is constantly negotiated between participants (Thornborrow, 2014). Power in the research interview context can be defined as controlling or constraining the contributions of the less powerful participants by the more powerful participants (Fairclough, 2001). A risk in respect of this research project is that participants who have self-selected to be part of the research could tend to try to please me as the workshop leader with their responses in interview, thus imbuing me as interviewer/owner of the workshop materials with power over them; so in establishing each interview I made it clear that I was seeking to hear the participant's actual experience/honest feedback and that their truth was more important than any positive 'spin'. I also sought during the interviews to maintain an overview of the dynamics during the exchange. The aim was to maintain awareness of how knowledge was being created (Aléx and Hammarström, 2008) so as to minimise power problems and maintain reflexivity. This managing of the power problems through reflexive awareness and management links strongly to the act of 'bracketing' as part of this research process. This is discussed in more detail in Section 3.9.3.

3.9.3 Bracketing for this project

I took the view that biggest risk in this project would be that of my bias as the researcher. My interest as already variously noted came from my personal experience that many businesses miss the benefits that an understanding of a brain sex differences might bring. That means that I hold the desire to see the value to participants from the workshop content. It is important for the validity of this research that any natural bias is clearly dealt with at each stage of the project, which has meant that the bracketing process has been particularly important throughout. Given this importance I read and prepared carefully for the bracketing process at each of the main stages of the research project. This active use of bracketing was a repetitive process whereby as researcher one goes into and withdraws from the data aiming to continuously gain a clearer picture and then reflect upon and compare the research output with the wider cultural context (Gearing, 2004; Tufford and Newman, 2012).

3.9.4 Tensions in bracketing

By definition the nature of this type of research is highly subjective and as the researcher one is the 'instrument for analysis' in all phases of the work (Starks and Brown Trinidad, 2007). Bracketing aims to help avoid the worst of the 'deleterious effects' of researcher bias and also has the potential positive of supporting deeper levels of reflexivity (Tufford and Newman, 2012).

Bracketing evolved within phenomenology as a philosophical and research movement (Small, 2017) ,though over time bracketing has, perhaps inevitably produced academic and operational tensions. Phenomenology gained popularity and credence when Husserl published 'Ideas' in 1913 (Husserl, 1958). Husserl's aim was 'direct seeing', which he defined as the essence of the experience under investigation (Husserl, 1958; Gearing, 2004). This process of trying to look beyond preconceptions became known as bracketing (and also as phenomenological reduction and epoche). Some students of Husserl developed differing approaches, notably Heidegger who rejected bracketing as a concept (Smith and Smith, 1995). He thought that any observation was a socially interpretative process and that it was not desirable or possible to reduce preconceptions to almost nothing (LeVasseur, 2003). Various schools of thought developed in relation to these two almost opposing stances and the debate continues (Tufford and Newman, 2012). This has led to multiple definitions of what constitutes bracketing, when it should be used and by whom and how (Tufford and Newman, 2012). This variety is also part of the richness of the process that can make it effective in qualitative research. One generally agreed principle is that bracketing should not be undertaken in a solitary manner and that it is of vital importance to explain how bracketing has been approached in each case (Beech, 1999).

Due to the importance of not becoming unduly influenced by my own preconceptions and my choice of the phenomenological psychological method it was important for me to have bracketing support and oversight at each stage. I chose to do this through bracketing interviews with three different constituencies at every phase of the research. I am an extrovert and exploring my thinking through talking works much better for me than through writing/journaling. The groups of people I used to support me in the bracketing interview process were my supervisors, two critical friends from different backgrounds and the Doctoral coaching group that we formed early in the D. Prof journey. I found that the process was particularly important in the early stages of developing the research question since this early bracketing demands a high level of self-awareness to identify the preconceptions that come from one's own background and experiences (Charmaz, 2006). From a neuroscientific point of view the amygdala (the 'guardhouse' of the brain) plays an important part in encoding for memory and personal experiences and this shapes the brain's actual response to experiences (Damasio, 2012) . Because of this, separating oneself from the preconceptions that come from class, gender, race and other social influences is a real challenge, my chosen method throughout being for bracketing interviews across the three constituencies which significantly supported the process.

3.10 Quality issues in qualitative research

One of the criticisms of attempting rigorous qualitative is that it lacks scientific rigour (Jones, 2002), especially as to whether the principles of validity, reliability and generalisability can be applied in qualitative studies(Stenbacka, 2001). It has been argued that alternative criteria are more relevant and applicable in qualitative research and the concepts of credibility, transferability and conformability have been put forward as better suited to the interpretivist approach (Seale, 1999; Lincoln and Guba, 1985). Mays and Pope (2000) argue that the concepts of validity, reliability and generalisability can indeed still apply in qualitative research but that they should be modified to take account of the different nature of the research. So, at this point I considered these concepts in more depth in relation to qualitative research at this point.

3.10.1 Validity

Joppe (2006) defined research validity as whether it 'truly measures that which it was intended to measure or how truthful the research results are'. Mays and Pope (2000) outline key ways in which validity can be improved:

- Triangulating results via different methods of data collection
- Asking participants to validate research interpretations
- Being aware of researcher bias in data collection
- Considering participant data that may contradict other data collected
- Ensuring a wide variety of perspectives are used in the research

For this research project participant validation was used as the most appropriate method of ensuring validity. It was not possible to triangulate findings. As the researcher, I used the 'bracketing' process, bringing current assumptions as actively into awareness as possible, into each of the steps in the research process. Contradictory participant data was held alive throughout the process of developing the conceptual framework. As many participants as possible were interviewed with a view to keep a wide variety of perspectives involved in the process.

3.10.2 Reliability and credibility in qualitative research

Joppe (2006) defines reliability as:

'The extent to which results are consistent over time and an accurate representation of the total population under study is referred to as reliability and if the results of a study can be reproduced under a similar methodology, then the research instrument is considered to be reliable.'

This approach to reliability is not possible within this particular research design given that the research question is looking to understand lived experience in individual cases at particular points in time, rather than produce a study that can be systematically repeated. So, I chose to focus on credibility (Patton, 1990).

Patton highlights three distinct concerns that enhance the credibility of qualitative analysis (Patton, 1990). The first is rigorous techniques for data gathering. In relation to this element of credibility it is especially important to describe very precisely each of the steps involved in the researching process. Ritchie et al. (2003) outline methods to support the credibility aspect of qualitative research:

- Conducting and reporting in a systematic way
- Ensuring that interpretations are supported by the data
- Asking for clarifications when there is uncertainty (Shank, 2006)

Whilst the interviews were semi-structured and varied in time, I was mindful to use as many systematic elements as possible to maximise reliability. The outline interview questions were the same for each participant. Each participant was sent the same information pack of the set-up questions before and in preparation for their own session. Each interview was designed to last for one hour with a 15-minute excess, if needed, but no more. I opted to record the information in the same way each time and the transcript write-up followed the guidelines outlined in Section 3.7.2. I also undertook quality control checks for the transcription write up. This mainly involved reviewing the recording and checking it against the actual transcript. Clarification questions were included to ensure that if a participant's comments were not completely clear this was dealt with at the time of the interview. The second aspect that Patton highlights is the competence and trustworthiness of the researcher but offers no clues as to how these qualities might be observed.

Finally, an important aspect of credibility is checking that one is seeking genuine generalisations versus extrapolations (Patton, 1990). This research reviewed data for any themes that might emerge and as such the search for generalisations is fundamentally part of the design. Generalisability is explored in more detail 3.10.3.

3.10.3 Generalisability – external validity

Given the specific individual nature of much qualitative research and small sample sizes, generalisability is a challenge, though the face-to-face literature proposes that there are ways that the concept of generalisability can be applied to qualitative research (Ritchie et al., 2003). It suggests that one can infer from one context to another provided that the 'thick description' (Geertz, 2008) from the original research is shared. Representational generalisation is also possible where it is clearly demonstrated that the participant sample is a true reflection of the population under investigation and also that the conclusions drawn

are an accurate reflection of the data analysis of the experiences reported by participants (Murphy et al., 1998; Ritchie et al., 2003). Morse (1999) is very firm in saying that 'if qualitative research is not considered generalisable then it is of little use, insignificant and hardly worth doing'. Clearly qualitative research is not generalisable in the same way that positivist scientific studies might be considered to be but there is, however, an essence to qualitative research in relation to human study that is of inherent importance in generating new insights and understanding.

3.11 Ethical considerations

This research project is a people intensive intervention. As such, relevant robust research guidelines for ethical rigour were required. The ethical considerations needed to ensure ethical rigour from a number of key perspectives, ensuring:

a) All relevant ethical considerations in respect of the psychological and emotional aspects of the research are recognised

b) Ethical standards are adhered to in respect of professional standards within coaching

c) Ethical standards are considered from a research perspective

d) The law must be upheld in respect of data protection

Gray (2021) defines research ethics as 'the appropriateness of the researcher's behaviour in relation to the subjects of the research or those who are affected by it'. He espouses four key principles in relation to working ethically with participants:

a) Avoid harm to participants

b) Ensure informed consent from all participants

c) Respect the privacy of the participants

d) Avoid the use of deception

As a professional executive coach these are the basic principles I work with on a daily basis so I am experienced in managing ethical challenges and issues. For example, holding the boundaries around privileged information when working within organisational systems is a daily part of my work. Taking on research at Doctoral level does, however, bring with it a wider range of considerations and it has been both important and useful to review several ethical codes in detail by way of preparation for the data gathering phase of the research.

The four relevant ethical codes that I applied in this project are:

- UWTSD who gave ethical approval to do the work
- Psychological and emotional safety of participants: British Psychological Society's (BPS) Code of Human Research Ethics.

- Professional standards in executive coaching: The Association for Professional Executive Coaching and Supervision (APECS)

- Research ethics: UWTSD Research Integrity and Ethics Code of Practice

- Data Protection: Ensuring that my data handling processes are in line with the law

The BPS Code of Human Research Ethics is very comprehensive and covers the following key principles:

- Respect for the autonomy, privacy and dignity of individuals and communities

- Scientific integrity

- Social responsibility

- Maximising benefit and minimising harm

- Risk

- Valid Consent

- Confidentiality

- Giving Advice

- Deception

- Debriefing

3.11.1 Ensuring ethical considerations for this project

To ensure that ethical considerations were properly handled for this research project participants were informed beforehand of the research procedures and provided with a cover letter, consent form and an information pack before the interview. The interviews only went ahead once written consent had been obtained. The cover letter assured the participants that their personal data would be held anonymously in line with data protection legislation. Full confidentiality was guaranteed, which is a normal part of the coaching process. Participants were advised that they could pull out of the research without consequence should they so wish. They were also told that they were free not to answer any of the questions. It was also made clear to them that they would receive a full debrief and details of any useful information arising from the research that might support them in their business endeavours. Each participant was asked whether they had any concerns of any nature before the interview and recording began, and none had.

3.12 Summary of research design

This Chapter has detailed what I considered to be the most appropriate choices for the research design in all its phases of development and ultimate overall design. This is summarised in Figure 3.1 of the "Research Onion" (Saunders et al., 2012) which, in the early stages of the literature review for research methodology proved helpful for how each element of the research design might fit together. Figure 3.1 has been adapted from Saunders et al. (2012) with my chosen research methodology elements highlighted in red.
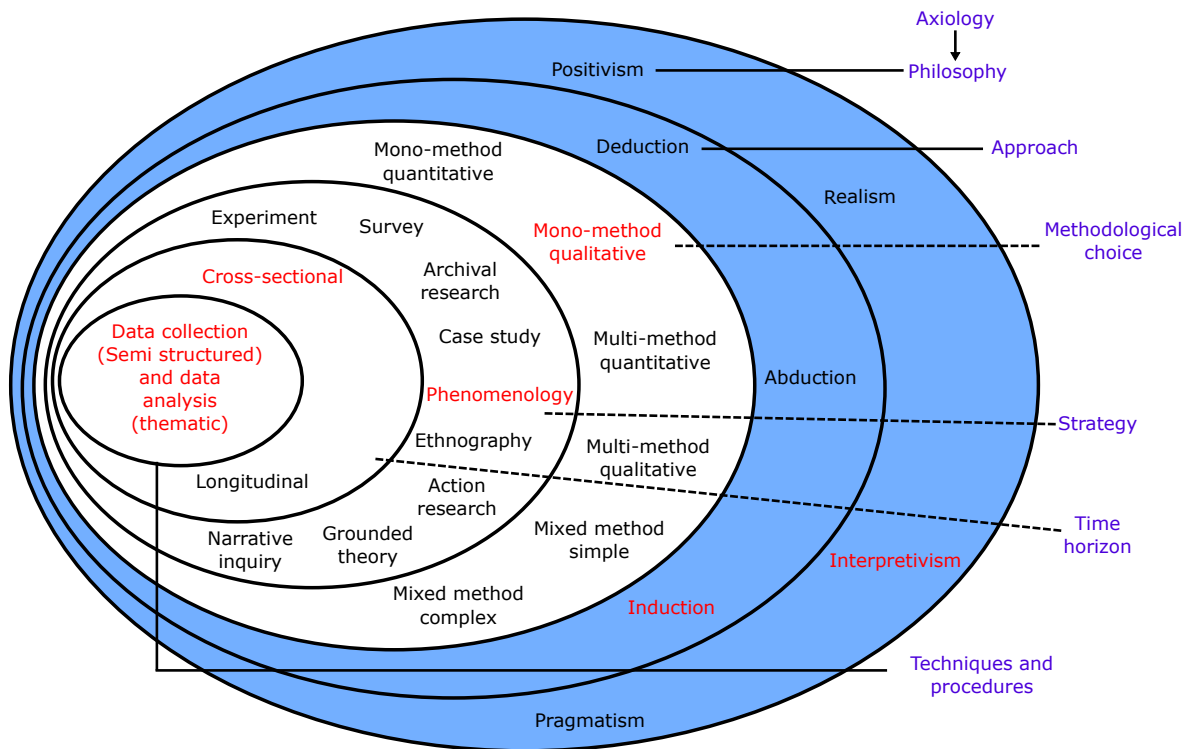
Figure 3.1: Research Onion adapted from Saunders et al. (2012) with overall methodology used in the present work highlighted in red.

Chapter 4: Project Findings

4.0 Chapter overview

My own data was collected over a period of six weeks in the form of ten semi-structured hour-long interviews with the selected participants (selection process detailed in Chapter 3). This resulted in ten hours of verbatim transcribed interviews. This Findings Chapter opens with a description of how data from the ten interviews was reviewed and analysed in the light of the phenomenological methodology discussed in Section 3.5. This is followed by a headline summary of how the key themes were identified in the interview data, how these became codes and includes five Coding Tables for each theme. These coding tables provide the next level of detail about the definitions of five key themes and their associated subthemes, and the main procedures for coding all with reference to the actual interviews. The Chapter then sets out in detail the relationship between the themes and subthemes.

4.1 Thematic analysis: The process-an overview

The aim of thematic analysis is to look for common patterns of meaning arising in what participants are talking about in the interviews allowing the phenomena to 'speak for themselves (Gray, 2021). These patterns finally form themes that reflect shared meaning organised around a central idea or concept (Braun and Clarke, 2019). The thematic analysis process is investigating these patterns in the data in relation to the research question (Gray, 2021). Given that the research methodology for this project is phenomenological, using the phenomenological psychology method, as summarised in Table 3.2, it was important to let the essence of each leader's experiences emerge. As discussed in Chapter 3 the main purpose of this thesis was to obtain an integrated picture of the phenomena arising from the one-on-one meetings (Giorgi, 2013). To enable this I undertook three separate reviews of the verbatim transcripts using the four framework analysis phases set out in Chapter 3 (Ritchie et al., 2003). At different points in this process, I also applied three steps as set out by Spinelli (Spinelli, 2005), these are denoted as reviews below. These are described in Sections 4.1.1 to 4.1.3. As discussed in the Methodology Chapter section 3.9.1 maintaining consistent and rigorous self-reflexivity was a particularly important aspect of this project. At the thematic analysis stage repetitive bracketing efforts became an emphasis and was the dominant self-reflexive technique used. Spinelli also termed bracketing as 'un-knowing' (Spinelli, 2005). In order to make best efforts to reach this state of 'un-knowing' my approach was to undertake a bracketing interview/discussion with one or more of my 'critical friend' contributors both before and after each review. These were a very important way of remaining self reflexive and maintaining an awareness of where my own preconceptions lay and attempting to keep them away from the process of interpreting the data. The sections below explain in detail how the definitions for the main themes were arrived at and the procedures for the final coding.

4.1.1 Review one

In the first main review of ten hours of transcribed interviews I read through and highlighted any comment that might represent a segment of meaning without ascribing it to any code at this stage. This was a highly iterative process. Initially it was difficult to read and review the data without instinctively being tempted to interpret it. Taking distance from the data such that this process became a deep immersion in the phenomenology that was being described without coding at this point took time and a shift of mind. This early part of the process highlighted one of the limitations of this methodology being researcher bias as discussed in 3.9.1. I had to actively step back from the review activity and allow my thinking to settle so that it was possible to better stand back from the data and review with a much more open mind. This process was an important element of the self reflexivity involved in this project design and methodology.

Once my bias to action had been (best) settled at this point I then began a simple highlighting process that selected comments in the data that appeared to be in common across different participants in relation to the research question (Gray, 2021). This was to help immerse myself deeply into each conversation with as open a mind as possible. I wanted to become deeply familiar with each conversation. At this stage I actively held back from thinking about assigning a code to potential segments of meaning. I was focusing on segments of meaning that could possibly be considered a pattern. There was an aspect of noticing the 'size' (Braun and Clarke, 2006) of the segments of meaning that might be considered a pattern in the data. This review reflects phase one of the framework analysis from Ritchie et al., 2003, detailed in Section 3.6.1.

4.1.2 Review two

In this second review, reflecting the second phase of the framework analysis (Ritchie et al., 2003), I engaged with the question: 'What are they talking about?' I was now looking for shared 'meaning making' and started the beginning of the coding process based on what I considered common segments of meaning that were connected to a similar central idea (Braun and Clarke, 2019). In this case it was looking to see if there were patterned responses in common reflecting 'What' participants were talking about. This was also an iterative process that involved the same degree of stepping back from the data as the first review stage. I engaged in several discussions with the different cohorts of critical friends. This was part of the ongoing bracketing process. This phase was frequently confusing as the attempt was made to begin to assign codes. For instance all participants discussed what they had used the information from the workshops for at work, they also discussed how they had used it. The purposes to which the workshop content had been put and the range of approaches to application resulted in many potential codes emerging at this review stage. Presenting possible codes based on my analysis to the audience of critical friends and receiving feedback on them to achieve clarity and cohesion out of initial chaos was a

vital part of the coding process.

In this second review I was careful to 'describe don't explain' (Spinelli, 2005). I also applied the so-called equalisation rule (Spinelli, 2005) which encourages the researcher to avoid giving hierarchies to items but rather initially treating each has having equal value (Spinelli, 2005).

By the end of this review phase all the data had been initially coded but not assigned to themes or sub-themes at this point.

4.1.3 Review three

This part of the process involved reducing the overlaps and redundancies in codes. This review involved both phases three and four of Ritchie's framework analysis (Spinelli, 2005). This took time and multiple reviews looking at the data through the lens of the question 'What are they talking about?' Once this had been done, I started to collapse the codes into themes. This time I engaged with the question:

"What (if anything) does what each person is saying have in common?" or "Is there any common thread to what each person is saying?"

I was careful to go back over the original full transcripts to see if there was anything that was important that had not been captured. This process was again highly iterative (Pope et al., 2000) and it was helpful to talk through the collapsing process with the community of critical friends to test my ability to explain the themes that were emerging. I was consistently checking for any outlying comments that did not fit with anything else and checking the common themes as the segments of meaning crystallised with the concept of equalisation (Spinelli, 2005) in mind, in total, there were 36 codes that emerged across all the data. I looked carefully at what these codes had in common which I then clustered and collapsed these codes into five themes.

Some of the five main themes were beginning to stand out as much clearer than others. The purpose to which participants had put the new workshop information and the process of how they had deployed it were the clearest segments of meaning. The challenges of using workshop content in particular situations also stood out reasonably clearly from the data. The impact of using the information and the insights and reflections arising for leaders was less clear. However, upon reviewing the references within the codes the distinction between impact and insights and reflections started to emerge. The differences and reasons for distinguishing these themes and their subthemes is set out in detail in 4.2.1.

Once each of the 36 codes was sitting within its theme, I then grouped and re-named the subthemes within each theme for consistency and this is the description used for future reference in this report and set out in Table 4.1. This stage of the activity represents

the fourth phase of Ritchie's framework analysis (Ritchie et al., 2003). At the end of this iterative process I also checked the data for any left-over comments that might be important as outliers. There remained only a few comments which upon review did not hold any meaning so were not included and as such did not constitute important outlying ideas. A summary of the themes follows in Sections 4.1 and 4.3 details how the codes distributed out into the themes and subthemes and includes detailed definitions of the sub-themes with examples of what participants actually said. These examples are called references throughout this document.

4.2 Summary of themes

In total there were 487 references taken from the ten transcripts where comments were relevant and important given participant's reflections, experience of and usage of the content from the Neurosmart^{TM} workshop. These 487 references were coded and coalesced into five themes, each with associated subthemes, over several iterations. The themes are presented here in order of most frequent to least frequent:

1) PURPOSE: 189 references

   - What the content was being used for.

2) PROCESS: 144 references

   - How the content was used.

3) IMPACT: 75 references

   - The impact in the workplace and at home.

4) INSIGHTS and REFLECTIONS: 41 references

   - The insights and reflections that were prompted for participants.

5) CHALLENGES with implementation: 38 references

   - The challenges with organisational implementation.

4.2.1 Theme one: Purpose
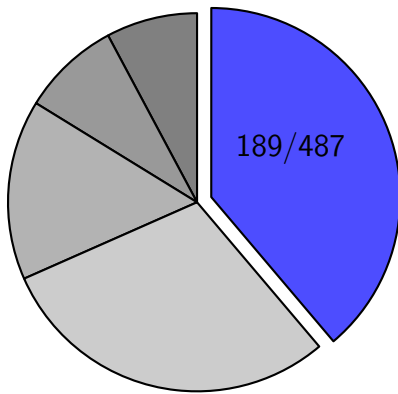
This was the most heavily reported theme and refers to the specific purposes to which participants were applying the new knowledge. All ten participants reported on this theme. The hallmark of the quotes in relation to this theme was that participants were applying the new knowledge from the workshop to immediate challenges that came from within their direct work environment. The usage in this regard was predominantly tactical and relating to live current issues. This 'What For' superordinate theme had just over 9% more references than the next closet theme. This superordinate theme broke down into five distinct subthemes.

4.2.2 Theme two: Process
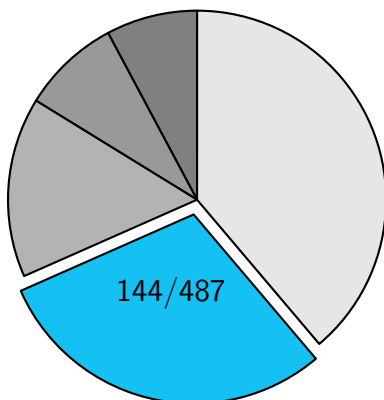
This was the second most reported theme and refers to the specifics of how participants went about applying their new knowledge in practice. The information about how they were applying the knowledge links directly to what they have been using it for on the whole. All ten participants reported on this theme, which yielded some 9% less than the 'What For' theme but some 14.5% more than the next closest theme. There were three distinct subthemes in this superordinate theme.

4.2.3 Theme three: Impact
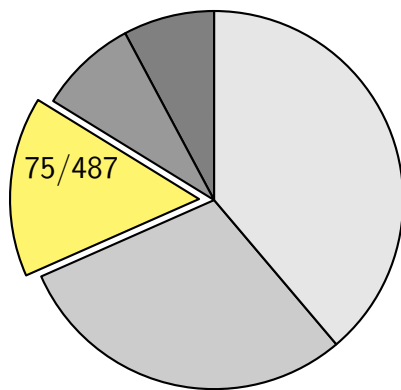
Impact refers to specific results and outcomes that had been noted by participants, such as the differences that using the newly acquired knowledge had on their work. In many instances the impact was described in relation to the specific purpose that the knowledge was being used for. However, in this theme participants also referred to the impact and outcomes more broadly, mentioning results from situations they had not previously described in relation to either of the themes above. Eight participants reported on Impact. There were four subthemes recorded.

4.2.4 Theme four: Insights and reflections
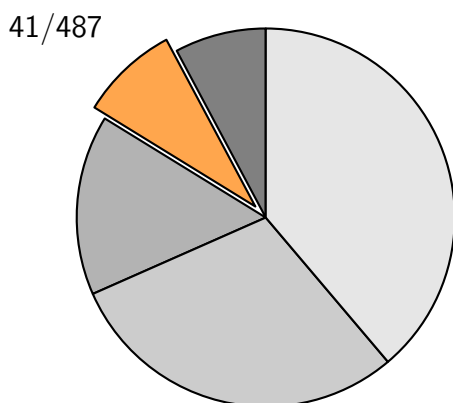
The definition 'insights and reflections' refers to the thoughts that had been provoked in participants by the workshop content but that did not link to any direct action that participants had taken. Another way of expressing this could be the musings of the participants in contrast to any practical outcomes. Eight of the participants reported in this superordinate theme. There were three subthemes.

4.2.5 Theme five: Challenges with implementation
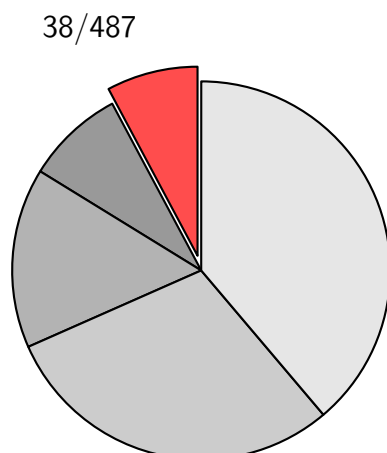
This theme struck me as a separate theme from insights and reflections in that participants were describing problems and challenges with implementing the knowledge from a practical point of view. The references had a practical, grounded quality to them. There were three subthemes that emerged within this theme.

In Section 4.3 the subthemes are set out under each theme in the form of a table.

4.3 Coding tables

The coding tables in this Section give an overview of each theme and its subthemes. They present each subtheme and their relation to the main theme. Also included are sample references to illustrate typical participant responses, and data of the total number of references associated with each subtheme and from how many leaders these references came from. Section 4.4 then expands on the theme and subtheme data.

Tables 4.1 to 4.5 are the coding tables for the themes Purpose, Process, Impact, Insights and Reflections, and Challenges respectively.

Table 4.1: Coding table for Purpose; summarising subthemes, samples of participant references, number of references, and number of leaders out of ten who commented on each subtheme.

Subthemes	What is it being used for?	Sample references from participants	No. of refs	No. of leaders
Sub theme 1: Enabling differences	Enabling differences in a team or group	Particularly when you're faced with short timelines, a whole new team and then a very intense pitch process. Where you need to come across as a well-connected team that the client would want to work with- how you create an environment of trust, how you create an environment that completely works with very diverse teams and diverse perspectives. How you bring out the best in those people in that intense short time period, I think was really useful.	80	10/10
Sub theme 2: Leadership	Adaptations of leadership style/approach	Having worked out where people are, to know, right that person is ultra-extreme male brain, like what is at number one or whatever. Therefore, in my interactions with them, it needs to be modified in this way and because they're meeting me, and I'm over here somewhere, how do we get closer to the middle.	41	9/10
Sub theme 3: Planning communications	Planning and delivery of meetings and formal communications	Then the RICH framework as well, so, applying that to almost every single meeting that we have. I used it for- I did a webcast video for all of [company] at the same time, to boost myself.	20	3/10
Sub theme 4: Female leadership	Enable female leaders	I get to mentor most of the women who are in our organisation. The understanding passed on to them of female power, I think is the best way of putting it. Of the fact that the feeling they often have of being excluded from higher level strategic discussion. The feeling they have of being unseen, and unheard and the feeling they have of being side-lined and unrecognised for promotion. Is largely not a product directly of a vindictive campaign to exclude them from the upper level of science. But actually, a product of the system, which is guided towards nurturing a particular kind of brain and a particular kind of behaviour. By the system I mean literally the metrics that are applied to measuring how well they're doing.	15	4/10
Sub theme 5: Homelife	Use within family at home	Hearing me talk about it last week when I was on holiday with my family and my in-laws and all that sort of stuff. So, at a personal level, I have been obviously really stimulated by it. I mean, I have brought it into my personal life...	10	4/10

Table 4.2: Coding table for Process; summarising subthemes, samples of participant responses, number of references, and number of leaders out of ten who commented on each subtheme.

Subthemes	How is it being used?	Sample references from participants	No. of refs	No. of leaders
Subtheme 1: Brain sex differences	Knowledge of brain sex differences used	My first reaction which did kind of start to pop out was, "Do you think I don't know what I'm doing? It's kind of logical, I've already thought through the process, I've got time so I'm going to do it, why are you asking that?", at that point she turns and looks like 'here we go again', at which point even as I was saying it I was thinking, She's asking because she's putting different things together and has a good question.	45	7/10
Sub theme 2: Brain response	Knowledge of brain response as emotional before rational used	There were times definitely where some directors would react strangely to a particular thing. I guess your explanation of the thought process and the different triggers, emotional triggers, that would create that reaction. understanding that more and then exploring and being curious around that. As opposed to then my own emotional reaction and creating that then slightly confrontational challenge, which was really useful to avoid.	31	7/10
Sub theme 3: Model usage	RICH^{TM} and 4 C's^{TM} tools used	Then the RICH framework as well, so, applying that in almost to every single meeting that we have. ...otherwise, I would have a tendency to drive all the conversations. And actually, taking a step back and hearing what they have got to say allowed them all to have a voice, which is, ultimately, what the 4 C's is about.	31	6/10

Table 4.3: Coding table for Impact; summarising subthemes, samples of participant responses, number of references, and number of leaders out of ten who commented on each subtheme.

Subthemes	What is the impact?	Sample references from participants	No. of refs	No. of leaders
Subtheme 1: Relationships	Improve relationships	I first began to learn about neurosmart, as you know, two, two and a half years ago. So, what it's done, I think is strengthen the understanding of the process and it's also provided techniques for managing the relationships well. In particular where conflict or unseemliness or inability to engage was present in these later stages.	30	7/10
Sub theme 2: Self-awareness	Better understanding of self and others	...do I think it's also because I'm thinking: Well, no, actually, it is different. Maybe I need to think and understand that difference. I found that more upsetting, in a way, interestingly enough. To ignore it was maybe easier than it is to think about it. Having thought about it more, and you raising some of those thoughts even more so, probably makes it more difficult than easier.	18	4/10
Sub theme 3: Memorability	Memorability of concepts	Just the idea that there's a spectrum of brains and different attitudes in different people. Just simply that idea is enough for this very intelligent person who's in their 60s, to pick up on the fact that they need to think a little before they speak. I think that's already made a difference. I think in a very short order. So, no formal training, coffee conversation about the concepts instantly has an impact.	18	5/10
Sub theme 4: Outcomes	Supports business outcome delivery	perhaps not even considering what I thought those outcomes needed to be. That sounds quite lazy and I don't think it's that, I think that sometimes I thought- I'd got to meetings with my agenda in my head and think this is all going to be fine. Then if somebody slightly railroaded me, I'd think, mmm, how am I going to get to back. So, now I'm much more in control.	16	4/10

Table 4.4: Coding table for Insights/Reflections; summarising subthemes, samples of participant responses, number of references, and number of leaders out of ten who commented on each subtheme.

Subthemes	What insights have there been?	Sample references from participants	No. of refs	No. of leaders
Subtheme 1: Brain diversity	Impact of brain difference at work	the concept of brain gender is in itself, given the male and, so you know, we're making an assumption about males and females in terms of what the characteristics are, and then subsequently going into this brain gender piece align along the male and female brain, and effectively what it tells me is that the way people are brought up, it's less about "gender" but more about different types of thinking...	22	6/10
Sub theme 2: Organisational scaling	Curiosity about scaling across a whole organisation	I genuinely believe that most of the staff would actually benefit quite a lot from understanding these models. how to scale these thoughts into larger organisations, through systematic training programmes. By approaching people who aren't egotistical males, as your first point of entry, is I think an interesting thing.	10	2/10
Sub theme 3: Academic underpinning	Interest in academic underpinning	I wanted to understand some of the academic literature behind the thesis.	5	2/10

Table 4.5: Coding table for Challenges; summarising subthemes, samples of participant responses, number of references, and number of leaders out of ten who commented on each subtheme.

Subthemes	What were the challenges?	Sample references from participants	No. of refs	No. of leaders
Subtheme 1: Anchoring new habits	New habits hard to anchor	It's this time-poor thing. I see that it's useful, but the challenge for me is taking it from something that is interesting, that I apply occasionally, to something that is interesting, that I apply systematically. ...partners, that they are always-on individuals. So, it's quite difficult. It's how do you get people to apply learning in that always-on mentality.	19	7/10
Sub theme 2: Dominant culture	Dominant male culture a force against change	It's really interesting, we talk a good game about, and one of our leaders in particular is really a strong advocate for it. Yet because we are such a male dominated team, it's still taking a while.	15	3/10
Sub theme 3: Multiple variables	Multiple factors influence, and a lot in common between men and women	Obviously male and female competencies, like spacial awareness, or whatever, are two Gaussian distributions and they're overlapping. ...I think that Gaussian distribution is another complicated factor, about the application of such thinking.	11	2/10

4.4 Relationship between themes and subthemes

4.4.1 Purpose: What is the content used for?

The purpose to which the new knowledge was put was the dominant theme from the interview data, totalling 189 total references. All ten leaders talked about what they had used the new information for. The interviews started in a very open way with the question about reflections since the workshop. Most leaders began the interview talking about purpose. As a whole leaders used the new information to try to notice different strengths that different people bring as well as think about improved ways to involve and use these strengths more effectively in a variety of circumstances:

"Who is bringing what here and where are the real strengths because there's strengths across the spectrum. Then how do we get each of those people into their thrive. To be able to think about that and really dedicated the time to that, I think is really powerful."

The subthemes detail in a more specific way on which circumstances, leaders actually did use their Neurosmart™ experience and the areas they particularly focused on. The subthemes are detailed below starting with the most prevalent.

Subtheme one: Enabling differences in teams/groups

All ten leaders mentioned using the Neurosmart^{TM} content to help them think about differences in thinking and perspectives within their team/s. The majority talked about actively reflecting on brain diversity in the service of the team task in order to support the team to be more effective. This was often through seeking to build trust more quickly and effectively between team members.

"How you create an environment of trust, how you create an environment that completely works with very diverse teams and diverse perspectives. How you bring out the best in those people in that intense short time period, I think was really useful."

Six of the ten mentioned using the new information for the purpose of speeding up team effectiveness. They did this through using the workshop content to try and create a more equal access to airtime in meetings, opportunity to challenge and put opposing opinions forward. The new information enabled them to identify a deeper level of diversity in their team members along with what some of the particular challenges for some team members might be:

"Exploring that and trying to get to the bottom of why that is and this sudden realisation of how it is a very sales macho, male dominated environment. That would therefore be quite intimidating for some, and really getting to understand that. Then trying to work with some of our female directors to be more, not to become more male like, because that's the last thing we want. But to just be more confident about speaking openly and challenging and actually contributing more to that conversation. Because there's so much to add and so much input for them to give."

Subtheme two: Adaptations in leadership approach and style

Nine of the ten leaders talked about how they had used the workshop content to understand themselves differently and make sense of other's reactions better. They used the knowledge for reflecting on and preparing differently for interactions. They reported readying themselves for adapting their leadership approach.

"I've thought, right, actually in my next interaction I need to know how to handle that a bit differently"

The act of reflection resulted in leaders using insights for the purpose of adjusting their leadership approach/style. They reported the application of this reflection and adjustment to particular situations or with particular individuals. Some leaders had used the knowledge to think more about themselves and some had applied it more to understanding the other individuals involved.

"Having worked out where people are, to know, right that person is ultra-extreme male brain, like what is at number one or whatever. Therefore, in my interactions with them, it needs to be modified in this way and because they're meeting me, and I'm over here somewhere, how do we get closer to the middle."

The adaptations in style were also applied to questioning others differently with a focus in some cases on gaining insight into others' emotions.

"I've been desperately trying to- every conversation understand exactly where he's coming from, what his concerns are. Almost kind of, I guess teasing out his hopes and fears for the programme."

Adaptations in style and approach were also used to influence others differently by actively trying to get the other person's brain into a thrive state before communicating about the work task:

"I had to get him to a place. I'd never put the effort in before to get someone else to a place. I just assumed that they're at the destination, a bit like [name] that we just talked about. I needed to get him to a place before that we start going along the same train track together. I think your methods of teaching me how to do that, and to get people in thrive mode has really helped."

Subtheme three: Planning communications

Three leaders talked very specifically about using the content and RICH^{TM} and 4 Cs^{TM} to plan and run their meetings.

"Then the RICH framework as well, so, applying that in almost to every single meeting that we have."

"I have used the four C's model myself perhaps more, in order to guide meetings."

Two of the leaders reported using the models to help connect with team members in a virtual setting:

"...definitely with curiosity and control. Now did I do connect and compassion, maybe probably, we connected, and I got everyone's kids on the line, so that was probably quite good."

One leader used the RICH^{TM} model to support his team to run more effective meetings when he was not in those meetings. He reported feeling that there was an over-reliance on his presence and he wanted to coach team members to run effective meetings without him always in attendance.

"They're far more comfortable in their conversations. That's meetings I'm running, but I also hear about meetings where I'm not present and others are running, and they're beginning to use these ideas and those meetings are going better as well."

One leader from this group also used the RICH^{TM} model very actively for a variety of other formal communications. These included events such as a producing video links to go out to wide communities within the business. Another leader also used the models for performance management situations. All of these organisational activities can be grouped into planning communications.

Subtheme four: Enable female leadership

Four leaders described how they had actively used the insights and content from the workshop to enable female leaders within the organisation. This included leaders reporting that they felt more able to see a situation from a female executive's point of view:

"I think I've been more aware than most, and having gone through this has definitely helped as I look at the world from their eyes and see some of the, hopefully in many cases, unintended sleights and offences that are meted against them, and the almost societal bias"

Two leaders described how they had raised awareness of brain sex differences with male leaders so that these men might be more cognisant of including all brains – and hence all individuals – being different. The content from the workshops was described as having given the leaders insights with which they could support women in leadership. A particular example of this was the awareness that some of the senior women did not feel fully included into the strategy discussions in the organisation. Several leaders mentioned developing a new awareness of different ways of expressing power:

"The understanding passed on to them of female power, I think is the best way of putting it. Of the fact that the feeling they often have of being excluded from higher level strategic discussion"

Three of the leaders reported coaching female leaders to contribute and speak up in situations where they might not typically do so. This was also an example of using the workshop content to enable women to see how their perspective brought balance to a debate:

"Then getting her to feel actually that she was a leader within the team and that we desperately needed her to actually contribute and bring in her perspective on this. it's got such a good balancing affect to the other points of view that were often being communicated."

Subtheme five: Supporting family dynamics and other interpersonal relationships outside the business

Four leaders talked actively about how they were using the insights at home with family.

"hearing some of the techniques around that, I think are really helpful for children."

The application ranged from extended family to partners and children. The reported purposes including, for example influencing children to do their homework. Another reason given was that this avoided confrontation by seeing a situation from a more female, family point of view.

In some of the conversations the focus of the leader was more on the application at home than it was at work. This may well have been connected with the fact that people were working from home at this time.

"It is and despite, it's kind of funny doing something in a work context but then you use it as much personally."

"I found it as useful in a work environment as I did in a home environment, funnily enough."

All four leaders who mentioned this theme found the insights very stimulating. The implication was that it was valuable since they had taken learnings for the work environment and brought them home:

"So, at a personal level, I have been obviously really stimulated by it. I mean, I have brought it into my personal life, so..."

4.4.2 Process: How is the content being used?

All ten leaders talked about how they applied the workshop content in practice. They gave examples of how they personally had gone about deploying the insights and new knowledge in practice. The examples from this data fell quite naturally into three distinct subthemes which are reviewed below.

Subtheme one: Brain Sex difference at work

Seven leaders talked about actively reflecting upon and using brain sex differences as a result of the workshop. One application of brain sex difference was a leader thinking about how the awareness could improve agile thinking and acting in a team context:

" the interesting bit is around how do we make our people more agile, and recognise if they are, if it goes to your current state personality type, what are the things that they can do to train themselves to be more balanced, because interoperability with other people with different personality types"

Another leader noticed that in conversations about who should be promoted the different qualities that a more female brain sex might contribute were not qualities that were being considered for promotion. This leader noticed that the fact that these more female brain sex qualities were not being taken into account in her business, but this leader could now see this:

"Because that's how they interpret. That's their interpretation. And that's not what I was hearing in the room. Nobody mentioned about... It was much more around behaviours, recognition, feeling they were making impact, feeling they were having a contribution...fairness, transparency. They are very different to promotion."

An additional reported area of practical application was leaders understanding in any moment of their own reactions and others differently.

"Do you think I don't know what I'm doing? It's kind of logical, I've already thought through the process, I've got time so I'm going to do it, why are you asking that?", at that point she turns and looks like 'here we go again', at which point even as I was saying it I was thinking, She's asking because she's putting different things together and has a good question"

One of the leaders gave a specific example of how they had chosen a team member to co-lead with a colleague who had a very different brain sex to theirs. They reported how they could see this partnership working well in practice:

"I think those two will go on to work together again, because they've seen the benefit of what each brings. I've enjoyed watching it, actually, it's almost been like a live experiment"

Subtheme two: The brain reacts emotionally before rationally thus needing more time to think actively

Seven leaders mentioned specific examples of how they were using the awareness of the brain responding emotionally before rationally to understand and manage reactions. This applied to both themselves and others in most cases. Two of the leaders talked about using this knowledge to create time to think by slowing communication down. Leaders often used their own language to describe, the concepts they had understood. This use of other terms to describe some of the key concepts from the workshop occurs in several of the themes and sub themes. This will be discussed in Chapter 4.

"But the sort of, what I would call the fight or flight reflexes, but you have a slightly more sophisticated term for them. The positives and the negatives. That I find not a bad way of preparing for a situation."

"giving that curiosity, some space for people to think."

"feel myself in the eye of the storm, saying right I need to do an energy plan."

"through every single conversation, every single interaction, building that story and road map around where his concerns are, what his hopes and fears are. Then mapping that out, so I can really understand where his agenda is and what triggers his thinking."

"I'm much more considered about the words that I use, because I am thinking about the steps ahead of me, in multiple conversations."

Subtheme three: RICH^{TM} and 4 C's^{TM} Usage

Six leaders reported ways in which they are using one or both of the tools from the workshop. The usage ranged from very formal application, working deliberately through the steps to a looser approach with a focus on one particular element of the model over the others. For example, 'Connect' from the 4 C's^{TM} was an element that a number of the leaders chose to focus on. The reasons for why this might be the case are explored further in Chapter 4.

"One thing that we set up for the first meeting, where I was looking at those two – the control and curiosity, and compassion and connect thing. I was trying to describe how we needed to be able to ... we want to be your transformation partner for the next two years"

"It's interesting, the conversation we've just had about the planning session: I probably have given time for what I would describe as "niceties", but I would have been itching to get on."

"otherwise, I would have a tendency to drive all the conversations. And actually, taking a step back and hearing what they have got to say allowed them all to have a voice, which is, ultimately, what the 4 C's is about."

"Then the RICH framework as well, so, applying that in almost to every single meeting that we have."

4.4.3 Impact

This was the third most quoted theme with eight leaders talking about examples of what the impact of using the new knowledge had been. The subthemes coalesced around four key topics. I gave some consideration about merging the two subthemes 'Better Relationships' with 'Better Understanding of Self and Others'. Upon reflection the subthemes seemed to have enough in difference rather than in common to remain separate.

Subtheme one: Better relationships

Better relationships was the dominant subtheme in impact. Seven of the leaders described how they had experienced improvement in relationships as a result of applying the new knowledge actively. One of the reported features of impact was being able to speed up understanding people's motivations both better and faster. Gaining faster insight into 'what makes people tick' was a characteristic of impact that several leaders mentioned in the context of impact. Having to work at pace was something that was much commented on during the interviews.

"I think actually the impact has been for me, with certain people in particular, just short circuit to a better relationship than I anticipated and better, more productive than I anticipated I could have. I feel like it's helped me get to know what makes people tick better."

Creating a more trusting environment between colleagues based on greater awareness of differences was another area of reported impact. Building trust through openness across diverse teams was mentioned as a constant endeavour in two of work cultures from which participants came.

"I think there's more to do there, but I think as more people go through the course and the training, which many have now. There has definitely been a shift and we've been working hard at it for a couple of years now, to try and get a more open and trusting environment."

One leader talked at length about how the impact of the new knowledge had enabled her to work better with a male colleague who had a very different style and personality from hers. She reported how the impact had improved her capacity to partner with the differences and that this had been noticed by others in the team in a way that had a positive impact on the team culture:

"We had feedback actually from the team, which was really unsolicited, that said, "we love working for you two, because you're so different. You come at a situation so differently, but you respect each other's, so you meet in the middle."

A final aspect of impact relates back to adapting styles/approaches. Several leaders men-

tioned being able to adapt communication style as a result of new insights. One in particular had shared some of the content with a colleague who sometimes struggled to communicate in an empathic way. The colleague had adopted a more friendly style with other team members where there had been some communication difficulties in the past.

"Has changed how he communicates, he now communicates in a way that's far more friendly to the particular people he's communicating with"

Subtheme two: Better understanding of self and others

This subtheme has to do with awareness raising in the leaders. This was either self-awareness or an improved awareness about and understanding of others within the broader organisational system. Four leaders talked about this subtheme and all four discussed awareness of brain differences within the wider organisational system. The dominant area of impact reported was an increased capacity to realise quickly that brain diversity and brain sex diversity in particular can generate genuinely differently perspectives.

"That what's been of value to me from your work mostly, I think has been the understanding of different types of brain, rather than the fact, the genders differ."

Although not explicitly explored, participants reported an enhanced capacity to stop and think about why others might have a different point of view: so, they took more time to take different perspectives into consideration:

"...thought about it more, and you raising some of those thoughts even more so, probably makes it more difficult than easier. Because now I am going to think: This is not right. No, not that it's not right, but you can't just ignore it and expect it to go away. Because it doesn't go away. It might be okay for me; maybe I'll succeed; and maybe I can forge my way through it, but it isn't, probably, right."

Six of these eight leaders referenced noticing diverse reactions based in brain sex differences and the linked behavioural differences. Whilst not explicitly explored, the examples suggested impact in respect of a more nuanced awareness of the range of reactions possible in a given situation and how some of the behaviours and reactions might be dominating others.

"I notice quite a big difference between the more alpha males, the males perhaps on the more female spectrum and the females. And the other thing I noticed through this process, <Name>, was how often our more dominant, senior males were seeking action."

Some of these leaders reported a desire to shift perceptions on a sustainable basis to become better at valuing their awareness of differences among individuals. There were challenges reported, as detailed in Section 4.4.5, to doing this at scale, yet some positive impact

of this work was mentioned as sometimes creating changes in some individual mindsets amongst a small group of senior leaders:

"I am bottom line broadly optimistic that this agenda will- or this intent will build in [company] and courses like the ones you run are just a contributing factor. In the sense that if 20 partners in a room, three or four of them come out thinking differently, then hey, that's not a bad result."

Subtheme three: Memorability of concepts

Five leaders mentioned this subtheme. The content of the workshop was easy to remember for them and impacted upon their day-to-day work behaviours and practices. Leaders talked about moments when they had noticed they had done or said something differently from how they might have reacted in the past.

"I mean it was intellectually interesting when we had the discussions but it's been kind of the slower filtering occasional light bulb moments that have lasted."

They reported noting that small changes were emerging in their own awareness and action and in what they were observing in others.

"I think just the fact that people are very conscious, and are thoughtful, means they are probably applying it."

Some commented on the absorption of the new information and how it became a non-conscious act of application quite quickly.

"...interesting thing for me is - I know this is a bit of a strange thing to say, it also applies to me personally - sometimes you don't necessarily know that you're applying it."

Some of these leaders talked about how RICH^{TM} and 4 C's^{TM} had helped with memorability and that actively using the knowledge that the brain responds emotionally before rationally, taking slightly longer as a consequence to address an issue with this in mind; and that this actually had a faster outcome than being very direct in communication might have done. This idea of 'slowing down to speed up' was indirectly referred to by a number of participants.

"...what the people round me wanted to achieve using RICH communication and understanding compassionate approach to the communication I was using. That achieved much more quickly than a more direct approach could possibly have done."

Subtheme four: Outcomes achieved more effectively

Four leaders talked about concrete outcomes resulting from applying the knowledge and models. The outcomes that were mentioned were in relation to achieving the business task. This was distinct from improving relationships for instance. The outcomes mentioned ranged in magnitude from driving for an outcome in a meeting to winning a large client contract, to enabling departments to work better together. Outcomes were referred to in respect of more concrete measurable business results, as distinct from the 'softer' impacts from Section 4.4.3.

Planning better for desired results was mentioned:

"I think definitely the impact has been driving to outcomes and planning those outcomes in advanced and not leaving it to chance."

Using the insights to help win business was another outcome where the insights were reported to have helped reach the result more effectively:

"actually within this strategic partner contract, so we've won it with them."

Helping clients create alignment in their teams more readily was a specific outcome referred to:

"I am trying to appeal to that diversity of background view and where they are as individuals. I think that has been really helpful. It helps me to pitch it right, then to get... But I am also helping them to get alignment, which is an important thing that <Name>, the chief exec, is trying to do."

Helping to access creativity in large groups of people was a specific example cited. The leader's desired outcome was to harness the full creativity of this group:

"it's been harder to think of ways to do something about it. So, we've been making quite a lot of progress on making meetings of 20 or so people, that are very highly creative and allow everybody in the meeting to contribute, based on your models."

More effective collaboration both with internal teams/colleagues as well as in client environments was referenced by two of the participants:

"I would say first signs are productivity in collaborative work is increasing, we're having more effective and better functioning collaborations."

4.4.4 Insights and reflections

This theme was mentioned by six leaders. It refers to participants reflections and musings post the programme but where they did not take any specific action. The reflections tended to more at a conceptual level than a practical level in most cases. The nature of the reflections was certainly less immediate than for other themes. There were three clear subthemes in respect of these reflections and these are detailed here.

Subtheme one: Reflections on sex differences at work

All six leaders from this theme commented on thinking much more about male/female sex differences in the workplace. The majority commented on enjoying learning new information about biological differences and also commented on how difference and diversity linked to other important issues for business and society.

Some of the leaders who commented on this subtheme linked brain sex diversity to other aspects of diversity such as race, noticing the importance of diversity and inclusion in the workplace:

"In terms of using all the brains in the business, to use your strap line an also moving forward on diversity and inclusion. We had a really really good conversation on a number of different occasions in the recent weeks on the back on Black Lives Matter, which is just as sharp and imperative as gender."

So, it seems that new awareness about neurobiological brain sex differences had stimulated a curiosity and a new level of awareness:

"the male and female brain, which is why we then did a line-up in terms of the different types of brain and I remember the thing about the hands, as well. that bit that I found most sort of interesting, and the bit that sort of resonated was around the brain gender,"

This awareness and interest gave some leaders pause for thought and enabled a more reflective stance:

"The course, particularly your session, has created a lot of thoughtfulness, I think, and dialogue, even during this Covid time, so people still refer to it."

"what was new to me, it's hard to look back and think where you learnt things isn't it. So, the concept of [pause] structure, chemistry and connectivity, and those being the space, the spectrum on which one measures brains and understands how brains work."

Subtheme two: Curiosity about scaling the ideas

Two of the leaders, notably one in particular, thought a lot about how the ideas might be taken into an organisational system at scale. Questions and ideas in relation to scaling the knowledge organisationally formed a large part of this leader's interview.

"I'm interested in how one goes from the education you've done at the more individual level into how one educates an organisation. That's the thing that's occurred to me most during this discussion."

Subtheme three: Academic underpinning of interest

Three leaders mentioned that they were interested in the academic underpinnings for the workshop. This appealed to them and in one case prompted the participant to go and read more around the topic.

"I wanted to understand some of the academic literature behind the thesis."

"I've been trying to understand la difference, ever since puberty [laughs] so, it kind of fitted in with that general air of interest. I think, as you know [company] is kind of working quite hard on its diversity and inclusion agenda, as most organisations need to."

"I found it really, really interesting and learned a lot from it. Some stuff I had been exposed to a little bit before – I'll just pull up the thing. The context around the prefrontal cortex and the limbic brain, all that sort of stuff, I haven't read."

4.4.5 Challenges with implementation

This theme was mentioned by seven of the leaders. All the participants referred both to themselves/their part of the organisation as well as to the wider organisation in relation to the challenges they experienced and these centred around three core subthemes.

Subtheme one: Habits not yet formed to anchor new behaviours

All seven leaders mentioned the challenge of moving from new awareness to habituated daily action as a challenge.

"I can understand that neural patterns in brains are typically forward back from men, and left to right for women, as a generalisation. But bridging that into a do differently or a do better, is hard."

"I think that's the next step for me, the hard thing. So, that it becomes instinctive, rather than you know- I think maybe I'm on that journey, but there are times when it comes more naturally than others probably."

Most leaders mentioned that having the time to think in the run of the day-to-day business pressures was the dominant reason that it was challenging to implement new thinking on an habitual basis.

"all of this, particularly with partners of a big four firm, you are dealing with people that are ridiculously time-poor."

Two of the leaders mentioned finding the jump from concept to daily behavioural change a challenge for them.

"despite the fact they are very simple models with easy to remember acronyms, I couldn't have told you exactly what they stood for again, so I haven't memorised them on that level, they just come into my mind a little."

"I can see bridges to practicality, if you see what I mean, but I'm still, I think probably at the be aware level."

Time was also mentioned in relation to creating new organisational ways of working needing longer with training and repetition being built in to enable change to happen.

"partners, that they are always-on individuals. So, it's quite difficult. It's how do you get people to apply learning in that always-on mentality".

"I think some of that's just about- actually it goes back to what we talked about early. Which is, energy and carving out the time to prepare in the way that you need to..."

Subtheme two: Dominant male culture is a force against change

Three leaders mentioned that the current dominant culture, which they described as more male in many of is characteristics, would mitigate against changes in ways of working to be more inclusive of brain sex differences. One leader linked this force against change to him personally in terms of his not seeing things differently in the moment.

"going back to the thing about dominant culture, it says stuff like, you just don't get it, because you're part of the dominant culture. It's really really hard to observe yourself, you've got positional velocity and you can measure one, but not the other."

"What I can't do easily is pick up cues, as to whether or not I'm triggering one of those reflexes, that I'm taking you into a positive zone or zone of discomfort. It's too hard to send and receive simultaneously, auditory and ocular are not wired to do that and process the information all at the same time."

The other two leaders talked about the organisational system being committed to becoming

more inclusive of brain differences at an intellectual and conceptual level but struggling to put this into practice at a day-to-day level, and there was one very clear example given of how the dominant culture inadvertently gets in its own way despite positive intentions to be more diverse and inclusive.

"It's really interesting, we talk a good game about, and one of our leaders in particular is really a strong advocate for it. Yet because we are such a male dominated team, it's still taking a while."

"I guess the competitive nature that ..drives obviously, but it's creating a barrier against that competitive urge."

"Do you think there is a danger, though, especially with Black Lives Matter and diversity targets, that people are now getting by it by pretending? And that's sometimes even worse?"

The general observation by all these leaders was that positive change to become more inclusive at the systemic level was a significant challenge:

"I wish there was something we could do quicker. Because at the moment you look in the pipeline and even the pipeline of those that are coming through to partner, again the stats aren't there. We're going to be some time before we get to 60/40."

"I think that's a leadership issue for one, but also, I guess, there needs to be a bigger group of people within that partnership that drive the change"

Subtheme three: Multiple complex factors and the gaussian overlap mean that brain diversity is difficult to distinguish

Two leaders mentioned this as an implementation challenge. There are many factors that influence human behaviour and by definition any attempt to describe and understand is always an oversimplification. Thus, looking through the lens of brain sex differences can only help illuminate up to a point.

"this is something that I remember from some of the books that I was alluding to earlier. Obviously male and female competencies, like special awareness, or whatever, are two Gaussian distributions and they're overlapping."

This subtheme could potentially have been included in the reflections and insights section but it felt important in the way it was brought up by these leaders to include it in the Challenges to implementation. One leader was concerned about the dangers of gender stereotyping and how this could create resistance in leaders.

"Now, that creates a dominant culture, which clearly has strong roots in gender. But dominant cultures again are complex, not just single factor cultures."

"in the gender stereotyping, we just run the risk of creating gender stereotypes. That was one thing that came up as a conversation around the table on that, where everyone was mature enough to talk about it and understand it in the right way, but you definitely need to land it in the right way, because otherwise talking about it in the wrong context, or with the wrong people, it actually runs the risk of being misinterpreted."

4.5 Summary

Figure 4.1, created by me, provides a simple clear visual summary of the five themes and their associated subthemes. The next Chapter discusses these findings.
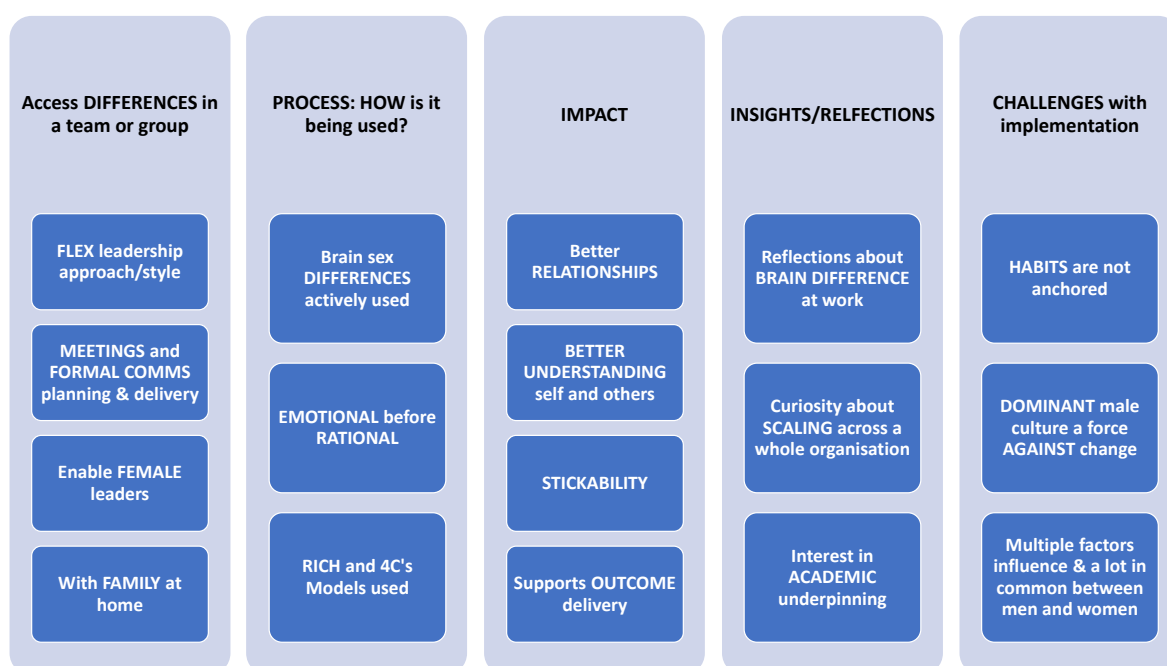
Figure 4.1: Visual summary of the five themes identified throughout these findings.

Chapter 5: Discussion of findings

5.0 Introduction

It became apparent during the findings review and analysis that the reported value/impact of the workshop content was occurring at a number of different scales, ranging from the individual/self to relationships with the team/others, to the whole organisational system and finally to the larger external domain of clients; they emerged with consistency across the majority of themes/subthemes. These scales are all connected with relationship. They can thus be described as 'domains of relationship' in respect of the activities undertaken by an organisation. What is meant by this is the relationship a leader has with themselves (self-reflexivity), the relationship that individuals have working together in teams to achieve the work task, the inter-relationships of teams working as part of the whole organisational system and then the relationships that extend outside the organisational boundary into the connection with clients. Working with these domains of relationship is in fact an established way of understanding the forces that exist within organisations. There is much research investigating aspects of organisational learning and performance across each domain (Rigby et al., 2018), but a review of each large body of literature in relation to all four domains is outside the scope of this thesis. It is however, important to consider the current state of the literature on applied neuroscience in each of these domains of relationship. This Chapter is structured accordingly, taking each domain of relationship (Self/Team/Organisation/Client) and looking at the current state of the literature as it pertains to applied neuroscience in relation to each. The Chapter concludes with a summary of the value reported by participants in relation to the research question:

"What is the value as described by senior leaders of understanding individual brain sex differences in the workplace – an exploration"

This additional literature review started with an exploration of business and leadership learning theories and models and their application to these four domains. Examining leadership programmes offered at the world's top ten business schools (Anna, 2023) revealed that they all teach and use analysis tools and models based on these four domains. It was clear, however, that there is no consensus across these programmes about the definition and measures in relation to each, though the four domains provide some kind of framing in the leadership learning environment.

What did emerge is that the literature on applied neuroscience in business is growing rapidly, notably in the last five years. Within this growing body of literature three of the four domains are explored (only the client domain is missing). The main method of exploration was in relation to the technology that enables access to understanding brain activity (Waldman et al., 2015). The literature is currently focused on existing leadership constructs that lend themselves to the applied use of neuroscience in organisational behavioural research; these

include such matters as measuring mood at the individual level and emotional contagion at the team level (Waldman et al., 2015). Such research investigates how current technology might be used to measure existing organisational activities, such as innovation meetings.

The consistency in the findings data across these four domains and the significance of these domains in leadership teaching and organisational research (despite the neuroscience being in its early stages) meant that the domains provided a useful lens on exploring and understanding the outputs from this research. I chose to use a simple model, still in general use in leadership teaching at INSEAD, (Kets de Vries, 2005) that includes attributes measured in each of the four domains. Figure 5.1 illustrates this model, showing the multiscale structure of individuals/teams within organisations and networks.

- Ability to execute
- Change Orientation
- Energizing
- Visioning

- Emotional Intelligence
- Integrity
- Tenacity & Courage

Networks
Organization
Team
Self

- Client & Stakeholder orientation
- Networks & Alliances

- Coaching & Feedback
- Empowering
- Team building
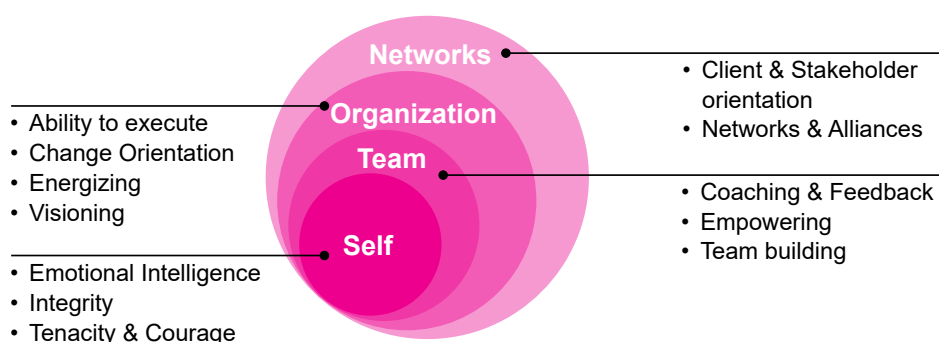
Figure 5.1: Leadership mirror, adapted from Kets de Vries (2014).

The attributes included in this model had been developed from a decade of research into the executive population attending INSEAD programmes, as the attributes being important for effective leadership within the different domains (Kets de Vries, 2014). In the domain of Self, integrity refers to the alignment in what a leader thinks, says and does. Tenacity and courage are generally well understood as leadership qualities. Emotional Intelligence requires more explanation. The literature on 'Emotional Intelligence', EQ (Emotional Quotient) (Khalili, 2012) identifies four aspects of EQ. Each aspect feeds into and supports the next one. Yet they are independent and being proficient in one does not necessarily mean being skilful in another. These four aspects described as commonly observed behaviours in EQ are (Goleman, 1996):

- Self-Awareness
- Self-Management (as a result of the awareness)
- Situation Sensing (capacity to read the room/see the whole from a well self-managed place)
- Empathy (in terms of how one then interacts with others, based on the above points)

In the team domain, coaching and feedback relates to the conversations that enable team members to continuously learn and develop in their roles, adding empowerment to the leadership capacity to build and create the conditions for developing confidence in team members to step up and take responsibility, supporting team members to work together

to deliver the team task. Within the organisational domain this model looks at a leader's capacity to create a vision that energises the workforce to deliver it, whilst being able to change course as the environment might demand. The final domain refers to the external world within which the organisation is seeking to be successful. Leaders need to be connected to key relationships within this external environment as with clients and policy makers in order to be able to understand and navigate the variabilities of what is happening in their external world. The elements of researched and tested model (Kets de Vries, 2005) provided a useful framing to the four domains that emerged in the themes/subthemes from the findings and are used here as lens through which to investigate the contribution to knowledge provided by this research.

5.1 Exploration of project findings

The findings demonstrate that the information shared about brain neurobiology, neurochemistry, brain sex differences and neuropsychological perspective was fundamentally new for participants. Participants identified that the positive value they gained from this new knowledge was in finding more effective ways of understanding themselves and others quickly and sustainably as well as seeking to lead effectively by motivating a thrive state. This improved understanding/new ways of seeing things provided value to leaders in a variety of ways at work and, in addition, at home and in their wider personal lives.

This Chapter explores next how the experience of and value reported by the participants contributes to the current literature on how people learn, work together in inclusive ways and thrive within organisations.

5.2 Domain one: Self

Leaders identified and reported that their insights based on applied neuroscience supported them to improve both self-awareness and self-management. For example, the leader who initially felt frustrated at being asked a question whilst he was enacting his decision was able to stop himself in the moment and reflect that his female colleague was asking her question because she had a genuinely different perspective. This act demonstrated a new level of self-awareness in relation to his own frustration, and ability to realise that there might be a new and potentially useful perspective available along with an almost immediate capacity to control his urge to just carry on.

The leaders' gained access to these insights in part, via the physiological level through their experience of thrive and survive states induced during the workshop. For instance, a workshop exercise induced a survive state and participants were able to appreciate the bodily sensations produced by the shift in neurochemistry that are associated with survive; noticing changes in heart rate (faster/change in rhythm), breathing (faster and shallower), tension (shoulders and jaw): to name just some. By contrast the thrive state induced an

awareness of smiling, a relaxation of the tense areas, and deeper diaphragmatic breathing. These states were clearly identified on the day of the workshop. This physiological awareness then enabled leaders to find ways to relax their bodies and brains using techniques such as slowing down their breathing rhythm, shaking their arms to release cortisol, thinking of a close relationship that put them into thrive being examples of some of the tactics that were discussed. Developing small techniques and habits to spot survive states and move into a thrive state on purpose was one of the workshop activities which supported leaders in a number of the areas of value that they reported in the findings; such as, adapting a leadership style to 'get closer' to the way that others saw the world, using their own reactions to help them better sense different responses.

Awareness of brain sex differences also supported individual self-related insights. These insights were often generated from a neuropsychological perspective. For instance, participants began to think about how their biological brain sex impacted their personal life, and what life experiences they had had, to shape who they had become to date. They were introduced in the workshop to the concept of how nature and nurture interact to inform the brain sex score used in this research. An example is a female leader with a slight female brain sex score (12/20 where 1 is very male and 20 very female – see Section 2.7.5), the eldest in a family of sisters, who became aware of how her father's desire for a son and her mother's desire for women to work had influenced her driving behaviours in the workplace. By nature, she could sense the more female part of her make-up and by nurture the more culturally driven 'male' side of her. This occurred to her as a helpful insight into understanding herself better. These neuropsychologically based insights helped leaders to reflect upon and then notice better their own direct experiences of the differences in brains and behaviour. Many participants reported an increased ability to actively see the world from another person's perspective. The references in Table 4.2 exemplify increased introspection at the leadership level as a result of the workshop. For example, one leader expressed that he realised *"She's asking because she's putting different things together and has a good question"*, rejecting his initial reaction to dismiss the question.

Another example from Table 4.2 was the leader who used his new self-awareness to stop dominating and driving the action in meetings and instead left the airtime freer for other types of brain to contribute in their way.

Leaders identified and reported that the content about brain function, brain sex diversity and models for application were novel and intellectually stimulating. This intellectual stimulation enabled new learning to occur at the cognitive level. The 'Reflections and Insights' and 'Challenges' findings, Sections 4.4.4 and 4.4.5, show some of the new awareness arising from the cognitive perspective. This cognitive awareness resulted in considering new approaches to existing organisational challenges such as the leader who began to think about the promotion metrics that the organisation was using and wondering whether these might be too narrow given her new knowledge about brain and brain sex differences.

This combination of the neurophysiological, neuropsychological and cognitive perspectives, informed by empirical evidence about brain sex differences, enabled (a reported) increase in self-awareness and self-management for these leaders. This increased self-awareness and self-management provided leaders an access, on their own terms, to positive value from the workshop as they applied it in the workplace. The literature on 'Self' was not incorporated during the initial literature review in Chapter 2 and is now reviewed in Section 5.2.1.

5.2.1 The literature on self

The literature from psychology, notably case studies described in the therapeutic setting, refers to the use of body awareness to change and manage physiological states (Siegel, 2010). The techniques described in this psychological literature are similar to the experience that these leaders reported. This was particularly evident in respect of raising awareness of the physiological and emotional responses and how these are related to differences in brain sex (Brizendine and Shoffner, 2008). The mindfulness literature uses bodily awareness and is increasingly entering the business arena (Chaskalson, 2011; Hyland et al., 2015). Mindfulness relates to the Self in that it focuses individual attention on events happening in the present moment (Brown et al., 2007). The literature records that in recent times organisations (e.g. General Mills, Google) (Hyland et al., 2015), including the military, have become active in using mindfulness to support employee well-being (Saraç, 2020). But the current literature also notes that despite the growing interest in mindfulness more research is required to understand the workplace benefits (Saraç, 2020). A positive impact of mindfulness is also demonstrated in the literature in relation to resilience, which is discussed in Section 5.2.4.

The literature on emotional intelligence identifies self-awareness as being the key starting point for understanding others effectively (Druskat et al., 2013). It is notable that the leaders interviewed for this thesis did not spend more time in introspection in relation to their own part in creating dynamics with others. These leader's typical responses were towards action. A leader's use of their own bodily awareness in the moment prompted the reflection that adding a mindfulness element might be a useful addition to the future development of the workshop. There was, however, some increased self-awareness demonstrated whereby leaders paid attention to the differences in brain sex scores between themselves and their colleagues, reflecting upon their own differences compared with others:

"A personal sort of reflection and then watching how other people behave based on their genders...it's almost like a light bulb goes on. I can see...I am not in the dark"

Much of the literature on learning in business focuses on taking time to understand another's perspective (Gregory et al., 2011). This is a widely used approach in leadership training and development. However, here participants in this study were using actual brain sex scores, an understanding of the brain responding emotionally before rationally, combined with the

awareness of brain sex differences in attention, communication and stress to support their own self-awareness when understanding their own reactions in contrast to others'. This use of their understanding of the available neuroscience was not in any other form demonstrated in the business literature and only in a limited way in the psychological literature. In the feminist literature this combination and its impact and usage is not at all explored as the dominant feminist argument focuses on how much male and female brains have in common rather than investigating what effect any differences cause or how these could be used for organisational or personal value (Rippon, 2019).

5.2.2 Emotional patterns and survive/thrive triggers are uniquely personal

As previously described participants reported an increase in self-awareness based on their new understanding that the brain responds emotionally and that survive emotions are likely to be triggered faster than thrive emotions. The literature on emotional intelligence and applied neuroscience discusses the emotional response occurring before the 'rational' part of the brain can react (Lanz and Brown, 2020). For instance, Ingram and Cangemi observe that -

"The daily challenge of dealing effectively with emotions is critical… because our brains are hard-wired to give emotions the upper hand…everything you see, smell, hear, taste and touch travels through your body in the form of electric signals. These signals pass from cell to cell until they reach…the place where rational, logical thinking takes place. This journey ensures you experience things emotionally before your reason can kick into gear" (Ingram and Cangemi, 2012, page 6)

Participants were asked to think about their own personal survive and thrive triggers. They were also asked to think about how other colleagues might be triggered differently from themselves. This personal insight from a neurological and neuropsychological perspective helped participants to understand their personal reactions at work. They identified that this insight into their triggers helped them to stop reacting too quickly. The knowledge that the human brain responds emotionally before it can respond rationally was of impact in relation to building and supporting participants emotional intelligence (Goleman, 1996). Leaders gave examples of how this insight increased their own self-awareness and self-management:

"I myself think… Okay I can feel the emotional reaction coming through, let's step back and deal with it logically"

It also impacted their capacity to sense whatever situation they found themselves in and respond empathically and more appropriately:

"and then suddenly there's just that little bit of Ah! Something has just happened here that I am now recognising as slightly discordant, rather than pushing forward…"

This awareness allowed patterns of pre-planning and preparation as well as post-action review sense-making to develop:

"I can understand that neural patterns in brains are typically forward to back for men and left right for women..as a first step I think it is useful to be aware of such things...I find that not a bad way of preparing for a situation"

In line with the experiential learning framework of (Kolb, 1984) participants also reported different phases of learning. They discussed an increased capacity to notice things differently. For instance, one participant described noticing the unique triggers as "it's a way of people staying alert". Another participant commented that this new noticing enabled them to slow the action down to create space for different outcomes to occur "giving that curiosity, some space for people to think".

The importance of understanding and managing emotion is widely explored in the leadership literature (Greenockle, 2010) as well as everyday living (Grewal and Salovey, 2005) . In this respect this project builds upon a long held and much discussed idea in effective leadership. The related field of positive psychology considers human flourishing which relates to the neurochemistry of thrive in this project. Meta research into positive psychology-based interventions in the workplace demonstrate that "positive psychology interventions seem to be a promising tool for enhancing employee well-being and performance" (Meyers et al., 2013). Some links between positive psychology and neuroscience are evidenced in the literature (Beattie, 2019) ,but there was no evidence I could find yet of linking positive psychology and individual brain sex differences in relation to creating thrive in the workplace.

Self-awareness and the capacity to self-reflect is central to understanding one's own thrive and survive triggers. The literature on the neuroscience of reflective practice has identified different brain areas that are active when in automatic response mode compared with a more self-aware mode (Lieberman, 2012). The evidence is that different brain circuits are active when we are either more aware or less consciously aware, though these brain circuits are also working together much of the time. The literature referred to in Chapter 1 demonstrate some sex differences in relation to some elements of these brain circuits, for example such as the Anterior Singular Gyrus (nicknamed 'the worrywart' of the brain) (Brizendine and Shoffner, 2008).

5.2.3 Self-confidence

Some participants reported that knowledge about brain sex differences in the way the brain pays attention had a positive impact on their self-confidence. This knowledge gave some participants the confidence to voice different points of view when they otherwise might not have done so. Some senior men identified that they had used the learning from the workshop to encourage female leaders to be more assertive – though that is still a very male

brain perspective. They recognised that following the workshop they felt more confident to do this. There was no evidence from the interviews of women leaders using the insights to do the same with other women or men. The female leaders seemed to use the information more to support themselves personally rather than enable other females, while the male leaders did use information from the workshop to better put themselves, so far as they were able, in the shoes of their female colleagues:

"Having gone through this (course) this has definitely helped me as I look at the world from their eyes and see some of the, hopefully unintended, sleights and offences that are meted out against them and the almost societal bias..."

The male leaders in question each sought to support the female leaders to speak up and feel they had the right to challenge and share their views more. These male leaders also used the new knowledge to manage their male colleagues and ask them to be quiet and allow others to speak more. These types of interventions were reported in a team meeting environment.

"compounded by male partners dominating the conversation and not letting female directors speak. Trying to get partners to hold back more to get the directors into the conversation more and particularly more diverse points of view within the conversations"

"it was giving this particular individual the confidence to speak up and the sense that she has a right to speak up and should speak up as a leader within the team"

The women were being encouraged to show more dominant behaviours, and this could be an example of the status quo driving how people are expected to behave to be seen as successful, rather than creating different ways of including all the diverse brains in a meeting? That said the fact that leaders were enabling female participants to speak up more and noticing how to include more diverse views is a good example of value from the workshop.

Self-confidence and understanding and using something of brain sex in the literature is in its very early stages and exists predominantly in the psychological/therapeutic and medical spheres at the current time. There is evidence in this literature of sex differences in brain connectivity and memory storage in relation to self-esteem/confidence (Miyamoto and Kikuchi, 2012), and it provides evidence that females store incongruent self-images in a different part of the brain than males and that the information is more firmly stored. fMRI images of brain activation in relation to this storage of self-image, suggest that females may have more of a tendency to ruminate in a way that could produce lower confidence. (Miyamoto and Kikuchi, 2012).

The business literature has addressed this discrepancy in male/female confidence at work over many years (Exley and Kessler, 2022). This literature consistently finds that men ap-

pear to behave as more confident/overconfident in their abilities than women. For instance, men will apply for roles when they are only 60% qualified for them, whereas women tend only to apply if they only consider themselves 100% qualified (Mohr, 2014). The business literature does not yet connect the neuroscience with the confidence gap despite there being evidence in the psychological/medical literature that there could be a biological basis for confidence differences. The confidence evidence from this study led to a review of the literature on organisational structure, motivation and reward at work. Organisational structures, culture and reward systems are closely interlinked (Nene et al., 2019) , and whilst they create a general state of organisational reward structure. This has not changed a great deal from a traditional OD design and thinking process for the last 70 years during the post-war years (Latham, 2012). Such reward systems have been developed predominantly by brains that manifest confidence in a particular way. It is this presentation of confidence that represents largely what gets measured and rewarded (Lanz and Brown, 2020). The experiences of these leaders at the level of Self is discussed in Section 5.4, with regard to organisational systems and what they measure, usefully or not, and reward.

5.2.4 Improving resilience

Leaders reported that they perceived their resilience had increased after the workshop. This was especially commented upon by the female leaders interviewed. This is a qualitative project with a small sample size so no general conclusions can be drawn from this, and resilience was not in itself tracked or assessed; but the reported perceptions seemed very clear.

However, the literature on applied neuroscience and resilience in business is relatively recent, it is beginning to grow (Swart et al., 2015; Schauss et al., 2019). It provides useful awareness into the brain structures that not only underlie resilience but strategies for enabling mental health. Human resilience has been defined as "making a positive outcome out of adversity which involves self-regulation in respect of how a person learns from and recovers from bad experiences" (McEwen et al., 2016). These abilities depend to an extent on the normal development of the prefrontal cortex and the hippocampus (Russo et al., 2012), which are both areas of the brain that can be adversely impacted by chronic stress and adverse experiences (Russo et al., 2012). The typical approach for supporting mental health involves the use of anti-depressants, talking therapies, physical exercise regimes and mindfulness (Hunter et al., 2018). Much of the research reported in the literature comes from in studies in the military and social work.

A key element of the biology of resilience is the way stress is experienced and how it impacts the immune system. The literature provides evidence of significant differences in immune responses between the sexes (Klein and Flanagan, 2016). For instance, 80% of autoimmune diseases are shown to be present in women whereas men are twice as likely to die from malignant cancer than women (Klein and Flanagan, 2016). The recent COVID 19

pandemic also drove research into sex and immunity (Ciarambino et al., 2021). Resilience is a significant topic that involves many complex parts of the bodily systems and there is much that is yet unknown.

5.3 Domain two: Team

In respect of the team domain, leaders perceived that their new understanding of brain differences in a team enhanced the development of trust between team members, also reporting a positive impact in team performance in five main areas, although no actual measures of enhancing team trust were taken. Such an attempt at measuring could be a topic for future research. This analysis explores the reported perceptions of these leaders in relation to the current wider literature. Each area of reported value is interconnected yet was considered differently by participants, each participant having a slightly different angle/understanding to the topic of team performance enhancement.

The five areas that arose from this are explored in Sections 5.3.1 to 5.3.5:

5.3.1 Seeking to enable thrive in individuals in order to build trust within teams

Leaders identified that they frequently used content from the workshop as preparation before meeting team members. The interviews revealed many examples of how leaders used the information to plan and predict possible reactions from team members and to use this to better communicate and connect. This built upon elements of the leader's own self-awareness. Leaders often started by reflecting on what they knew of the individual survive/thrive responses and the awareness that emotions happen first and fastest.

"I could anticipate how it would affect her and I was thinking that for (NAME) it will mean that it will feel a little bit like this.."

"The immediate reflections were how useful the frameworks are regards adopting within your own teams..if you've got a short response time on a proposal..it creates a high performing, well connected and particularly trusted team"

Leaders also reported making sense afterwards of what had happened in a team exchange using a post-action review informed by and understanding basic brain function and differences.

"I have used it in my reflection and analysis, in my observations of people. I've used it to understand why they are behaving, reacting, doing what they are doing."

The aim of many of the leaders with this pre-planning and post-action review was to influence and persuade team members in a positive way to promote effective teamwork.

"techniques like that for me have really helped in terms of understanding getting people into a different mindset and then they are more susceptible to your ideas and that exchange of ideas"

The interviews also revealed that leaders shared the concepts from neuroscience with their teams to enable team members to discuss differences in styles and approaches and to collectively access these quickly. The main workshop concepts shared were the information that the brain responds emotionally before rationally, Survive and Thrive triggering the neurochemistry on brain sex differences and key aspects of brain sex differences. There is more on this in Section 5.3.2, giving evidence of how these leaders tried to co-create a positive team dynamic. It is also an example of how these leaders applied the neuroscience concepts in an attempt to empower team members.

"I talked about it with my team. I think it's made me more cognisant of different styles and different communication methods, more than anything else"

Coaching team members as a joint effort to support team performance was also reported in the data.

"On the teams around me, I have found it really useful in coaching conversations, where I have got 5 or 6 different people to line manage, I think introducing the concepts to them, there were a couple where it was really interesting"

Participants talked about a range of business outcomes. One particular key outcome was enabling an increased sense of ownership and performance amongst team members.

"They've come back with some really great stuff and they've taken ownership for it"

"I would say the first signs are productivity in collaborative work is increasing. We're having more effective and better functioning team collaborations"

All three elements of the team domain within de Vries (2004) INSEAD Global Leadership Inventory were reported in the findings.

This additional exploration of the literature into the application of neuroscience and team performance revealed developments into using applied neuroscience in decision-making (*Disruptive Technologies: Your Path to the Future*, 2019) and team performance (Balthazard et al., 2021). This emerging literature is often being generated across the University sector in conjunction with business (Wang et al., 2021). It is encouraging to have academe combining knowledge with business in developing new understanding under rigorous measurement/conditions. Research is beginning to include the use of wearing various types of biophysical technological devices that seem to be taking individual differences into account with a view to making sense of the physiological state (thrive/survive in my terms).

The literature debates the ethical considerations of involving wearable technology. The main ethical issues are concerned with personal privacy and the importance of participants knowing what actually happens to their data (Segura Anaya et al., 2018), given that the technology is worn by an individual so that it is possible that individual brain differences may be highlighted (Wang et al., 2021).

A review into male/female inclusion in team environments identified studies that indicated an increase in the collective intelligence of a team when it included up to 60% women (Woolley et al., 2011). This research showed that group intelligence had little to do with all the individuals' intelligence in the team but that teams became more effective at tasks where social sensitivity was high. Social sensitivity in the research increased with the percentage of women on teams (Woolley et al., 2011). A meta study of 6.6 million papers in medical science over 20 years demonstrated that mixed gender teams produced more novel and higher impact scientific ideas (Yang et al., 2022). This is consistent with the diversity literature reviewed in Chapter 1. This literature did not include the neuroscience of brain sex differences.

5.3.2 Active inclusion of brain sex diversity in teams

The interviews identified that leaders were taking more time to think about brain sex diversity in particular (as a specific aspect of individual difference) and how they could better access diversity in their teams. Several leaders referenced actively trying to find ways to access brain sex differences and obtain new value from the diversity of viewpoints in ways that they previously were simply not aware of:

"I do think the whole concept of the male brain, the female brain and the collective intelligence, when you start applying it to your leadership team and you think well where are we on this? Who is bringing what here and where are the real strengths across the spectrum? Then how do you get each of those people into their Thrive? To be able to think about that and really dedicate time to that I think is really powerful."

Kline (2009) developed a model of actively creating the time for all participants to contribute their thinking. This methodology is used in business but not widely as it does require a lot of time dedicated to the processes. Kline's more recent work does reference neuroscience in relation to how the brain pays attention. Kline's work does not, however, refer to individual brain sex differences (Kline, 2020).

In the growing literature discussed above in Section 5.3, with respect to applied neuroscience and team processes/performance, there is an emphasis on the individual brain beginning to emerge, but not yet in relation to brain sex differences and the potential for performance enhancement.

5.3.3 Proactive partnering with brain sex difference

Several leaders talked about partnering more effectively with individual team members using brain sex differences as the partnership approach. For instance, some leaders had used the information about brain sex to partner with certain team members to encourage them to speak up more and establish their authority. This was notably in relation to team environments that were more male dominated. One leader mentioned a 'sudden realisation' that a series of regular meetings is a "very sales macho, male dominated environment. This is therefore quite intimidating for some.." This leader described how they had been partnering with the women in the meeting to speak up but not in a way 'to become more male like' rather to challenge and contribute more so that their different perspective could be included. Other findings data demonstrated that leaders had paired people together to co-lead projects using aspects of brain diversity.

De Backer (De Backer and Rinaudo, 2019) observed that partnering effectively is an important aspect of creating successful business outcomes and that 'partnerships never go out of style'. There is a large literature on partnerships and partnering that ranges across many different sectors and seeks to identify what are the characteristics that support effective partnership (Horton et al., 2009). Aspects of successful partnering include clarity of purpose, nurturing relationships, transparency in communication and appreciating and valuing differences (De Backer and Rinaudo, 2019). These are in essence no different to the observations reported in these Findings. This research does, however, bring additional insights and information to an awareness of successful partnering that does not currently appear in the business literature.

5.3.4 Brain 'aware' meetings and communications using RICH^{TM} and the 4 C's^{TM} tools

The workshop introduced to participants two specific tools to enable the application of the neuroscience knowledge. These were the RICH^{TM} Model of Communication (Lanz and Brown, 2020) and the 4 C's^{TM} model. (Lanz and Brown, 2020) As reported in the Chapter 4: Findings, the application of these models emerged as a specific subtheme. The RICH^{TM} Model of Communication was more widely used than the 4 C's^{TM} model, though it is not clear from the data why this was the case.

Both models were used in meetings with teams and were either deliberately used to structure the whole meeting or more loosely to guide the agenda. The RICH^{TM} model was formally implemented in all the organisations represented in the study and in one organisation was used as the design framework for a company-wide video communication:

"I used the RICH structure to shape the whole narrative of the video"

The tools were used more often in the pre-planning, preparation and live action stages of team interactions. There was no evidence of their usage as a means of reviewing and understanding what had gone on after the event. Other elements of the programme were actively used in post-action review as discussed in Section 5.3.1. There was no data arising that explained why the models had not been used in this way.

Whilst there is a significant body of research into meetings and measuring their effectiveness (Grady, 2016) , research into applied neuroscience, meeting effectiveness and brain differences are in their infancy. One dominant source was the book Leadership and the Sexes (Annis and Merron, 2014) already reviewed in detail in Chapter 2. Much of the research focuses on the generic application of neuroscience and less upon individual brain differences including brain sex differences. This is a current a gap in the literature and this thesis contributes new directions to the current debate and seeks to close this awareness gap. This project also hopes to promote future research into the capacity to include individual brain differences in meetings.

5.3.5 Improving family relationships

Some leaders took their insights into their family systems. This could be said to reflect the team domain. In my experience it is unusual for leaders to take models and concepts they have learned at work straight back home in such a direct way, and I have seen no research literature that explores this potentially permeable boundary.

"I found it as useful in a work environment as I did in a home environment funnily enough"

"At a personal level I have been really stimulated by it. I mean I have brought it into my personal life..."

Equal numbers of men and women commented on this theme and it was certainly a topic that came up during the workshops. People asked a number of questions in relation to application of the ideas in their families.

The focus of the comments in relation to families were:

- How to understand people better
- Increased capacity to take on a different point of view in the moment
- Improved relationships

The last element was especially identified by a number of participants as being of value. This raises an interesting question about whether what was used at home is then played back into the work environment to create more value still. Does the dual application have an amplifying effect or not? This would be a possible exploration in any future research.

5.3.6 Summary of team domain

Understanding the neuroscience of what drives team dynamics and performance is a growing area in the literature (Waldman et al., 2015). Team performance is a key driver for organisational performance and so attracts research attention; but, as we have already seen, focus is generally applied at the team rather than the individual level. There is a risk that by remaining at the more general level that the literature will miss the potential that exists in taking a more nuanced look at individual brain differences and how work-based partnerships can access latent performance potential. A clear focus on enabling thrive in the individual brain is where I see a limitation in the current debate and where this project extends current knowledge. The dominant feminist approach that male and female brains have more in common than in difference (Rippon, 2019) could possibly encourage the tendency to settle at a more generic level and restrict the curiosity to explore individual brain sex differences at a more granular level. This project proved of practical value for leaders in considering individual brain sex differences. As such these findings contribute to the existing literature on how individuals learn, all of whom are unique in life experience and brain connectivity learn, work together better and can thrive within the organisation.

5.4 Domain three: Organisation

The organisational domain was the domain where the insights from neuroscience and their application was the least evidenced. It was also the domain where the greatest number of challenges were perceived. This domain could also be called the systemic domain since it represents the whole of any organisational system.

Participants were stimulated by the workshop content to think about how the knowledge from neuroscience and brain sex differences could support their businesses at an organisational level. Participants spoke specifically about three potential areas of application. These are:

a) The operational model of a division
b) The performance review system of the organisation
c) The approach to new ways to innovate

What was notable about the transcript data on these topics was that the application was less clear, in terms of actual actions taken, compared with the other domains. Leaders were raising questions about how the application might change the way things got done organisationally. There were some examples of application in the organisational domain but more often the new ideas caused reflection rather than action.

"Taking your ideas about the structure and the things we measure. How we see people in their work is largely designed for male brains. Now, we've scratched the surface on the things that we can change in order to improve that."

Such reflections are understandable given that the three organisational areas mentioned in interview are big and individual leaders have less immediate influence on changing organisational systems than is the case in the other three domains. The three areas mentioned in interview (as mentioned above) are all aspects in any organisation change can be challenging and slow.

The current literature on organisational change is extensive, evidencing some 37 established organisational change models (Errida and Lotfi, 2021). Organisational change models appear to fall into two main types (Parry et al., 2014). The first type are the process models that set out the key steps involved in creating change in organisations. These process models began in the early post-war years (Lewin, 1951) and onwards. The second type of model is known as descriptive (Parry et al., 2014) and focuses on the factors that influence organisational change and explain how they are interrelated. The descriptive models of change look at human behaviour and motivation in relation to change (Rafferty et al., 2013), evidencing common and consistent factors, there are 12 which are consistent (Errida and Lotfi, 2021). These are:

- Clear and shared vision and strategy for change
- Readiness for change
- Team performance as a guiding coalition
- Activities for change management
- Resistance management
- Effective communication
- Motivation of employees
- Stakeholder engagement
- Leadership and sponsorship
- Structured change methodology
- Reinforcement and sustainment of change
- Monitoring and measurement

Individual human responses towards and away from any change are explored in these models, and in particular in the descriptions given. Yet at the time of writing there is very little that includes primary research using applied neuroscience in exploring organisational change, being at the stage of creating frameworks that link neuroscience to existing change leadership models at a conceptual level (Scheepers et al., 2020). There is some evidence of business consultants connecting with the neuroscience departments of academic institu-

tions and beginning to discuss how consultancy might apply knowledge from neuroscience to organisational change (Scarlett, 2019).

There is a risk that as the literature on applied neuroscience and change develops it could be carried out within existing cultural norms of business and at a generic level rather than focusing on individual brains feeling included. This could run the risk of being blind to the unconscious biases that the feminist argument points out as discussed in Section 2.5.3. This could mean that the framing of the research is set up within dominant existing paradigms rather than creating new models for change. This research project aims to contribute to the literature through the provocation to look carefully at individual brain sex differences and how best to harness them when designing change initiatives. The following themes that arose in the findings in the organisational domain support the contribution that this project makes to the current conversation on organisational change.

5.4.1 Enabling women within the wider organisational system

There was some evidence of concrete action by course participants of thinking about women in the organisational domain. This was in respect of supporting working mothers coming back from maternity leave. Some leaders reported their aim to give returning mothers projects that would support these women to be in 'thrive' as professionals while being working mothers too. In one instance this involved a complete change of work project and geography and needed quite considerable push-back from the leader who wanted to help the returning mother, despite the existing organisational norms. This was a very active use of the workshop information.

"I think we need to create a different kind of environment that gives young mums, young parents coming back into work the flexibility of managing and getting the balance right"

In another case the leader noted that their questioning of the norms that the organisational system used to measure power and success were changed as a result of the new knowledge:

"The understanding passed on to them of female power. Of the fact they often feel excluded from higher level strategic discussion. The feeling they have of being unseen, unheard, sidelined and unrecognised for promotion. …This is actually the product of the system which is guided towards nurturing a particular kind of behaviour. By the system I literally mean the metrics that are applied to measuring how well they're doing"

These male leaders were taking some personal risks inside the status quo of their organisational system, while creating examples of the Global Leadership Mirror attributes of Kets De Vries, to bring a new way of paying attention and acting within the organisational system. Knowledge about brain sex differences were referred to as the means which led them to deal differently with situations. Leaders frequently reported that brain sex had caught

their attention, had high face value, and enabled sense-making of situations in a new light. Leaders said that these aspects made to putting insights into action faster than it might otherwise have been.

In this second review of the literature, brain sex and diversity and inclusion were used as key search terms. This yielded some of the same literature that had been reviewed in Section 2.5.3, regarding the feminist position that men's and women's brains have more in common than in difference, and that as such, the differences should be ignored (Fine, 2010). There were a small number of business articles that discussed gender neuroscience and inclusion but did not look at individual brain sex (Hills, 2019). The articles were not based on primary research (Grey and Cox, 2016; Matshabane, 2021). The current published literature seems to be weighted in favour of the feminist view mentioned.

At the time of writing transgender issues are receiving somewhat more attention. The literature on transgender equity at work is emerging in line with this (Davi and Spelman, 2021). Studies are also beginning to investigate the underlying neurobiology of the transgender brain (Kiyar et al., 2020). Study sizes have been small to date and the evidence is inconsistent, although it suggests that brain structure is similar to birth sex (Kiyar et al., 2020). This literature explores acceptance of the individual in different societal settings (Verbeek et al., 2020). Much of the transgender literature focuses on healthcare since sex differences often need to be considered through medical care (Fernández and Burke, 2022). This literature is investigating brain sex differences (Fernández and Burke, 2022). This is early evidence of this element of the literature beginning to look at individual brain sex differences.

5.4.2 Better understanding of the organisational system and its reward structures

Leaders reported that the workshop content helped them to improve their ability to take an overview of the whole at the same time as seeing a situation from the viewpoint of all the individual participants. Some leaders described that they could see some of the blind spots in the organisational system as a result of their personal reflections. One leader reported a 'listening session' for senior leaders seeking to understand the dynamics of a particular situation. This female leader noticed how hard it was for senior alpha male leaders to just stay in a listening-to-understand mode rather than to push to action.

"I notice quite a big difference between the more alpha males and the males perhaps on the more female end of the spectrum along with the females. The other thing I noticed through this process was how often our more dominant senior males were seeking action"

This evidence is reminiscent of the systems thinking from the Adaptive Leadership Framework developed at Harvard (Heifetz et al., 2009). This framework looks at a leader's capacity to see the whole system 'from the balcony not the dancefloor' and inspire change

from this perspective (Heifetz et al., 2009).

So, the literature on systems thinking in organisations that has been explored for this thesis, has shown only a limited number of papers on applied neuroscience and systems thinking, using existing models of leadership, organisational systems and change, and seeking with aspects of modern neuroscience (Juhro and Aulia, 2017). I could find no primary research into applied neuroscience connected to systems thinking in business. This is an opportunity for future research to be specifically developed for the organisational domain.

5.4.3 Challenges to creating organisational change

There were no questions in the interview protocol that specifically addressed challenges; so, this material emerged spontaneously from the way participants reflected upon the new knowledge they had acquired. The three major challenges to change at the organisational level were evidenced as:

- Habits not anchored
- Dominant 'alpha' male culture a force against change
- Multiple factors influence behaviour and there is a lot in common as well between men and women

5.4.4 Habits not anchored

All research evidence supports the view that habits are difficult to change (Lally et al., 2010). They are what got each of us to where we are. It can take anywhere from 18 to 254 days for a new behaviour to become a habit. For a habit to change an individual must really want to change it (Lally et al., 2010). This requires consistently putting the mind to the directed effort of instigating a new habit. Individuals who want to make a new habit sustainable can find it difficult. The leaders who wanted to actively participate in this research reported finding creating change at the organisational level a major challenge. It is reasonable to assume that causing a change of habits that would support organisational change is a difficult challenge when many individuals have to commit to new habits in order to effect the change.

The research literature on neuroscience and habits demonstrates that up to 40% of our daily behaviour is driven by habitual patterns in the brain (Graybiel, 2008). When we are under stress the brain reverts to habit as this demands less energy usage in the moment (Lally et al., 2010). This is one of the factors making changing a habit very difficult (Lally et al., 2010). All seven leaders who reflected on this subtheme mentioned the challenge of habituating the usage of the new knowledge. They frequently reported time pressure as the blocker that stopped them.

"You are dealing with people that are ridiculously time poor. So, I don't know if we should be pushing for more time to be given to this"

"It's a time thing. I see that it is useful but the challenge for me is taking it from something that is interesting, that I apply occasionally to something that is interesting that I apply systematically"

Research studies on brain science, habits and organisational change, with work on the topic beginning to appear especially in the last three years (Beer, 2021). So, there are not many scholarly articles available, though my searching showed a small number of business schools (mostly in the USA) and commercial organisations active in this area. They are conducting business-based research (Rock, 2020). This perhaps marks the beginning of testing applied neuroscience based on collaboration between commercial organisations and universities, linking business, funding, and replicable research.

The participants reported that awareness is not enough to create sustainable behavioural change, and this awareness is prevalent in the literature on adult learning and learning in the workplace (Scheepers et al., 2020; Beer, 2021). Data from this project described, however, a high level of memorability of the workshop content, though it remains to be seen, how long the value in the reported changes will hold for participants in the face of slow or no organisational change. The sustainability of the changes and reported value from the workshops is something I am keen to track.

5.4.5 Dominant alpha male culture a force against change

Participants commented on the difficulty of going against the dominant culture at a day-to-day tactical level. They also commented on the challenges of working against a dominant male culture at a strategic/systemic level. Some of the references raised the issue of being blind to what you don't know that you don't know and that you may not be aware if you are part of the dominant culture. It was a positive outcome for me to hear that awareness levels of some of the senior leaders who play a role in creating the culture was raised to this extent.

Many of the leader's comments highlighted that the company leaders 'talked a good game' but that in relation to the inclusion of more senior female leaders progress was still very slow:

"It is really interesting; we talk a good game and one of our senior leaders in particular is a really strong advocate for it. Yet because we are such a male dominated team it's still taking a while"

There were links made by participants about a dominant culture that slows the pace of promoting women to partners; that this leads to a lack of role models for younger women

at key points in their careers, which in turn leads to a lack of a pipeline of promotable young women. Some participants suggested that at key points in these women's lives, notably when they decided to start a family, the internal working patterns and conditions were insufficiently conducive to make women stay. Some leaders suggested that where working patterns were driven by the dominant male culture not enough heed was paid to how to make work work for young professional mothers.

"It's never the clients, it's never the clients with the problem. The clients totally understand it and are always willing to accommodate and work around it"

"It's actually the peer group and the partners that are the problem. We talk a good game about it until it impacts their particular project and then its suddenly all change"

There were specific examples given where the projects for young parents made it impossible for people to do a good job of work and be home to care for young children. One challenge seemed to be creating a consistent experience across the whole organisation.

At the organisational level these observations reflected a lack of pipeline of male/female diversity awareness within the system. There was also reference made to the risk at the organisational level that the dominant cultural 'in-group'[1] consisting of senior males made 'pretending' a possibility in relation to diversity and inclusion targets.

"Do you think there is a danger though, especially with Black Lives Matter and diversity targets that people are now getting by it by pretending?"

An example was given where a senior partner wanted to put a female candidate up for promotion not because he thought she was the right person for the role but because it would 'look good' in his team if he had 'two women that had gone up'. This highlights yet again the risk of a status quo prevailing and anything new being made to fit inside existing norms. Although it is increasingly recognised that this is a real challenge for creating organisational change (Beer, 2021), a large body of evidence into the difficulties of organisational change suggests that over 70% of change initiatives fail (Ewenstein et al., 2015). As already variously noted there is little on this topic in the literature.

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[1] A group of people sharing similar interests and attitudes, producing feelings of solidarity, community, and exclusivity

5.4.6 Multiple factors influence behaviour, and there is a lot in common as well between men and women

The final challenge evidenced by the leaders is that human behaviour in organisations is extremely complex.

"Professional services firms will continue to be dominated by alpha males. Now, that creates a dominant culture, which clearly has strong roots in gender. But dominant cultures are again complex not just single factor cultures"

Work culture is a broad and complex topic and open to wide interpretations, though as variously noted understanding work culture through applied neuroscience is beginning to emerge in the literature (Cheng et al., 2010). As previously discussed, the feminist view is that there is more in common than in difference between male and female brains and that as such brain sex difference at work should be ignored and that the sexes should be considered equal in terms of brain function (Lanz and Brown, 2020). However, such a position not only defines the female by reference to the male but completely ignores the potential organisational value of the differences. This project is aimed precisely at understanding and highlighting the differences to avoid the female being defined in such a way (Perez, 2019) . The contribution this work hopes to make is that future research and the ensuing literature will further explore and develop this understanding of the great organisational and personal value of brain sex differences.

5.5 Domain four: Client

In the present study, the network domain from Figure 5.1 is referred to as the 'Client' domain due to the business focused scope of this study. Network could be defined otherwise based on context, e.g. political networks, however all extra-organisational interactions in this study were between businesses and their clients.

Nine out of ten leaders referenced the application of the workshop content with clients and other partners in their organisation's external network. This application with clients covered a wide range of areas. Leaders talked about and gave examples of new ways of applying the ideas, knowledge and insights in relation to:

- Innovating with their business partners
- Negotiating with clients with the Neurosmart™ ideas in mind
- Wondering how government could use the knowledge in relation to education
- Agility in responding to clients' changing needs
- Winning new business
- Understanding the stress clients are under

- Managing emotional well-being in relation to client work

- Building new and trust-based client relationships

- Planning approaches to winning new business

- Dealing with conflict in client situations

- Actively putting co-leaders together to access brain sex difference to lead teams into a client assignment

Given that successful client relationships is what these leaders and their teams get measured on it was not a surprise that clients were a particular focus for applying what had been learnt. The data demonstrated that leaders had put new ideas into action with clients immediately and described positive value from this. For example, one leader talked about taking a broader view of including more diverse brains in solving a client problem. This involved changing a CEOs mind about the contribution to the overall work task of different team members.

"It's slower but I think it's more sustainable and probably gets a more optimised answer for them"

There is a body of evidence in the literature observing that gender diversity in particular, improves business outcomes as discussed in Section 2.6.1, and very recently is beginning to be referenced within the literature (Leonard and Straus, 1997; Schimmelpfennig et al., 2022); but there is little yet on brain sex differences (Lanz and Brown, 2020).

There is a long-established literature on the neuroscience of relationship and empathy in therapy and counselling psychology (Coutinho et al., 2014).Business research into external relationships and applied neuroscience is in its early stages yet growing. The focus of this literature tends to be on the experience of trust in relationships (Johannsen and Zak, 2021). As business schools, in the USA especially, increasingly move to combine, the business school, psychology, and medical/neuroscience faculties with heavy investing in such combined institutions. MIT, Wharton and Colombia advertise programmes for neuroscience in business, as does Kings College London in association with the Maudsley Hospital.

5.6 Summary

This thesis has, I hope, brought together information from neurobiology, neurochemistry and neuropsychology and translated it into business-friendly language, concepts and tools. The workshop introduced tools for application and the opportunity to apply knowledge to real work challenges, and as has been observed all of these elements were new for participants. Leaders reported this combination useful for finding new and effective ways of understanding themselves and others. They also reported accessing new behaviours quickly and sustainably using the new knowledge. The elements of the workshop leaders highlighted

that had especially enabled these changes in behaviour and knowing of that from a scientific point of view, were:

- The brain responds emotionally and underpins what people generally call 'rational' behaviour.
- Survive and thrive are different neurochemical states that impact behavioural responses.
- Everybody has their own individual thrive and survive responses/triggers
- Brain sex differences are neurobiological and are patterned by personal experience (nature and nurture)
- Brain sex exists on a spectrum of very male to very female and is likely to influence behaviour
- Everyone's brain has its own unique neural patterning
- Brain friendly tools can support the inclusion of diverse brains

Leaders described being able to pay a different kind of attention at both a micro level (themselves/one to one/teams) and at a macro level (thinking about organisational processes). Some of the reported experiences in this study begin to challenge existing organisational norms and highlight blind spots in assumptions such as those in the reward systems mentioned in the findings. In respect of the four domains (self, team, organisation, client) the study has built on the existing literature by adding an applied neuroscientific lens to each domain, leaders describing their personal experience of gaining positive value from using neuroscience in all the domains.

The problems faced by modern business and society are complex and now interrelated, digitally world-wide in a way that has never been the case before. For example, all businesses are likely to have to respond in some form to the impact of climate change, renewable energy, AI and the need for a more circular economy. This is likely to require a more inter- and trans-disciplinary approach to seeking organisational solutions. Working across disciplines and boundaries is beginning to happen and there is evidence of this in the early literature in relation to applied neuroscience, as we see psychology departments, medical, computational, business research and business coming together to find new integrated solutions (Wang et al., 2021).

This project, though very small in scale, is typical of single case-study reporting. It provoked the leaders that participated into stopping and questioning some of the key assumptions that impact individual capacity to thrive within the organisational system. The data tells us that these leaders found new ways of helping individuals to thrive as a result of their new knowledge and support in applying it. It raised some new questions for business leaders to ask themselves how they and their organisational systems can best enable the best of all the brains in their business.

There are three overarching observations arising from the appreciation and discussion of the findings. These observations are the foundation of the conclusions that are drawn in the next and final Chapter of this thesis.

Firstly, there is a gap in our understanding regarding brain sex differences in business. Brain sex difference is generally little understood by senior leaders at present, yet I observe an increasing interest.

Secondly, leaders seem able to apply the new concepts about applied neuroscience and brain sex diversity, easily in the domains of Self, Team and Client. They reported applying them readily and to good effect and readily.

Thirdly, the gap and the biggest challenge to the application of the concepts, tools and new insights presented in this thesis occur in the organisational/systemic change domain. This is in my view the domain which represents the biggest opportunity for sustainable business growth and personal well-being at work.

Chapter 6: Conclusions and Recommendations

6.0 Chapter overview

This project set out to explore the lived experience of senior leaders in answer to the question:

"What is the value as described by senior leaders of understanding individual brain sex differences in the workplace?"

There are five key conclusions arising from this research. These are summarised in Section 6.1 and result from the two phases of the literature review, the detailed analysis and discussion of the themes from findings, and my observations from all elements of the research.

Recommendations in relation to each of the five conclusions follow. These recommendations form the basis of a framework that could be used by leaders to both assess and access the value from brain diversity in their businesses.

This Chapter also considers how the findings from this project might be further disseminated, with recommendations for further research and highlights the changes arising in my own professional practice from having undertaken this Professional Doctorate.

6.1 Conclusions

6.1.1 There is a gap in awareness and knowledge about brain sex differences in the workplace

This project shows that there is a significant gap in our understanding of how organisations do and could access the best of brain sex inclusivity in their businesses. The evidence for this comes from two detailed reviews of the literatures that emerged in relation to the question. In addition, evidence of this gap was identified in the actual experience of all the senior leaders involved in the research for whom the applied neuroscience of brain gender diversity was completely new.

The current bias in the published literature and public debate has its centre of gravity in the feminist argument that whilst there are biological differences these should be ignored and that women can do anything that men can do within the current organisational systems. This represents a cul-de-sac in the feminist argument and restricts rather than opens up what could change for the better by truly embracing brain diversity and not just from the point of view of brain sex. This research and the propositions it is putting forward aim to provoke broader thinking about the inclusion of individual difference.

6.1.2 Active interest and application of new knowledge in three domains: Self, team, client

The second major conclusion is that when leaders are introduced to the neuroscience of brain sex differences and its use, they become very interested at a personal level. Each participant was fascinated by what it means for them as an individual as well as a leader and how this might connect to their teams, families and clients, and also immediately engaged in how they could use it. Both the Findings and Discussions Chapters provide ample evidence of this with 10 out of 10 leaders providing a lot of detailed descriptions of their own personal interest in and application of the ideas. Of course, volunteers that participate in such research probably start with a natural bias towards being interested. However, it is fair to say that having run dozens of the Neurosmart™ workshops, including some in quite hostile environments, the interest in the applied neuroscience of brain sex diversity has been consistently high.

6.1.3 Engenders deep learning with a shift in perspective

A third conclusion from this research is that the application and implementation of the new knowledge caused a deep mindset-shift for many leaders, fundamentally revising some of their long-held or previously unexamined assumptions. All leaders tried to apply the new information and insights in practice to improve business outcomes. This was an iterative process and the reported value to the leaders was derived by their capacity to engage with people differently as a result of the new insights and reflections informed by what happened. This deep shift in underpinning values and behaviours connects to the double-loop learning model (Argyris, 1983) as well as the more recent work on growth mindsets by Carol Dweck (Dweck, 2006).

6.1.4 Improved relationships are both an outcome and cause of the other three impact areas

In the thematic analysis the third most referenced theme of Impact summarised four key areas of value to these leaders (Section 4.4.3). The dominant area of impact or value was better/improved relationships. The double loop learning (Argyris, 1983) that occurred allowed leaders to revise their understanding and approach to others in the service of improving relationships. This learning about how to improve relationships contributed to the three other areas of impact or value reported by participants:

- Better understanding of self and others
- Sustainability whereby leaders began to habituate new approaches
- Business outcomes more effectively achieved

6.1.5 Scaling the value is a challenge at the organisational level

The final major conclusion from this research is that in the domains of Self, Team, and Client, the new insights were put quickly into practice leading to increased personal and organisational value. However, enacting and accessing the full reported value of brain sex difference inclusivity at an organisational level was seen to be much more challenging. The evidence from the interviews was very clear on this point with seven of the ten leaders reporting that they felt it would be difficult to implement brain sex inclusivity consistently at an organisational level. There was, in addition, no evidence in the literature of this having been attempted or achieved. Yet this is where potentially the most profound organisational and personal value lies.

As demonstrated by the data, the two most significant reasons for organisational implementation being a challenge are both to do with habits, established organisationally as well as personally, driven by the current dominant culture in any business. These are: no time to anchor new habits within the existing cultures, and leaders saying that organisationally the dominant culture is more driven by and suited to males/male brained approaches. These two challenges, detailed in Sections 5.4.4 and 5.4.5 are likely to perpetuate each other, thus bolstering the status quo.

Currently one of my major clients is attempting to actively access the neurochemistry of Thrive through his current knowledge of brain sex differences at a systemic organisational level. It will be very interesting to observe how this works for his organisation as I follow it up in my consulting work.

6.2 Limitations of the Research

This project is very early stage research on the topic of brain sex inclusivity in the workplace. Given this early stage, which represents the beginnings of mapping this territory, the research design is qualitative. This has the limitation of the small number of participants involved in a qualitative study of this nature. In addition to the restricted number of participants there was the issue of having to protect against both researcher and participant bias which has been discussed in detail in section 3.9. in the Methodology Chapter.

Whilst the findings and conclusions represent a useful starting point for further research on the topic having highlighted gaps in awareness and knowledge that can be further explored I believe that Action Research would have a given a more in depth understanding of the value to senior leaders. Action Research would also have allowed for changes to the content and tools to be developed as the research progressed. Were I to conduct research on brain sex inclusivity in the future I would seek to set up an Action Research design with participants based in the knowledge gained here and with full awareness of the difficulty of getting participants to commit to repeated reviews. In order to mitigate for participants

not being able to attend each time one could consider running two groups in parallel to ensure sufficient data.

An additional limitation of this research is it did not identify in which other different contexts the workshop content might apply. For example the principles of enabling a thrive state in the brain might be benefical in a school educational setting. An Action Research design might have opened up discussion on different contexts where it would be both interesting and valuable to develop the research.

Given the qualitative nature of the first stage research it would be valuable in future studies to seek to build in a quantitative element so as to be able to see if there are any measures that might apply to the value that leaders find in the content and tools. A combination of additional adjustments to the content, tools and techniques for using them combined with some quantitative data could be a useful expansion of this work.

6.3 Recommendations arising from these conclusions

6.3.1 Introduction and context

An organisational system that is not able to actively include this past 15 years of understanding brain sex differences, such that individual brain diversity can thrive and flourish, is at major risk of missing out on the kinds of values reported by the leaders in this project, though scaling brain sex inclusivity at the organisational level is the most significant challenge, in acknowledgment of this risk.

If different brain sexes are expected to (or worse, forced to) act out of their authentic or natural mode to try to 'fit in' with a dominant culture the evidence now from the neurosciences is that the brain will not be functioning optimally (Arnsten, 2009). This is because a brain that is being variably stressed by being forced to act inauthentically is likely to be in a survive state more often than a thrive state. Not functioning optimally means that the brain's most evolved region that supports our highest-level cognitive capacity, the prefrontal cortex (PFC) is unlikely to be fully active (Arnsten, 2009). Under even limited amounts of stress, the brain's emotional systems in the limbic system are activated and will therefore impede the functioning of the PFC (Arnsten, 2009). The best of the brain sex diversity is unlikely to be being accessed in this scenario.

Thus, any organisational culture that is 'blind' to the areas where it may be missing out in understanding and using brain sex differences is likely to be underleveraging access to the best of the brain of diversity within it. As highlighted in the Introduction the genesis of this research was my curiosity to understand just how and how much latent brain power was not being accessed by organisations. My best estimate based on previous experience is that up to 30% of the best of the brain diversity is being lost to an organisation at any given

point in time. This estimate is based on a combination of interviews, online questionnaires, group coaching and individual coaching that has been part of working with various clients on this topic over a number of years.

6.3.2 Contribution to knowledge

This study contributes, I believe, a novel understanding of the brain and brain sex differences which can act as a point of access for leaders in creating thrive states and accessing positive performance from brain differences. Some of the business literature referenced in Chapter 2 began to explore this but only to a superficial extent. New empirical evidence has provided the basis for this more precise application of the

neuroscience (Ryali et al., 2024). Knowing that the current conversation in the feminist literature is predominantly against this exploration, business leaders that have been exposed to the latest science were very interested. It is common that business leaders search for initiatives that could improve productivity (Atkins et al., 2023). These findings indicate that leaders are very interested in brain differences and how to leverage them for both business performance and personal well-being and that there is underutilised brain potential latent in organisations. The findings indicate that this research is inhabiting a gap, waiting for further exploration, in the current literature.

The literature discussed in this Chapter reveals a potential risk, that future primary research could over focus on the organisational domain and remain at a general conceptual level, thereby missing out on an understanding of individual brain differences within the organisational domain. There was evidence of this in aspects of the current literature across all four domains of self, team, organisation, and client. An example of this risk of limiting the frame of reference and investigating a problem based in existing assumptions, is the change management literature where neuroscience is being used to 'explain' existing organisational change models, rather than seeking completely novel ways of understanding modern knowledge of the human brain to affect organisational change.

Based on my findings from this project and my wider experience of being involved in the Neurosmart^{TM} workshops over a number of years I have the following recommendations in relation to each of the five key conclusions from this research.

6.3.3 Recommendation one: Raise awareness and educate leaders about brain gender differences and inclusivity

This project has demonstrated clearly that there is a significant gap in knowledge, awareness and understanding of the way we now understand the way the brain functions in relation to brain sex differences and how to best include these at work. My first recommendation for Stage One of creating change is that organisations set about educating and sharing

knowledge on the subject in ways that are appropriate for them. In my experience over the years that I have been engaged with this work the following formats can work well in this regard:

- Workshops
- Master Classes
- Keynote talks
- Information videos
- Group Coaching
- Supervision of internal coaches

Based on the second conclusion (active interest and application) this awareness-raising activity taps into the curiosity that some leaders in particular have in respect of the topic. It quickly becomes apparent which leaders are most engaged and what it is specifically they want to find out more about. Building relationships with this group of actively interested leaders through the above contact points, then enables the second stage in the process.

6.3.4 Recommendation two: Understand the size and location of the 'brain inclusivity gap' in the organisation

My second recommendation and Stage Two in the process of accessing the full value of brain sex inclusivity is to find out which brains do not feel fully included and why. This requires genuine curiosity and commitment from senior leadership to find out; and the preparedness to do something active with the findings. This is the topic for my ongoing/future research, whilst I am consulting in this area.

To date the methods I have used to establish where the brain gender inclusivity gaps exist are:

- Interviews
- Group Coaching
- Online questionnaires
- One-to-one coaching
- Supervision groups

6.3.5 Recommendation three: Actively support double loop learning through relationship building during early phases of post-awareness raising

As highlighted above in respect of the key conclusions in Sections 6.1.3 and 6.1.4, leaders demonstrated that they reviewed deeply held assumptions about others (Argyris, 1983) and through this changed the way to access the other areas of value reported in Chapter 4.

Studies in neuroscience demonstrate that brains don't change quickly but that they are very effective at adapting if habit changes are appropriately reinforced (Graybiel, 2008). A third recommendation is therefore, that the habit change and double loop learning is supported through ongoing coaching of leaders who are keen to champion including of brain sex differences.

The third recommendation and Stage Three of the process of accessing the full value of brain sex inclusivity is therefore leadership coaching. Coaching provides the opportunity for leaders to reflect upon their new insights and reinforce the double loop. Coaching also supports relationship building amongst people who are very diverse in a confidential space where some of the potential difficulties can be explored without fear of company politics intruding. As reported in the Findings building new habits is one of the barriers to change. Coaching during the embedding phase enables greater sustainability of the changes.

6.3.6 Recommendation four: Set up forums for the discussion and co-creation of changes to the organisational system

People in an organisational system focus on the behaviours and deliverables that are rewarded within that system (Bratton, 2007). My experience undertaking this research and more broadly as an international coaching and organisational consultant, is that the optimal brain performance from all the diverse brains in a business is usually not in any way fully accessed. The biggest challenge arising in this research is creating change at the systemic/organisational domain. In order for change to occur in the organisational domain, consideration, co-creation and commitment from as many individuals as possible who have systemic power to try to initiate such changes is necessary. Research highlights the habit-based inertia and opposition from individuals who might stand to lose out on any changes (Ewenstein et al., 2015). Many of the leaders who did not put themselves forward for involvement in this study might well be resistant to change, simply not interested enough or too busy doing what they habitually do.

Thus, the final recommendation is an ongoing set of forums set up to enable potential organisational changes to be discussed, debated, decided upon and enacted. This represents a Fourth Stage of this process. The type of forum would be dependent upon what works in a particular organisation. It is important that the forums include real brain sex diversity and are not set up populated by the dominant cultural 'in-group'. This is an instance where clear and thoughtful leadership is especially important.

Researching what happens that causes change and inhibits change in relation to the inclusion of brain sex differences at this collective level is currently part of my ongoing professional consulting practice research.

6.4 A framework: Accessing the value of brain sex inclusivity

The recommendations lend themselves to a stagewise framework that could act as a guideline to leaders who are looking to create value to their businesses by fully accessing the breadth of brain sex differences in their organisation. Figure 6.1 highlights the four stages of the framework and the phases within each stage.
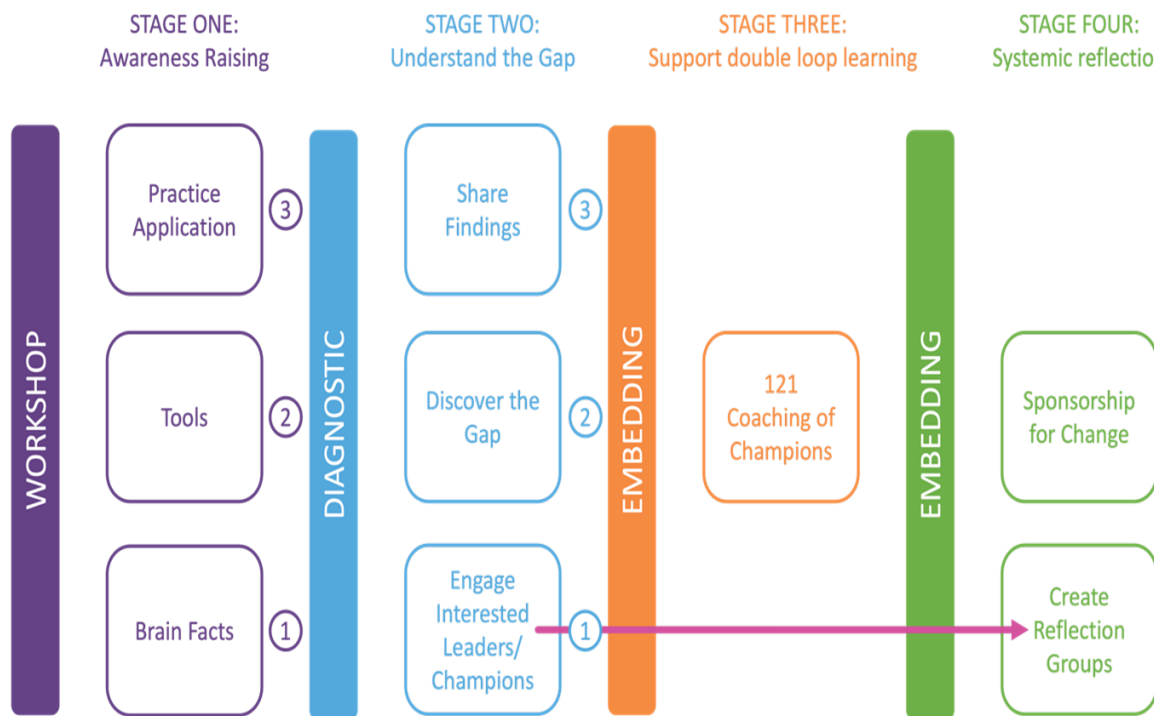
Figure 6.1: The Best of All the Brains Framework^{TM} Lanz and Brown, 2020

The first stage is awareness-raising which starts with a workshop. That workshop shares key information about the brain and the influence of brain sex as described in Section 2.7. The flow of this information starts in phase 1 which are key brain facts. Once participants are familiar enough with the key facts from neuroscience, they are introduced to the RICH^{TM} and 4 C's^{TM} models which help them understand how to work in a brain-friendly way. This is phase 2 in the framework Figure 6.1. Finally in phase 3, participants have ample opportunity within the workshop to practice using the tools, applying them to real world situations from within their own business context.

Stage two of the framework is applicable for organisations where the leadership is interested to understand more deeply where there may be a loss of access to all the brain diversity potential in the business. This stage requires commitment from senior leadership to sponsor further investigation (phase 1 in stage two in Figure 6.1). It has been my experience that some organisations want to take a close look at issues to do with both the retention and development of the top talent in the organisation. For example, I undertook some research interviews with the identified young talent in a particular company to assess the Thrive/Survive status of young executives this business particularly wanted to retain and promote. This is a three-phase process. Phase one is the sponsorship of senior leaders who

have been inspired by the workshop content. Phase two is discovering the (possible) gap in accessing the best of brain diversity. This can be done in a variety of ways as highlighted in Section 6.3.4. I have typically used interviews, group coaching, and questionnaires to investigate how effectively brains were being supported to thrive amongst the communities I was researching. Phase three in the Diagnostic stage from Figure 6.1 is to share the findings with the sponsoring leaders and participants so that they have a clear picture of the gap in their organisation. This enables leaders and the target group to co-create any appropriate next steps.

Stage three from Figure 6.1 is a vital part of any change process. The embedding stage of doing things differently to support sustainable change seems to have some power to counteract the fact that the majority of change initiatives fail, as changing human habits is difficult. The neuroscience of habit change, discussed in Section 5.4.4, helps us to understand why. If an organisation is serious about creating more effective access to all the brains in the business, embedding new ways of thinking, working and behaving that focus on creating the neurochemistry of thrive takes persistent commitment. At this stage an internal community of champions for the change can have an important impact. This community can be supported through one-to-one coaching or working in groups, continuing to test and challenge existing assumptions so that 'double-loop learning' can occur. As demonstrated in the challenges variously highlighted by leaders it is all too easy to maintain the status quo in a time-impoverished environment.

Stage Four is the continuation of the embedding process. A leadership that is serious about achieving systemic inclusion of brain sex differences will need to continue to focus on embedding new ways of thinking and creating the means by which a business is able to explore and use the neurochemistry of thrive. Taking time out for proper reflection on a consistent basis is important to keep awareness alive, build the habits that enable thrive and keep the adaptation process going.

6.5 Future research

This project set out to discover the actual lived experience of leaders in relation to understanding some key facts about brain sex differences. As the topic is little understood in business, as demonstrated by these Findings, there is a significant research opportunity to track what the impact is of continuing to disseminate and embed knowledge about brain diversity in all its forms in business. This project provides several starting points from which future research could be designed.

Brain sex is only one dimension of brain difference. One core message from leaders at the workshops was that including all the types of brain differences at an individual level is what effectively builds trust and creates the conditions for optimal brain function (Arnsten, 2009). It would be very interesting to discover the key 'drivers and blockers' (Woodward et al.,

2019) in relation to each stage of the framework. This would provide bespoke information for the organisation in question and the kind of data that could feed into Stage Four and feed forward into the ongoing embedding of new knowledge.

6.6 Dissemination of this research

6.6.1 Book writing

Disseminating this research already started with the publication of my co-authored book "All the Brains in the Business: the engendered brain in the 21st Century organisation"(Lanz and Brown, 2020).

I had originally imagined that the writing of that book would track more closely alongside this work. But the book went ahead before this project was finalised and agreed with UWTSD. I plan to write a further book that develops the framework for leaders detailing more of the 'how to s' of implementing the changes that are possible from the inclusion of brain diversity. This will be a project for the coming year.

6.6.2 Articles

I have written 15 articles in relation to this topic which have already been published over the last 3 years. I plan to write more articles based on the actual Findings from this project. The target audience for the articles will be business leaders, since they are best positioned to create scalable organisational change in relation to brain diversity inclusion.

6.6.3 Corporate leadership events

Keynote speeches at corporate events are another effective way to engage a wide community in learning about the benefits of brain diversity inclusion. Once I have successfully completed this Professional Doctorate and the current company research with which I am engaged I want to share the findings with business people as widely as possible. This will require creating a plan of how to target and communicate with business leaders most effectively.

6.6.4 Podcasting

Podcasting was one of the methods of communicating ideas I became involved with after the publication of the book (Lanz and Brown, 2020). This is a lively, interactive way of getting ideas across and I would very much like to do more podcasting as this project closes.

6.7 Personal reflections

I will share three key aspects of my personal reflections that have particular relevance for my professional practice.

Taking on a Professional Doctorate is a true act of persistence. One of my clients shared how her own PhD supervisor had said it is rather like the game where you see who can hold their hand over the candle flame the longest! This story resonated with me. The rigour and discipline of researching and writing up Doctoral research requires deep persistence. This persistence under the expert scrutiny and review of experienced supervisors with their constant questioning and commentary forces a depth of thinking and returning to thought that is vital in creating well-informed insights and sustainable change. The discipline of being very clear on why one writes, what one writes, and being able to back up each thought is an extremely important professional discipline. My practice, in what I say and how I say it has become more careful, thoughtful, and rigorous as a result of completing this doctoral process.

Accessing collective wisdom is another important skill that I have honed during the course of this Professional Doctorate (D.Prof). Working as a sole practitioner it is easy to become over-reliant on one's own habitual thinking processes. Becoming more open to a variety of input and constructive criticism in the service of the quality of output has been another ongoing learning from this process. The Coaching Group that Professor Fillery-Travis formed early in the Doctoral journey has been a vital part of helping both my learning and my motivation. I am very grateful to all my friends and colleagues from the D.Prof.

Charting one's own course and having the confidence to step into areas unknown in order to break new ground that benefits others is the third important learning that I value from being a Doctoral student. The status quo is not good enough and new ways of learning are important in business as well as more broadly. It would be easy to have a few insights and keep them to oneself. The Professional Doctorate forces one out into the world to articulate new thinking. This is both scary and inspiring in equal measure. I am grateful to have been persuaded by this whole process, my wonderful supervisors, colleagues, family and friends to 'put myself out there'. In closing I would like to share one of my favourite quotations made famous by one of my all-time heroes, Nelson Mandela:

"Action without vision is only passing time, vision without action is merely daydreaming, but vision with action can change the world" (Barker, 1991)

I want this work to contribute to positive change in the way organisations create the conditions for the brain diversity within them to thrive. True innovation in business and beyond can only really happen through the full inclusion of brain diversity in all its forms- brain sex differences being only one of the many dimensions of difference.

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Appendix A: Project Brief and Invitation for Prospective Participants

Dear XXXXX,

INVITATION TO PARTICIPATE IN THE NEUROSMART^{TM} DOCTORAL RESEARCH AT Company X

Thank you for signing up to take part in this exciting piece of leading-edge doctoral research. I very much appreciate your interest and commitment. From your participation you will gain some useful insights from the latest neuroscience about your own brain and behaviour along with highly practical methods and tools of applying your new knowledge at work and beyond.

What's involved - it's simple and designed to be time light!

You have already participated in the Neurosmart^{TM} workshop where you have learned about optimal conditions for effective brain performance (THRIVE/SURVIVE and brain gender influence on behavioural preferences.) You have also learned some key differences between the male and female brain and two useful frameworks for applying the neuroscience (RICH^{TM} communication model and 4 C's^{TM} Meetings Model).

Participating in this doctoral research involves reviewing the content of the workshop contained in the enclosed information pack. This will be followed by a short interview of up to one hour (either in person or over the phone) to find out what changes you have made to your work practices as a result of your new knowledge about neuroscience and brain gender.

The data analysis and use

Your inputs will be collated together (anonymously) with the information from all other research participants. The research is seeking to establish:

1) How have you experienced the new information about brain inclusivity and brain gender?

2) What have you done or changed in practice as a result?

3) What is your personal experiences of any changes you made? What is your experience of the impact of these changes?

4) What are the outcomes/changes you notice from the use of the RICH^{TM} communication model and the 4 C's^{TM} meeting model at work?

The information from this study will be used strictly anonymously. I will share key thematic insights with you as a research participant. All information will be held in line with current

GDPR requirements. The goal is to help your organisation create more brain gender friendly work practices and conditions.

The Benefits to you of participation

You may see some clear patterns about the types of people and situations that cause optimal/THRIVE or suboptimal/SURVIVE brain performance for you. With this information you will be able to begin to develop new strategies and approaches to the situations that generate SURVIVE for you and start changing these to support the neurochemistry of THRIVE in your brain. This is likely to have a positive impact on reducing your stress levels, increasing your well-being and your productivity and performance.

Actions to take now

If you have any questions that would you like to discuss in relation to the research drop me an email and we can set up a call at a convenient time to speak.

If you are happy to just get going please sign the attached consent form, email it back to me and I will be in touch within a couple of weeks to set up a time for a short telephone interview to explore your reflections on the questions above.

Thank you for your participation in this research it is very much appreciated and I am sure will be well worth your while.

Warmest wishes,

Kate

Participant Consent Form

The value to senior managers of understanding brain sex diversity – an exploration

This consent form is designed to check that you understand the purpose of the study, that you are aware of your rights as a participant and to confirm that you are willing to take part.

Please tick as appropriate

	YES	NO
1. I have read the participant information letter		
2. I have received sufficient information about the study for me to decide whether to take part		
3. I understand that I am free to refuse to take part if I wish without prejudice		
4. I understand that I may withdraw from the study at any time without having to provide a reason and without prejudice		
5. I know that I can ask further information about the study from the researcher		
6. I understand that while information arising from the study may be published, I will not be identified and my personal results will be treated as confidential		
7. I know that it will not be possible to identify any individual respondent in the study report including myself		
8. I understand that I will be audiotaped during the interview and that I can stop the recording at any point during the interview		
9. I understand that all data will be held securely, and electronic copies of transcripts will be password protected and only accessible to the researcher		
10. I understand that I can ask for a debriefing session following the completion of the interview		
11. I understand the process of escalation should issues arise that cannot be resolved by the researcher		
I agree to take part in this study		
Signature:	Date:	
Name In block letters please:		
I confirm that quotations from the journaling can be used in the final research output and other publications. I understand that these will be used anonymously and that no individual respondent will be identified		
Signature:	Date:	
Name in Block letters please:		

Appendix B: Research Ethics - Participant Consent Form for D.Prof Projects

		Yes	No	N/A
1.	Has the draft project proposal and ethical considerations been completed an submitted to the adviser?			
Participant's well being				
2	Does your proposed activity involve the participation of human/sentient beings?			
3	Have participants been given information about the aims, procedure/ processes and possible risks in easily understood language			
4	Will any person's position or treatment be in any way prejudiced if they choose not to participate in the project?			
5	Can participants freely withdraw from the project at any stage without risk or harm or prejudice?			
6	Have all necessary steps been taken to protect the privacy of participants and the need for anonymity?			
7	Will the project involve working with or studying minors (under the age of 16 years)?			
8	If **YES**, will signed parental consent be obtained?			
9	Have you considered the ethical implications of selecting data and the obligation to accurately represent participants' views?			
Research Methods				
10	Are there any questions or procedures likely to be considered in any way offensive or inappropriate?			
11	Does your research involve access to confidential/ personal records?			
12	If **YES**, have you sought permission from the individuals concerned/ followed the protocols required?			
13	Have you made yourself aware of intellectual property issues regarding any documents, materials you wish to use?			
14	Have you clarified with participants the ownership of data?			
15	Is there provision for the safekeeping of written data and video/audio recordings of participants			
16	Are there safekeeping strategies for electronic data and correspondence? Refer to the Data Protection Act on keeping personal information of participants?			
17	If any specialised instruments, for example psychometric instruments are to be employed, will their use be controlled and supervised by a qualified practitioner, such as a psychologist?			
		Yes	No	N/A
Effects/Impact				
18	Have you explored the impact of change that may result in your project activity on any participants/ people/sentients involved directly or indirectly in the project?			
19	If applicable is there provision for debriefing participants after the intervention or project?			
20	Have you engaged with your sponsor/employer about any ethics relating to how this research will be used?			
Ethical approval from other bodies				
21	Does your project require ethical approval from another body?			
22	If **YES** have the proper approval documents been attached?			
General				
23	Is there any ethical issue/potential issue you have/may have difficulty managing on which you would like more input? If **YES** please attach a summary			

Appendix C: Brain Sex Questionnaire and Score Sheet

Test Questionnaire

It helps to understand your own learning and thinking styles if you know the balance of your own brain organisation. Simple though they are, the following questions show large differences in the brain. Answer them 'yes' or 'no' − depending on how near the answer is to your own behaviour. Inevitably these questions are generalisations, so please tick the one that most applies to you. There are no right or wrong answers - just answer quickly and intuitively.

Please fill in the details below:

Name:_____

Are you mostly Left-handed or Right-handed? ....

What is your occupation? ....

	Questions (Place 'X' as appropriate)	Yes	No
1	It's easy for me to sing in tune, singing alone.		
2	When I was younger, winning was really important to me.		
3	It's easy for me to hear what people are saying in a crowded room.		
4	As a child I enjoyed going as high as possible when climbing trees.		
5	If someone interrupts what I am doing it's difficult to go back to it.		
6	I find it easy to do more than one thing at once.		
7	I find it easy to know what someone is feeling just by looking at their face.		
8	I like to collect things and sort them into categories.		
9	I solve problems more often with intuition than logic.		
10	As a child, I loved playing games where I pretended to be someone I knew or a character I had created.		
11	At school it was easy for me to write neatly.		
12	As a child, I enjoyed taking things apart to see how they work.		
13	I get bored easily so I need to keep doing new things.		
14	I don't like fast speeds, they make me nervous.		
15	I enjoy reading novels more than non-fiction.		
16	I can find my way more easily using a map rather than landmark directions.		
17	I keep in regular contact with my friends and family.		
18	As a child, I enjoyed physical sports.		
19	Imagining things in three dimensions is easy for me. For example: I can see in my mind's eye just how an architect's drawings or plans will look once built.		
20	As a child, I loved doing things like 'wheelies' on my bike.		

If you answered 'Yes' to questions: 1, 3, 6, 7, 9, 10, 11, 14, 15, 17 score 1 point each. ('No' answers to these questions receive 0 points.)

If you answered 'No' to questions: 2, 4, 5, 8, 12, 13, 16, 18, 19, 20 score 1 point each.

('Yes' answers to these questions receive 0 points.)

Now total up your scores. Fill in your score out of 20 here: