



**MONASH** University

**Gender, new science, and old stories: Persistent discourses of brain sex in news media**

Natasha Beth Abrahams

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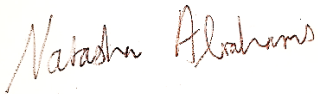
## Abstract

This thesis investigates popular news media reporting of scientific findings on behavioural sex differences. The research, positioned at the intersection of critical studies of science, gender, and mass media, examines how news reporting creates, sustains, naturalises, and transgresses traditional gender roles. News media have been identified as a key site for the reproduction of ideas about essential differences. Using a large sample of Australian news articles published over a 25-year period, the thesis reveals how news reporting uses science to reinforce a traditional, heteronormative sexual division of labour. Overall, I find that accounts of differences between male and female brains position women as naturally submissive, empathetic, and responsible; and men as naturally assertive, emotionally inept, and domestically challenged. I argue that news reporting uses scientific evidence and expert statements to create sexual dimorphism in the eye, ear, and brain from which the gender division of labour is held to naturally follow. The operations of this dimorphism are illustrated through two case studies, on ‘baby brain’, a purported condition experienced by new mothers, and on gender differences in multi-tasking ability. These phenomena are referred to in explaining the gendered division of labour and the cases illuminate how news reporting selectively uses scientific knowledge to legitimise gender stereotypes. I find that the use and presentation of evidence, which relies heavily on the selective use of statements from claimed scientific experts, is deeply flawed according to the accepted standards of science. In the case study on ‘baby brain’, news media systematically refers to less robust scientific evidence that promotes the existence of gender stereotypes, yet calls for a higher standard of evidence in coverage that counters stereotypes.

Four key themes have emerged from this investigation. These are, namely: the legitimisation of popular knowledge as science; the persistent belief in a scientific basis for gender stereotypes over time; the ubiquity of metaphors to explain and simplify science in mass media, and the uncritical reporting of scientific claims relating to gender. These trends are influenced by the scientific research funding climate, which privileges research programs and publications that support a gender essentialist construction of difference. The pressure to publish articles with strong ‘news value’ combined with the politico-economic conditions of news production serve to privilege essentialist discourses with minimal fact-checking or critical analysis.

## Declaration

This thesis is an original work of my research and contains no material which has been accepted for the award of any other degree or diploma at any university or equivalent institution and that, to the best of my knowledge and belief, this thesis contains no material previously published or written by another person, except where due reference is made in the text of the thesis.

A handwritten signature in brown ink that reads "Natasha Abrahams". The signature is written in a cursive style with a large initial 'N'.

Natasha Abrahams

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## Chapter one: Introduction

On 28 April 1894, newspapers around Australia reported on a lecture on 'Sex in Education' delivered by the prominent psychiatrist Sir James Crichton-Browne. The news article details Crichton-Browne's demonstration that the male brain is larger than the female brain, even when adjusted for body size. The article relays his conclusions about the relative strengths of men and women, including the following statement on the essential characteristics of each:

Man, the lecturer said, was more active, wilful, enterprising, and energetic, while woman was more receptive, tranquil, sensitive, affectionate, and constant. Man was more original, woman more intuitive. Man ranged into the past and the future, woman was content with the present. Man was experimental, woman conservative. He had grasp and scientific insight, she subtlety and common sense. (Unknown author 1894)

The listed masculine traits are those required for intellectual pursuits and success in the public sphere, whereas the feminine traits are pleasant and mundane- ideal for the performance of domestic and emotional labour. The author then describes the role of education for girls, arguing that schools should focus more on teaching the branches of housewifery, and cautioning that the school system in its current state is destroying girls' beauty. The news article goes on to establish that this is not to say that women are inferior. Rather, the sexes occupy different roles that cannot be ranked:

To blot out distinctions would be to de-humanise humanity. It was not a question of the inferiority or the superiority of the one sex to the other. Each was higher, each lower. (Unknown author 1894)

## **SIR CRICHTON BROWNE ON SEX AND EDUCATION.**

*(Newcastle Weekly Chronicle.)*

Sir James Crichton-Browne had a large audience at the Tyne Theatre, when he lectured on 'Sex in Education.' A table of cases investigated by himself showed, the lecturer said, that the male brain exceeded the female in weight by exactly  $4\frac{1}{2}$  ounces, and after allowing for stature, taking 5ft 7in and 5ft 2in as the average male and female heights respectively, there was still an excess of brain weight for the male of one ounce. All available evidence pointed to the conclusion that the male brain exceeded the female to an even greater degree than had been hitherto supposed. The different size between the male and female brain was a fundamental sexual distinction, of physiological import, and not to be abolished by education. To insist on the two brains working exactly alike was to incur some dangers to health for the sake of problematical advantages analogous to those found in crowing hens. Man, the lecturer said, was more active, wilful, enterprising, and energetic, while woman was more receptive, tranquil, sensitive, affectionate, and constant. Man was more original, woman

Figure 1: Article on Sir James Crichton-Browne's pronouncements on differences between male and female aptitudes owing to brain differences (Unknown author 1894).

Over a century of scientific developments later, it would now be laughable to argue that the relative size difference in female and male brains is the source of gender-typical behaviour. Instead, assertions about stereotypical gender roles are now evidenced by new sciences, such as genetics, endocrinology, and neuroscience. As explored in the chapters that follow, the messaging of innate gender roles is hardly different to that of the nineteenth century. New scientific facts have been retrofitted to the enduring script of the gender order.

In 2006, high-profile American psychologist Leonard Sax delivered a lecture at Melbourne's Lauriston Girls' School, expounding on the differences between male and female brains. Like Crichton-Browne's lecture over one hundred years earlier, Sax's talk was reported in the news as trusted science. Similarly to the 1984 article, the journalist emphasises physiological differences, stating that 'Sax says research shows differences between girls and boys are hard-wired' (Clark 2006). The journalist goes on to describe the impact of sex differences on education:

He says regions in the brain develop at different times in girls and boys. 'In girls the language areas of the brain develop before the areas used for spatial relations and

geometry. In boys, it's the reverse,' he says. 'If people aren't aware of these differences, by the age of 12, girls will tell you maths is hard and boys will say poetry is a waste of time. 'Teaching them things at the wrong time will only serve to reinforce the stereotypes.' He says boys are being subjected to books and assignments in a co-education setting that are inappropriate to their learning needs. He says boys should be reading *Treasure Island* rather than *The Handmaid's Tale*. (Clark 2006)

Like Crichton-Browne, Sax emphasises that he is not arguing for either sex being superior to the other:

'Differences do not imply an order of rank . . . (it) doesn't mean that boys are better or girls are better,' he says. (Clark 2006)

Sax's enduring claims appear in news reporting in subsequent years. His rhetoric is the descendant of much earlier ideas, with new science underpinning messaging reminiscent of the nineteenth-century panic about girls' education. This thesis aims to explore news reporting of scientific evidence for essential gender differences, focusing on articles published in Australian media between 1990 and 2016. This thesis investigates how news media portrays these differences, particularly probing how media frames, reference to scientific authority, and popular metaphors are utilised to explain traditional gender roles. I find that science, as well as unsourced expert statements masquerading as science, is used to legitimise the sexual division of domestic labour as biological in origin. Despite the gains of the women's movement in the mid to late twentieth century, which critiqued all kinds of subordination of women including that from scientific knowledge, this thesis finds that newspaper coverage is barely more progressive than the 1890s article shown above. Many aspects of the 1890s article – logical fallacies, stereotypes, scientific authority, and the 'equal but different' dictum – are echoed by more recent news reporting of science pertaining to sex differences.

I have selected news articles as an object of study because I believe they contain ideas about gender in a compressed form, in part due to their heavy reliance on metaphors to introduce new knowledge in an accessible manner. I take as a starting premise that the popular press is authoritative and influential in establishing and recycling gender discourses. Mainstream news outlets, meaning outlets such as daily newspapers distributed to a large, general audience, no longer have a monopoly on news production and consumption, with the rise of social media, but remain an important source of gender ideology. The approach adopted here is in line with the feminist argument that the media, including print and online news (the investigation of

which will be discussed in the following chapter), is a key site for the reproduction of ideas about gender-based differences (Tuchman 1979; Van Zoonen 1994). This type of critique can be traced back to Betty Friedan's content analysis of women's magazines in her influential book *The Feminine Mystique* (1963) wherein she investigated the unhappiness of married women and argued that this stemmed from expectations of housewifery. It is hoped that this thesis contributes to contemporary feminist analyses of mainstream media, taking place at the intersection of critical studies of science, gender, and mass media.

Before proceeding further, it is necessary to explain the definitions of sex and gender applied throughout. Gender refers to the set of behaviours and traits that are associated with each sex; normative gender roles can vary across different cultures and time periods. Different viewpoints on the origin of normative gender roles can be considered along a spectrum of purely socially determined at one extreme and purely biologically determined at the other, or some interaction of the two. In this thesis, I adopt the social constructionist view that gender is socially constructed, a product of culture, that is internalised by the individual (Rudman & Glick 2008, p. 8). I follow Judith Butler's (1990) understanding that gender is culturally contingent, created and recreated by the actions of each individual. Utilising a constructionist view of gender encourages a critical eye towards scientific pronouncements relating to gender roles. This has facilitated my ability to examine the gender work performed by news reporting of science. This social constructionist view of gender contrasts with the sociobiological view of gender roles as an evolutionary adaptation. This sociobiological view is conveyed by much of the primary source material examined in the results chapters. This is not to say that sociobiological arguments are entirely devoid of scientific merit; rather, that sociobiological arguments must be considered critically for their construction of gender roles, regardless of one's belief in the underlying statements.

Despite sex and gender being conceptually distinct, they are often used interchangeably when considering behavioural differences between men and women. 'Sex difference' and 'gender difference' are inseparable and indistinguishable as both sex and gender are implicated in creating the differences between men and women (Krieger 2003). While some sex differences, such as the function of reproductive organs, are largely dictated by nature (though still contingent on environmental factors), others are formed through an interplay of social and biological factors. Some brain differences are of the latter variety. A sex/gender difference occurs when the average measure of a trait differs between females and males; the size of the difference can itself be small. 'Sexual dimorphism' means that there are two wholly distinct

types (such as the reproductive organs) rather than an overlapping distribution (such as height). Overlapping distributions can be a type of sex difference, but not all sex/gender differences amount to sexual dimorphism.

In the chapters that follow, I find that recent popular scientific understandings of behavioural sex differences create and reflect gender stereotypes, particularly pertaining to the sexual division of labour. I argue that popular media and scientific literature work in tandem, scaffolded by the politico-economic realities of each, to perpetuate a reductive understanding of distinct roles, behaviours, and strengths of men and women. In mass media, journalists often apply scientific facts to promote a sexual division of labour wherein the female brain possesses the natural talents to perform domestic and emotional work in addition to low-level employment outside of the home, while the male brain is intellectual, socially dominant, and excused from menial tasks.

The findings presented in this thesis are based on an exploration of a large sample of Australian news articles published between 1990 and 2016, supplemented by findings from two case studies. This thesis explores the nuances of how science is used to promote gender ideology in popular news media. I also probe the types of evidence used, finding that incorrect or irrelevant facts are presented as scientific knowledge that justifies known or common-sense differences between the sexes. The unique contribution of this thesis is to find that this use of scientific knowledge to create, sustain, and naturalise the sexual division of labour is remarkably durable over time, and is facilitated by selective and simplified reference to science in mass media.

In the next chapter (Chapter Two), I outline the method of analysis for the sample of news articles. It contains details on how I selected and studied news articles, as well as theoretical imperatives for doing so. I refer to a range of literature on the method of framing analysis and on techniques used for media analysis more recently with the rise of online news. The second half of the research design chapter chronicles how news articles collected for this study were sourced, archived, and analysed. The results of this analysis are presented later in chapters five through seven.

Following the chapter on research design (Chapter Two), I have included two chapters (Chapter Three and Four) that introduce the key concepts appearing throughout this thesis, drawing on published literature to consider how the institution of science is used to enforce gender roles. The first of these chapters focuses on popular representations of science. Chapter Three begins with an overview of news values as they shape science reporting, before summarising empirical

studies on news reporting of science. These studies largely do not use a gendered perspective but nonetheless pre-empt some of the themes and challenges encountered in the results chapters. I examine popular science books, focusing on those that have had the most impact on understandings of gender. This links to the later finding in the results chapter that expert opinion, particularly drawn from books, figures as a prominent source of evidence for scientific gender differences. Finally, I discuss the use of metaphors in science communication, particularly the computer metaphor of the brain which is called upon by much news reporting. The use of metaphors to explain the gendered brain is ubiquitous in news reporting, as these metaphors allow the reader to quickly obtain a limited understanding of new and complex information.

Chapter Four takes a chronological journey through selected biological sciences as they have been used to enforce views about the sexed mind, after outlaying the context of biomedical ascendancy over the past century. This historical review begins with the foundations of gendered anatomy, before moving to the nineteenth century to explore phrenology and Darwin's Theory of Evolution, both of which were key sites of creating difference between the sexes (as well as between other social divisions such as race). I then review the critical feminist literature on modern biomedical sciences of relevance to this thesis, particularly endocrinology and neuroscience, drawing on the wealth of recent critical feminist neuroscience. Finally, I discuss how the funding environment of Australian sciences influences the research that is conducted.

After establishing the context for my original research, I present the three results and discussion chapters (Chapters Five, Six, and Seven). Chapter Five deals with themes identified in the main sample of 685 news articles. It explores how news reporting of science constructs a naturalised sexual division of labour in the home, particularly by creating sexual dimorphism of the eye, ear, and brain to justify differences in domestic labour. I also investigate how the spectre of the caveman is used in news reporting as a rhetorical device to show how behavioural sex differences are natural and adaptive. The caveman is understood as both a metaphor and a factual claim. Different types of evidence are considered in order to demonstrate that what is regarded as scientific knowledge is, in many cases, a mirage.

The next two results chapters consist of a more detailed case study approach that casts further light on themes identified in the main results chapter, particularly relating to the transformation of folk knowledge into scientific claims. The first case study (Chapter Six) probes Australian

news reporting on the gendered science of ‘baby brain’, the condition of forgetfulness said to befall pregnant women and new mothers. The concept of baby brain becomes shorthand for essential differences between the sexes, packaging together understandings of women’s natural, biologically-determined role as child-rearing with beliefs about women’s unsuitability for intellectual pursuits. Baby brain ideology is of interest for its role in transforming the social issue of women undertaking a disproportionately large share of parenting labour into a matter of biology. News coverage on baby brain is polarised, declaring baby brain to be either proven or disproven, and I find that newspapers require a higher standard of evidence if they are to report that baby brain has been shown to be an illusion. Rather than scientific findings being used to inform news reporting, news reporting adjusts the presentation of scientific findings to legitimise widely-held beliefs about gender roles.

The second case study (Chapter Seven) charts global news coverage on a single study on brain imaging of transgender individuals, which resulted in erroneous news reports that the study found that women possess a natural advantage at multi-tasking. Multi-tasking is stereotypically considered to be a female talent, despite this not being reflected in published psychological studies. This stereotype provides further rationale for an unequal division of domestic labour. News reporting of a study on women’s greater multi-tasking ability – despite this being an exaggeration and not based on the experiment that was performed – therefore creates the illusion of a scientific basis for the sexual division of household labour. This builds on the constructed sexual dimorphism of the eye and ear, as discussed in the main results chapter, which excuse men’s smaller contributions to domestic and emotional labour as being biologically determined.

Through systematically analysing the types of evidence in news articles and how they are presented, I find that news reporting of science quite often falls short of scientific standards, in which the gold standard is peer-reviewed, empirical studies or meta-analyses. News reporting relies heavily upon expert opinions and statements of fact that cannot be sourced to any legitimate study; these statements are nonetheless revered as authoritative and scientific. There are also many instances of scientific studies being paired with headlines that promote gendered conclusions that cannot be reasonably deduced from the evidence. News reporting of science relating to gender amounts to a legitimisation of folk knowledge.

In the final chapter (Chapter Eight), I distil the material presented into four key themes which emerge in this thesis: the legitimisation of popular knowledge as science; the persistent belief

in a scientific basis for gender stereotypes over time; the ubiquity of metaphors to explain and simplify science in mass media, and the uncritical acceptance of scientific authority in news media. As highlighted at the beginning of this chapter, there is a long history of scientific investigations that appear to naturalise social divisions, providing material for journalists to report upon. There are many factors which influence how scientific knowledge is used to support traditional gender roles in mass media. The final chapter of this thesis emphasises the role of the politico-economic contexts of news production and scientific research, combined with a pervasive patriarchy, in perpetuating gender ideology. The primary contribution of this research is the finding that the use of science to promote traditional gender roles in mass media has endured over time, despite decades of feminist critiques of how scientific knowledge is used to subordinate women. This thesis shows that news media consistently relies upon biased interpretations of the evidence to uphold the idea of fundamental, biologically based differences between the sexes and their roles.



## Chapter two: Research design

My research investigates how scientific findings pertaining to psychological and neuroscientific sex differences are reported in popular news media. I particularly draw on framing analysis of news articles to examine how news reporting portrays science to reinforce a traditional, heteronormative sexual division of labour. In this chapter, I outline the research design, articulating both my theoretical perspectives and to explain how this research was performed. I distinguish between methodology (the explanation for why particular methods were chosen) and its implementation. In the first section, I refer to a range of literature to justify the choice to study news media and to use the method of framing analysis. I synthesise existing literature on framing analysis to arrive at my own definition of taking media frames as the unit of analysis in order to qualitatively examine how a certain interpretation of information is encouraged by its author. This is contrasted to other possible ways of presenting a story. Framing analysis is ideal for media analysis with a gendered lens, as gender stereotypes can be considered as particularly powerful cultural frames. As online news was included in the data used here, I also delve into perspectives and techniques that researchers have applied to online news within the last two decades. The second section of this chapter details how I collected news articles for this study, before outlining procedures for analysis.

### Methodology

#### Theorising mass communication

Studying news media has been undertaken by researchers across many different disciplines and from different theoretical frameworks, particularly by communication studies and political science scholars. This section covers key developments in the study of news media that are relevant to the method of framing analysis and articulates the importance of studying mass media. In the following section, I provide a more detailed account of framing analysis and its application in this thesis.

There is a proliferation of accounts of mass communication studies research, with differing opinions of how many paradigms underlie the field (Potter, Cooper & Dupagne 1993). Here I give an overview of some of the main ways that the mass media has been theorised. Scholarly investigations of media began with the development of mass society theory in the late nineteenth and early twentieth centuries, according to communication scholar Jeffrey Bineham (1988). Mass society was conceptualised as an alienated populace, due to the decline of their local groups and communities, who are easily mobilised into extremism by elites (Buechler

2013). Twentieth century researchers therefore considered that the people of a mass society could be 'uniformly manipulated' by messages conveyed through the media (Bineham 1988, p. 234). Together with elements of behaviourism, a school of thought among psychologists that emphasised the uniformity of human nature, mass society theory led to the hypodermic needle theory of mass media (also known as the direct effects model), wherein it is claimed that the mass media imparts a singular and strong message onto its audience (Bineham 1988, p. 234). The hypodermic needle theory is no longer in vogue due to the discrediting of its underlying assumptions (Buechler 2013) (although, as Bineham (1988) discusses, some scholars argue that the hypodermic needle account was not as monolithic as it has been claimed; for example, proponents of the hypodermic needle theory understand there are many audiences each requiring different messaging in order to be influenced).

The hypodermic needle theory gave way to audience effects models that portray more complex understandings of how media is consumed and interpreted. Some aspects of the hypodermic needle theory were adapted into a two-step model in the 1940s that continues to be utilised today and is especially relevant in discussions of social media. The two-step model, which was first developed based on research into the 1940 election of the President of the United States, argues that a small group of opinion leaders are influenced by mass media messages, and the opinion leaders in turn influence those in their social groups (Lazarsfeld, Berelson & Gaudet 1948; Katz & Lazarsfeld 1955). The two-step model is also known as the limited effects paradigm. The implication of the two-step model is that, unlike in the hypodermic needle model, researchers do not assume that the audience will respond to media messaging uniformly.

More recently, researchers have utilised postmodern perspectives to make sense of how media is used and understood. In contrast to decades of research wherein it is assumed that audiences absorb media messages through a one-way interaction, directly or otherwise, postmodern perspectives on media studies hold that the audiences use the media to create their own meanings and politics (Harms & Dickens 1996, p. 217). By imbuing audiences with more agency in how media is consumed, the postmodern viewpoint de-emphasises the power held by mass media in influencing the populace. According to postmodernists, audiences are not manipulated by mass media, with the proliferation of content allowing audiences to curate their own media messages (Harms & Dickens 1996, p. 217). The postmodern perspective continues to inform many current studies of media and its effects.

Most relevant to the current research is the theory of agenda setting that asserts that media companies dictate what is being discussed in the news. This is the perspective used throughout this thesis. Central to agenda setting is the concept of salience, which is the prominence or importance of a certain issue or claim. Agenda setting addresses how salience is transferred from mass media content to the audience (McCombs & Ghanem 2001, p. 67). Agenda setting as a method for media analysis was first set out by Maxwell McCombs and Donald Shaw (1972), in their study of audience understandings of key issues in the 1968 United States Presidential campaign. The theory of agenda setting is linked with the concept of framing, as it can consider what is being presented and how it is being presented (the 'how' is the frame selected by the journalist), as well as audience effects. Framing analysis can thus be used as part of research into agenda setting. Framing analysis and agenda setting theory emerged out of different traditions, and their overlap has been characterised as a convergence (McCombs 2005, p. 546; McCombs & Ghanem 2001). The use of framing analysis for the current investigation encourages identification and questioning of the dominant reading of a text. Interrogating the beliefs that underlie news reporting on scientific understandings of the gendered brain is one of the intentions of this research. Framing analysis is useful as it allows consideration of alternative ways of presenting the same news story.

Mass media can be studied independently of investigating audience effects (such as the research performed here). However, it is still important to consider a perspective on audience effects, as this impacts the choice of an appropriate method. My perspective is that news media is influential in helping individuals construct their world-views, and is therefore of interest to researchers (McCombs & Shaw 1972). I assume (but do not investigate) that there is some audience absorption of dominant frames that appear in news reporting, regardless of the audience's opinion on that news reporting. This assumption is validated by the 'illusory truth effect' wherein a person who is repeatedly told an incorrect fact begins to assimilate this into their own knowledge (Begg, Anas & Farinacci 1992). In this study, I have restricted the sample to news articles relating to scientifically determined gender facts. This is premised upon the dual assumptions that both the mass media and scientific authority are influential upon the world-view of the audience. The influence of scientific understandings of gender is discussed in Chapter Four.

This section has contextualised the study of mass media, discussing several influential paradigms that have been used to theorise the significance of news media, and justifying the use of news media as an object of analysis. Agenda setting is identified as the theory, and

framing analysis as the approach, underpinning the current research. This leads into the next section that provides a detailed account of framing analysis and how it has been understood for the purposes of this thesis.

### Framing analysis

This section introduces framing analysis, the approach used for the current research. I canvass the literature that defines and debates the technique of framing analysis, as well as examples where it has been applied to investigating media reporting of science and medicine. Finally, I draw on this material to elucidate my own perspective on framing analysis as it is applied in this thesis.

Media framing refers to how stories are presented to provide the audience with a meaningful narrative: guiding their moral judgments about the issue, creating problem definition, and apportioning of blame or a solution. Framing can encompass not just written elements but also non-textual elements such as use of images. Central to framing is the idea of salience: making a piece of information more meaningful (Entman 1993). In this thesis, I follow Robert Entman's (1993, p. 52) definition of framing, which is:

To select some aspects of a perceived reality and make them more salient in a communicating text, in such a way as to promote a particular problem definition, causal interpretation, moral evaluation, and/or treatment recommendation.

Framing analysis emerges from several disciplines. It emerged chiefly from cognitive psychology and anthropology (Van Gorp 2007, p. 60). The concept of framing has been integrated into sociology, with Erving Goffman (1974) first using the concept to refer to a system of rules that individuals use to make sense of reality. According to Goffman, the collective primary frameworks of a social group are defined to be part of its culture. He labels this 'framework of frameworks' held by a group as its belief system, or 'cosmology'. Goffman's writings on framing do not provide guidance in terms of analysing frames, instead being concerned with the definition of individual frames. Note that a distinction can be made between individual frames and media frames: media frames are defined as being a central organising idea that creates meaning for a particular news story, while individual frames refer to the concepts used by individuals to help them understand information (Scheufele 1999).

Framing analysis is a popular approach employed by communication scholars (Van Gorp 2007, p. 60). The current paradigm of framing analysis is to assume that mass media's impact is moderated by audience characteristics (Scheufele & Tewksbury 2007). However, conducting

framing analysis does not necessarily include any investigation of audience effects. Some authors have expressed concern that framing has been inadequately defined, leaving researchers without a shared idea of what constitutes framing, and have attempted to remedy this situation (Scheufele 1999; Entman 1993; see also the 2007 special issue of the *Journal of Communication*). This loose definition and consequent ease of use may be why framing research has enjoyed such dramatic growth from the 1990s onwards (Weaver 2007, p. 144). Framing analysis can therefore be characterised as an inclination rather than a method or theory. Due to the methodological confusion, each researcher using framing analysis must be explicit about their definition and method.

Other than the lack of coherence between applications, there are several other methodological issues plaguing framing analysis. Van Gorp (2007) argues that naming frames constitutes an act of framing itself. To remedy this problem, he gives as an example a study wherein two framing packages are extensively described but are not given names. This approach has not been applied here as I do not believe it adequately deals with the problem; the researcher must still decide which aspects of the frame to privilege. Even if the researcher supplies an exhaustive description of an unnamed frame, decisions must be made as to which parts to list first (and, more practically, how to summarise the frame in concluding remarks). I accept that performing framing analysis does entail that the researcher is imposing a frame, and I make no claims as to objectivity of the frames identified. Another difficulty, according to Stephen Reese (2007) is that of researchers claiming use of the word 'frame' as a stand-in for 'topic' and therefore they are limited to producing descriptions of the media they are studying. Reese argues that the Robert Entman's (1993) concept of salience must be emphasised in framing analysis in order to avoid this hazard.

Framing analysis tends to be used to analyse news reporting of political developments (e.g. Sheafer 2007) and has also been applied to analysing news reporting on scientific topics such as climate change (e.g. Weathers & Kendall 2016; Olausson 2009; Boykoff 2007; Trumbo 1996), nanotechnology (e.g. Anderson, Allan, Petersen & Wilkinson 2005), and geoenvironment (Corner & Pidgeon 2015). There are some instances of framing analysis being applied to biomedical topics: Samuel and Kitzinger's (2013) analysis of news articles on functional magnetic resonance imaging (fMRI) technology being used to monitor brain activity in vegetative or minimally conscious patients; Nisbet, Brossard and Kroepsch's (2003) investigation of three decades of reporting on stem cell research; and Marks, Kalaitzandonakes, Wilkins and Zakharova's (2007) comparison between media framing of medical and of

agricultural biotechnology. I have identified one instance of framing analysis being applied to reporting biomedical developments with an explicitly gendered dimension: Shaw and Giles' (2009) investigation of how mothers of advanced age are presented in news coverage of a medical conference. These articles, some of which note the definitional confusion around framing analysis, further illuminate the variety of ways in which framing analysis can be applied to understand how reporters progress certain narratives to make sense of the facts before them. They also demonstrate how the approach must be tailored to the source material and subject matter.

My own definition of framing analysis, as it is applied in this research, takes media frames as the unit of analysis with the objective of interrogating how frames are used to encourage certain interpretations of a story. A crucial component of framing analysis is the consideration of alternative frames that could have been used; this is used as a way of illuminating the values and knowledge-claims implicit in each media frame. While framing analysis can be applied in both quantitative and qualitative ways, I have found it to be most relevant to qualitative investigations that consider the context and small differences between how frames are applied. I agree with Baldwin Van Gorp's (2007) assertion that frames are part of culture and therefore media reporting need not contain the entire frame that is in use. He argues that frames activate a schema (defined as a gradually evolving collection of organised knowledge, assisting individuals to interpret new information) to allow the audience to infer the reasoning devices that are not written into the article. Therefore, a particularly powerful frame is not necessarily prominent in the text in order to activate a schema. Van Gorp's arguments are particularly relevant to investigating news reporting with a gendered dimension, in which the entirety of traditional gender roles does not need to be explicated for the reader to understand the implications. Having now defined framing analysis, I will provide further details on its application later in this chapter. In the next section, I turn to discussing the peculiarities of online news, as online news articles made up a substantial portion of the sample for analysis.

### Studying online news

Studying online news presents the researcher with new opportunities as well as new challenges, as compared to investigations of print news. In this section, I explain the distinctions between online and print news, and discuss issues specific to studying online news. Where necessary, I outline how these differences are relevant for the current research. Despite being similar to traditional print news in many ways, online news has some important differences that can be considered when it is used as an object of study. Online news offers opportunities for audience

interactivity, such as comments and polls. These can be utilised to study how audiences use media, though this has not been investigated by the research performed here.

Online news is a relatively new development, as compared to print news which can be traced back to Germany in 1605<sup>1</sup> (Weber 2006). The first newspaper printed in Australia was the *Sydney Gazette and New South Wales Advertiser* in 1803 (Isaacs & Kirkpatrick 2003). According to Ben Scott (2005), while precursors to online news emerged in the 1980s, online news entered the mainstream in the mid-1990s as web browsers such as Internet Explorer became widely used. Online news has been characterised by Robert Kautsky and Andreas Widholm (2008, p. 84) as a hybrid medium that takes elements of televised and printed news. They write that online news is primarily text-based, but not to the same extent as print media. Online and print news interact with each other as major online news sites are usually affiliated with printed newspapers. The rise of online news coincided with a time of crisis and cost-cutting for print news publications, with hopes that the new opportunities afforded by the web would rejuvenate the industry (Scott 2005). Simultaneously, online news has created a period of economic upheaval for print news, as many readers expect to access online news for free, resulting in a lack of sales and advertising revenue (Scott 2005, p. 97). Eulogising of print news is common in the current climate of newsroom uncertainty (e.g. Beecher 2013). The changing politico-economic environment of news production is revisited in the final chapter of this thesis.

Online and print news differ in that the wording of articles, and headlines in particular, is impacted by the demands of the web environment. Readers of webpages do not necessarily read all the text, or read in order. Readers of webpages look at headings and links before scanning the regular text (Nielsen & Pernice 2010, p. 144). Savvy journalists may take the advice of web usability expert Jakob Nielsen and others, and adjust their writing to be more palatable for an online audience. This may result in less nuanced news reporting that is easily digestible for the speed-reader. Furthermore, journalists must consider how search engines will 'read' their articles in addition to considering the needs of their human audience. Search engine optimisation (SEO), which consists of techniques to improve a website's ranking in search engine results pages, is a crucial feature of the online landscape. There is an ever-changing and

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<sup>1</sup> Germany as the point of origin of modern print newspapers has been contested by Yangming He (2015) who claims that periodicals in eleventh and twelfth century China can be considered the first newspapers. Central to this dispute are two key issues: firstly, the definition of newspaper, and secondly, the Eurocentric bias of historians.

complex assortment of procedures to improve a website's SEO, but a simple and popular technique to improve the ranking of an article is the inclusion of relevant keywords, particularly in important places such as the headline (Richmond 2008). Attempts to improve the SEO of an article may result in simpler language and the seeding of keywords (Richmond 2008). It is plausible that SEO could affect the framing used by articles, in that journalists may decide to use keywords suggestive of a particular frame in order to improve the search engine ranking of their article. These two developments taken together may indicate a simplification of online news reporting as compared to print news; although it may be noted that online news has more freedom for in-depth analysis as it is cheaper to host a long article online than it is to print that article in a physical newspaper.

The influence of SEO has implications for the sample selection of this study. I expect that there is selection bias towards articles with good SEO, due to the collection of some articles through search engines. This is particularly relevant for the case studies. While I have endeavoured to find all English language online news reporting for the case study on 'multi-tasking and gender', I may have failed to find some articles that are poorly optimised for Google searching and do not contain references to the authors of the original scientific studies. Therefore, I may not have included reporting that presents the scientific studies in novel ways. However, this is of limited concern as this research is intended to investigate only mainstream news media, particularly print and online articles from large media companies, as it is consumed by a large number of people. Articles with poor SEO will receive less traction online than those with good SEO, due to search engines being the most common way for online audiences to access news and media according to data from the United Kingdom (Nel & Westlund 2013, p. 189).

There are substantial differences between the audiences of newspapers and online news. The reader of print news articles must have either purchased the newspaper or otherwise have access through another person's purchase<sup>2</sup>. However, online news is accessible to all who have an internet connection, with the exception of some news articles that are restricted to paying customers. Arguably, audiences of online news sites are less cohesive and more transient. Browsing a news site is akin to flicking through a newspaper, but there are many other ways that online news can be consumed. One need not be a regular reader of a particular news site in order to view an article. In the online environment, it is simple to follow external links to

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<sup>2</sup> Some newspapers are free for the reader and supported by advertising. However, there are differences in how free newspapers and free online news are accessed. Usually, free newspapers are delivered on a local scale, limiting how many people can easily access that newspaper.



news sites (particularly through social media and through the websites of news aggregators) as well as to perform searches to obtain news of interest (Richmond 2008, p. 51). While I do not investigate audience effects, it is nevertheless important to be cognizant of these differences in readership when constructing arguments or making assumptions about how an article will be interpreted.

A print newspaper will rarely travel outside the area in which it is circulated, while an online news article may be read far beyond the region in (or for) which it was produced. This was demonstrated by Neil Thurman (2007), who investigated the audience demographics of British news websites and found that two in five readers were drawn from outside Britain. He furthermore argued that some news websites acknowledge their international audiences, who are monetized through the sale of advertising space. More recently, Andreas Widholm (2019) found that over one quarter of the Swedish population consume news from other countries on at least a weekly basis. While it is reasonable to restrict the study of newspaper articles to a geographical area in order to restrict to a particular cultural context, these boundaries are not applicable on the web, where the reader may not be located in the same area in which the news website is based, and may not even be part of the intended audience. Because geographic boundaries are less relevant for online news, for some case studies I expanded the study parameters to include English language news articles from international sources.

The relatively affordability of producing online news is another consideration in the current study. While the majority of mainstream news sites considered in this research are affiliated with print newspapers, there are some news outlets that are online only. Online-only news sites run a spectrum ranging from the amateur efforts of citizen journalists to relatively reputable and well-organised online news providers (the *Huffington Post* is a prominent example). Setting up a news website has few barriers to entry, with the availability of free and low-cost website hosting services. This has resulted in the proliferation of special interest news websites, as well as those that cater to political viewpoints (Scott 2005, p. 96). While this is no different to a variety of print newspapers and magazines leaning towards different views and interests, the online landscape of special interest news media is of an entirely new scale. Furthermore, a local newspaper or magazine has little opportunity to be seen by those outside its targeted geographical area; whereas even a low-budget website is accessible globally. This is not to say that the internet is a free-for-all as it had been characterised in the 1990s; further to the above discussion on search engine optimisation, it is usually mainstream and well-funded news sites that dominate web traffic (Richmond 2008). A detailed investigation of American news sites

by Matthew Hindman (2018) found that contrary to claims that the internet has facilitated the growth of hyper-local news sites, such local news sites only receive a tiny share of news page views. Hindman argues that this is due to larger websites having small advantages in attracting views, with this effect compounding over time. For this reason, the characterisation of wide-circulation, general-audience newspapers and news websites as being mainstream is maintained even with the multiplicity of niche online news media now available. However, it is easy to find niche news sites if they are specifically searched for. This is relevant to the current study in that I have not weighted articles for readership – an article for a niche site is not considered differently to one from a publication reaching a larger audience. Any assumptions about the readership must be carefully considered in light of this limitation. However, as is shown in Chapter Five, the majority of articles are drawn from high-circulation publications, and the sample is dominated by articles published by News Limited and to a lesser extent Fairfax.

An advantage (as far as this research is concerned) of online news is ease of access, and being able to view each article as intended by the publisher, although, as Kautsky and Widholm (2008, p. 85) note, there are effectively many different versions of online articles due to factors such as the reader's web browser and the place where the article is viewed. I would also suggest that the presence of targeted advertising should be added to their list of factors which generate different versions of online articles. This is in contrast to many databases of print news articles, such as Factiva, that provide the text of each article only, stripping the article of valuable context such as inclusion of images, placement and layout, and content of other articles on the same page. While archived copies of newspapers are kept by libraries, finding the archived copy of each article would be a momentous undertaking and has not been attempted here.

Scholarly research into online news is a relatively new area of investigation, however, there are some authors who have written specifically about methods that can be used for studying online news. Writing in the earlier years of social media, Kautsky and Widholm (2008, p. 82) observed that the evolution of an online news article over time (for example, as further details emerge on a breaking news story) provides an extra dimension that researchers can investigate<sup>3</sup>. More recently, computational methods for studying online news have emerged. Digital

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<sup>3</sup> The development of breaking news was not considered in this study, though the dynamic nature of the web did occasionally present a difficulty, such as when I wanted to access the web version of a previously printed article which had since been removed from the news website. However, through accessing cached copies of articles through Google and using an archiving website called the Wayback Machine, in some cases I was able to view the article as it had appeared earlier.

journalism presents researchers with the opportunity to access large data sets, with the application of novel methods such as machine learning (Boumans & Trilling 2016; Günther & Quandt 2016; Sormanen, Rohila, Lauk, Uskali, Jouhki & Penttinen 2016).

While cognizant of the ways in which the online environment may have impacted sampling for the current investigation, as outlined above, no distinction has been made in this research between the methods used for analysing print and online news articles. This is because the unique elements of online news, such as opportunities for audience interaction and spread on social media, have not been systematically investigated. For both online and print articles in the sample, I was most interested in how scientific knowledge is portrayed within the text and headlines of news articles. This negated the need for specialised techniques designed to probe features of articles specific to the online environment. As audience effects were also not investigated in this research, there is no need for the method to accommodate how differences in online news may influence reader perceptions, or the different audiences that online articles may reach.

This section has provided an overview of how online news deviates from print news, and a discussion of features of online news articles that are relevant to the research undertaken here. Understanding the economy of news mediation is essential to interpreting how and why news is presented in certain ways, as well as how it might be understood by the target audience. Having now discussed the methodology of the current project, the second half of this chapter will provide details on how articles were sourced and analysed.

## Procedures

### Sample selection

This section details the procedure for obtaining a sample of news articles. I outline the databases and keywords that were used for the main results. Articles reporting developments pertaining to the gendered brain or mind were collected in two groups: contemporary Australian news articles, and contemporary global case studies. The details for each are provided in this section. The next section outlines how analysis of these articles was performed.

All articles were gathered online, through searches conducted via the database Factiva, the archive News Store, and the search engine Google. Boolean operators were utilised in searching in order to restrict or widen searches as needed. The exact search terms used are shown in this chapter; in order to interpret these, some understanding of Boolean logic (a system of algebra that has been applied to computer software) is required. I will briefly explain

the basics of Boolean operators before proceeding to discuss sampling for each set of articles. The Boolean retrieval model has been used for electronic databases from the 1970s onwards and remains extremely popular today (Stock & Stock 2013, p. 250). Due to it being almost universally used, I was able to use Boolean operators on all of the different databases used in this study. There are four Boolean search operators that are used to link keywords, that may be understood most intuitively in terms of set theory (Stock & Stock 2013, p. 245). The operator **AND** is used to denote the intersection between the set of results yielded by two or more keywords and thus is used to restrict the number of results. For example, a search on ‘testosterone **AND** brain’ will only return results that contain both the words ‘testosterone’ and ‘brain’. The operator **OR** is used to denote the union of two sets of results, increasing the total number of results. Using the previous example, a search on ‘testosterone **OR** brain’ will contain results containing ‘testosterone’ on its own, ‘brain’ on its own, and the intersection between the two. Parenthesis are used in Boolean searching to change the order of operations. For example, a search on ‘testosterone **AND** (brain **OR** mind)’ will yield the intersection of articles containing the word ‘testosterone’ as well as at least one of either ‘brain’ or ‘mind’. One further operator of relevance here is quotation marks. These are used to restrict to an exact phrase. Search engines such as Google interpret the absence of an operator to mean **AND**. Therefore, a search on ‘male brain’ will only return results where the exact phrase is found; while searching for male brain (without quotation marks) will yield articles containing both the words ‘male’ and ‘brain’ but not necessarily in succession. Additionally, there are some more advanced Boolean operators, that can be used to yield only the most relevant results, that were not used here.

Several limitations are a natural consequence of this method. A result of synthesising themes is that the quotes, extracted from articles, are not contextualised with the full article. More importantly, though, the broader context is lost. For print articles, I have no information about page placement and images. Nor is there any knowledge of what other articles and advertisements appear on the same page as the story of interest. The surrounding material could be relevant to how the article is interpreted. Moreover, each article appeared at a particular time, that, beyond the context of year, is not considered here. Some articles can be attributed to a broader trend. For example, in the mid-2000s in Australia there was media panic about boys falling behind in school and concerns about young men contributing to the road toll. Some of these articles, which implicate the male brain in the issues, are captured by the sample. However, these trends are not an object of analysis for this study. Instead, as established in the

preceding chapters, I have focused on the context of how science has been used to colour behavioural sex differences. Applying framing analysis introspectively, there are myriad ways in which the news articles collected and quoted here could have been studied and synthesised. I have chosen to emphasise one story among many.

#### *Contemporary news articles*

The largest sample used in this research consists of (relatively) contemporary Australian news articles. This sample is restricted to contain articles from 1990 until 2016 (2016 being the year when the articles were collected). The 1990s were chosen as a starting point for this sample due to capturing the time period in which key scientific advances, such as the development of brain imaging techniques, coincided with renewed fervour for finding biological reasons for gender differences in behaviour.

The majority of searches were performed in the database Factiva (which contains full-text archives of newspapers), with supplementation from News Store (an online archive of news articles from the large Australian media company Fairfax). A limitation of News Store is that it only shows the first 200 results (sorted by relevance) for any search. I elected not to include articles found in Newsbank, as the results overlapped with those found in Factiva. All Factiva searches as described in the below table were restricted to Australian articles only. Otherwise, search terms were left as broad as possible. The keywords used, and the number of articles that were retained from these searches, are shown in Table 1 below. The keywords used were designed to capture news articles reporting upon scientific developments relating to essential gender differences as located in the brain. The keyword ‘Brizendine’ was added to find any additional articles quoting Louann Brizendine, the author of several popular books on brain sex differences and who is frequently quoted in news articles.

<b>Keyword/s</b>	<b>Database</b>	<b>Date of search</b>	<b>Number of articles saved</b>
Neuroscience AND (sex OR gender)	Factiva	29 October 2016	78
‘Male brain’	Factiva	30 October 2016	191
Brizendine	Factiva	31 October 2016	35
‘Female brain’	Factiva	31 October 2016	75

'Brain sex'	Factiva	31 October 2016	17
Science AND (brain OR mind) AND (sex OR gender)	Factiva	31 October 2016	167
'Brain wiring' AND (sex OR gender OR male OR female OR men OR women)	Factiva	2 November 2016	5
'Sexual selection	Factiva	12 November 2016	56
'Male thinking'	Factiva	12 November 2016	3
'Female thinking'	Factiva	13 November 2016	2
Testosterone AND brain	Factiva	28 November 2016	250
(Hormone OR hormones) AND brain	Factiva	18 December 2016	246
'Male brain'	News Store	26 June 2016	59
Brizendine	News Store	26 June 2016	1
'Female brain'	News Store	26 June 2016	49
'Brain sex'	News Store	26 June 2016	18
Neuroscience AND gender	News Store	29 June 2016	17
Brain AND gender	News Store	29 June 2016	67

Science AND gender	News Store	1 July 2016	46
Sexual selection	News Store	24 July 2016	21

*Table 1: Searches conducted for sample of contemporary Australian news articles*

In addition to the searches listed in the above table, there were also a number of keywords that did not yield relevant articles. In Factiva, the following searches were not fruitful:

- Brain sex
- Brain AND (sex OR gender)
- Science AND (sex OR gender)

The above three searches were unsuccessful due to returning a large number of irrelevant articles.

- Brain AND (estrogen OR oestrogen)

This search yielded only articles that I had already saved from previous searches, and irrelevant articles about estrogen therapy for mental disorders

The following News Store searches were unsuccessful:

- Brain wiring  
This search did not return any articles relating to gender.
- Male thinking
- Female thinking

The above two searches did not return any relevant results.

The above table indicates that there are 1,403 articles obtained for the contemporary Australian news sample; 1,125 articles from Factiva and 278 from News Store. However, not all of these articles were retained at the analysis stage. After obtaining the complete sample, I sifted through the articles again during coding. Many of the articles were duplicates (either due to syndication, or due to different keyword combinations returning the same article) that were deleted. I also applied more stringent criteria for relevance at the analysis stage. Reasons for removal included: not being from Australian publications, not containing explicit applications to humans in the case of animal studies, and being from niche publications. Some of the articles found were radio transcripts, press releases, or letters to the editor; these were also removed. I

furthermore excluded certain topics that I deemed to be less relevant: articles on legal challenges relating to transgender rights, and articles that blamed pregnant women for issues with their children's development. Also, articles on 'baby brain' were moved from the main sample into the case study sample so they would not be analysed twice. The initial sample was distilled into 685 articles once duplicates, press releases, and articles from fringe publications were removed.

### *Case studies*

This section details how news articles were collected for each case study. There are two case studies that focus on reporting around one specific topic (in the case of baby brain) or news story (in the case of multitasking). Each is intended to show one specific aspect of news reporting on gendered science. The objectives of each case study are, firstly, to investigate how that topic was reported upon, paying particular attention to how scientific concepts are used to justify traditional gender roles; and secondly, to illustrate a broader observation about how scientific research pertaining to gender is reported in general. The case studies were conducted mainly using the qualitative method of framing analysis. This allows a more in-depth examination of gendered aspects of reporting on the stereotypes relating to motherhood and multi-tasking, and how metaphors are used to construct a supposedly scientific basis for these gender stereotypes, complementing the more general findings of the main sample.

There is no consensus definition of case study, a situation that many scholars have sought to remedy, adding to the plurality of definitions (Gerring 2004). As Bent Flyvbjerg (2011) argues, defining a case study as the analysis of an individual unit requires the researcher to decide what constitutes an individual unit. Additionally, the researcher must draw boundaries to demarcate what is included as part of the case and what remains as context to the case study. In the following case studies, I have defined the individual units as being topics. This is to distinguish from the main sample of articles, from which it is possible to investigate many different topics. In the case study on 'baby brain', I have investigated the reporting on scientific research on this topic, drawing from many different studies over a long period of time. The other case study on 'gender and multitasking' is much narrower in the object of investigation, with the sample being comprised of news articles resulting from one specific piece of scientific research, over a relatively short period of time.



### *Baby brain*

The case study on ‘baby brain’ examined Australian news reporting on the effects of pregnancy and motherhood on the (female) brain, in order to demonstrate how mainstream news sources promote biological explanations for essential differences despite contradictory and insufficient evidence. These news articles are based on many different scientific studies and claims, appearing from the 1999 until 2016. I identified the topic of ‘baby brain’ as a recurring theme while searching for articles containing the keywords ‘hormones’ and ‘brain’ as part of the main sample of contemporary news articles. Following this, I completed more searches in order to gain a more comprehensive sample on the topic of baby brain, including articles that did not mention hormones. The keywords ‘mumnesia’, ‘pregnancy brain’, ‘placenta brain’, and ‘nappy brain’ were identified from articles yielded by initial searching. The additional searches performed are summarised in Table 2.

<b>Keyword/s</b>	<b>Database</b>	<b>Date of search</b>	<b>Number of articles saved</b>
‘Baby brain’	Factiva	23 December 2016	64
Mumnesia	Factiva	23 December 2016	5
Pregnancy brain	Factiva	23 December 2016	
Hormone/hormones AND brain	Factiva	18 December 2016	29
‘Placenta brain’	Factiva	31 December 2016	3
‘Nappy brain’	Factiva	31 December 2016	1

*Table 2: Searches conducted for the ‘baby brain’ case study*

Altogether, I obtained 103 Australian news articles reporting on scientific research on the effects of pregnancy on the brain. This is comprised largely of the archived versions of print articles. All sources were what I would describe as mainstream news publications (with articles from special interest publications being excluded). The sample is drawn from a large cross-section of newspaper types including regional, national, and metropolitan newspapers. Articles were drawn over a seventeen-year period from 1999 to 2016. There was no date restriction applied during searching (so articles earlier than 1999 were not deliberately excluded; they either do not exist or were not present in Factiva).

### *Multi-tasking and gender*

The case study on ‘multi-tasking and gender’ focuses on news coverage from one scientific study in August 2015. A study presented at a neuropsychopharmacology conference, which found that trans men taking testosterone treatment experienced brain structure changes, attracted significant news coverage. I selected this for a case study due to the new claims to do with cognition and multi-tasking that were not discussed in the paper or press release but later emerged in the news reporting. Thus, it is used to illustrate how mainstream news can exaggerate findings from what the author intended, that in this case has highly gendered implications.

As well as investigating the news coverage garnered by the study, I performed a close reading of the primary materials: a two-page abstract of the study from the program of the conference at which it was presented; a journal article on the study, that was published the year after the results received news coverage, and the media release whereupon most of the coverage was based. Again, this bears resemblance to the method used by O’Connor and Joffe (2014) wherein they drew upon a range of sources to investigate news coverage of a particular scientific finding.

The identification of keywords for this case study was an iterative process; the first few articles were inspected for common elements that could be used to generate more keywords. Because I was seeking news coverage of one particular study (as opposed to a group of studies, as in the main sample or the case study on ‘baby brain’), it is expected that the sample collected is an exhaustive collection of all English language articles that were indexed by Google that reported based on the press release. However, it is possible that there was more coverage of this study that did not contain either quotes from the press release or the last author’s name.

For this case study, articles were not restricted to Australian news outlets. Almost all articles were drawn from online coverage (searches in databases of print news were not fruitful). The keywords used are shown in Table 3 below. Some keywords as shown in the table below were direct quotes from the press release, for example, ‘Research shows testosterone changes brain structures in female-to-male transsexuals’ was the title of the press release, and ‘Genuine difference between the brains of women and men is substantially attributable to the effects of circulating sex hormones’ was part of a quote supplied in the press release. Other keywords used include the surname of one of the authors quoted in the press release, the name of the conference at which the research was presented, and key terms relating to the study findings.

One further search was conducted using a reverse image search of a diagram which was included with the press release. Additionally, I also conducted several searches that did not yield any new results. This including repeating earlier Google searches in the databases Newsbank, Factiva, and Trove in order to identify if any articles had been missed. In total, there were 46 unique articles found collectively by the searches identified in the Table 3.

<b>Keyword/s and search images</b>	<b>Database</b>	<b>Date of search</b>	<b>Number of articles saved</b>
Research shows testosterone changes brain structures in female-to-male transsexuals	Google search	April 2016	46 unique articles (91 articles total)
Lanzenberger AND multitasking	Google search	April 2016	
European College of Neuropsychopharmacology AND verbal ability	Google search	April 2016	
Testosterone AND multitasking	Google search	April 2016	
‘Genuine difference between the brains of women and men is substantially attributable to the effects of circulating sex hormones’	Google search	April 2016	
‘Men and women differ in brain structure within regions involved in language and speech’	Google search	April 2016	

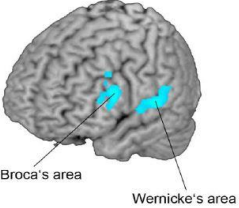
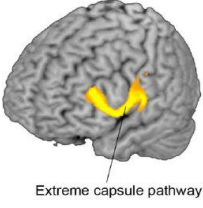
‘When it comes to certain language skills, the loss of grey matter outweighs the strengthened white matter connection’	Google search	April 2016	
<div style="display: flex; justify-content: space-around;"> <div style="text-align: center;"> <p>Testosterone decreases gray matter volume</p>  <p>Broca's area Wernicke's area</p> </div> <div style="text-align: center;"> <p>Testosterone strengthens white matter pathway</p>  <p>Extreme capsule pathway</p> </div> </div>	Google image search	April 2016	
Lanzenberger	Newsbank	April 2016	

Table 3: Searches performed to collect articles for the multi-tasking case study.

### Procedure for analysis

As discussed in the earlier methodology section, framing analysis has been criticised as being poorly defined. While there have been some attempts to unify framing analysis as a reaction to its perceived shortcomings (e.g. Entman 1993), framing analysis remains a paradigm that must be established by each researcher as it is used. However, the literature does contain some suggestions as to the implementation of framing analysis. I follow Baldwin Van Gorp’s (2007, p. 72) recommendation to utilise both quantitative and qualitative methods, with the qualitative methods being used to first identify and finally interpret frames, and quantitative methods used as an intermediate step to find the prevalence of particular frames. I also employ Van Gorp’s suggestion to use a matrix to inductively identify frames by noting the framing or reasoning devices for each article, that can then be distilled into a smaller number of frames. This constitutes a reconstruction of frames (Van Gorp 2007, p. 72). The exact details of how analysis was performed was different for the case studies and for the main sample. Owing to the different features of each sample, different strategies were required. More details are provided for each below.

#### Main sample analysis

The main sample was analysed using NVivo software, which was chosen for its ability to handle large amounts of data. As mentioned above, I reduced the initial sample into 685 articles, with most of this reduction achieved by removing copies of syndicated articles. I initially coded a small sample of the articles in order to develop a list of appropriate themes for coding. I then proceeded to code the entire sample according to the following themes: animal

study, anthropometry, anti-stereotype or anti-brain differences, attachment hormones, biomedical applications, brain image as explanation, brain imaging, brain metaphor, desire as a brain process, domestic labour, early humans, economics metaphor, emotionality, equal but different, evolution, excusing men, excusing women, female brain, female submissive behaviour, gay brain, genes and sex, homosexuality as opposite sex brain, hormone brain changes, hormones and pheromones, lies, male brain, male dominance, men sexual variety, more intelligent men, multi-tasking, paragon of truth, reproductive success, scientific authority, scientific discovery, sexes as opposites, sexually dimorphic behaviour or cognition, sexually dimorphic time use, and, women as decoration.

The initial coding was used to identify prominent themes that recurred in the sample. The coding produced much more data than can be used here. I focused the results, presented in chapter five, on aspects relating to biological differences relating to the sexual division of labour. After initial coding was complete, I noted that the types of evidence used in news reporting were not what I had expected and that it would be instructive to generate quantitative data on this. I then proceeded to code the sample for types of evidence. The list of types of evidence, with accompanying explanations, is provided in Appendix 1. The results of this analysis are presented in chapter five, in which I argue that much of what is presented as evidence would not meet internal scientific standards.

#### *Case study analysis*

In order to conduct a systematic analysis with quantitative components, the full set of articles for each case study was first catalogued into a spreadsheet using Microsoft Excel. This was selected over NVivo as it allows easy sorting and production of quantitative data, and is appropriate for smaller samples. Columns were generated for bibliographic information such as title, date, publication, and author, as well as a general 'notes' column. In the first instance, I recorded features that may be of interest. All coding was performed manually. As patterns were observed, I added in columns for aspects of interest (for example, whether or not an article mentions statistical significance). Some of these columns referred to frames (for example, I initially identified four primary frames in the case study on baby brain- see the chapter on baby brain for more detail). Where possible, I defined questions with a discrete range of answers, so that some simple quantitative analysis could be performed. This system also allowed me to investigate how different conditions occurred together. This was particularly useful in the case study on baby brain. Each of the four primary frames had its own column. In each column, articles in which that frame appeared were assigned a value of one, with a value of zero

denoting the absence of that frame. I was then able to identify how frames occurred together (which has been depicted in a Venn diagram in the chapter on baby brain). Simultaneously to implementing the numbering scheme, I took notes on recurring themes that then illuminated the path for further investigation. The process of analysis was an iterative procedure. Necessarily, I did not have a full picture of relevant features of the articles sampled until they had all been catalogued and combed for themes multiple times.

Similar articles that appeared on more than one website or newspaper, often with changes in the title or pictures used, were counted as two separate articles unless they were wholly identical. This was most relevant for the multi-tasking case study, in which slightly altered syndicated articles dominated the news coverage. While I have noted which articles were in print and which were online, I have not treated online and print articles separately.

### Summary

In this chapter, I have presented a rationale for the methods used to investigate scientific conceptions of gender in mainstream news media, and I have detailed how I performed my research. The section on methodology first outlined key theories used by scholars of mass media, situating this research as primarily drawing upon the theory of agenda setting. This was followed by a discussion of online news, explaining what constitutes online news and how it departs from print news media, as well as summarising how online news has been treated by researchers. As returned to in Chapter Three, the politico-economic forces at play in the newsroom since the advent of online news shape which stories are reported, how they are presented, and the audience they can reach and influence. The final part of the methodology section focused on framing analysis, that has been employed in this research to understand the dominant ways that gendered scientific news reporting is performed. The second section of this chapter discussed how this research was performed, providing detail on sample selection and analysis. The following two chapters traverse literature relating to the use of scientific knowledge to create and sustain gender roles, and popular communication of science. These initial chapters establish the foundation for the analysis presented in chapters five through seven.

## Chapter three: Popular representations of science

### Introduction

This chapter considers mainstream representations of science through news reporting and popular books. I first situate science news reporting in the politico-economic context of news production and within conventional news values and review the literature on exaggeration in biomedical reporting. I then discuss popular science books, which are later found to leak into news reporting of science as a form of evidence. Finally, I examine the use of metaphors in popular understandings of the brain. Metaphors of the brain are of interest here because they are so embedded in news reporting of gendered neuroscience. The next chapter will provide an overview of key scientific developments that are influential in commonly held beliefs on difference between male and female brains. The themes discussed below and in the next chapter are brought together in the results chapters that follow, in which I examine news representations of science pertaining to the sexual division of labour.

### News reporting of science

In this section, I first provide the context of recent economic pressures in news production, followed by a broad overview of journalistic practices and norms as they relate to science reporting. Noting the medicalisation of science news, I then canvass the literature relating to exaggeration and other systemic issues in biomedical news reporting.

### Increasing pressures in the newsroom

Pronouncements of the demise of traditional news have been common alongside the rise of online news and citizen journalism. In the early days of online news, the web version of a newspaper was a supplement to the print edition, and readers became accustomed to accessing news for free. Continued expectations of access to free online news caused a decline in sales of print news, and therefore less revenue from printed advertisements (Scott 2005). The impact of this has been quantified in the United States, with the number of newspaper employees declining 45 percent in the period between 2008 and 2017 (Grieco 2018). In Australia, depressing of the news market and the opening of the 24-hour online news cycle has had significant impacts on the economic conditions in which journalists operate. There is a need for news outlets to publish online rapidly and in large volumes, as well as produce headlines that will attract shares on social media and clicks from users (in order to boost advertising revenue).

One impact of the resulting newsroom cuts is that journalists are more time-poor and have less time to spare for fact-checking. Journalists are increasingly expected to produce more content and are evaluated on the basis of how many page views their stories receive online (Waggoner 2018). Workloads have increased for science journalists, according to *Nature's* survey of American journalists (Brumfiel 2009). There are fewer editorial staff, further increasing the problem of unchecked claims proliferating in the news. Some publications no longer employ sub-editors. This means there is nobody to fact-check, and often nobody to even carefully edit news items before they are published. Stories tend to be published as submitted by journalists rather than being subjected to rounds of editing (Garg 2015). Some publications have even declined to pay journalists, offering journalists 'exposure' in exchange for their work. This results in some journalists acting like public relations professionals, seeking payment from clients who wish to obtain news coverage of their product (Christian 2018). Lack of adequate editorial staff and underpayment of journalists necessarily impacts the content which is produced and published. Quality control measures in journalism have fallen victim to budget cuts and the twenty-four-hour news cycle.

Finally, there is less specialisation amongst journalists. The number of specialist science reporters in Australia dropped from approximately 35 in 2005, to less than five by 2017 (Leach 2017). Very few publications have specialised science or medicine journalists on staff, and journalists who favour these areas may have insufficient training in these fields. As a result, science news is written by those who have limited scientific expertise and may struggle with evaluating the evidence and narrative presented to them. At the same time, there have been efforts to improve science journalism. The Australian Science Media Centre, launched in 2005, provides briefings on science news topics and expert comments to journalists on a subscription-only basis. This can be expected to both assist in the accuracy of science reporting and create dominant frames for issues. Research news is also brought to a general audience directly through online media outlet *The Conversation*, founded in 2011, which invites academics to contribute articles on their work.

Changes in the economics of the newsroom, while a contributing factor to the spread of unfounded scientific claims as seen throughout the following chapters, does not explain the reliance on simplistic gender stereotypes. The promotion of rigid and inborn gender roles is evident throughout the entire sample, including those articles that pre-date the mainstreaming of online news.



### The values that shape scientific reporting

News articles reporting scientific discoveries are often criticised by scientists for being inaccurate or exaggerated (Condit 2004, p. 1415). This is in part because news values and journalistic standards clash with responsible reporting of science. According to Harcup and O'Neill (2001), who determined a list of contemporary news values drawing on older lists and a content analysis of British newspapers, news stories generally must contain at least one of the following: the power elite; celebrity; entertainment; surprise; bad news; good news; magnitude; relevance; follow-up; fitting newspaper agenda (Harcup & O'Neill 2001)

In Harcup and O'Neill's updated taxonomy fifteen years later, they add several other news values appropriate to modern and online journalism: exclusivity, audio-visuals, shareability, and drama (Harcup & O'Neill 2017). They expand on the meaning of entertainment as: 'stories concerning sex, showbusiness, human interest, animals, an unfolding drama, or offering opportunities for humorous treatment, entertaining photographs or witty headlines' (Harcup & O'Neill 2017, p. 1471). As will be seen later in the results chapters, much of science reporting can be fitted to the category of entertainment, being presented in amusing and sometimes salacious ways. Shareability also comes into play when headlines are considered, although the traction of news stories on social media is not investigated by this thesis. A form of the file drawer problem can be considered to operate in news media due to the framework of news values: scientific studies that do not find sex differences are less interesting according to news values, and thus less likely to be reported upon in the news.

Journalistic norms – based on the principles of honesty, fairness, independence, and respect for the rights of others (Media, Entertainment & Arts Alliance 2019) – promote responsible and accurate reporting. In accordance with these ethics, journalists strive to include balance in their articles, usually by seeking alternative viewpoints. However, this requirement results in a point of failure in much science reporting, particularly when there are vested interests involved. Boykoff and Boykoff (2004) have argued, in the context of climate science, that the journalistic value of balance introduces a source of bias as fringe viewpoints are given prominence as a counterpoint to established scientific consensus.

Science journalism also has its own values, that Badenschier and Wormer (2012) designate as: importance factor, surprise factor, and usability factor. However, with the decline of specialist science journalism, it is possible that such practices are changing or merging with mainstream news values. In the United States and in Europe, most science reporting is conducted by

generalists, despite a handful of high-profile scientists becoming prominent in the media and the emergence of science journalism courses in the 1980s (Wilkes 2002). It appears to be a similar situation in Australia, as mentioned earlier, there has been a sharp decline in specialist science journalism since the early 2000s (Leach 2017).

In Winsten's (1985) interviews with leading science reporters and editors, he found that journalists justified overstatement of findings as this enabled them to secure more prominent page placement of their articles (Winsten 1985, p. 8). As Badenschier and Wormer (2012) found more recently, science news stories are subject to being delayed or bumped from the front page in favour of breaking political news. Journalists in Winsten's study admitted walking a fine line between truth and impact, wishing to remain credible while writing stories gripping enough for the editor to approve. Winsten also discusses how competitive pressures result in some scientists courting the popular press and presenting exaggerated findings (Winsten 1985, p. 14). Winsten characterises science journalism as comprising of a small fraction of stories preying on public hope and fear, another small fraction of brilliant, independently reported stories, and a large majority of stories being news reports based on information released by sources, often lacking adequate context and regard for limitations (Winsten 1985, p. 20). The conditions under which news is produced have undergone substantial change since Winsten's study over thirty years ago, however, there has not been a repeat of his type of research in that time. Investigations of science reporting since then tend to examine media reporting of case studies (e.g. Kiernan 2000; Ladle, Jepson & Whittaker 2005; Priest 2001) or in particular fields of science (e.g. Bell 1994; Bubela & Caulfield 2004), as opposed to Winsten's journalist-centred interviewing approach.

### Exaggeration in science news

This section canvasses literature relating to exaggeration and misreporting in science news. Most contemporary literature on reporting of science in the popular press is focused on the health sciences and does not examine gendered elements. The articles canvassed below on reporting of medical discoveries have largely been conducted by researchers in medical faculties. They focus on appraising if news coverage is exaggerated, and are more empiricist and less nuanced than media research conducted by those in the social sciences. Evidence-based medicine draws on several epistemologies including logical positivism, deductivism, holism and instrumentalism (Djulbegovic, Guyatt & Ashcroft 2009); each of these has empiricist tendencies. These tendencies emerge in the following articles synthesised, in which it is implicitly assumed that there is a way of presenting findings without embellishment.

Crucially, this literature is relevant to some of the findings of the results chapters, particularly the multi-tasking case study (Chapter Seven) which probes the introduction of new material in news reporting on a scientific discovery.

Medicine and science are distinct in definition and in practice (Munson 1981). However, there is some conflation of medicine and science in popular representation. In the latter half of the twentieth century, science news became more focused on reporting medical advancements (Bauer 1998). Note that an important difference between medicine and science in general is that medicine tends to be evidence-based (chiefly reliant on clinical trials) rather than science-based (ideally, the development of knowledge from first principles). This may have implications for differences in reporting, as it could be the case that evidence-based medicine offers more opportunities for overstating findings.

The press release – a brief written statement communicated to journalists – is a frequently utilised medium for scientists inform the public about their work, mediated through journalists who may or may not heavily draw upon the press release in their reporting. Journalists reporting scientific developments rely upon the public relations offices of universities and other scientific organisations to source stories (Brumfiel 2009). In *Nature*'s survey of science reporters, they found that 39% regularly directly quote from science press releases (Brumfiel 2009). Matt Shipman (2014) makes a distinction between public relations efforts (which are intended to improve the reputation of institutions and achieve strategic goals) and science communication (which conveys scientific findings or concepts), arguing that public relations offices of research institutions perform both functions, which are often in alignment with each other. He furthermore highlights the role of public relations offices in building public support for research funding. The influence of public relations offices on scientific messaging must be considered critically. As highlighted by Winfried Göpfert (2008), the ascendancy of public relations is occurring simultaneously with the decline in journalism that was discussed earlier in the chapter. Göpfert cautions that independent journalism, which includes fact-checking, is needed to avoid a decline in trustworthiness of public communication of science.

Exaggeration in press releases is correlated with exaggeration in news articles (Yavchitz et al 2012; Sumner et al 2014). This may be expected to occur when journalists rely on the press release as their sole source of information for the article. Press releases often do not contain information about limitations; Woloshin and Schwarz (2002) found that only 23 percent of press releases for highly regarded medical journals caution the reader about limitations.

Similarly, in their study of press releases from the top ten ranked and bottom ten academic medical centres, Woloshin et al (2009) found that 43 percent of press releases included relevant caveats.

Journalists may include information beyond what was contained within the scientific article or press release; entirely new claims are sometimes introduced in news articles (Brechman, Lee & Cappella 2009). A further issue in medical research is presented by inferences about humans drawn from animal studies. Woloshin et al (2009) found that, out of animal studies, 74 percent claimed relevance to human health, 90 percent of which did not contain caveats about extrapolating animal studies to humans. Relatedly, in a study of health-related news articles and their accompanying press releases, Sumner et al (2014) found that 47 percent of news articles contained inflated inferences to humans. They found that news articles were 56 times more likely to draw conclusions about humans from animal studies if the press release did so.

Newspapers systematically publish articles on poor quality medical research, rarely acknowledging limitations. This is partly due to the framework of news values. Within medical research, there are hierarchies of evidence privileging studies that are regarded as more robust. Observational studies, comprising case-control, cross-sectional, longitudinal and cohort studies, are those that lack a control group. Observational studies are regarded by medical researchers as less reliable than randomised controlled trials, which contain a control group (NHMRC 2009, p. 15). There is a higher likelihood of curious results occurring by chance in studies with less robust methodology. Any such unexpected results align with the news value of sensation, referring to novelty (Schultz 2007, p. 198). As such, newspapers are more likely to cover less robust medical research. In a comparison of the 75 medical research articles receiving the most coverage in the most popular five daily newspapers in the United States against 75 medical research articles appearing in the five mostly highly ranked medical journals, Selvaraj, Borkar and Prasad (2014) found that newspapers were more likely to cover studies with weaker methodology. That is, they found that articles covered in newspapers were more likely to be observational studies and less likely to be randomised controlled trials, as compared to top journal articles. They also found that newspapers were more likely to select studies with lower sample sizes. They assert that observational studies have weaker methodology, and therefore argue that newspapers preferentially favour inferior articles. A study by Yuk Yeu Lai and Lane (2009), who investigated whether medical research appearing as front-page news was published or preliminary, also confirms that newspapers tend to publish poor quality research. They found that 57 percent of front-page articles on medical research

were based on mature (published) research, and that 24 percent of articles were on preliminary research that did not get published within three years of the article. Of the articles on preliminary research, they found that only 18 percent acknowledged the preliminary nature of the findings. The authors also investigated evidence level of the reported research, with observational studies, that have the weakest methodology as mentioned above, being the most popular.

The body of research canvassed above suggests a systematic tendency of newspapers to exaggerate the importance of findings. Selection of poor quality or immature research (Selvaraj, Borkar & Prasad 2014; Yuk Yeu Lai & Lane 2009), lack of information about limitations (Woloshin & Schwarz 2002), and extrapolation of animal studies to humans (Woloshin et al 2009; Sumner et al 2014) are consistent findings in the literature. This provides insight into how journalists construct a story from scientific articles and press releases, making statements that are often beyond that conveyed by the original source. The above articles in which press releases were also an object of study also implicate the press releases themselves as sometimes being a source of hyperbole.

It could be argued that poor quality scientific news reporting is of limited importance, as the reader should be reading critically rather than unquestioningly absorbing information – particularly for publications that carry a poor reputation. However, I believe that inaccurate news reporting can have significant impacts due to the ‘illusory truth effect’, in which repeated exposure to a fact leads to the reader believing it is true (Begg, Anas & Farinacci 1992). This effect has been probed in many psychological experiments (Dechêne, Stahl, Hansen, & Wänke 2010). The perceived credibility of the source affects how much the reader believes the repeated statement, though a repeated statement from a less credible source carries more weight than a new statement from a credible source (Dechêne, Stahl, Hansen, & Wänke 2010, p. 241). Belief in false repeated statements occurs even when the statement is previously known by the reader to be inaccurate (Fazio, Brashier, Payne and Marsh (2015). As such, news reporting has the power to re-frame the audience’s reality, particularly when the same story appears across many different outlets through syndication and recycling of stories.

### Popular science books

Popular science books are relevant to the current study as they provide a supply of evidence for many news articles reporting upon the sexually dimorphic brain. Claims originating from popular science books appear in the sample in two main ways: firstly, a fact published in a

book may be reported as a new scientific finding, often as part of advertising a newly published book; and secondly, quotes from authors of popular books are often used to provide an expert opinion, adding context to an issue or finding. Popular science books aim to communicate scientific knowledge in a way that is digestible and appealing to lay-people. They are usually written by prominent scientists or science journalists (Turney 2008, p. 5). Popular science books represent one of the channels by which scientific knowledge is disseminated to the general population.

Self-help books are a separate but often overlapping genre to popular science books, with many self-help books premised on applying science to the lives of individuals. Use of scientific explanations for relationship issues is a popular tactic in self-help literature (Cameron 2007). The sexism of self-help literature has been the subject of extensive scholarly investigation (e.g. Cameron 2007; Wood 2002; Zimmerman, Holm & Haddock 2001). There is a parallel here between the accessibility and audience of self-help books, and that of phrenological demonstrations in the nineteenth century as discussed in the previous chapter. Women were encouraged (through reduced pricing) to attend public lectures on phrenology, that could be applied to their efforts as parents. Similarly, self-help books relating to interpersonal relationships draw a largely female readership (McLean & Kapell 2015), with scientifically-evidenced advice intended to be consumed by readers to improve themselves and their relationships.

Heralded by the popularity of John Gray's relationship advice book *Men Are From Mars, Women Are From Venus*, first published in 1992, there was in the early 1990s a surge of publications providing explanations and advice on differences between how men and women think and communicate (Cameron 2007, p. 1). While Gray's book did not provide a biological explanation for his common-sense stories of men's and women's different natures, his contemporaries (particularly in the popular science genre) added brain facts to their accounts, building on Gray's cultural legacy. A central tenet of Gray's theory is that a man retreats into his 'cave' when distressed, while women are naturally inclined to talk through any issues. The following example is typical of the content in his book:

To expect a man who is in his cave instantly to become open, responsive, and loving is as unrealistic as expecting a woman who is upset immediately to calm down and make complete sense. It is a mistake to expect a man to always be in touch with his loving

feelings just as it is a mistake to expect a woman's feelings to always be rational and logical. (Gray 1992)

There is no scientific evidence presented for these sweeping claims. Some of the most successful books of the relationship advice genre tend to be written by married couples who together dispense their common-sense wisdom with a sprinkle of science. In keeping with conservative viewpoints about men's intellectual strengths, the husband typically enjoys first authorship. Australian authors Allan and Barbara Pease, who have together written eighteen best-selling books that are mostly about psychological differences between men and women, represent neuroscientific consensus as 'we are who we are because of hormones' (2017), taking the strong viewpoint that nature has a blueprint from which there are very few departures.

A prototypical example of popular literature driven by scientific explanations of difference is Moir and Moir's (1998a) book *Why Men Don't Iron: The Real Science of Gender Studies*. This text is best described as a popular science book, that also contains elements of self-help books as the reader is able to apply its contents to their own experiences, if only to explain and naturalise the status quo. A sizeable section of the book focuses on the brain, arguing that men and women are optimised for different ways of thinking. The authors present their beliefs on the brain as being driven by a conclusive and consistent body of research, positioning themselves as revealing a truth that is repudiated by the dominant paradigm of the postmodern academy. Presenting men and women as two distinct groups in terms of behaviour, their strategy is to rely on data about the behaviour of men and women to prove that it is natural for men and women to act in this way. They also conflate sex and sexuality, arguing that gay men possess female brains. Many of the news articles examined in Chapter Five can be considered as short-form versions of Moir and Moir's book, with gender roles explained with reference to simple, equivocal facts about the brain.

Moir and Moir use brain facts to assert that men have shorter attention spans and do not possess interpersonal talents; in other words, they excuse men from taking on repetitive labour and caring labour while presenting women as perfectly content to engage in unstimulating tasks. Their inferences from brain to behaviour often appear plausible and fit in with a common-sense view of the world, justifying male supremacy with biological factors. The authors appear to dismiss socialisation and oppression by unseen factors. A main line of argument appears to be that (visible) barriers against women's progress have been removed, therefore any remaining

disparities must be due to biological causes. This is consistent with their work being a part of the backlash against women's gains in the public sphere (Faludi 1991).

Their final chapter brings together their assertions throughout the book to construct a picture of men as unable to be emotionally available to women, care equally for children and engage in domestic labour fairly. This is not because man is selfish, they argue, but because his brain conspires against him. For instance, he is oblivious to dust in the home due to his inferior powers of observation (p. 252), he does not iron because this is too unstimulating for his sensation-seeking tendencies (p. 251), and he is emotionally out of touch in his relationships due to his primitive limbic system, a vestige of when early man was required to attack invaders rather than stopping to empathise with them (p. 262). This section of the book makes increasingly tenuous connections between brain and hormonal activity, and behaviour. The role of socialisation, which is acknowledged though regarded as minimal throughout the rest of the book, is entirely absent in the concluding chapter. The legacy of Moir and Moir's claims is evident throughout the sample of popular news articles. The concepts endure, though they are not always mentioned by name. In some instances, the book is directly quoted. For example, an excerpt published in *The Australian* states:

His memory for detail is not as good as hers. He is four times less likely to remember a tune than she is (and six times less likely to sing it in tune if he does). Women perform better than men on simple memory tests, so is it surprising he cannot remember what dress she wore on a special occasion? Or even that she is wearing a new outfit? When he fails to compliment a woman on a new dress, it is not because he is being deliberately crass but probably because he has not even noticed. All clothes look much the same to him unless, of course, they are provocatively revealing, in which case they do register strongly on his regrettably male mind. So his apparent carelessness towards the women he ostensibly loves is not a personal failing but a biological one. He simply cannot help it. (Moir & Moir 1998b)

Another popular science book with similar content to the above, as well as sharing a co-author, is *Brainsex: The Real Difference Between Men and Women* by Moir and Jessel (1989). This text differs from the previous book in that, rather than discuss differences between adult men and women, it traces difference throughout the life cycle, from foetal development to adult life. Differences in behaviour and roles of men and women, they argue, derive from hormonal influences and differing brain architecture. Biological differences are held to explain and justify



phenomena including the male propensity to have extramarital affairs, male success in the workplace, women's larger share of child-rearing, and girls' poorer performance at mathematics. According to Moir and Jessel, historical attempts to quantify the differences between male and female brains were rudimentary precursors to the science of today, with crude methodology but accurate implications.

Bill and Pam Farrel are another example of a couple that has built their brand on writing marriage and relationship guides that accommodate and embrace the (assumed) differences between the sexes. Their religiously inspired guide for couples, *Men Are Like Waffles, Women Are Like Spaghetti*, argues that women's brains are akin to a plate of spaghetti, with all thoughts intertwined, in contrast to men's compartmentalised waffle-like brains that can only focus on one thought or task at a time. They have produced several books premised on how to manage romantic relationships to account for these two very different styles of thinking. Their books may be rooted in biblically prescribed differences, but, as they argue, their assertions are backed up by scientific research discovering two distinct male and female brains (Farrel & Farrel 2016, p. 23). Such popular books do not acknowledge any confusion or debate in the scientific literature, instead presenting the gendered brain as an established and scientifically uncontroversial fact.

Popular science books are able to convey more information than brief newspaper articles. They also provide an insight into popular debates and what the author presumes to be the reader's beliefs. The popular science books discussed above are not an object of study in this project. However, they provide valuable context on cultural beliefs about sex differences located the brain. They are also of interest because statements made in popular books are re-imagined as scientific evidence in some news reporting. The authors are utilised as experts, owing to their credentials as best-selling authors. Additionally, when they publish new books, facts picked from the promotional materials are reported upon as news. As will be shown in Chapter Five, this allows folk claims presented in popular books to be legitimised as scientific evidence despite not meeting any scientific standards.

### Metaphors in science communication

This final section considers the use popular usage of metaphors to explain scientific concepts. Metaphors have the power to convey images through the imagination, using the reader's existing knowledge. Metaphors of the brain figure heavily in news reporting. Hence, I focus on brain metaphors, including a detailed explanation of the current circuitry or computer

metaphor, and discuss the limitations of metaphor. The use of metaphor efficiently imparts knowledge of unfamiliar concepts. Print news articles are a prime site for reliance upon metaphors, as journalists are allocated limited space by newspaper editors and write to be understood by a large and varied audience.

For all the utility of metaphors, their entrenchment in how the brain is understood fosters unnecessarily rigid understandings of the gendered brain. As the computer metaphor grows more pervasive, the brain is seen as being a computer, placing limitations on what can be understood about its features which do not have a computing analogy, such as the experiences of learning and of feeling emotions. Placing understandings of the brain on a timeline allows one to consider that the computer metaphor is not so much a description of the brain's operation as it is a description of current technology. I concur with communication scholar Brian Winston's argument that since the late eighteenth century, human capacities have been likened to whichever machine dominates at the time, a tendency that he calls 'mechanemorphism' (2002, p. 155). In this section, I suggest that such 'mechanemorphism' has an even longer history. A consequence of this argument is that metaphors of the brain will change to accommodate the prominence of new technologies (Brooks 2015, p. 296). The converse of 'mechanemorphism' also occurs: understandings of the brain can inspire the development of technologies. This is evident in artificial neural networks, which are problem-solving entities modelled on the brain (e.g. McCulloch & Pitts 1943), and in image-analysis algorithms that are inspired by edge-sensitive neurons found in the brains of cats and primates (Bell & Sejnowski 1997). McCulloch and Pitts' influential article, which laid the groundwork for development of artificial neural networks, pre-dated the computing metaphor of the brain. Their article was probably the inspiration for the first suggestion that the brain functions like a computer (Gigerenzer & Goldstein 1996, p. 134). There is some degree of circularity between computing metaphors to explain the brain, and brain metaphors to explain electronic computing.

For the remainder of this section, I explore metaphors that have been used for the brain in the past, to demonstrate that the computing metaphor is not self-evident. I then explain how the computing metaphor reinforces understandings of sex differences in the human brain and therefore in behaviour. In anatomical descriptions, no other body part is as replete with metaphors as the brain. This is because the role of the brain is privileged in the mind/body split. One could argue that the panoply of metaphors is not due to cultural projections but rather is reflective of the intricacies of the brain. However, this is an unsatisfying explanation, itself

reflective of the cultural beliefs that give rise to so many metaphors. There are many other parts of the body that are also quite complicated or poorly understood but are not accorded similar attention. According to medical historian Cornelius Borck (2012, p. 118), complexity is an attributed quality that could be expected in this case due to the cultural importance of the brain. He gives the example of the liver as an incredibly complex organ that has lost its cultural significance and is therefore not subjected to the deluge of metaphors applied to the brain.

In addition to the brain being singled out for understanding through metaphors, it experiences an instability in the metaphors projected upon it. The computing analogy, which now dominates both expert and lay-understandings of the brain, is only the most recent in a long history of metaphors to describe the brain and its functions. Second to the brain, in terms of cultural significance, is the heart, which has been reliably described as a pump since its role in circulating blood was discovered in the early seventeenth century (Ribatti 2009). In recent times, no metaphor for the brain has experienced the durability and acceptance of the pump metaphor of the heart.

A hydraulic metaphor of the body, which included the brain, characterised understandings from Hippocrates (460 – 370 BC) until medieval times. The movement of the four humours within the body was analogous to the mechanism of ancient water clocks. According to artificial intelligence scholar George Zarkadakis (2015), the hydraulic metaphor was so compelling because Hippocrates' ideas about the body emerged simultaneously with the invention of hydraulic engineering. Due to this confluence, the understanding of the body through the flow of its humours appeared to be self-evident, much like the current computing metaphor. Later, Graeco-Roman physician Galen (130 – 210 AD) theorised that people are hydraulic automata (robots) (Zarkadakis 2015). Hydraulic automata that repetitively imitated the movements of living creatures were constructed as proof of Galen's idea (Zarkadakis 2015). A commonality between the automaton and computer metaphors of the brain is that both demonstrate fixed patterns of action ('programming', in the computer metaphor). Hydraulic automata, being simple water-powered robots, represent an intermediate step between the hydraulic and computing metaphors of the brain. The automaton metaphor was later adapted by René Descartes in the 1600s, who argued that the human body is a machine with the organs serving the role of components such as gears and pistons (Zarkadakis 2015). Like computing metaphors for the brain, the machine metaphor captures the notion of modularity. More recent metaphors for the brain have not supplanted the machine metaphor for the rest of the body, for example, the bodies of athletes are considered to be finely-tuned machines.

No newer metaphor for the brain has enjoyed the longevity of the hydraulic metaphor, as understandings of the brain have kept up with developments in information and communication technologies since the late nineteenth century. While the previous 150 years of brain metaphors have particularly borrowed from information and communication technologies, I believe the earliest incarnation of this pattern is Aristotle's likening of the mind to a blank writing tablet (Hamlyn 1968 [2002], p. 59). The industrial revolution accelerated technological development and thus increased the number of available metaphors. Electrical telegraphy, and later telephone switchboards, became metaphors for the brain's workings (Borck 2012, p. 120).

Most recently, computing metaphors have characterised how the brain is understood, arising in the mid-twentieth century alongside the building of the first electronic computers (Gigerenzer & Goldstein 1996, p. 134). The computer metaphor is now pervasive in discussions of the brain. Psychologist Robert Epstein (2016) argues that human intelligence can no longer be discussed without utilising the computing metaphor. He compares this to how in the past, discussions of human intelligence could not occur without making statements about a deity. The computer metaphor of the brain has become a definition of the brain, and it is inconceivable to describe one without the other.

The computer metaphor encapsulates neuroscientific understandings of the modular brain, as outlined in the previous chapter's section on gendered neuroscience and psychology. Different faculties can be considered as the components of a computer, for example, hard drive for working memory and peripherals for sensory organs. The implication is that different functions can be located in parts of the brain. Behaviour can be conceptualised as the brain following pre-set 'programs' (e.g. Wilson 1978, p. 6). Neural circuits are an example where the terminology overlaps; with the word 'circuit' being borrowed from electronics. 'Hard-wiring' is a defining feature of brain and nervous system metaphors – including the computer metaphor – that rely upon electronics. In a literal sense, hard-wiring refers to the fixed physical connections between components of a circuit. When applied to the brain, 'hard-wiring' indicates that there are immutable structures underlying the brain's workings. The 'hard-wiring' of the brain is therefore often used in popular understandings as an explanation for gender differences.

The computer metaphor simplifies understandings of the brain by casting off elements that do not have a computer hardware analogue. Adapting to one's environment (i.e. learning) is impossible within the computer metaphor (as noted earlier, artificial neural networks that

'learn' are modelled on the brain, rather than the other way around). Notably, consciousness cannot be accommodated by the computer metaphor. Consciousness has been likened to software running on the 'hardware' of the brain structures, but this is a weak point of the metaphor as it defies the picture of emergent consciousness arising from the brain's structures. As consciousness is so poorly understood by current models of the brain, it is unsurprising that it is inadequately explained within the computer metaphor.

All of the aforementioned brain metaphors illustrate the interplay between metaphor and what is regarded as the true nature of things. Galen did not conceptualise people as 'like' automata, rather, he thought people essentially are automata, albeit more complicated than human-made versions. The same mixing of reality and metaphor is evident in recent metaphors of the brain. As the brain relies on small electrical signals, it can be considered as made up of (neural) circuits. The brain is then analogous to the circuit boards of a computer, with neurons in place of metal wiring. The computer metaphor was utilised quite literally by computer scientist Eric Jonas and neuroscientist Konrad Kording to lampoon the neuroscientific research program of mapping the structure of the brain, or connectome, to yield insight about its workings (Jonas & Kording 2017). The pair applied this paradigm to a microprocessor, subjecting it to a series of experiments mimicking those performed by neuroscientists, and finding that the results of the experiments did not provide a meaningful understanding of the processor. They conclude that current neuroscientific methods provide only a rudimentary understanding of the cognition. The foundation of their argument is that the brain and the computer processor can be probed and understood in the same ways – they believe it is the experimental programme rather than the metaphor that is lacking. Alternatively, they could have presented their evidence as an argument against the utility of the computer metaphor, expanding their argument to show that the computer metaphor of the brain cannot be taken so literally.

The hydraulic and computer metaphors appear to be so fitting because of similarities between outputs of the human brain, and outputs of the various technologies involved. These outputs are similar precisely because we have invented technologies to make our activities easier, more efficient, and more accurate. From the similarity in results, the brain and the technology can then be considered the same if one takes a 'black box' approach. Unfortunately, the analogy is less applicable to the components of the black box. Humans are capable of remembering information and performing calculations, but in our case, memories are not retrieved from a hard drive, and calculations are not achieved through manipulating binary information. Metaphors assist us to learn new concepts quickly, and can help with the deduction of further

information about the new concept (Haken 1993, p. 135). However, applying the metaphor too literally becomes an issue when it shapes entire research programs (Brooks 2015; Haken 1993, p. 135), as in the case of Galen's engineer's automata (Zarkidakis 2015), or in the case of some neuroscientific investigations today (Jonas & Kording 2017).

The computing metaphor of the brain is not explicitly gendered, though, the disembodied, algorithmic, rational nature of the computing brain may be understood as inherently masculine. The implied masculinity of the brain and of the computer feed into one another. Ellen Van Oost (2000) argues that computers came to be masculine in the 1950s and 1960s through comparisons to the brain, as well as through re-characterisation of computer programmers as creative (male) rather than diligent (female). This masculinisation of the computer occurred simultaneously with the development of the computing metaphor of the brain. The masculine brain-computer nexus may therefore create the impression that the male brain is the default, and that the female brain is a variation on this. However, the gender work performed by the computer metaphor lies not only in othering the female brain, but by establishing the male and female brain as two distinct objects that are structured differently.

Importantly, the computer metaphor implies that there are aspects of the brain that are unchangeable and set at birth ('hard-wiring'). It is through the notion of hard-wiring that the metaphor utilised to create gender, as it can be claimed that there are essential and immutable female and male brain structures. In other words, hard-wiring affirms gendered architecture of the brain, and emphasises that it is a fixed attribute. The current sex differences paradigm in neuroscientific research, in which exposure to hormones in the womb is regarded as setting the sexed brain structure, is known as the 'hard-wiring' model (Jordan-Young & Rumiati 2012). Additionally, the 'programming' aspect of the metaphor can be an analogy for the influence of sex hormones. The brain is regarded as following a pre-determined program, triggered by the release of hormones at different times. As noted earlier, the computer metaphor has no provisions for learning or plasticity of the brain. Therefore, it excludes the ideas of feminist neuroscientists who contend that observed differences in the brain result from interactions between the brain and the culture it inhabits (e.g. Fine 2013).

As well as the computer metaphor being itself a stereotype used by the mass media (Haken 1993, p. 136), it becomes a crutch for gender stereotypes. The computer metaphor is the most prominent, but not the only, metaphor that is used in news reporting to emphasise essential differences between the male and female brain (O'Connor & Joffe 2014). In addition to

metaphors that explain the unsexed, disembodied brain, there are metaphors applied to explain the difference between male and female brains. Such metaphors are given life through popular media sources, often originating in books that claim to apply the psychology of sex differences to achieving harmony in heterosexual relationships. For example, as discussed in the previous section, a popular relationship advice book contends that men possess ‘waffle brains’ while women have ‘spaghetti brains’. This is used to illustrate that men think in a single-minded, compartmentalised fashion; while women’s thoughts are all intertwined (Farrel & Farrel 2016). Another example is that male and female brains have been compared to different makes of cars, with small modifications accumulating to the difference between a Volvo and a Corvette (Cahill 2014, p. 7). As will be shown in the following results chapters, metaphors are heavily utilised in the communication of science news.

## Conclusion

This chapter has discussed mainstream representations of science, focusing on news reporting and popular books. It also delves into the use of metaphors to understand the brain. Journalistic practice creates some tensions with science news reporting; scientific discoveries are often nuanced, while journalists seek to flatten this complexity for their readers. The section on science reporting introduced the politico-economic conditions of news production as a shaping factor; this theme will be returned to in the concluding chapter. The existence of popular books that promote gender roles as scientifically established form a background that news media draws upon, fitting new discoveries to the existing narrative of equivocally distinct gendered brains. As is shown in Chapter Five, these popular books also become a source of scientific authority themselves. The claims made by these books can become legitimised as scientific in news reporting. Metaphors that we use to understand the brain assist in the delivery of essentialist ideas, with the ‘hard-wiring’ metaphor of particular importance in accounts of the sexed brain. The literature reviewed here, and my account of key developments in gendered science in the next chapter, together lay the groundwork for the results chapters, in which I investigate the gendered patterns in news reporting of science relating to the sexual division of labour.

## Chapter four: The scientific subordination of women

### Introduction

Contemporary portrayals of science as making sense of gender rely on a long history of scientific investigations and theories on essential differences. In order to understand how and why mass media frames scientific conceptions of sex differences, it is crucial to appreciate the historical context of the science of gender roles. Understandings of behavioural sex differences have gained legitimacy through science, especially the biological sciences, with metaphors often being utilised to convey these ideas to a mass audience. Currently, neuroscience is particularly drawn upon to construct and explain gender roles. As this chapter shows, current understandings are built upon historical attempts to understand gender via science. Some of these scientific endeavours have been discredited, while others remain foundational for more recently emerging fields. This chapter aims to show the continuous and enduring nature of scientific explanations for traditional gender roles, which are reflected in mass media portrayals. Understanding how different sciences have been utilised to create and promote the gender order also allows these logics to be identified in more recent news reporting, in the results chapters that follow. After contextualising recent large-scale initiatives to understand human nature, this is achieved through a chronological account of past scientific endeavours which theorised the gender order. Finally, the influence of the research funding environment is considered in how knowledge relating to gender is generated. This is linked to Chapter Three, in which popular representations of science, including use of metaphor, were discussed in more depth.

The vast majority of societies are based upon a patriarchal structure that creates and embeds distinct roles for men and women, with the male role privileged and the female role denigrated (Millett 1969 [2016], p. 28). To some extent, the specifics of tasks designated as feminine and masculine shifts through time and place, though caring labour had been consistently seen as a woman's work. The legacy of nineteenth and twentieth century cultural mores is that women are believed to be suited to domestic labour, enabling men to dominate in the public sphere. In the West in the twentieth and twenty-first centuries, mainstream explanations for inequality between the sexes are based upon biological differences (Ehrenreich & English 1973 [2011], p. 32).

Women's inferiority to the male standard has been explained in the past with reference to biblical Eve's original sin. However, scientific explanations for the gender order had to be



invented for a post-Enlightenment world wherein religion no longer carried the same authority (Shields 1975). The construction of scientific knowledge of the body echoes that of divinely imparted knowledge: both are hailed as pure, disembodied, and all-knowing (Haraway 1988, p. 581). This chapter canvasses the evolution of scientific explanations for women's subordination.

It would be a simplification to consider that the Enlightenment heralded a clean break between religious and biomedical understandings of the inferior female body. Religion and science inhabit, as they have in the past, an uneasy interdependence. Some nineteenth-century religious leaders incorporated new knowledge of the body into their teachings (Ehrenreich & English 1973 [2011], p. 35); this persists more recently with biblically inspired relationship advice books utilising scientific knowledge of the sexed brain to argue for natural gender roles (e.g. Farrel & Farrel 2016). Conversely, the Ancient Greek and Roman biomedical knowledge systems discussed here pre-date Christianity but would later inspire theological understandings of sex differences. This chapter focuses solely upon the use of scientific knowledge to justify sexism and leaves discussion of the interaction between biomedicine and religion for another time. However, it is important to note that science did not 'discover' women's subordination, rather, science is conscripted to explain and reconstruct existing inequalities, and it is but one of many institutions that performs this role (Shields 1975).

The scientific endeavour has the goal of creating objective knowledge, propped up by the articulated scientific method (Haraway 1988, p. 576). Scientists have largely denied the interference of culture with biomedical sciences, with critical writings usually coming from outsider philosophers (e.g. Haraway 1988; Harding 1986) or from feminist biologists (e.g. Bleier 1984; Fausto-Sterling 2000). The collection of data and checking of hypotheses can be insulated from feminist criticism as the data supposedly tells its own story. As linguist Deborah Cameron points out, popular science authors such as Simon Baron-Cohen emphasise that they were lead to their conclusions through their data, valiantly risking others seeing their research as sexist (Cameron 2007, p.2). However, the scientific enterprise is a product of the surrounding culture, from which it cannot be disentangled (Fausto-Sterling 2000, p. 9). Feminist criticism has problematised the perspective that the scientific method is objective, sitting outside of cultural influences. It is instructive to query why certain questions are deserving of scientific investigation but not others, why certain methods are used, what assumptions are made in order to interpret results, and whose interests are being served by the results.

Feminists have long argued against biological explanations for women's unsuitability for intellectual work. One of the earliest examples is Antoinette Brown Blackwell's work. Writing in 1875, she repudiated evolutionary arguments for women's lesser intelligence, arguing that scientists such as Charles Darwin were disproportionately focused on masculine characteristics and therefore measured women against a male yardstick (Brown Blackwell 1875). During the feminist movements of the twentieth century, the use and production of scientific knowledge to subjugate women has been dissected in detail by numerous authors including Naomi Weisstein (1971), Anne Fausto-Sterling (1985), and Carol Tavris (1992). Yet, there continues to be a niche for twenty-first century writers to highlight how neuroscience is utilised to reinforce and excuse gender roles (e.g. Eliot 2009; Fine 2010a; Jordan-Young 2010).

Examining the history of sciences that have been discredited allows us to consider the assumed objectivity of the biomedical sciences. It reminds us that current scientific understandings occupy a moment in history. The aim here is not to reflect on the misguidedness of earlier scientific approaches to gender according to current scientific knowledge, nor to utilise scientific knowledge to bolster my own arguments. In this account, I follow the approach outlined by David Bloor in the 'strong programme' of sociology of scientific knowledge (Bloor 1976), in which both outmoded and currently accepted scientific theories are treated symmetrically. In this view, the correctness of a scientific theory cannot be used as an explanation for its acceptance by the scientific community of practice. Rather, the ascendancy of theories must be considered in relation to sociocultural factors. This symmetrical approach probes how science both emerges from and creates the gender order.

Historically, times of radical change in which women have agitated for new rights are met with renewed understandings of the female body that circumscribe appropriate roles for women (Foxcroft 2009, p. 32). The deluge of scientific investigations into the sexed brain can be considered as a resistance to social changes in the twentieth century. Anne Fausto-Sterling (2000) argues that feminist attacks on the institution of gender left sex as a weak point, as investigations of natural and biological sex differences could determine how gender is a reflection of the physical body. Fausto-Sterling and other feminist scientists have sought to problematise understandings of the body, arguing that there is interdependence between the body, knowledge, and the sociocultural context. Janet Bing, writing in 1999 about the issue of media reporting of brain research, argues that we should be suspicious of neuroscientific knowledge locating gender roles in the brain because in the past, the emergence of new gender facts is a harbinger of new approaches to the gender order (Bing 1999). It is with this in mind

that I examine current popular understandings of the sexed brain, arguing that new science is being used to re-create old stories about gender.

Throughout this chapter, I demonstrate how different branches of science have been used to argue for different male and female strengths. The bluntest distinction is that between men's greater intellect and women's nurturing disposition. It is here important to note that the quality of intelligence itself is not genderless. In addition to numerous scientific attempts to assert that certain groups (whites, males) are congenitally more intelligent than groups regarded as inferior, intelligence has been defined in terms of whiteness and maleness. Historically, intelligence and the scientific enterprise have been associated with maleness. The acquisition of new abstract knowledge has been seen as a masculine pursuit (Schiebinger 1989). Schools and universities were first open only to males. As women began to access higher education, scientists and educators raised concerns that this was incompatible with women's reproductive capacities. Today, the more prestigious and abstract disciplines such as philosophy and physics remain male-dominated and hostile to female interlopers (Ivie, White, Garrett & Anderson 2013; Equality Challenge Unit 2014 p. 237). This reflects assumptions, by some within these disciplines, that disciplinary success is due to natural talent, combined with the belief that women lack this natural talent and that their achievements are only due to working hard (Leslie, Cimpian, Meyer & Freeland 2015).

In previous centuries, men's greater intelligence seemed self-evident to scientists because there were so few women of eminence in any field (Belkhir 1994, p. 66). Similar reasoning is still used in the 2010s. For example, in 2017 there was a high-profile incident of a Google employee circulating an internal memo that refers to essential sex differences as an explanation for why women are less likely than men to succeed in the technology industry. While women now have access to the advantages of education, intelligence in its extreme remains associated with maleness. The greater male variability hypothesis, that asserts that men have more variation in their traits and are therefore better represented at the extreme high and low ends of the intelligence spectrum, is the lynchpin of this viewpoint. The concept of the sexually dimorphic brain facilitates continued belief in greater male intelligence.

It is important to note that the generalisations about women invented by scientific inquiry do not affect and describe all women equally. There are simultaneously interactions with scientific and popular understandings of race and class in particular. Such interactions both refer to how women and other groups have historically been subjected to similar scientific understandings

of inferiority (Ehrenreich & English 1973 [2011], p. 102), as well as the enhanced othering experienced on the basis of race, class, and sexuality. Scientific pronouncements about racial inferiority are no longer as commonplace or explicit as in previous centuries, and the few books and studies in this area attract controversy and backlash. However, there are persistent popularly held beliefs about racial differences in intelligence that would impact how facts about sex differences in intelligence are received.

This chapter discusses several branches of human biology and medicine that are or have in the past been utilised to establish essential differences between men and women. Following an overview of the scientific context of the past three decades, these topics are ordered chronologically according to when the discipline developed. The ‘othering’ of women is perpetuated through the value placed upon sexually dimorphic anatomy and physiology. There is a historical precedent for seeing deviations from the male norm as pathological, beginning with Ancient Greek and Roman doctors (Foxcroft 2009, p. 36). The female body is conceptualised as inherently diseased, laying the groundwork for the female mind to also be inferior. As such, I provide an overview of understandings of sex differences developed by anatomists; ideas that became mainstreamed over two thousand years ago and dominated medical understandings for almost this entire timespan.

Phrenology, a nineteenth century science wherein the shape of the skull was used to infer a person’s characteristics, relied upon anatomical understandings (as do biological sciences today). In this chapter, attention is given to phrenology as it was used to find a scientific basis for women’s inferiority. Phrenology is of particular interest in this thesis because it parallels more current neuroscientific explorations of difference between the sexes. A considerable difference between the two is that phrenology is now regarded as a fiction, whereas later developments enjoy widespread acceptance.

The final piece of nineteenth-century science is Darwin’s Theory of Evolution, which was influential in producing understandings of humans’ place in the world – as well as understanding the relation of different groups of humans to each other. Darwin’s Theory of Evolution was used to promulgate the viewpoint that women’s intellectual abilities are lacking in comparison to men, and is still used for this purpose today. I then provide brief overviews of selected elements of genetics and endocrinology, as a basis for the section on sociobiology. Sociobiology draws on many branches of biology to promote an understanding of human behaviour as fixed by our evolutionary conditions in the African savannah. The final scientific

development reviewed is gendered neuroscience, which is reported upon heavily in the news. This forms the knowledge foundation that is required to understand how science is presented in the news to produce gender roles as natural and inevitable. Finally, I provide context on the science funding environment, particularly in Australia, and discuss how this encourages essentialist lines of inquiry. I return to this discussion in the final concluding chapter, in which I bring together the key themes emerging from the results chapters and briefly discuss the interaction of the scientific research funding climate with the politico-economic conditions of news production to privilege essentialist and equivocal discourses in news media.

Each of the sciences discussed here aiming to explain human behaviour is premised on the type of reductionism that characterises physical science. The central idea is to derive human behaviour from physiological observables. Note that there are overlaps in each field, for example, neuroscientists may rely on knowledge from endocrinology to investigate the effect of circulating hormones in the brain (as is seen in the multi-tasking case study presented in chapter six).

### Biomedical ascendancy in the late 20<sup>th</sup> and early 21<sup>st</sup> centuries

The 1990s was heralded by public interest and public funding being directed towards biomedical research. The United States was the point of origin for the scientific endeavours discussed here, with international collaborations a defining feature. The research program in the United States is highly relevant to the news articles examined in the following chapters, despite sampling being mainly restricted to Australian articles, as the majority of articles reported on international (and particularly North American) research.

The scientific enterprise in the late twentieth century and early twenty-first century is crested by large, international projects. Due to their scale, such projects become a collaboration between scientists from different countries and different fields. Examples from biomedicine include the Human Genome Project (Olson 1993; Human Genome Project 2003), the Visible Human Project (Waldby 2000), the Genographic Project (Wells 2006), the Human Genome Diversity Project (M'charek 2005), the Human Brain Project (Huerta & Koslow 2013), and the Human Connectome Project (Human Connectome Project, n.d.). These grand-scale projects, requiring significant financial, technological, and human resources, occur following a long history of scientific inquiry. In many cases, they are the driver of development of new technologies. Aside from their ambitious scale, these projects have another commonality: all are aimed at developing an understanding of what it means to be human. Scientific knowledge

shapes how we understand ourselves and our place in society. As humans necessarily experience the world through the lens of the sexed body, scientific knowledge about the body is inherently gendered. This deluge of research also presents new opportunities for data to be combed for sexual dimorphism at every level of the body: genes, cells, and organs, among which the brain is imbued with superior status. Each large-scale scientific project results in new mediated ways of seeing the body and its constituent parts.

The Human Genome Project, launched in 1990 and completed in 2003, mapped the human genome. The reader may wonder whose genome was mapped for the Human Genome Project. The result of the project was not the genome of a single individual, but a composite drawn from a ‘diverse population’ (Human Genome Project 2003)<sup>4</sup>. The genome can be likened to a manual containing instructions to make a human (Human Genome Project 2003), but additional insight and research is required so scientists are able to read and understand the ‘manual’. Theoretically, mapping the genome may one day lead to advances in biomedical science including personalised preventative medicine. The Human Genome Project is of interest here because some may interpret it as creating a list of traits that may one day be simply read off the mapped genome, completely divorced of the social context in which genes manifest. It is representative of a simplified public view of science that privileges innate aspects of human biology and holds that there are simple relations between biology and behaviour.

Another scientific initiative occurring alongside the Human Genome Project was the Decade of the Brain. The years 1990 to 1999 were proclaimed by then President of the United States, George Bush, as the Decade of the Brain. The main objective of the Decade of the Brain was to increase public awareness of the benefits of neuroscientific research (Library of Congress 2000). For example, one high profile event held as part of the Decade of the Brain was a public conference entitled ‘Discovering our selves [sic]: The science of emotion’, which has gendered undertones due to the association of emotion with femininity. The Decade of the Brain was followed by an analogous Decade of Behaviour. According to its now defunct website<sup>5</sup>, the Decade of Behaviour was initiated by the American Psychological Association and sought to highlight to the public research in the behavioural and social sciences. This was not a government initiative like its predecessor, and had a much lower profile. Currently, we are

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<sup>4</sup> Simultaneously, a rival private company, Celera Genomics, also sequenced the genome using a different technique, claiming they could deliver the genome comparatively cheaply and quickly (see Shreeve (2005) for the story of Celera).

<sup>5</sup> Accessed via the Wayback Machine, an archive of web pages including their previous versions.

coming to the end of the Decade of the Mind, as designated by a group of scientists in their proposal published in the prestigious journal *Science*. According to the proposal, the Decade of the Mind requires an interdisciplinary effort develop ‘a deep scientific understanding of how the mind perceives, thinks, and acts’ (Albus et al 2007). Neither the Human Genome Project nor the various decade designations are explicitly gendered. However, they are significant in that all seek an understanding of how nature determines the human body and therefore its behaviour. Importantly, these initiatives extended beyond the scientific community with the explicit goals of engaging the public. These three decade designations provide some context for the articles sampled here: the time period is one of discovering the workings of the brain and mind. This rests upon the assumption that neuroscientific research yields insights into behaviour and cognition, with a further implication that sexually dimorphic behaviour (both observed and assumed) can be pinpointed to brain differences.

The news reporting examined in the coming chapters is set within this late twentieth and early twenty-first century context of biological supremacy. The acceleration of research programs relating to the human body arose from a long history of humans trying to understand our bodies. The imperative of modern neuroscience to locate gender in the structure of the brain and in its circulating hormones is contextualised by the long history of demonstrated female inferiority to the male norm to be located within the body rather than within social structures. The rest of this chapter traces, in chronological order, some of the biomedical developments that are relevant to the current framework of providing a physical, biological imperative for social roles.

## Anatomy

Anatomy is the oldest scientific attempt to understand the human body. The ideas and discoveries of Ancient Greek thinkers such as Hippocrates (460 – 370 BC) and Aristotle (384 – 322 BC) were instrumental to establishing a science-based anatomy, and their groundwork remains influential today (Malomo, Idowu & Osuagwu 2006). Ancient understandings of anatomy included models for essential difference, into which female subordination was inbuilt. Hippocrates, who is regarded as the ‘father of modern medicine’ due to his substantial contributions including establishing medicine as a field in its own right (Malomo, Idowu & Osuagwu 2006, p. 100), explained differences between men and women with reference to the four humours: the states hot, cold, moist, and dry. Men were regarded as more hot and dry while women were considered to be relatively cold and moist; from this it somehow followed that men were naturally more intelligent due to the association between dryness and intellect (Shields 1975, p. 740). Aristotle expanded on Hippocrates’s idea, arguing that females were

inferior to males due to the production of copious quantities of menstrual fluid (and thus loss of heat), compared to the relative thriftiness of seminal fluid (Foxcroft 2009, p. 37).

Differences in composition of humours dominated concepts of sex differences up until the mid-eighteenth century (Schiebinger 1986). According to historian of science Londa Schiebinger (1986; 1989), it was at this point that anatomists began seeking and documenting sexual dimorphism of the musculoskeletal, circulatory, and peripheral nervous systems. This was important because it allowed anatomists to demonstrate that difference from the male norm permeates the entire female body. Again, the lesser status of women was inbuilt and explicit. The relatively smaller female bones were thought to be the result of a 'weak constitution' (Schiebinger 1989, p. 193). Prior to the eighteenth century, Schiebinger observes, only the male skeleton had been illustrated, establishing the male as the standard.

The work of historian Thomas Laqueur (1990) is influential in tracing the creation of understandings of sex differences from antiquity until after the Enlightenment. Laqueur's ideas descend from Schiebinger's, as he argues anatomists sought to delineate gendered reproductive organs, in parallel with the construction of the gendered skeleton. While today the reproductive anatomy is considered the quintessential difference between the sexes, Laqueur problematises this notion by arguing that this ideology is man-made. He contends that ideas about the human body from the time of Graeco-Roman physician Galen (130 – 210 AD) were based on the one-sex model. In the one-sex model, the female body is regarded as the same as the male body but with the reproductive organs being inverted due to a lack of heat. The female body, Laqueur argues, was conceptualised as a less perfect version of the male body (Laqueur 1990, p. 28). By the end of the seventeenth century, the one-sex model gave way to the two-sex model (Laqueur 1990, p. 154). In the two-sex model, men's and women's bodies are regarded as fundamentally different, as demarcated by new language for female anatomy.

In the context of the one-sex model, the naturalness of gender roles was taken as starting point; the one-sex model did not have to invent this. In other words, at the time of the one-sex model, discoveries or theories about the body had to match with the existing facts relating to gender roles. Conversely, the two-sex model derived gender roles from anatomical facts. This ideology remains dominant today, as shown in the later results chapters, though the specific anatomical facts have undergone substantial change. Laqueur argues that in the context of the Enlightenment, which valorised principles of equality, a new explanation to preserve the inequality of the sexes had to be invented. Therefore, the two-sex model, which spoke the



scientific language of the Enlightenment, provided a biological imperative for the oppression of women. Later, in the main results chapter, I argue that news reporting constructs a two-sex model of the eye and ear, justifying differences in the sexual division of household labour as naturally following from this dimorphism. These claims run counter to mainstream understandings of physical sex differences and may be considered as the creation of new claims relying upon the logic of previous understandings of anatomy.

Anatomy was used to locate female inferiority in the head specifically. The legacy of this remains in current conceptions of difference. In the eighteenth century, woman's smaller skull was used to demonstrate her inferior mental faculties and justify her exclusion from intellectual pursuits, while her larger pelvis was used to explain her place in the home (Schiebinger 1986). The preoccupation with the characteristics of the head is the focus of the following section.

### Phrenology

This section discusses the nineteenth century science of phrenology, a skull measuring system that was used to explain the natural inferiority of women and people of colour. In this section, I first briefly contextualise the development of phrenology and summarise its core principles. I then discuss how phrenology was applied to justify women's subordination, particularly focusing on brain mass analyses, before arguing that phrenologists made their pronouncements on women's roles palatable to women by perpetuating an 'equal but different' doctrine. Finally, I mention the parallels between phrenology and modern neuroscience, a comparison that has been made extensively by other authors. The parallel makes phrenology an instructive point of comparison to neuroscientific beliefs today.

Phrenology was a branch of anthropometry (the science of measuring the human body) that consisted of making inferences about a person's propensities from measurements of their skull. While its predictions are no more accurate than a horoscope, it was an active area of scientific research spanning almost the entire nineteenth century. Phrenology was based on the teachings of medical doctor Franz Joseph Gall, who argued that the mind's functions are compartmentalised (Conlin 2014). He believed that each trait or faculty was located on the surface of the brain and that the development of each area could be inferred from the idiosyncrasies of one's skull (Fee 1979, pp. 419 – 420).

The aims and techniques of phrenology must be understood in context in they emerged from. The most influential phrenologists were German, but it was in nineteenth century England that phrenology quickly became popular both in scientific circles and in public performances. From

there, interest in phrenology spread to France (Goldstein 2009), the United States and Australia (Smithers 2013). The 1800s were a time of significant social changes developing alongside industrialisation in the Western world. Phrenology gained ascendancy on the heels of the Enlightenment. It represented a new and scientific attempt to ground the mind within the physical brain (Dolar 1994). Elizabeth Fee (1979) argues that nineteenth century interest in measuring the female skull occurred in England as a reaction to the fledgling women's rights movement of the time. She asserts this was a coordinated effort by the London Anthropological Society, which sought to present facts about the natural role of women as mothers in order to guard against misguided attempts at social reform.

Phrenology was utilised primarily to make determinations about the condition of individuals, but it was applied to make generalisations (Cooter 1984, p. 119). An 1860s derivative of phrenology known as craniology, that involved ranking skulls on attributes such as circumference, was used expressly to make generalisations about groups (Fee 1979, p. 420). It is these group-level explanations that are of interest here. Phrenology was particularly used to affirm the superiority of Europeans over other races, for example, the 'savage tribes' were believed to be innumerate due to a deficiency in the 'Number' faculty located in the brow area (Donovan 1870, p. 61). Parallel to its role in promoting racist ideology, phrenology was deployed to provide a scientific explanation for women's roles. Both women and people of colour were considered childlike, guided by feelings, and incapable of higher thought (Fee 1979, p. 425); phrenology then facilitated a pathway for scientists to chart common features of both groups to identify markers of simple-mindedness. According to phrenologists, women's heads, generally being differently shaped to men's heads, evidenced that women lacked the capacity for intellectual thought and were more suited for child rearing (Staum 2003, p. 64). An example of phrenological reasoning is shown in Figure 2 below, an excerpt of a handbook on phrenology.

As the female head does not measure so much round as the male, neither is it so wide, so high, nor so long. Single heads may be found to arrive at male proportions, but these are exceptions, just as male heads may be found to conform to the female in size. It follows necessarily that the Brain being the Mental Organ, and size being a measure of its power, though not the only one, the female mind is much less fitted for the hard and rough work of life than the male, and that those philosophers who would prove the female mind to be equally strong with the male know little or nothing of the Brain and its laws. As well may they contend for equal bodily strength and activity between the sexes as for equal mental power; woman is but the softer man, and he who would give her equal strength of mind with man would at once deprive her of her best charm.

*Figure 2: Quote from a handbook on phrenology, inferring women's traits from their smaller head circumference as compared to men (Donovan 1870, p. 101).*

Despite being used to justify female inferiority, phrenology was an accessible science for women to absorb. Phrenologists were committed to public outreach, like many scientists today, and the basic principles were easily explained and understood by people who did not have a formal scientific education. Women eagerly attended public lectures on phrenology, and there were even some efforts to increase female attendance such as by offering reduced-price admission (Goldstein 2009, p. 304).

Brain size was used as strong evidence for female intellectual inferiority. It was through the study of craniology that scientists took brain mass measurements and interpreted women's smaller and lighter brains as corresponding to intellectual paucity. Craniologists believed that intelligence increases with brain size in much the same way that large muscles translate to greater strength (Fee 1979, p. 420). This has gendered implications, particularly as no adjustments were made to account for body size. The female brain is famously weighs five ounces (142 grams) less than the male brain<sup>6</sup>, resulting in a lack of capacity for higher thought according to nineteenth century scientists (e.g. Romanes 1887, p. 383). This was later unified with Darwin's Theory of Evolution: the difference in brain size and therefore intelligence was believed to be forged in the African savannah, with early man planning ahead for survival while early woman was not required to have thoughts beyond raising her children (Gould 1980

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<sup>6</sup> This nineteenth century figure is consistent with more recent determinations of the sex difference in brain mass; for example, Hartmann and colleagues (1994) found a difference of 138 grams.

[2010], p. 154). Furthermore, craniologists determined that there was a larger sex difference in brain mass in what they regarded as the superior races (Russett 1991, p. 36). This demarcated intelligence as a white male trait and provided a justification to deny women entry into the public sphere.

The craniologists acknowledged that there were some women of notable achievement. However, this was dealt with creatively to avoid ascribing intelligence to women in general. Social psychologist Gustave Le Bon believed that highly intelligent women were freaks of nature, so rare that they did not have to be explained by theory (Belkhir 1994, p. 65), while prison doctor La Roquette argued Catherine the Great had a male-typed head shape and therefore was not a challenge to beliefs about women's unsuitability for the public sphere (Staum 2003, p. 65).

Analysis of brain mass was doomed to failure as its practitioners encountered the 'elephant problem': if intelligence scales with brain size, then elephants should be more intelligent than humans owing to their large brains (Fee 1979, p. 421). Relative brain size (dividing the mass of the brain by the mass of the body) was a possible solution to this problem, as humans outrank elephants by this measure. However, this could not be used to prove the superiority of men, as women, children, and some particularly unintelligent animals such as birds all have a greater relative brain size than men (Fee 1979, p. 421). The ever more obscure attempts at pinpointing what characteristics of the female skull indicate low intelligence have been canvassed in detail by Fee (1979). She argues the eventual result of this was a conception of women as primitive and childlike, as evidenced by a plurality of skull metrics, until mathematician Alice Lee debunked the entire enterprise in 1901 (Fee 1979, p. 424). Note that brain size measurements were not vanquished forever, as some early twenty-first century research has resurrected the early craniological work by seeking correlations between head circumference and IQ score (Gallup, Frederick & Pipitone 2008).

Skull measuring was a controversial discipline, with many suspecting that it was based upon extrapolations of flimsy evidence. By the twentieth century, psychologists had turned their attention away from taking measurements of the skull, and instead focused on intelligence testing as a way of establishing male superiority (Belkhir 1994, p. 65). A key distinction between these approaches is that the phrenologists aimed to explain the known simpleness of certain groups; whereas intelligence testing is aimed at quantifying a difference in intelligence between groups and does not posit a mechanism for any differences found. Phrenologists took

it as a given that women are, on average, not quite as intelligent as men (e.g. Broca 1861, in Russett 1991, p. 37). It was simply posited as ‘woman’s information is less wide, and deep, and thorough, than that of a man’ (Romanes 1887, p. 384); which conveniently ignores one of the confounding variables that girls were undereducated as compared to boys.

Some phrenological accounts of differences between the sexes’ natural abilities perpetuate the ‘equal but different’ doctrine that remains popular today. Current examples of this doctrine are labelled as ‘gender equality 2.0’ by Cordelia Fine (2010), who asserts conservative authors promulgate this view to argue that segregation of interests and occupations by gender is not a social problem, and that it would be more equitable to accommodate and embrace differing interests and strengths. Through promoting ‘equal but different’ gender roles, some phrenologists could position themselves as facilitating female empowerment (long before such a term existed<sup>7</sup>) through promoting the unique strengths of women. Influential phrenologists believed that women possessed more developed faculties for bonding with children, and therefore had a special role in child rearing (Staum 2003, p. 65). For example, the editor of a women’s magazine, reflecting upon the death of prominent phrenologist Johann Spurzheim, declared him a ‘friend of woman’ and reported that he had told her that phrenology would serve women by allowing them to become better mothers (Hale 1832, p. 572). Even Romanes, who was critical of women’s intellectual capacity, believed that women possessed special virtues such as religiosity, home decorating, and caring for others (Romanes 1887, p. 387).

An interesting sidenote in the story of phrenology is its use by one phrenologist to subvert male dominance. One of the few female phrenologists, Agnes Sillars Hamilton, argued that phrenology demonstrated that women’s brains were equal to or even better than men’s brains, which would ultimately facilitate women to ‘break the chains of the tyrant and the oppressor’ (Gleadle 2002, p. 37). However, Hamilton’s resistance against mainstream phrenology made her unpopular among her contemporaries, who shunned her from their community, declared her to be unqualified, and painted her as a narcissist due to her inclusion of anecdotes in speeches (e.g. Unknown author 1840, pp. 187 – 188).

The now debunked science of phrenology is of interest here, not just because it is one in a long line of scientific attempts to establish women as being less cerebral than men, but rather

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<sup>7</sup> Women’s empowerment was first ‘invented’ in the 1980s to refer to participation in the public sphere, but the concept has since deradicalized and now refers to the choices of individual women without reference to a political context (Calvès 2009). It is this latter definition that bears a close resemblance to phrenologists’ advocacy for women to realise their innate feminine strengths.

because it parallels neuroscientific studies that investigate sexual dimorphism in the brain, as argued by several feminist authors (e.g. Bluhm 2013a; Fausto-Sterling 2000, p. 118; Tavis 1992, p. 55). Phrenology represents a precursor to current neuroscientific attempts to understand sex differences in behaviour. Both can suffer from similar issues of reverse inferences, statistical errors, and selection bias. Phrenology and neuroscience share the common foundation of believing that cognitive functions can be mapped onto regions of the brain. Both phrenology and neuroscience use the relative size of particular regions of the brain to make inferences about behaviour. For example, in the multi-tasking case study presented in Chapter Seven, the authors measured a decrease in grey matter in parts of the brain associated with speech in patients administered testosterone; it was implied that this explained known differences in male and female language ability (Hahn et al 2015a). Cognitive neuroscience has been disparaged as a ‘new phrenology’ for its assumption that psychological processes are compartmentalised (Uttal 2001). Both phrenology and neuroscience have also been plagued by similar methodological issues, namely, broad conclusions being drawn and widely publicised from small sample sizes. (See Gould 1980 [2010], p. 156 for a discussion of sample size in phrenology.) A key difference between neuroscience and phrenology is that the tenets of neuroscience are accepted as fact by mainstream science, whereas phrenology is now considered absurd. Neuroscience appears prominently in many of the articles analysed in the later results chapters, with its representation closely resembling historical public communication on phrenology.

In this section, I have discussed the first methodical attempt to quantify and explain women’s apparent lesser intelligence as compared to men. The next section discusses Darwin’s Theory of Evolution, which developed alongside phrenology, and its later application to sociobiology. A grounding in these concepts is crucial to understanding the news articles examined in the later results chapters. Biological explanations for inequality are compelling to readers seeking to understand the world around them.

### Darwin’s Theory of Evolution

This section briefly summarises the defining features of Darwin’s Theory of Evolution before discussing how the concept of natural selection was and is used to explain essential differences between the sexes. This leads into the next section’s discussion of sociobiology, or the application of evolutionary theory to explain human social behaviours, that became popular in the latter decades of the twentieth century. While this section is a critical account of how Darwin’s Theory of Evolution has been used to reinforce the institution of gender, it does not

seek to problematise the Theory of Evolution itself. Evolutionary theory is today synonymous with the discoveries of Charles Darwin, who published his trail-blazing book 'On the Origin of Species by Means of Natural Selection' in 1859. Darwin's Theory of Evolution was preceded by different theories of evolution put forth by others, including by his own grandfather (Rose 1998, p. 13). The Theory of Evolution posited by Darwin was pioneering due to its inclusion of natural selection as a plausible mechanism for evolution. Others' theories of evolution faltered due to the absence of a mechanism.

The premise of Darwin's Theory of Evolution is that all living organisms share a common ancestor, with mutations accruing over time to create new species. This centres on the principle of natural selection, that holds that mutations that are beneficial to the organism's chances of survival and reproduction are retained over future generations. Additionally, Darwin theorised sexual selection, referring to the development of traits that increase the organism's chance of attracting a mate, with the colourful feathers of a male peacock being a notable example. By introducing the concept of a common ancestor for all living things, Darwin's Theory of Evolution destroyed the boundary between human and animal and thus revolutionised how humans are understood in the natural order. This also paved the way for animal studies to yield insight about human behaviour: a brain is a brain whether human or murine.

It is a common misunderstanding that evolution is synonymous with progress, with each species marching towards new heights of advancement, humans being the pinnacle (Laland & Brown 2002, pp. 40 - 42). Such reasoning is an integral component of scientific racism. The error in this logic can be seen by considering that improvement of a species is not an objective concept: beneficial mutations can become detrimental if there is a change in environment. This advancement viewpoint was popularised by Darwin's contemporary, Jean Baptiste de Lamarck, who famously (and incorrectly) theorised that characteristics acquired by an organism over the course of its lifetime could be passed down to its offspring (Laland & Brown 2002, p. 40). An understanding of evolution as advancement, combined with the illogical belief that white Europeans are more evolved (and therefore more advanced) than other races, led to the eugenics movement invented by Darwin's own cousin, Francis Galton.

Darwin's theory invited new kinds of explanations for observations about humans and society. It could be applied in novel ways to argue for the naturalness and origin of gender roles. Following the publication of *On the Origin of Species by Means of Natural Selection* (Darwin 1859), there was a proliferation of arguments put forth to explain male superiority and female

inferiority. This is despite Darwin's tome being solely focused upon animals, only touching upon the implications for humans in its conclusion. Darwin later promulgated his viewpoint on the lesser intelligence of women; in his book *The Descent of Man*, he argues that 'man has become ultimately superior to woman' due to males developing greater mental prowess owing to their competitive nature (Darwin 1871). Other men of science at the time enthusiastically adopted concepts from Darwin's Theory of Evolution to explain the disparity between the capacities of the sexes as well as between races. Such arguments assume inferior female intellect as a fact and concentrate on providing an explanation for this observation rather than justifying the observation itself. The polymath Francis Galton was particularly active in anthropology and anthropometry, and utilised Darwin's ideas to explain the lesser achievements on certain groups including women. Galton is the inventor of the study of psychological sex differences, having conducted studies to prove that women are intellectually inferior (Buss 1976).

The concept of natural selection was influential in justifying the status quo of men's more prominent intellectual faculties. Natural selection leads to the idea of an incidental by-product (Buss 1998). The functionless male nipple is a prominent example of this. Because nipples are strongly selected for in women (the offspring of women with non-functioning nipples are much less likely to survive infancy), and because there is no selection pressure against the male nipple, men then experience the incidental by-product of having superfluous, under-sized nipples (Buss 1998, p. 22). An analogous argument states that intelligence in men is selected for, resulting in women developing some inchoate mental faculties. However, like the male nipple, female intellect is a poor imitation. This argument was put forth by Darwin, who stated that, if not for equal transmission of traits to both sexes, the magnitude of the difference between male and female intelligence would be equal to the differences in appearance of the beautifully feathered peacock and its plain female counterpart (Darwin 1871).

While this argument is no longer used by mainstream scientists, there are traces of this concept in modern evolutionary psychology, in surveys and behavioural experiments that determine that women place higher weight on intelligence when selecting a partner. This may be assumed to be for evolutionary reasons (e.g. Fisman, Iyengar, Kamenica, & Simonson 2006). A separate argument invoking evolution to explain women's stunted intellect, spearheaded by Herbert Spencer in 1873, states that women's energy is shuttled into reproduction, leaving little energy to develop the brain (Gates 1998, p. 14). This notion was translated into practice by medical doctors, who suggested that women should not exert themselves with education (Gates 1998,



p. 15). While some women at the time opposed Spencer's reasoning (Gates 1998, pp. 15 – 19), the idea was influential for decades into the early twentieth century.

Evolutionary arguments continue to be used to explain the gender order, often (but not always) in a way that is palatable to a modern audience. The greater male variability hypothesis asserts that the males of a species have more variation in their traits as a prerequisite for sexual selection (Shields 1975, p. 743). From this it followed that the male drives evolutionary change, and variation became regarded as an intrinsically valued quality (Shields 1975). The greater male variability hypothesis can be applied to explain female intellectual mediocrity. It is widely believed that there are more men with extremely low and extremely high IQs, while women's IQ values are more clustered towards the average (Irwing & Lynn 2005). Proponents of the greater male variability hypothesis believe that this gender effect is determined by nature, though, there are possible social explanations for greater male variability in IQ test performance (Noddings 1992). If greater male variability is an intrinsic sex difference, it can be argued that there are more accomplished men not because of social factors, but because there are more men of extreme intelligence who then rise to the more influential positions in the public sphere. This idea was popularised by Havelock Ellis (1903), who observed there were more men institutionalised in homes for the mentally disabled and that there were more renowned genius men (Belkhir 1994, p. 65). While the greater male variability hypothesis is well-known, and would explain male dominance across many different domains, the evidence is patchy (Iliescu, Ilie, Ispas, Dobrean, & Cliniciu 2016). As the 2016 study would indicate, this remains a legitimised area of research today.

Darwin's Theory of Evolution provided a foundation for scientific explanations of gender roles. The theory heralded the current paradigm for conceptualising and explaining differences between the sexes. Later developments, particularly endocrinology in the early twentieth century and brain imaging technology in the late twentieth century, have provided new tools for creating and justifying essential differences. The discipline of psychology, which rapidly developed in the twentieth century, has also utilised evolutionary reasoning to understand and explain gender roles. Evolution by natural and sexual selection remains at the heart of explanations for male dominance and the sexual division of labour.

Darwin's ideas were later fused with the study of genetics, of which Darwin was unaware (Sclater 2006), to give a complete understanding of evolution. The synthesis of genetics with evolution was completed in the 1930s and 1940s (Laland & Brown 2002, p. 54). Darwin's

Theory of Evolution remains as one of the most well-evidenced theories in science and forms the foundations of modern biology. Evolution is widely believed among the general population, and, as can be seen in the later results chapters of this thesis, evolution and genetics continue to be used in popular explanations for human behaviour. As discussed in Chapter Five, the genetic legacy of the caveman is a common form of evidence in mainstream news to promote behavioural sex differences.

## Genetics

Genetics investigates the relation between an organism's genes and its characteristics. More recently, genomics is the study of the entire genome (all of the genes) of an organism. Genes are encoded in DNA and are inherited from one generation to the next, interacting with the environment in complex ways to produce the characteristics we observe in an organism. Many of our genes are never even expressed. As mentioned on the section on Darwin's Theory of Evolution, in the early twentieth century, the emerging discipline of genetics combined were combined with Darwin's ideas to create the current understanding of evolution.

Genes and genetic research are prone to be presented by scientists and science communicators as unlocking definitive knowledge about humans' true nature. This can be represented using biblical language to emphasise the all-powerful nature of the gene. According to Dorothy Nelkin (2000), scientists present the gene as a soul and the genome as a book of life. Genetic research is often represented in the news as the search for the gene 'for' particular traits or diseases. For example, in the 1990s there was much activity around identifying the 'gay gene', that ultimately did not produce a simple result as early reportage would suggest. Searching for the 'gene for X' is a reductive account of genetic investigations, not only entirely erasing the interplay between the social world and gene expression (i.e. epigenetics), but also obscuring understandings that there are usually many genes implicated in a single trait.

Genes located on the X and Y chromosomes – the only chromosomes that are sexually dimorphic – are frequently assumed to be related to observed behavioural sex differences (Kaplan & Rogers 2003, p. 48). However, it is difficult to establish direct causal relationships between genes and behaviour.

According to biologists Gisella Kaplan and Lesley Rogers, who contend that genetic research is hyped in unlocking human behaviour and disease (2003), beliefs about behavioural sex differences are given new life by genetic claims. Kaplan and Rogers (2003, p. 5) argue that media accounts of science espousing a socially conservative genetic determinism are

dominated by evolutionary psychologists (as discussed in the previous section) and molecular geneticists. Genetic understandings are integrated into peoples' beliefs about the origin of difference; for example, Suhay and Epstein Jayaratne (2013) found that politically conservative people in the United States are more likely than progressives to believe genetic explanations for class and race differences, and Donovan, Stuhlsatz, Edelson and Buck Bracey (2019) found that high school students learning about 'neurogenetic essentialism' in biology class were influenced to believe that there are innate sex differences in scientific ability.

Genetics, as well as endocrinology (discussed in the next section), are both incredibly complex disciplines that are drawn upon to provide definitive and scientifically alluring answers about human nature. As shown in the later results chapters, this includes instances where the scientific knowledge has limited relevance to the claims being made about human behaviour. Genetic breakthroughs are of extreme interest to mainstream audiences, as is evident in the sampled news articles examined in the results chapters.

## Endocrinology

Endocrinology is the study of hormones in the body; hormones being chemicals produced by the body's endocrine glands. Hormones are one of the body's ways of regulating itself, for example, the hormone insulin is released by the pancreas to adjust blood sugar levels after eating. Doctors and scientists first began noticing and investigating hormones around the dawn of the twentieth century (Luck 2014). There are many different hormones that regulate the human body, but of interest here are the sex hormones: 'female' hormones known as oestrogens (of which estradiol is the most notable – it is often referred to as oestrogen) and 'male' hormones known as androgens (of which testosterone is the most prominent). Both sexes produce both types of hormone, though in very different amounts. Sex hormones are both produced by, and essential for, the optimal functioning of the reproductive organs. One of their impacts is to develop the secondary sexual characteristics (though people with intersex conditions can deviate from these general rules). Sex hormones have a presence in the brain, but their effects (that may be different for each sex) and mechanisms are not well characterised<sup>8</sup>. This uncertainty, combined with the unambiguous sexual dimorphism of sex hormone levels, positions sex hormones as an ideal site upon which behavioural gender differences can be projected.

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<sup>8</sup> For a comprehensive review of research into the behavioural effects of testosterone, see Celec, Ostatnikova, and Hodosy (2015), and for an overview of the effects of oestrogen on the brain, see Gillies and McArthur (2010).

The twentieth century was a time of discovery and experimentation with sex hormones. Scientists were particularly interested in the vital powers of testosterone. They sought biomedical applications such as giving men hormones taken from other animals to improve the patient's virility (Luck 2014). Later, scientists developed the idea that brain structures were set in the womb due to the presence or absence of testosterone. It is supposed that this creates either a globally male or female brain structure. The brain organisation theory is implicit in neuroscience of the sexed brain. This theory has its roots in the 1960s, when psychologist Milton Diamond proposed that hormones regulated gender identity and sexuality, suggesting that the increase in hormone production at puberty activated the gendered architecture of the brain. The sexed brain could be considered analogous to a car that runs best on the right 'petrol' (sex hormone). Diamond's theory was a challenge to accounts of gender identity and expression as being shaped by upbringing as a boy or girl, as exemplified by the controversial case of David Reimer (Fausto-Sterling 2000, p. 67).

Testosterone is associated with aggressive and dominant behaviour, and can also be conflated with ambition. It can therefore be employed as an explanation for differences in behaviour between men and women (Fine 2017). Meanwhile, oestrogen is associated with nurturing, mothering behaviour. The under-determination of the effects of sex hormones on the brain creates logical pitfalls that are evident in the material examined in later chapters. In many of these articles, the influence of 'hormones' is produced as a complete explanation for behavioural differences, without specifying how this works. The incompleteness of explanations may not be apparent to media audiences due to their background knowledge that testosterone is a 'male essence' and oestrogen is a 'female essence'. Hormonal explanations are thus ripe for the projection of gender-based behavioural differences, as is evident throughout the results chapters. Using the impact of testosterone as a complete explanation for behavioural sex difference – while failing to explain the assumptions or mechanisms underpinning this logic – figures heavily in the articles analysed in the later results chapters.

It must be emphasised that I do not seek to argue that gender differences are completely unrelated to the actions of sex hormones. It is plausible, though certainly not established, that hormonal differences are implicated in the near-universalism of patriarchy. My contention is that biological facts, whether well-established or divisive within scientific circles, are used in the mass media to justify, explain, reinforce, and recreate gender stereotypes. Whether or not brain organisation theory is ultimately accepted, there remains a difficulty with its popular representation to create two distinct types of brains that explain gender inequalities without

reference to social structures. The knowledge provided by evolution, genetics, and endocrinology are the foundation on which sociobiology is built. The assumption is that the behaviours inherited from our ancestors are encoded in our genes. This is the focus of the next section.

## Sociobiology

Sociobiology, also known as evolutionary psychology, posits that human social behaviour developed due to, and can be explained by, evolutionary pressures. This line of thinking is strongly evident in the news articles investigated in the later results chapters. As presented in Chapter Five, I find that news articles draw upon the idea of the ‘caveman’ as explaining how the lifestyle of early humans has created the behaviour of modern men. Sociobiology is set apart from Darwinism by its emphasis on sexual selection. The central premise is that due to the sexual division of labour, men and women are subjected to different evolutionary pressures; sociobiologists contend that this can explain differences in behaviour observed today (Panther-Brick 2002). For sociobiologists, reproductive success is the most important factor in shaping behaviour: every individual acts in such a way to maximise his or her chance of having offspring, and those who are most successful have their genes (and, therefore, their behaviour) better represented in future generations.

The term ‘sociobiology’ was popularised by Edward Wilson’s (1975) influential textbook on the topic. Wilson’s book marked a break between the new science of sociobiology and the field of ethology (the study of animal behaviour) from which it arose. Fields concerned with applying evolutionary arguments to human behaviour have highly contested boundaries, with those occupying such spaces seeking to distance themselves from other approaches (Laland & Brown 2002, p. 8). Here I am not concerned with the intradisciplinary debates, and rather seek to present an overview of how sexually dimorphic behaviour has been explained with reference to evolutionary pressures.

Sociobiological explanations for gender roles began to appear in popular media in the early 1990s (Hasinoff 2009, p. 270), having propagated in scientific circles from the late 1970s. Marianne van den Wijngaard (1997, p. 8) argues that popular books on genetic underpinnings for behaviour were received poorly in the 1960s and early 1970s, as such ideas were reminiscent of the eugenics ideology that was used to justify Nazi atrocities. However, she argues, by the late 1970s enough time had passed that genetic determinism was able to become

popular, with prominent publications including 'The Selfish Gene' (Dawkins 1976) and 'On Human Nature' (Wilson 1978).

The logic of sociobiology recapitulates the structure of Edward Wilson's influential book. Most of the book is spent discussing the biological imperatives for behaviour in many different animals, drawing together a wealth of studies. Finally, he applies this knowledge to human societies and behaviour in the final chapter of the text, with sweeping assertions and scant supporting evidence. The evidence given is largely information about hunter-gatherer tribal societies (the assumption being that these less economically advanced societies are organised in a way more faithful to essential human nature). This is echoed by others' sociobiological arguments that seek to explain human behaviour and differences between groups or people as being a consequence of natural drives which, at least for early humans, maximised one's reproductive success.

Theories of sociobiology are characterised by unprovable speculations about the lives of early humans (Gould 1978a), as well as for implying that the human brain is frozen in time in the savannah with the selection pressures of the intervening years being unaccounted for. This principle is stated plainly by controversial sociobiologist Satoshi Kanazawa (2004), who claims that humans evolved over millions of years in the African savannah with very few changes to the brain in the 10,000 years since then. Criticisms of sociobiology at the time of its ascension called into question its ability to be defined as a science (e.g. Lewontin 1977). In addition to these empirical concerns, sociobiology was extensively criticised by Wilson's contemporaries for being sexist by promoting gender stereotypes as natural, evolved behaviour (e.g. Lowe 1978).

For sociobiologists, the differential investment of the sexes in reproduction has far-reaching consequences. Due to the long gestation and breastfeeding period of human babies, women must put more resources into reproduction. Contrastingly, a father only needs to contribute a single sperm cell, out of the half a trillion sperm he produces over his lifetime (at least in principle). Sociobiologists contend that this creates a battle of the sexes that is responsible for differences in sexual and romantic behaviour between men and women. According to the sociobiological narrative, a man has a biological imperative to impregnate as many women as possible, while a woman seeks to entrap a man into providing her with resources to improve the survival rates of her children. This would suggest that the genes of men who are successful in having many brief encounters with women are better represented in the next generation,

while the genes of women who are able to acquire a male provider are better represented in the next generation. This aligns with current beliefs that men are naturally inclined towards seeking relations with multiple women, whereas women are driven towards long-term monogamous couplings and are not motivated by sexual variety. It is obvious that a male's ability to pass on his genes is not constrained by how many sperm he can produce over his lifetime – a practically infinite number – but by how many females will reproduce with him and raise those children to in turn be reproductively successful.

The fatal flaw in the sociobiological paradigm is that it only counts successful mating outcomes when determining what drives a creature's behaviour. It operates under the assumption that females need only find one male to mate with, and will not seek out other males afterwards. It is true that female mammals, especially humans, are very much limited in the number of offspring they can have at one time, and (except in extremely rare cases where twins can have different fathers) each birth is the result of one sexual encounter. However, that does not mean a mother only had a single sexual encounter. As animal biologist Sarah Blaffer Hrdy (1977) brought to light, female monkeys seek out different males, possibly to create confusion over paternity to improve the survival rates of their young. The difference in parental investment does not entail that females are naturally monogamous while males are naturally polygamous.

A key piece of evidence for the choosy female/promiscuous male narrative is Angus Bateman's study on reproductive success of flies, in which he determined that while nearly all female flies reproduced, there was a large variation in male reproductive success, with one fifth not fathering any young (Bateman 1948). According to Bateman and those building upon his results later on, this demonstrated that male flies pursued many female flies where possible, in comparison to the relatively chaste female flies, due to the difference in how they can achieve reproductive success. Cordelia Fine (2017) has criticised Bateman's study and the discipline that relies upon it, arguing the results were invalid. Among the problems in the study were that the male flies somehow had more offspring than the female flies, and that the conclusion relies on the exclusion of most of Bateman's data. I believe Bateman's study also suffers the flaw mentioned above; even if his data was unshakeable, it does not follow that male flies are more promiscuous than female flies. He had no way to determine if female flies were having relations with many different male flies, including the fly that fathered their offspring. Fine (2017, p. 39) argues that the influence of Bateman's study cast a shadow over the study of female sexual behaviour. It provided grounding for the belief that females are naturally chaste, and therefore this became the starting premise for much of the research that came afterwards. The principles

of female chastity espoused by sociobiologists constitute a scientific account to replace religious values as encapsulated by the Virgin Mary. According to feminist scholars such as Mari Ruti (2015), sociobiology promotes an account of female sexuality in line with Victorian era sensibilities.

While sociobiology no longer enjoys the ascendancy of its earlier years, inferences made about how genes impact human behaviour (on both a societal and individual scale) can be regarded as outgrowths of sociobiological reasoning. Moreover, despite sociobiology losing favour among scientists, it is still dominant in popular explanations for difference. This is shown in my later results chapters, in which sociobiological claims are made in popular science books and legitimised as scientific knowledge in news reporting which does not distinguish between expert opinion and empirical science.

### Gendered neuroscience and psychology

A key area of investigation in this thesis is news media representations of the application of neuroscience to essential gender differences. Neuroscience is the study of the nervous system, which includes the brain. It does not necessarily imply the study of the human nervous system, with one of its central premises being that study of the nervous system of other animals can yield insights beyond that species. Neuroscience in its current form developed from the 1950s onwards. It is a broadly defined field that includes many different sub-disciplines. The approach of psychology differs from that of neuroscience in that it investigates behaviours rather than nervous activity. Psychology and neuroscience are here discussed together due to their uniting feature of both serving to locate gender within the brain or mind. Metaphors of the brain, and the impact these metaphors have on understandings of gender, is returned to in the following chapter.

The last few decades of neuroscience have been characterised by brain imaging, in particular functional magnetic resonance imaging (fMRI) which has resulted in a proliferation of studies producing arresting images that represent activity in the living brain. Along with other imaging techniques, fMRI can be considered an extension of the supposedly objective and disembodied eye (Haraway 1988, p. 581). The advent of fMRI technology, combined (in the United States) with a surge in funding during the 1990s 'Decade of the Brain', begat new disciplines bearing the 'neuro' prefix such as 'neuroeconomics' and 'neuroaesthetics' (Legrenzi & Umiltà 2011, p. 11). One prominent strand within neuroscience consists of producing connectomes, which are maps of the brain's structure. In the computing metaphor of the brain (discussed in detail



in the following chapter), the connectome is considered as a circuit diagram. Studies of the connectome have emphasised sexual dimorphism.

Popular representations of neuroscientific research are characterised by striking visual imagery and a focus on potential applications. This anticipation surrounding neuroscience echoes what Petersen and Krisjansen (2015) describe as ‘promissory discourses’ in biotechnology. Their argument focuses on the possibility of clinical treatments resulting from biotechnology research in areas such as genomics and stem cells. They argue that the promises themselves carry value, and attract funding to basic research, despite the modest outcomes to date (Petersen & Krisjansen 2015, p. 32). This is analogous to neuroimaging and its applications. Newspaper articles suggest future applications such as mind-reading but despite many years of promissory discourse, MRI lie detectors (for example) have not come to fruition (Merikangas 2008).

An unfortunate offshoot of neuroscience is the existence of ‘neuromyths’. Neuromyths are invalidated yet widely believed facts about the brain and its workings, often arising from the result of a single study (Tokuhamma-Espinosa 2010, p. 90). Tracey Tokuhamma-Espinosa argues, in a book aimed at schoolteachers, that neuromyths diffuse into the teaching literature and from there into classrooms. Neuromyths are often gendered. In the results chapters that follow, neuromyths frequently appear as established scientific fact.

Gendered neuroscientific research, as reported by the news articles I examine later in this dissertation, is characterised by providing a physical location for social roles. Barbara Ehrenreich and Deirdre English (1973 [2011], p. 148) argue that psychology supplanted the earlier use of gynaecology to position women as being inherently inferior to men. According to their argument, unconstrained emotions such as rage were previously explained as arising from female reproductive organs (the mere possession of which was regarded as an affliction); but the invention of Freud’s psychoanalysis re-categorised such problems into mental illnesses.

As discussed in the earlier section on phrenology, neuroscience can be considered as a descendant of earlier attempts to localise cognitive functions to particular regions of the brain. Paul Broca is regarded as the first scientist to have articulated this locality in the form that is accepted by contemporary neuroscience (Legrenzi & Umiltà 2011, p. 3), which distances itself from the efforts of the phrenologists. The idea of the modular brain fell out of favour in the early twentieth century but was reinvigorated in the 1950s and 1960s, and continues to dominate current neuroscience (Legrenzi & Umiltà 2011, p. 8). The concept of the modular brain is instrumental in creating under-determined arguments of the structure described by

Donna Maney (2016): that (i) a structure X differs between the sexes, (ii) X is related to Y behaviour, and (iii) Y behaviour differs between the sexes and therefore the different structure X causes the behavioural difference Y.

Since the ascendance of fMRI studies, there have been several regions of the brain that have received attention for their sexual dimorphism. However, despite some promising initial studies, there are few reliably produced differences between male and female brains. Such findings enjoy media attention, with possible implications teased out. The corpus callosum (the connections between the hemispheres of the brain) is one such area. Having been previously used to delineate racial differences in brain structure, the corpus callosum has now been reincarnated as the seat of some gender differences (Fausto-Sterling 2000, p. 122). A larger corpus callosum in women is utilised to explain many observed gender differences, such as women's intuition, women's greater verbal skills, men's overrepresentation in the hard sciences, and men's enhanced spatial skills (Fausto-Sterling 2000, p. 117). The infinitely malleable corpus callosum, onto which raced and gendered traits can be projected, is reminiscent of phrenologists' findings. I will return to a discussion of the corpus callosum in the case study chapter on multi-tasking, due to the centrality of the corpus callosum in explanations for an assumed gender difference in multi-tasking ability.

The methods and assumptions underpinning neuroscience have been called into question. For example, Robyn Bluhm (2013a; 2013b) has criticised fMRI studies for relying on the dichotomy of emotion and cognition, for explaining data in terms of gendered expectations when there are other, more parsimonious explanations available. Bluhm draws attention to three studies finding oppositional data that all make the necessary twists of logic to reach the conclusion that women are more emotional, and have less cognitive control of emotions, than men. Similarly, Cordelia Fine attacks the methods of particular studies that find conclusions in line with traditional gender roles (Fine 2010b; Fine 2012). Such arguments state that the scientific evidence for sexually dimorphic behaviour based on innate brain structures or functions is insufficient and flawed, but that the evidence has gained acceptance regardless due to their alignment with traditional gender roles.

An observed difference between the structure of men's and women's brains does not necessarily imply that this difference is inevitable or innate. Feminist neuroscientists, such as Gina Rippon, emphasise the role of plasticity in creating difference between male and female brains. According to this account, the brain physically changes due to each person's lived

experiences. This is a way of reconciling neuroscientific findings with the social construction of gender roles. Katherine Woollett and Eleanor Maguire's (2011) discovery that London taxi drivers possess a slightly enlarged hippocampus due to the acquisition of mental maps of the city was a landmark moment in neuroscience. This oft-repeated finding demonstrates the notion of plasticity. Learning changes the brain in ways that are (in principle, at least) physically observable. This has massive implications for any gender difference found in the brain. Such differences are not necessarily inborn and could be caused by the interplay between biology and a lifetime of gendered conditioning.

Crucially, the argument expressed in this thesis does not require that the brain is unisex or that differences are caused by gender enculturation. Even if it is one day found that there are large, inborn, and unchangeable differences between the male and female brain, it remains the case that presently, stereotypes are reinforced by the use of brain facts that are at best tenuously linked to behavioural differences. As argued by neuroscientist Marcel Kinsbourne (1980), if sex differences in the brain did not exist, they would have to be invented by scientists who set out to prove essential differences.

### The research funding environment

This final section considers how the research funding environment, particularly in Australia, shapes research outputs. Gender facts begin to be created at the problem formation and funding allocation stage. Research funding grants in Australia privilege medical lines of inquiry. Over 15 percent of the Australian Government research investment goes to health (Australian Research Council (ARC) 2019). This compares to only seven percent of federal research funding directed to education, culture, and political/social systems, combined (ARC 2019). Fields that tend to find nuanced and rich explanations for gender ideology are systematically underfunded compared to those that tend towards unequivocal fact gathering. There is a disdain for the former type of research in Australian culture, as evidenced by government intervention in revoking funding from ARC-funded projects in 2017 and 2018. The research funding environment in Australia promotes the creation of medical and hard scientific knowledge over other types of knowledge. The existence of hype of scientific research is an issue in several stages in scientific generation, including at the problem formation and funding stage. Projects that communicate promising outcomes, even where such speculation is unfounded, are in a better position to secure research funding.

Additionally, research grant allocation is biased in favour of men, impacting which research is funded to fruition. In an analysis of ten years of ARC Linkage Infrastructure, Equipment and Facilities and NHMRC grants, Deb Verhoeven found that 79 percent and 82 percent, respectively, were received by men, and that 84 percent of men receiving NHMRC grants had no women on their research teams (Bogle, 2017). Across all ARC grants schemes, the number of male applicants dwarfs the number of female applicants, and this is then reflected in the composition of grants awarded (ARC 2018). With the rising average age of lead investigators on NHMRC grants (Phillips 2015), leaky pipeline effects (i.e., that women do not reach the same level of seniority that men do in their field, for a variety of reasons including child-rearing duties) can be expected to be implicated. Similar observations on a gender bias in grant allocation have been made for public science grants in other Western countries. Canadian research concluded that the funding gap was not due to lower quality of female-led applications, but to peer review being harsher on female principal investigators (Witteman, Hendricks, Straus & Tannenbaum 2019); a similar result was also found for funding attained by early career scientists in the Netherlands (Van Der Lee & Ellemers 2015).

It is well established that there is a gender bias in terms of research funding allocation, but the implications of this (in terms of the research produced) are less clear. Researcher gender impacts which research is conducted and what methods are used. For example, male researchers are more likely to use quantitative research methods, while female researchers are more likely to use qualitative methods (Thelwall, Bailey, Tobin, & Bradshaw 2019). There have also been documented gender effects on results of human experiments (Chapman, Benedict & Schiöth 2018). The most well-known of this is in pain sensitivity experiments, in which men are (or claim to be) less sensitive to pain when the experimenter is female. This is not to say that research conducted by men lends itself to the gender-stereotypical outcomes highlighted previously in this chapter; rather, that this is one possible contributor to gender bias in research. Nielsen, Bloch, and Schiebinger (2018) argue that, while there have been no systematic investigations on differences in research questions asked by gender diverse teams, women's entry into traditionally male-dominated fields coincided with consideration of research questions impacting women. Further investigation is required in order to determine if, and the extent of, gender effects on producing stereotype-validating research.

There is one further implicating factor worth noting during the problem formation and funding stage of research creating. In the United States in 1993, it became compulsory for publicly funded clinical drug trials to include women as study participants (National Institutes of Health

1993). This was to correct for studies that had previously only been conducted on males, while the results were extrapolated to females – with the result that medical treatments were for men, with the hope that they would work similarly for women. Women had previously been excluded from many drug trials due to the risk to any potential pregnancies. While this change resolved an important problem, the introduction of gender questions means that medical literature is now populated by gender differences that may or may not be relevant to behaviour and which can be subjected to over-interpretation. Other aspects of the US funding environment, including the Decade of the Brain initiative as mentioned earlier, may also impact on which research is funded to fruition.

Research funding allocation is just one aspect of the generation of gender stereotypical findings. Publication of research is another area that must be examined. There are two key issues: the hyping of published research, and the file drawer problem. Exaggeration of the implications of results is particularly an issue in the medical sciences. As canvassed in the Chapter Three, research findings are prone to contain unfounded assertions (such as drawing conclusions about humans from animal data) that then proliferates in news reporting. Scientific research has also become more prone to hype over time. This is evidenced by a study analysing PubMed abstracts over a thirty-year period, in which the researchers found that the frequency of positive words (such as ‘novel’ and ‘robust’), as well as highly negative words, dramatically increased (Vinkers, Tjldink, & Otte 2015). This could be a feedback effect between news values and science communication. When it comes to publication of results, positive findings are more likely to be published than null results (the ‘file drawer problem’). This is because a study that finds no statistically significant result is generally not interesting enough to merit publication. As a result, a study finding a sex difference in some metric is more likely to be published than a study that finds no difference. This can bias the published findings of entire fields of research, and continues to be an enduring problem (Fine & Fidler 2015). Cordelia Fine (2010) argues that the file drawer problem can result in entirely false beliefs populating the literature on sex differences, as some of the published studies will have been from spurious findings, while research disproving that finding struggles to be published.

This links back to decisions made at the research funding allocation stage. Conceivably, published studies will have feedback effects on which research attains funding. As a strong publication track record is necessary for career progression and in the success of future research grant applications, those who are able to prolifically publish research are more likely to have opportunities to do so in the future. There is therefore an environment wherein those who find

and publish sensational results are then at an advantageous position for securing further research funding.

## Conclusion

It is important to understand historical attempts to theorise gender in order to make sense of contemporary media portrayals of a scientific basis for traditional gender roles. While many of these ideas have been discredited by more recent science, they continue to circulate in popular media, including through commonly used metaphors, as will be demonstrated in Chapter Five. This chapter has shown the persistence of scientific understandings of gender roles, even as the scientific facts change. This was achieved through providing a tour of key scientific developments that have been historically and contemporarily used to argue that gender roles are fixed and determined by nature. Most of these disciplines have focused on locating female inferiority in the head or brain; in contrast, according to anatomy and endocrinology, gender difference is systemic to all parts of the body. Many of these disciplines and their methods are left in the past and are no longer accepted as true. However, all disciplines discussed here – whether currently accepted or not – are united by their imperative to produce facts that explain the different roles of the sexes. In doing so, they perpetuate gender roles. It is remarkable that the notion of distinct male and female strengths in line with Western societal arrangements has endured as a science-based belief over a period of many centuries, despite the methods and evidence changing over time. A natural explanation for the gender order has only become more crucial over time, as proto-feminists and feminists have challenged this worldview.

## Chapter five: Australian news reporting on brain sex

### Introduction

In this chapter, I argue that news reporting of scientific facts pertaining to brain sex upholds a traditional sexual division of labour. Biological arguments can be used to endorse men's lack of interest or ability in domestic labour, while creating genetically determined reasons for women to be domestically capable as well as subservient and marginalised. Similarly, emotional labour in relationships is cast as a natural talent of women, arising out of physiological differences between the sexes. I find that news reporting of science lacks nuance and contains few examples of resistance to traditional gender roles, and firmly establishes a scientific foundation to explain stereotypical gendered behaviour, often in a way that presents scientific discoveries as finally proving common-sense knowledge that had been disrupted by feminist ideas. In this way, recent scientific research is utilised to re-tell old stories about gender roles.

Overall, I find that accounts of differences between male and female brains position women as naturally submissive, empathetic, and responsible; and men as naturally assertive, emotionally inept, and domestically challenged. This provides a legitimising rationale for men to act selfishly in the home and in interpersonal relationships; this is figured as women's labour due to differences in capabilities. According to some news articles this present a grossly simplified account of scientific findings, possessing a male brain absolves men of performing domestic and emotional labour in heterosexual relationships. This account complements the scientific news reporting presenting female submissive behaviour as an artefact of the female brain. Such narratives are invariably situated within heterosexual arrangements. News articles reporting on the science of gender roles invariably do not discuss the implications for same-sex couples or any other types of relationship that fall outside traditional bounds.

The sexually dimorphic behaviours naturalised in news reporting are simplistic and reflective of early twentieth century stereotypical differences between men and women. There is little understanding of socialisation into gender roles, transporting the reader back to a time before the nuanced understandings of domestic labour first investigated by Betty Friedan's *The Feminine Mystique* (1963). Women are portrayed as the masterful and self-sacrificing 'Angel in the House' (Patmore 1856), retrogressing into Victorian era conceptions of women's roles. Meanwhile, men's abilities to perform domestic and emotional labour are portrayed as childlike

at best. The feminised ‘new man’ of the 1990s, whose masculinity could accommodate being helpful around the home and sensitive to emotions, does not figure in these articles.

This chapter begins by noting that the articles discussed here are not exclusively drawn from newspapers with reputations for poor fact-checking, contrary to what the reader may expect. For example, the reader may expect overrepresentation from publications such as *Mail Online*, which launched an Australian edition in 2014 and is the website of British tabloid newspaper *The Daily Mail*. *The Daily Mail* has a reputation for publishing enticing headlines that overpromise the content of the article; some of their former journalists have openly admitted that they forgo originality, balance, and fact-checking to attract readers (e.g. King 2015). *The Daily Mail*'s reputation is compromised to the extent that online encyclopedia Wikipedia adopted the unusual policy of not using *The Daily Mail* as a source for their articles (Unknown author (Wikipedia) 2017). With a conservative editorial slant, *Mail Online* may also be expected to place more emphasis on traditional gender roles. However, articles steeped in gender stereotypes were not only the purview of *Mail Online* and other popular publications. The relative frequency of different publications is not systemically analysed here, however, the articles appeared in a diverse range of mainstream Australian news publications. The promotion of purportedly scientific claims of gender differences based on little evidence is a systemic issue in news media, including in publications many regard as respectable or relatively progressive.

The 685 articles used for the analysis undertaken in Chapter Five are drawn from 75 different publications (when Sunday and regional variants are counted as separate publications). However, most articles appear in a small subset of publications, with a long tail of publications with only one or two articles each. The most commonly appearing publications are: the Australian (n = 64), the Herald Sun (n = 53), the Courier Mail (n = 47), the Sydney Morning Herald (n = 39), and the Conversation (n = 36).

Despite the apparent diversity of publications, most articles are drawn from a small range of publishers, due to the shallow media landscape in Australia. When categorised by publishing company, the sample is dominated by News Limited (n = 445) and to a lesser extent Fairfax (n = 127). The Conversation (n = 26) and APN News (n = 25) were the next most prevalent. APN News has been considered its own category, as it was only acquired by News Corp (the parent company of News Limited) in 2016 and was independent of News Corp at the time the sampled articles were published.

Furthermore, there is an impact by so-called gender facts in tabloid and quality press alike. One may assume that outrageous claims made in the news may be ignored by the savvy reader, who actively assesses rather than passively consumed media. However, as mentioned earlier in the research design chapter, psychological experiments have demonstrated that simple and



repeated messaging has an impact on the recipient’s beliefs, even where this messaging runs counter to their existing knowledge. Repeated exposure can cause the reader to absorb false claims as part of their world-picture. Consistent media portrayals influence public debates and perceptions.

### Types of evidence

Before delving into how evidence is used in news reporting to promote understandings of gender stereotypes as natural, I first frame the discussion with a quantitative investigation of the types of scientific evidence used in the news reporting sampled here. I find that the use and presentation of evidence is deeply flawed by the internal standards of the scientific endeavour, by conducting a systematic examination of the types of evidence presented in news articles. The use of evidence in the articles is interpreted in the context of the hierarchy of evidence used on medical and scientific research.

There are two main issues arising here. Firstly, the most frequently used types of evidence do not constitute empirical evidence by any scientific standard. Secondly, news reporting tends to favour less robust types of empirical evidence. The table below presents the results of this systematic investigation, showing the number of articles sampled that use each type. A description of each type of evidence is provided in the appendix. Not all articles promote traditional gender roles (though this is true for the majority); this table includes all articles sampled, including those with evidence against gender stereotypes.

<b>Type of evidence</b>	<b>Number of articles</b>
Expert opinion	271
Reference to belief or fact	136
Brain imaging	116
Behavioural experiment	108
Hormone study	64
Animal study	59
Survey	45
Population or statistical study	29
Genetics study	26
Anthropometry	20
Evolutionary conjecture	16
Meta-analysis	9

Drug trial	5
Planned research	5
Anthropology	4
Interview study	2
Longitudinal study	2
Other type of experiment	2

Table 4: Types of evidence found in main sample articles, ordered by frequency (descending).

Certain unreliable types of evidence are the most common types of evidence used in news articles. These include supposed expert opinion – a quote from a scientist, medical practitioner or other expert, which is not based on any particular empirical evidence – which was the most popular type of evidence, appearing in 40 percent of all articles. This is most concerning for articles in which expert opinion was the sole type of evidence used. Where the expert opinion is drawn from a popular book or author and is presented as being a new scientific finding, this causes their often-unfounded statements to become regarded as factual. In other cases, expert opinion was used to supplement other types of evidence, for example, assisting the reader in interpreting a new result.

The second most popular type of evidence, involving reference to belief or fact but without an ascribed, verifiable source, appeared in 20 percent of articles. This cannot be considered evidence by any scientific standards. This category was used to denote unsourced statements and factoids. A sense of the evidence appearing in this category is outlined in the below examples:

A female brain at rest still has 90 percent electrical activity – in the male brain, it’s 30 per cent (Neville 2009)

Collected research suggests girls begin to talk sooner and more clearly than boys. The average 20-month-old girl has twice the vocabulary of the average 20-month-old boy. (Unknown author (Geelong Advertiser) 2012)

In fact it has long been known there are certain structural differences between male and female brains. For example, our brains are made up of two hemispheres that are very much more symmetrical in females than in males. (Robert 2003)

Within each category, there are articles and evidence of variable quality. For example, expert opinions run a spectrum from unfounded speculation on the origin or truth of gender

stereotypes (often by someone with a book to sell) to considered, fact-based statements based on someone's professional experience and knowledge of their field. Combinations of different types of evidence also changes scientific soundness of an article. The addition of an expert's interpretation to an article reporting on an experiment can help assist the reader to understand and contextualise the results. Alternatively, the addition of expert opinion can add speculation far beyond what can be reasonably inferred from the experiment. Empirically cataloguing the type of each instance of expert opinion is beyond the scope of this investigation. However, it is apparent from the qualitative investigation later in this chapter that many instances of expert opinion that promote the existence of psychological sex differences are not based upon empirical evidence and simply reflect popular understandings of gender.

Most articles in the sample promote a stereotypical understanding of gender roles. However, a small proportion (11 percent;  $n = 75$ ) include a counter-narrative that argues against the existence of the gendered brain. Many such articles were based upon expert opinion as their primary evidence. A small number of experts are cited in news articles, most notably Cordelia Fine ( $n = 17$ ) and Gina Rippon ( $n = 9$ ). This does not necessarily suggest that the scientific evidence against stereotypical brain differences being innate is paltry. An alternative (and likely) explanation is that individual studies that fail to find gendered differences are less likely to be published, both in scientific journals and in mass media. Null results – where a study does not find evidence for its hypothesis – are not published in scientific journals. Meanwhile, positive findings are more likely to be published. This is known as the 'file drawer problem', or 'publication bias'. The most extreme version of file drawer holds that journals publish the 5 percent of articles resulting from false positive results while the remaining 95 percent (which find no statistically significant result) languish in the researcher's desk, never to be seen by the scientific community (Rosenthal 1979). While researchers have known about this issue since the 1960s, according to Robert Rosenthal (1979), it remains a problem in scientific literature (Fine & Fidler 2015, p. 1450). The file drawer problem is one reason for the 'replication crisis' in science, particularly psychology, which entails that many experimental results are unable to be reproduced by others and are therefore of questionable validity (Pashler & Wagenmakers 2012).

Notwithstanding deeper questions on determining validity of knowledge, the scientific news reporting explored here relies heavily on types of evidence that are likely to reinforce stereotypical views and sensational portrayals of gender. Isolating the news articles that are clearly based upon one or more scientific studies, the most popular categories of scientific

evidence used are: brain imaging (17 percent; n = 116), behavioural study (16 percent; n = 108), hormone study (9 percent; n = 64), animal study (9 percent; n = 59), and survey (7 percent; n = 45). Beyond this, there are some other types of evidence used occasionally. There are some methodological issues that systemically plague brain imaging studies that make them especially prone to spurious results (Fine 2013). There are many examples of brain-imaging studies that have produced a promising result, only for this result to fail to be replicable as it was a statistical artefact.

Meta-analysis (a study that combines the results of many studies) is regarded as the most robust form of evidence in biomedical studies. In the articles sampled, there are only nine meta-analyses reported. Of these, three argued against the existence of gender brain differences, two neither promoted nor denied the naturalness of gender stereotypes, two (based on the same scientific evidence) came close to stating there is a hormonal basis for gender stereotypes, and two similar articles stated that the meta-analysis referenced had scientifically proven a brain basis for well-worn gender stereotypes despite the fact that this could not be reasonably concluded from the study.

Some of the articles in the sample have misused or over-interpreted scientific evidence. In many cases it is the interpretation of the study that allows the journalist to superimpose societal myths and values onto that piece of evidence. While most articles in the sample have not strayed too far from the original message of the evidence they report upon, there are many articles in which claims are made that are not supported by the evidence. In one extreme example, a genetics study on skin colour and sun sensitivity was used to support the viewpoint that scientists have claimed that redheads are more attractive than blondes and brunettes, and this attractiveness has led to their prevalence through sexual selection (O'Connell 2000). While this claim was indeed made by the lead author as a matter of opinion or conjecture, his statement has been dubbed as a scientific finding, while the actual study findings were buried six paragraphs into the brief news article.

The problem of sometimes-robust scientific studies being used poorly is found particularly with animal studies. Animal studies are prone to being used to promote conclusions that were not supported by the evidence. For example, an article headlined 'BRAIN FACTOR – Girls can't stop stressing' stated that women 'may be more prone to emotional stress than men because of their brain chemistry' before revealing in the third paragraph that they are reporting on a rat study (Unknown author (MX) 2010). This is not unexpected, as studies from the health

sciences (e.g. Sumner et al 2014; Woloshin et al 2009) have revealed that unfounded conclusions about humans are drawn from animal studies in news reporting. Similarly, the next chapter – a case study on news reporting of ‘baby brain’ – also finds that animal studies are relied upon to construct a narrative about human women. Due to the nature of the current investigation – in which articles not containing direct inferences about humans were not included in the sample – it would not be instructive to determine the proportion of articles drawing human conclusions from animal studies, as this would be 100 percent.

### Empirical science vs popular science

As the above table of evidence shows, not all articles examined here rely upon empirical or peer-reviewed scientific research. Many articles quote experts, who tend to be the authors of popular relationship advice books. These books may themselves rely on scientific claims, truthful or otherwise. I have chosen to include these instances in the sample because the reportage of popular science self-help books is often indistinguishable from that of peer-reviewed science, particularly in the headline and lead paragraph of each article. These statements may thus become accepted as science by readers. Categorising these instances of expert opinion lifted from books as ‘science news’ is questionable, though it can certainly be regarded as a form of science communication. Also, in some cases it is not made clear to the reader that a claim has been drawn from a popular book. The majority of articles relying on expert opinion as evidence are published as general news, with few being from reviews, and hardly any from features or opinion articles. Through publication in popular books, claims that have not undergone any formal review process have made their way into news reporting of science. Endorsement by an expert allows folk knowledge to be transformed into scientific evidence, or at least be regarded as such by journalists. I have also chosen to retain all news articles that quote experts making unsourced claims whose origin and accuracy cannot be determined (as assessing the accuracy of each article is outside the scope of this thesis).

There are several high-profile experts who write popular books that arm readers with scientifically-based tools and advice on managing the conflict that can arise out of these differences. Those who have developed a theory – that provides a scientific-sounding yet simple way of grouping and understanding the sexes – tend to have the most currency in news reporting. Popular authors appearing frequently in the sampled articles include Dr Louann Brizendine, a psychiatrist who authored *The Female Brain* (2006) and *The Male Brain* (2010); Professor Simon Baron-Cohen, a psychologist who wrote *The Essential Difference* (2003) and other books based on his empathising-systemising theory of gender differences; and Allan and

Barbara Pease, relationship advice authors of over a dozen books, most notably including *Why Men Don't Listen and Women Can't Read Maps* (1998). Claims made in these books have been transformed into news throughout the sample. As the reporting is so similar to reporting on actual peer-reviewed literature, a reader who is not scientifically informed is unlikely to realise the distinction between empirical science and expert opinion.

Louann Brizendine features prominently in scientific reporting of behavioural sex differences, owing to her popular books on the subject. Brizendine appears in 52 of the articles sampled (if 'Brizendine' had been considered a stand-alone category of evidence in the above section's analysis, she would be the seventh most popular type of evidence). Her statements marry together scientific-sounding facts with practical advice:

It comes as no real surprise too that one of Brizendine's studies showed how, when viewing emotional images, brain scans found nine areas light up in a woman's brain and only two in a man's. Nor is it surprising to learn that the area in the brain that is responsive to anxiety is more developed in women than men. Or that men pick up subtle signs of sadness in a female face only 40 per cent of the time, whereas women pick up signs of sadness 90 per cent of the time. And as for women and their "gut feelings", Brizendine explains that these so-called feelings are in fact responses to real physical sensations in the body, and that a woman's brain has more cells to detect bodily sensations than a man's. (Unknown author (The Canberra Times) 2007)

Brizendine's books and associated promotional materials are quite fact-dense, though the scientific origin of these facts is not always clear. A confirmed instance of a false scientific claim is her statement that women speak 20,000 words per day, in comparison to men's 7000 words; this statement was made in her book *The Female Brain*, was widely quoted in the promotion of her book, and subsequently became general knowledge (the 20,000/7000 factoid is quoted in 21 of the news articles sampled here). In the book, this figure was not sourced to any scientific experiment. The origin of this claim was painstakingly traced by linguist Mark Liberman, who determined that the idea came from religious relationship advice before being reimagined as scientific evidence in Brizendine's book (Liberman 2006). This represents an example of common-sense folk knowledge becoming legitimised as scientific.

Psychologist author Simon Baron-Cohen's empathising/systemising hypothesis has infiltrated popular understandings of gender. According to Baron-Cohen, who specialises in autism research, female brains are on average fine-tuned for empathising, and male brains are on

average optimised for systemising (systemising is defined as the ability or desire to make or deconstruct systems). Or, as explained by one of the news articles in the sample:

So, based on his theory, those of us with the female brain, or empathising brain as Baron-Cohen calls it, intuitively figure out how people are feeling and how to treat people with care and sensitivity. And those with the male brain, which he dubs the systemising brain, intuitively figure out how systems -- from a car to a computer to a maths equation -- work. (Maye 2003)

Baron-Cohen argues that testosterone levels in the womb are correlated with higher systemising quotient scores and lower empathy quotient scores (both quotient tests were created by Baron-Cohen and his team). Moreover, he mounts evolutionary explanations for sex differences in empathy and systemising ability. The empathising/systemising hypothesis derives from Baron-Cohen's theory that autism spectrum disorders are caused by possessing an extreme male brain – exceptional at systemising, but deficient at empathising – which, he believes, is created by abnormally high foetal testosterone levels. Baron-Cohen is staunch in his claims that he does not have a sexist agenda; rather he maintains that his hypothesis arose out of his data, and that he has decided to convey this despite risking criticism (Cameron 2007, p.2). His popular book, *The Essential Difference*, which outlined the empathising/systemising hypothesis, was published in 2003. It is difficult to determine the degree to which his book influenced news reporting, as the book grasped an existing stereotype. Baron-Cohen transformed the stereotype into a matter of objective science, and the legacy of this permeates the subsequent news reporting. He appears by name in 32 of the articles sampled here, and there are also instances of the empathising-systemising concept being mentioned but not sourced to Baron-Cohen.

Many of the articles quoted in this chapter are promoting popular relationship advice books that are supposedly grounded in science. Some of these texts were examined in more depth in Chapter Four. It is in the interest of these authors to promulgate the viewpoint that there are scientific explanations for common relationship problems arising from gender differences, with the scientifically based solutions to these issues being conveniently contained in their book. The authors extract some of the most gripping knowledge claims made in their books to achieve this media coverage. In the articles canvassed here, these claims are usually presented as hard news. From the headlines and leading paragraphs, these articles are indistinguishable from news coverage of recently published peer-reviewed scientific findings. It is typical for an article

to report on expert opinion from books as news itself, rather than as supporting evidence for another piece of news. The sale of books by experts, and the currency that best-selling books provide to their careers, are thus an economic factor influencing the content of science news reporting.

Having sketched an outline of science news coverage and the types of evidence it favours, in the rest of this chapter I perform a qualitative analysis of the sampled articles, focusing on recurring themes throughout. In the following discussion, I first explore how news articles use science to justify male incompetency and lack of interest in housework, before moving on to discuss news representations of the science behind emotional labour.

### His eyes don't see household labour

News portrayals of domestic labour present men as being physically incapable of undertaking household tasks to the same standard as women. The concept of a sexually dimorphic eye and visual cortex serves to provide a seemingly objective, physiological excuse for male deficiency in seeing household labour. The concept of a sexually dimorphic eye, despite being prominently featured in the news articles that follow, is not borne out in mainstream accounts of the eye<sup>9</sup>.

The following news articles focus on the different constructions of the gendered eye, which, they claim or imply, arose from the gender roles of early humans. What Thomas Laqueur (1990) describes as the two-sex model of the body, discussed earlier, is evident in these accounts of the sexually dimorphic eye. Laqueur focuses his analyses on the reproductive system, arguing that male and female reproductive organs began to be conceptualised as completely different structures in the eighteenth century. Prior to that, he argues, the female was regarded as an inverted male. There is a parallel between this journey and that taken by conceptualisations of the eye as presented in the following news articles. While a two-sex model of the eye is nowhere near mainstream, the following articles replace the idea of a gender-neutral eye with a specialised male or female eye. Male and female eyes are imbued with complementary capabilities, aligning with their public and private sphere roles.

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<sup>9</sup> While there are sex differences in prevalence of some eye diseases, there is little research or discussion on sex differences in normally functioning eyes.



The idea of men being unable to find their car keys, while women are unable to read maps, is a common trope, having been bolstered by popular books. This stereotype is given a scientific explanation in mainstream news:

Why can't men find their keys? And, for that matter, why can't they find their socks? Body language expert Allan Pease says a man will stand in front of a fridge demanding to know where, say, the butter is while a woman will reach past him and instantly lay her hand on the item. Pease, who co-wrote *Why Men Don't Listen And Women Can't Read Maps*, claims women have wider peripheral vision and a greater ability to delineate colour. (Dow 2005)

In February, the New Zealand Herald quoted research which suggests that while women can't read maps, men can't see things right under their noses. That explains why men can't find their car keys or the proper knives and forks in the cutlery drawer but women locate them in a flash. The Herald says the differences developed because of specific roles in evolution. Men had to hunt and stalk their prey so became skilled at navigation over long distances, while women foraged for food and became good at spotting fruit and nuts in the foreground. (Jory 2009)

The stereotype of men being unable to locate their keys becomes a synecdoche for gender roles. Creating a wholly neuroscientific explanation for this social phenomenon then carries consequences for the division of labour in the home, as women's greater contributions become a matter of how their eyes and brains are configured from birth. News articles promulgate the belief that the male visual system conspires to prevent men from cleaning:

WOMEN have a wider arc of peripheral vision so they can see most of the contents of a fridge or cupboard without moving the head. Men move their heads from side to side and up and down as they scan for the objects. A woman's wider peripheral vision is why women rarely get caught peeping on men. (Baskett 2000)

The articles quoted here rely on the teachings of Allan and Barbara Pease, whose best-selling books present heterosexual relationship advice based on essential differences between the sexes. The claims are therefore not traced back to a study; instead, they are reliant upon the authority of the duo. Quotations from Allan and Barbara Pease are enduring, first appearing within the sampled articles in 1999, with the most recent appearance in 2012. There are also references to gender facts that were first proclaimed by Pease and Pease (without referring to Pease and Pease by name), giving these claims a life of their own, their status elevated from

opinion to scientific research. For example, an article profiling an advertising agency (specialising in marketing to women) states:

‘Stevens says research also shows women have wider peripheral vision, and their brains rest at 70 per cent of activity state compared to 30 per cent for men.

This means advertisers can ‘slip messages into a woman's periphery’ when she is not actively seeking information. Peripheral advertising can be more effective because the message is not competing with similar messages simultaneously.’ (Kershaw 2003)

Belief in the sexually dimorphic eye is used not only for the promotion of books such as those by Pease and Pease, but also to encourage business for the advertising agency discussed in the above article. This is an example of the different economic interests at play in news reporting of scientific knowledge about gender roles – scientific accuracy is sacrificed as made-up facts are used as an angle to promote a product.

Supposed differences between male and female eyes can also be applied by journalists in more creative ways, always aligning with traditional gender roles. For example, this article argues for a scientific excuse for men being less capable of wrapping gifts:

But there is a scientific reason why men don't like wrapping presents. Men and women's eyes are constructed differently. Men suffer greater eyestrain than women because, as hunters, their eyes are genetically configured for long distances -- for scanning the horizon for the next kill. (Unknown author (Sunday Herald Sun) 2007)

The origin of the fact produced is a mystery. It is possible that the author is referring to the slightly higher prevalence of near-sightedness in women (which does not suggest that there is a genetic predisposition for this, as near-sightedness and its progression are dependent on environment). If this is the case, the fallacy in reasoning would be that the statement would not hold true for the majority of men and women who have normal distance vision. Regardless of how the authors have arrived at their statement, they have followed the pattern of projecting a gender role onto some vague fact about slight physiological sex differences. Added to this is some reasoning about the hunting needs of early humans, which, as I visit in more detail later in this chapter, is a rhetorical device that provides a catch-all explanation for behavioural sex differences in modern humans.

Different elements of the male brain – not just relating to vision, but also sense of self – are invoked as reasons for men failing to see when a house needs cleaning:

His brain takes in less sensory detail than a woman's, so he doesn't see or even feel the dust and household mess in the same way. And the male brain also attaches less personal identity to the inside of a home and more to the workplace or the garden. (Unknown author (Gold Coast Bulletin) 2003)

Most men navigate by mental maps - they can glance at a street directory, remember salient streets and easily rotate their mental mud-maps and remember to make opposite-direction turns if they are travelling from the top towards the bottom of the page. In contrast, most women navigate by landmarks - their memory for familiar objects or features is undoubtedly superior, which is why wives know where everything is at home, and men can not remember or find anything - the condition known as domestic blindness. (O'Neill 1999)

The statement about the male brain prioritising the workplace to the home in identity-making replicates traditionally gendered public and private sphere differences. The journalist does not question if the 'male brain' finds its identity in work or the garden (and, conversely, that female identity-formation is grounded in the home) due to inborn sex differences, or due to the sociocultural fabric in which it is embedded. Other than the above example, the articles quoted here do not present the home as a site for women's identity-making. Ensuring the completion of household labour is presented as the natural responsibility of women. While news reporting of science presents women as uniquely adapted for household work, the labour itself is largely regarded as universally disliked by both men and women. Further, news articles abound with practical tips for how women can cajole their male-brained partners into helping with housework.

The naturalisation of an inequitable division of household labour in mainstream sources serves to create additional work for women to perform in their relationships. If a biological justification for men's behaviour can be found, it then falls on the women in his life to accommodate the consequences of essential male-ness. This is made explicit in some articles that suggest strategies for women in managing a partner's limited capabilities:

'There is recent research which talked about the male brain -- men sometimes just don't see the work,' Muller says. 'So making a list of chores can be helpful.' (Davies 2008)

Ever noticed how men will ignore the mess and read the Sunday papers instead? It's not that they're lazy, it's because they're not focused on a specific household task at the time, says wellness coach Fiona Cosgrove. 'Women tend to view keeping a clean and

tidy home as one of their main tasks of the day, compared with men's priority of doing outdoor tasks,' she says. 'Women don't need to take everything on their shoulders, but they may need to learn how to ask for help without it coming across as nagging.' Cosgrove suggests getting into the habit of saying, 'What I would like is ...' rather than 'You never help out', which puts the other person on the defensive. And be sure to give a reason. 'This will appeal to men's logical and cognitive way of thinking. Ultimately, try to avoid the blame game.' (Yabsley 2010)

Other examples of extra work for women include suggestions for presenting a man with 'one clear idea at a time' to entice him to 'help' (Bennett 2009), and to give a man a 'gold star' for 'helping around the house' (Unknown author (Sunday Herald Sun) 2007). The advice delivered in these articles presumes that the woman in a relationship is responsible for overseeing her male partner's contributions to the household and keeping a mental register of tasks to be completed. If he is not contributing to domestic labour, or if he is having difficulties performing housework to an acceptable standard, she must micromanage and manipulate his contributions using infantilising tricks borrowed from parenting and pet-rearing techniques. These articles perpetuate the regressive stereotype of a bumbling man in the home (despite whatever power he wields in the public sphere).

This section has focused on news reporting on how (supposed) physiological differences in the visual system are utilised to construct and excuse male domestic incompetence. I find that the sweeping pronouncements of news articles reduce a social arrangement to innate sex differences and construct a rationale for women to perform tedious household tasks, wrapped in the equivocal language of physiology. Small differences in visual perception are held to amount to large differences in the share of domestic labour, according to the world picture portrayed by the above articles- with one even naming the male condition as 'domestic blindness', boldly stating what is implied by most of the reportage. While I have not systematically examined the evidentiary basis of claims, it is worth noting that the concept of the sexually dimorphic eye cannot be considered mainstream biology – there is little scientific research on sex differences in visual acuity, or on evolutionary causes of any difference. Having examined news portrayals of scientific explanations for gender differences in doing household labour, the next section shifts to scrutinising news reporting relating to emotional labour. In particular, the next section draws on the sampled news articles to look at how news reporting uses claims of physiological differences relating to hearing in order to naturalise a gender order in which men ignore women.

## Selective hearing and the male brain

In addition to positioning women as household managers, and providing a rationale for men's lesser contributions in the home, news articles also provide ready excuses for men not to listen to women. In the previous section, (mis)understandings of the visual system as sexually dimorphic were implicated in why men are naturally inferior at performing domestic labour. Here, I highlight how physiological differences in hearing are constructed to assert that men are predisposed ignore women who speak.

The male auditory system is presented as deficient, resulting in the male dominant behaviour of failing to notice women's voices. These news articles produce a menagerie of flaws in men's hearing, all with the same result- men are biologically primed to disregard women's voices. For example, one article concocts a scientific explanation for female voices being 'harder to listen to' for male research subjects:

The Sheffield researchers uncovered differences in the way the male brain responded to male and female sounds. The researchers found men deciphered female voices using the auditory part of their brain, which processes music, while male voices engaged a more simple mechanism. Therefore, they were almost twice as likely to listen to a man talking and block out what a woman had said. Researcher Michael Hunter said the complexities of the female voice meant it had more 'melody'. He said female voices were harder to listen to for long periods and especially easy to ignore when it was giving high-pitched instructions. (Unknown author (Redcliffe Bayside Herald) 2005)

The above article includes enough information to locate the research article upon which it is based. I found that the message of the article deviates from that of the research paper, which only claimed that hearing male and female voices appeared to activate different regions of the male brain, with a region implicated in perceiving intonations activating more for female voices – nowhere stating that female voices require more effort to understand (Sokhi, Hunter, Wilkinson, & Woodruff 2005). The article is also inconsistent with the message of the press release, which re-stated the researchers' findings and did not claim that female voices were harder to listen to. Rather, the quoted researcher said the opposite: 'This could be linked to the fact that female voices are interpreted in the auditory part of the brain, and are therefore more easily decoded' (The University of Sheffield 2005). A variation on the above article was noted by linguist Deborah Cameron (2007, p. 18), who sees the reporting as claiming to be decisive evidence for one aspect of the 'battle of the sexes'. The exaggerated scientific facts are used to

provide a justification why men may fail to listen to women due to their higher-pitched voices – a criticism often levied at female politicians. For example, then Australian Prime Minister Julia Gillard’s famous 2012 speech on misogyny in parliament was dismissed by media commentators as being ‘shrill’, overly emotional, and incompatible with leadership (Wright & Holland 2014). A scientific imperative for ignoring female voices would have severe consequences for women’s participation in the public sphere.

In contrast to the above example, most articles on men’s auditory limitations do not begin by producing evidence that men find it difficult to listen to women. Rather, most begin from the premise that men do not listen, a fact that then must be explained using science. For example, the following article that contains this premise in a question, that it then answers with reference to a study:

Why does it seem communicating with boys can be like talking to a brick wall? It could be because from birth they don't hear as well as girls. A 2007 study in Stockholm of 30,000 newborns found girls hearing was slightly, but significantly, better than boys. (Unknown author (Geelong Advertiser) 2012)

This was a genuine study (Berninger 2007) which is correctly summarised in the article (the word ‘significantly’ used in the article refers to statistical significance but may be interpreted by the reader more colloquially). Berninger’s study on infants is used as a possible explanation for boys’ difficulty in communicating. For this to be a satisfying explanation, several assumptions must be made. The reader must accept that boys struggle to listen, and that poor hearing is a contributing factor. In addition, it must be taken that sex differences in infants’ hearing beget sex differences in children’s hearing. Invoking a study on infants pre-emptively undermines any suggestion of socialisation, or a nature/nurture interaction, being the primary cause of boys’ lack of listening ability, as newborns have not yet been socialised. The message of the article is that an inborn, unchangeable sex difference ‘could’ be the cause of boys’ difficulties in listening.

Some articles go so far as to attribute a type of deafness to men, reminiscent of the ‘domestic blindness’ created by articles in the previous section:

TESTOSTERONE reduces the hearing section of a man's brain, allowing men to become deaf to the most logical arguments put forward by women. Dr Laura Brizendine claims, in her book *The Female Mind*, the sex hormone testosterone shrinks the areas in a man's brain responsible for communication, emotion and memory. (Cornes 2006)

Brain scans show men can only do one thing at a time and become technically deaf if they are reading the paper or watching television. To get a man to listen, give him advance notice and provide an agenda. (Metcalf 2001)

It is unclear what is meant by 'technically deaf', and if such an effect would also be found in women who are concentrating on another task. It is furthermore doubtful that a brain scan could demonstrate behavioural effects of that nature. There is a known effect of irrelevant neuroscientific details making poor explanations seem more satisfying to a non-expert reader (Weisberg, Keil, Goodstein, Rawson & Gray 2008). A reader unfamiliar with brain imaging will be ill-equipped to spot the gap in logic, and will be left with the impression that neuroscience has proven that men have difficulty listening and that women must therefore undertake additional labour to accommodate this limitation.

Both of the above excerpts construct a two-sex model of hearing, wherein the aural system and therefore the hearing ability of men and women is wholly divergent in order to support observed (or assumed) behavioural sex differences. The two-sex model of the ear is apparent in the following excerpt from an article discussing the need for single-sex schools:

A family physician and psychologist, Sax says research shows differences between girls and boys are hard-wired. 'Boys and girls are born seeing the world very differently. Their eyes are built differently, they hear differently because their ears are built differently,' he says. A typical teenage girl has a sense of hearing seven times more acute than a teenage boy and boys respond better to a booming male voice than girls do, he says. (Clark 2006)

The author or expert does not describe what the differences are in the eyes and ears of each sex. The article, which was also excerpted in the introduction chapter, had a lasting influence on debates on single-sex schooling in Australian media. The facts produced by Sax took on a life of their own, becoming part of the accepted truth about sex differences in adolescence.

News articles drawing on purported facts about ear and aural processing recurred throughout the sample. I highlight one final example from this set, that illustrates the use of neuroscience to legitimise men's behaviour in relationships:

According to the Society for Women's Health Research in the US, men lack the higher rates of blood flow in parts of the brain associated with increased memory of verbal tasks. Or in other words, if you tell us stuff, we might forget it. (Readfearn 2009)

This excerpt links scientific knowledge to a colloquial common-sense truth about gender roles, legitimising sexism as a matter of scientific fact. It contains a logical leap between blood flow in brain regions (which presumably was inferred using fMRI) to behaviour; in other words, it falls victim to the false cause fallacy that is common in neuroscientific knowledge (Maney 2016). The construction of the above paragraph is unique in that the premises are written in the language of science, but the conclusion ('if you tell us stuff, we might forget it') is written informally, excusing 'us' (men) to the implicitly female reader.

The articles quoted in this section are written in the framework of an assumed heterosexual family unit: a husband not listening to his wife or noticing her emotions, or a son ignoring his mother; thus requiring extra efforts by women to ensure they are heard. However, if the scientific facts delivered by these articles are to be believed, there are profound consequences for women in the workplace. The sexually dimorphic ear would create a wholly biological explanation for all manner of male dominant behaviours such as talking over women, repeating and taking credit for women's ideas, and failing to believe women. Dominant behaviours become a matter of the physical limitations of men's ears and auditory cortices, rather than of learned gender roles in a patriarchal society.

The above articles provide no hint that men can enhance or work around their hearing issues. No advice is offered to men wishing to become better listeners. Instead, the articles serve as explanations for female readers, who may use the supposedly scientific facts to excuse the men who ignore them, and to adapt their own communication strategies as a result. This is plainly stated in a newspaper article on popular author Louann Brizendine's book *The Male Brain* (2010), in which the journalist delves into Brizendine's intentions:

As a self-professed feminist, Brizendine accepts that her views may be unpalatable to many women. But she hopes her latest book will help women to see the world through 'male-coloured glasses' so they can better understand their sons and lovers. (Freaun 2010)

This is reminiscent of the phrenologists' public outreach efforts, as discussed earlier in the Chapter Four. Phrenology, while mostly constructed by men, was deliberately made accessible for women and those without scientific training, facilitating the spread of phrenological ideas that were particularly useful to mothers in understanding the mental strengths and weaknesses of their children. The science described by Brizendine and her peers employs entirely different



methods, but contains the common thread of generating revenue by equipping women with scientific knowledge to better understand and raise their children.

The complementarity between gender roles is used to reinforce male dominance at every turn. This chapter so far has shown that scientific terminology in mainstream Australian news is used to justify male domestic incompetence and failure to pay attention to women, resulting in suggestions for women to modify their behaviour to accommodate the male brain. The scientific basis of these facts is often questionable and overly simplistic. In the next section, I turn to examining how scientific pronouncements are used in news reporting to produce an altruistic, perceptive female brain. The use of scientific facts serves to legitimise emotional and domestic labour as naturally female.

### The naturalisation of female submissive behaviour

Complementing the news articles establishing male dominant behaviours as arising from inborn sex differences, are news articles that use scientific facts to convey that submissive behaviours are caused by the architecture of the female brain. The reportage asserts that women are innately more sensitive to others' needs and feelings. These brain facts are used to proclaim that emotional labour is the purview of women, with news reporting from different sources emphasising three interrelated traits (perceptiveness, emotionality, and self-reflection). The supposed natural talents of the female brain are cast in news articles as explanations for what may be interpreted as subordinate behaviour. In the following articles, only female brains can adroitly perceive the true meaning of social interactions:

In females, the left hemisphere of the brain (the verbal expression centre) links better with the right hemisphere (the touchy-feely part of the brain), making them better at listening, emphasising and communicating. The female brain is superior at decoding non-verbal communication and picking up subtle nuances from tone or voice or facial expression. (Bennett 2009)

WOMEN can read between the lines - they have superior sensitivity in differentiating tone changes in voice volume and pitch. MEN can't lie to women - a woman's superior sensory equipment picks up and analyses incongruencies between verbal and non-verbal signs. (Syers 2001)

So, based on his theory, those of us with the female brain, or empathising brain as Baron-Cohen calls it, intuitively figure out how people are feeling and how to treat people with care and sensitivity. (Maye 2003)

He sees, hears and remembers far less than she does, while the details of social encounters hardly even register on his brain. Those details are expressed by nuance and gesture, things women note effortlessly but which pass him by. Various studies show that men are bad at reading delicate social situations. An awkward subject crops up at a dinner party, someone stiffens, the wife notices, but the husband blunders on in hobnailed boots until she kicks him beneath the table. She wonders how he could possibly have missed the reaction shown by the embarrassed guest, but his blunt senses are simply not sensitive enough to detect subtle signals. And what does get through to his brain is stored in compartments without being cross-referenced or integrated. He lacks what one scientist has termed social cognition, or what some call intuition. (Moir & Moir 1998b)

Being able to notice and interpret nuance in social situations is a subordinate behaviour, required of those who are low status and therefore have a greater need to be alert to their surroundings. None of the above articles name the described behaviours, which are presented as natural female aptitudes, as subordinate. The above articles also do not provide an explanation for how or why the female brain is more sensitive in social situations. The observable consequences of brain differences are fleshed out (in the Moir & Moir excerpt, an entire scenario is constructed) to exemplify stereotypical sex differences. The facts are produced by expert knowledge, with no reference to experiments or other types of evidence for how the differences between male and female brains (and how this could relate to behaviour) were determined.

Similarly poor explanatory power is apparent in news articles that present scientific terminology to argue that women are not only perceptive of others' feelings, but more cognizant of their own emotional states and better communicators:

The female brains were more symmetrical than the male brains, which the scientists suggest could explain why women are better at expressing their feelings than men. (Ferrari 2003)

After studying nearly 80,000 brain scans, Amen has found scientific proof that male and female brains are very different. Women worry more; care more; organise and pack for a family holiday because they have more brain cells in the pre-frontal cortex -- the area of the brain which controls planning, empathy, judgment. Boys are born with larger

parietal lobes, which deal with spatial awareness and logic, but have less brain cells in the major memory centre. (Girls, didn't we know it!) (Ostrow 2013)

That men and women have different amounts of grey and white matter in their brains explains why men are better at tasks like maths, which requires more local processing, and women have better language and communication skills, which require them to integrate information from different processing centres. (Ferrari 2005)

In these articles, the physical structures of male and female brains are posited as essentially different. A female propensity for communicating emotions is then transferred on to these structures. In the final example, it is stated that different allocations of white and grey matter 'explains why' men are better at maths and women are better communicators. Much more information would be needed in order to claim this as a satisfying explanation. This is an example of what Donna Maney (2016) points to as the false cause fallacy (if we make the generous assumption that there is an additional piece of evidence, correlating the brain structure to a behaviour, not included in the article). As Maney notes, a gendered structural difference (even when that structure is known to be related to certain functions) does not necessarily produce the gendered behaviours that are projected upon it. In the following example, there is little connection between the scientific evidence presented and the stereotypical behaviour it is supposed to explain:

THEY will never forget an anniversary. And they have an uncanny knack of being able to remind their husbands or boyfriends about that argument three months ago. Now scientists have come up with an explanation -- women really do have better memories than men. They say there is compelling evidence that the female brain is much more capable of recalling certain information than a male's, regardless of age. (Unknown author (Sunday Times Perth) 2010)

There are many possible different interpretations of the facts presented. For example, having superior memories could be used to advocate for women's professional success rather than their ability to remember the minutiae of romantic relationships. However, neither this nor the article above are a fair interpretation of the scientific research reported upon, which was a short-term memory test (Blackwell et al 2010). The story of women's superior ability to remember anniversaries and arguments in relationships is superimposed onto the scientists' findings that women perform better than men in an eight-minute memory test. As in the articles presented

in the previous sections, the details of the scientific facts presented are themselves almost immaterial; the impression conveyed is that a gender stereotype has been proven by scientists.

Occasionally, news reporting harks back to what amounts to nineteenth-century phrenological reasoning, in which the size of different faculties in the brain was believed to relate to their propensities. This further demonstrates how irrelevant brain facts are recruited into explaining subordinate behaviour as being inherently female. For example, the following articles ties the size of different brain regions to gendered traits:

WOMEN are good listeners, while men take more risks. These may be familiar stereotypes, but they are now also a matter of science. A team from Cambridge University in England has found key differences between the brains of men and women. In women, parts of the brain linked to the emotions, calculating risks, and the ability to listen were more prominent. (Hope 2014)

According to a US psychologist and writer of surprisingly useful relationship books, Scott Haltzman, men's and women's brains have completely different responses to emotional issues. The male brain has fewer pathways to and from emotional centres, and it's harder for them to access emotion and language at the same time. Hence the 'what?' look. In women, the memory centre is larger and has more pathways to emotive centres. The female brain lingers on feelings and holds on to the memory. Hence the wounded look. See? So it's not a man's fault that he's forgetful and emotionally challenged. And it's not a woman's fault she remembers everything and has strong emotional responses. (Bennett 2010)

The conclusions are unsupported by the evidence. In this example, it is unclear how links between different brain regions improve women's emotional abilities. One would need to produce further evidence in order to make that link. This demonstrates how the take-home message of a scientific study is altered in news reporting. The team of scientists found physical differences in brain regions known to be related to certain functions, and did not perform any tests or reach any conclusions relating to behaviour. In the lead paragraph, this morphs into gender stereotypes becoming a 'matter of science'. A reader could easily be persuaded by the brain facts presented, not realising that no explanation was given for the gender stereotypes being promoted. The above article, as well as many others quoted in this chapter, is an example of what feminist authors Diane Beck (2010) and Cordelia Fine (2010) have argued are circular neuroscientific explanations. In the logical fallacy of circular reasoning, one begins with the

premise that one is trying to prove, and therefore finds it proven. The language of neuroscience can distract from circular reasoning to a lay-audience, as it is presumed that the claims being made are a legitimate explanation.

The majority of news articles here on submissive behaviours produced by the female brain, only apply the claims to the context of interpersonal relationships. They rarely present female-stereotyped behaviour as either positive or negative. I end this section by spotlighting a decade-old trend in news reporting that takes more of a post-feminist view of sex differences, celebrating women as having unique talents that are valuable in the workplace. This small number of news articles, published in the long shadow of the Global Financial Crisis of 2008, cast women's sensitive and cautious nature as an advantage in business. Articles that celebrate stereotypical strengths of women tend to be lauding behaviour that could be described as submissive or subordinate, such as possessing a greater capacity for understanding others' emotions. Rather than mention the power relations between men and women, such articles often present subordinate behaviour as an innate feminine gift and an asset to women's employers:

Women lean towards intuition or right-brain instead of left-brain, which emphasises analysis, the processing of information methodically, and developing procedures. Intuitive processes often allow someone to see opportunities that aren't readily apparent and to know if they are right without the use of reason and analysis. It looks to me that female investors make decisions usually more whole-brained than men's (that is, it is more evenly distributed between right-brain and left-brain). (Kaplan 2008)

While the book title might be controversial, *Warren Buffett Invests Like a Girl* posits that many of the attributes that make him so successful are natural to women. First, Buffett is naturally cautious, undertaking copious research and making decisions slowly, but once an investment is made, is happy to stick with it for the long term, able to calmly ignore short-term vicissitudes. Buffett takes investment very seriously and while happy to take risks, seldom gambles. He rarely strays away from areas he knows well and is comfortable to swim against the prevailing investment trend. These are all character traits women naturally display when investing. (Robson 2016)

What is even more exciting is that the research and studies demonstrate that female brains have unique differences from their male counterparts that make women natural leaders. Because of our increased activity, we exhibit greater strengths in empathy,

intuition, collaboration and teamwork. These are great strengths to possess, especially for leadership roles. (McDonald 2014)

The above examples, while deviating from the norm in that they argue for a woman's natural advantages in the public sphere, retain rigid conceptions of brain differences aligning with gender stereotypes. These articles have taken women out of the home and into the workplace, but have done so due to their feminine traits of being intuitive and empathetic.

This chapter has found that scientific and scientific-sounding claims appear in mainstream news promote a traditional sexual division of labour. Some news articles go further, producing an explanation for why gendered brain differences exist. Therefore, in the following section I explore how the spectre of early humans is invoked to provide evolutionary explanations for sexually dimorphic brains and behaviour. This is entwined with the metaphor of the 'hard-wired' brain; caveman explanations are presumed to be valid due to the 'hard-wiring' of the brain being set at this stage of evolution. Presenting a plausible evolutionary mechanism for the sexual division of labour serves to further legitimise such narratives.

### The legacy of the caveman

When a cause for sex differences in household management is presented in news reporting, it involves selective pressures on early humans, following the logic of sociobiology as discussed earlier in Chapter Four. Behavioural sex differences are thus given additional credibility by borrowing from Darwin's well-established and respected Theory of Evolution. In the quotes presented earlier about the sexually dimorphic eye, it is stated that men have poor close-range vision as their eyes are optimised for hunting. The authors do not go into any more detail, but one can infer that they are relying upon the premise of evolutionary psychology: that natural and sexual selection amongst early humans has created the gendered behaviour of modern humans (a corollary to this is that humans are best optimised for the conditions in which we underwent most of our evolution).

In some articles, the evolutionary mechanism of natural or sexual selection is not explained. For example, one (representative) article simply says 'This has been attributed to the division of labour in the hunter/gatherer society' to explain why women are able to multi-task (Unknown author (Townsville Bulletin) 2015). In the rest of this section, I focus on the articles that provide more detail on hunter-gatherer narratives. However, as ideas about evolutionary psychology so frequently co-exist with facts about behavioural sex differences, as established

here, in articles that do not provide an explanation for some sex difference, the reader may assume that this is a result of evolution.

A ‘caveman’ narrative dominates the news articles containing explanations with reference to evolution. In these articles, the selective pressure of hunting, and to a lesser extent gathering, is given precedence:

Unfortunately, human evolution has been working against this gender-less ideal for more than a million years and has ensured that significant differences in male and female thinking do exist, deep inside our brains. This evolutionary trend had nothing to do with one sex dominating the other. Throughout our ancient tribal past, in prehistoric times, men and women were of equal importance. There was a vital division of labour, with men specialising in hunting prey, and women in food-gathering and caring for the young. (Morris 2004)

But there may be some neurological grounding for the joke. Apparently the single biggest alleged gap in brain difference is in spatial ability: men are better at mentally rotating an object, a skill related to navigation and maths. The theory is that, centuries ago, men were the hunters who wandered in search of prey and so had to use geometric cues such as distance and direction to navigate in unknown territory. Because women stayed close to home taking care of children, they had less need for such spatial skills and could rely, instead, on familiar landmarks to find their way. (Midgley 2006)

According to this narrative, the hallmarks of male psychology arose out of early man’s hunting activities. The traits that create a good hunter, selected for over many generations, explain why there are behavioural sex differences today. The relation between hunting and spatial ability is under-explored. It is considered that this robust sex difference derives from the roles of early humans, rather than being a trait consistently better developed in men due to more practice arising from gendered lifestyles. These evolved traits align with only women exhibiting domestic competence, while men are helpless in the home. The traits that one can imagine would befit a hunter, such as enhanced spatial awareness, in this narrative do not translate to an advantage in performing household tasks.

An article pondering why women possess the unique talent of being able to locate items in the kitchen while men struggle to see the ingredients in front of them mounts the following explanation:

But, as with most of life's mysteries, there apparently is an evolutionary explanation. Back when we were nomadic cavepeople, men's sole focus was to safely get the family from point A to point B. Don't deviate from the path and take the shortest, easiest most energy-saving route. But the women had to take note of details such as where the fruit trees were, where the waterhole was, what poisonous plants were around, etc. (Tomlinson 2013)

Another article, presenting brain scans as evidence for men being unable to find the keys, implicates the lifestyles of early humans in this gender difference, though for different reasons than in the above excerpt:

University of Sydney psychology professor Dianna Kenny said there were three distinct ideas on what caused the differences between men and women -- evolution, structure of the brain and the presence of the male sex hormone testosterone: 'It goes back to when men were the hunters and women were the gatherers. Women spent more time close to a base because they had young children to look after,' she said. (Saurine 2009)

All causes of difference suggested by the quoted expert are interrelated and strictly biological in origin, with no token mention of socialisation or even of the interplay between gender roles and biology. Regardless of which of the co-dependent causes one chooses, the difference, according to the expert quoted, has evolved due to the sexual division of labour in early humans. An article from 1998, an edited extract from the book *Why men don't iron: The real science of gender studies* (Moir & Moir 1998a), goes into detail as it speculates how modern man and woman came to be so different from one another:

To women, most men are partially autistic. They put less value on family relationships and friends, they care less about social relations and they are more selfish. Why is he like this? Again, his brain was forged and moulded by a past in which the ability to empathise would have been a distinct disadvantage. If the invader is storming ashore with spears and shields, then it is not very productive to empathise with the attacker's feelings or try to engage him in meaningful discussions. What was needed from the male was the limbic brain's swift and primitive response. The male brain was forged over hundreds of thousands of years to engage in action, in attack and defence, and it was not equipped to be as sensitive as a woman's brain to the feelings of others. (Moir & Moir 1998)



This evocative language – that the male brain was ‘forged over hundreds of thousands of years’ – is echoed throughout the articles considered here. This is because the authors, Moir and Moir, were influential in propagating scientific-sounding explanations for gender roles. In this article (which is a book extract presented as news), as is their usual approach, the Moirs take a stereotype of men’s difficulty in emotional or domestic labour and conjure a plausible narrative of man-the-hunter to explain and excuse this behaviour. Simultaneously, this provides an evolutionary explanation for female submissive behaviour: evolution has exclusively equipped women with the ability to process others’ feelings.

Evolutionary narratives, while particularly popular in the late 1990s, are repeated over the entire publication period of the sample articles. For example, one 2009 explanation for differences in domestic competence, labelled as the work of a ‘feminist writer’, sketches a vivid account of the lives of early man and woman:

In those days, a woman had only one option. She needed to make a home her man couldn’t bear to leave. She must have got really good at arranging the perfect fire. She probably would have collected up all the flint axes and spearheads and put them in neat piles. And she would have designed, and made, warm clothes from animal skins. All of this, says Maushart, would have had the effect of ‘making males vulnerable’. It would have accustomed them to a standard of living that they could not possibly have achieved on their own. This all has deep implications. Let’s assume that female domestic competence and male incompetence helped the family to develop as an institution. Over millennia, these characteristics would have become hardwired, making women naturally good at domestic tasks and men bad. The family and therefore the survival of the human race depended on women being tidy and men being messy. (Leith 2009)

This is an elaborate example of a just-so story. The expert in the article is not an evolutionary psychologist, but her argument calls upon an evolutionary psychology paradigm. There can be no evidence either for or against Maushart’s account as cave paintings do not depict domestic labour, nor do they show a sexual division of productive and reproductive labour. A plausible narrative of the caveman, going out to provide for his family, with a woman kept as a full-time home-maker (or, in this case, cave-maker) exactly matches many nuclear families’ arrangements today. The breadwinner model of the family becomes a seemingly timeless and biologically entrenched arrangement, rather than a consequence of the industrial revolution.

Hunting and gathering are interpreted in creative ways, conveniently applying to gendered activities. For example, rushed gift shopping is likened to hunting, while careful and early shopping is cast as gathering:

As a hunter, ancient man liked to make a quick kill then go home. Today, that's exactly how men like to shop. They know who they have to buy presents for, they probably have a vague idea of what to get and they go out and buy all the presents in one go. Women, on the other hand, shop the same way as their ancient ancestors would gather food - heading off for the day with a group of other women to a place where someone remembered seeing some tasty things growing. Women tend to start Christmas shopping much earlier than men and it's not uncommon for some women to start next year's shopping in this year's Christmas sales. (Pease & Pease 2007)

There is no scientific evidence presented for these claims, and the comparisons are questionable. One could just as easily compare social shopping days to long, tribal hunting expeditions in which the group of male hunters do not know in advance what beast will cross their path.

Sexual behaviours are a key part of the dimorphic brain paradigm. The female brain is supposedly geared towards commitment, monogamy, and frigidity; while the male brain is presented as being driven by biological imperative to impregnate as many women as possible. This draws upon sociobiological ideas about the differential investment of mothers and fathers in parenting. An overlay of evolutionary biology can be applied to provide an explanation for the differences in how men and women approach relationships:

From a genetic perspective, the years of effort are wasted if you end up raising another male's offspring. So there will be powerful selection pressures for male behaviors that inhibit cuckoldry - they include intense jealousy, aggression and even, in extremis, murder. Through natural selection, our ancestors acquired behaviors and mating strategies that, whatever angst they may cause in a modern society with different moral values, fuelled the reproductive success of our species in a prehistoric world. The different behaviors and mating strategies of the sexes today thus reflect an unchanged bottom line - men can maximise their reproductive success by mating with many different women (albeit, sometimes at high cost to the reproductive success of rival males), but women cannot maximise their reproductive success by mating with many males. (O'Neill 1998)

And although some gender roles are socially constructed, virtually all reputable evolutionary biologists today think there are profound differences between the sexes that are genetically, rather than culturally, rooted and that these differences extend beyond the body into the realm of the mind. Again, this stands to reason from a Darwinian point of view: sexual reproduction has been going on not for thousands but hundreds of millions of years. (Fukuyama 1998)

It's fashionable to pretend to each other that men and women are now the same, have the same needs, wants and motivations,' Allan said, by email from Europe this week. 'Science shows us convincingly that this is not the case.' Women are driven to find a protector and provider and men are driven by the need to plant their seed and perpetuate the species, so they are willing to be the hunter/provider in order to be accepted by women. These drives are 'hardwired' into the brain and have evolved over hundreds of thousands of years. Recognising them 'allows you to understand and manage your relationships', Allan said. (Arthur 2009)

The overall impression is of a monolithic hunter-gatherer lifestyle embodied by early humans, that has caused our psychology to be frozen in time. There is no potential for change; rather, the narrative is one of our evolved quirks shaping our lifestyles and providing limitations on equality between men and women, particularly in terms of their roles in relationships. Facts and assumptions about cave-people's sexual division of labour are projected onto current social arrangements, the consequences being vague enough to explain all manner of gender stereotypes and social inequalities.

The findings presented here echo and build upon those of Amy Adele Hasinoff (2009), who investigated the use of sociobiological knowledge in the women's lifestyle magazine *Cosmopolitan*. Hasinoff contends the magazine presents male behaviour as traceable to that of 'cavemen' and therefore exaggerates and excuses undesirable behaviours. Unlike the women's magazine articles examined by Hasinoff, the articles referred to in this chapter appear in mainstream news publications, reaching a wider audience. News articles are briefer than the feature articles of magazines, and are intended to provide the reader with new information rather than exploring an issue of interest.

## Conclusion

In this chapter, I have drawn on a range of mainstream news articles from the 1990s onwards to argue that scientific facts are deployed to establish an immutable sexual division of labour.

Furthermore, I have established that the scientific basis of many of these claims is questionable. The articles excerpted here include both reliance upon experts, particularly those who sell popular relationship advice books, and reportage of new scientific studies that are often interpreted creatively as proof for behavioural sex differences. I argue that different aspects of neurological function, including the visual and auditory systems, serve rhetorically to argue that modern men are less capable of domestic and emotional labour, while women are uniquely equipped with sensitivity and empathy that leads to their own subordination. I explore evolutionary psychology as the dominant explanation for behavioural sex differences, finding that the hunting activities of early man occupy a privileged role in narratives that conflate early and current sexual divisions of labour. Overall, the picture is one of questionable scientific evidence being used to support essentialist portrayals of gender in the mass media. The news reporting presented here takes place in the context of a long history of scientific knowledge being used to create and justify gender roles, as established in Chapter Four.

It bears mentioning that there has been a small change in news representation of the sexed brain over time. The most high-profile example is Cordelia Fine's expert opinion. Her book, *Delusions of Gender*, was first published in 2010. This generated news coverage that countered the narratives espoused by the canon of popular science authors Moir and Moir (1998a), Pease and Pease (2017 [1998]), Baron-Cohen (2003), and Brizendine (2006; 2010). This is not to say that news articles using science to promote gender roles disappeared after the publication of Fine's book, as demonstrated by the inclusion of news coverage from the 2010s in this chapter. Rather, Fine popularised a new perspective that sits alongside coverage of the science of traditional gender roles.

The remaining substantive chapters provide two case studies where topics appearing in news reporting are explored in depth. This allows the opportunity to examine not just the narratives but also the supporting evidence, that leads to the conclusion that exaggerated or even fabricated scientific knowledge is used in mainstream media as equivocal evidence for the innateness of gender stereotypes. Later, in the concluding chapter, I bring this material together into four key themes which have emerged in this thesis: the legitimisation of popular knowledge as science; the persistent belief in a scientific basis for gender stereotypes over time; the ubiquity of metaphors to explain and simplify science in mass media, and the uncritical acceptance of scientific authority in news media.

## Chapter six: The case of ‘baby brain’

### Introduction

This chapter contributes a case study demonstrating the workings and endurance of biological explanations to explain essential differences between men and women in mainstream news sources. This case study draws upon a sample of 103 news articles that report on research pertaining to the effects of pregnancy on the brain. The topic of ‘baby brain’ is of interest here because it explicitly ties beliefs about behavioural sex differences to reproductive function in women. These contemporary news articles on ‘baby brain’ show the enduring nature of traditional gender roles as purportedly explained by science. This case study also builds upon the previous chapter’s investigation of standards of scientific evidence in mass media, here finding that news media systematically utilises scientific evidence that promotes the existence of gender stereotypes, while requiring a higher standard of evidence in coverage that counters stereotypes.

‘Baby brain’, as it is known in the news articles discussed here, is a condition of chronic forgetfulness that is said to befall pregnant women and mothers of infants. It may also be referred to as ‘pregnancy brain’ and ‘mumnesia’. Typical examples of memory lapses attributed to baby brain include misplacing car keys (e.g. Mayoh 2015) or missing an appointment (e.g. Wallace 2010). Studies conducted by neuroscientists or psychologists on the baby brain phenomenon are heavily reported on in mainstream news. As will be discussed in this chapter, it is usually in a way that uncritically accepts the (questionable) existence of baby brain. Evaluating the veracity of the scientific evidence in regards to baby brain is outside the scope of this chapter. Where I use the phrase ‘baby brain’, it is intended to refer to the ideological construct, rather than validating it as an experience or a physical reality.

Germaine Greer argues in her influential 1970 book *The Female Eunuch* that while science had attempted to locate sex differences of the mind for over fifty years (at the time of her writing), it had failed to yield any biological reasons for women’s assumed inferiority (Greer 1970, p. 113). She asserted that the extent of scientific knowledge (at the time) was that sex hormones are present in the brain, and that there were no links, but only assumptions, established between physical brain differences and behaviour or intelligence (p. 113). My contention in this chapter is that contemporary baby brain rhetoric relies upon very limited scientific knowledge, linking the sexed brain with the gendered mind in order to justify traditional gender roles and in particular the sexual division of labour. In other words, this chapter demonstrates that in regards

to scientific attempts to establish that women are less intellectually capable than men, little has changed since the time of *The Female Eunuch*, almost fifty years ago, despite the scientific methods being (sometimes) different from those of the twentieth century and earlier.

The idea of baby brain is emblematic of the ways in which male and female brains are held more broadly to be different in mainstream news media. The recent use of neuroscientific explanations for the baby brain phenomenon serves to ascribe gender roles, particularly pertaining to infant care, to a supposedly apolitical matter of human biology. In brain imaging studies of pregnant women, any observations are interpreted as having implications for sexually dimorphic cognition and behaviour. As baby brain is supposedly a direct result of pregnancy (and later caring for an infant), in particular from the hormonal changes wrought on the body, female embodiment is central to its workings. The concept of baby brain therefore packages hormonal and neuroscientific justifications for sex roles. Explanations for baby brain may also draw on evolutionary theory. The concept of baby brain as a purely biological condition serves to conceal the aspects of structural sexism that affect mothers: problems experienced are instead transformed into a biological process unfolding within the minds of women.

This case study seeks to demonstrate how scientific studies are presented in news media to establish and justify women's supposed lesser capabilities, as well as the existence of gender roles. As such, it is part of a broader investigation of how scientific evidence for the gendered brain is reported in mainstream news, with particular emphasis on the continuity of these messages over time. I first contextualise the concept of baby brain, presenting it as part of more general scientific efforts to find essential differences between male and female brains. I also canvass the limited feminist literature criticising aspects of baby brain rhetoric. After discussing some scientific developments that are particularly salient in the concept of baby brain, the remainder of the chapter then draws on a sample of over one hundred Australian news articles from 1999 to 2016 in order to analyse reporting on baby brain.

I divide the sample of articles into three categories (represented in Figure 3): those reporting that baby brain has been scientifically proven to exist, those reporting baby brain has been scientifically proven to be a falsehood, and those that report on scientifically established cognitive benefits caused by pregnancy or motherhood. The first category of reporting is used to demonstrate how news representations of baby brain privilege hormonal explanations for the phenomenon. From this follows a discussion of how journalists cast baby brain as an adaptation designed to ensure the infant is cared for, reinforcing gender roles in which it is

assumed that women's destiny is to raise children. The second category of reporting is used to show how studies that claim to disprove baby brain are presented in the news alongside anecdotes of women claiming to suffer from baby brain, which serves to undermine the conclusions of the scientific evidence presented. Reporting in this category largely fails to acknowledge the impact of socio-cultural factors in creating the illusion of baby brain, and furthermore contradicts the evidence presented by including anecdotes of women claiming to suffer from baby brain. The third category of reporting is shown to focus on how brain changes can be utilised in the public sphere, running counter to the concept of baby brain hampering women's workplace performance. Finally, I discuss the quality of evidence used in reporting on baby brain, arguing that the definitive conclusions promoted by news reporting are in some cases underdetermined by the evidence they rely upon. This chapter's exploration of reporting on baby brain demonstrates that news reporting is inclined towards presenting purported scientific evidence, no matter how scant, to promote the existence of baby brain and justify traditional gender roles. This chapter furthermore intends to question the assumptions that allow the concept of baby brain to proliferate.

### The ideology of baby brain

This section examines the meaning of baby brain. I assess the small amount of critical literature on baby brain before presenting my own interpretation of baby brain ideology. The forthcoming discussion provides a foundation for the rest of this chapter, in which I examine reporting on baby brain in Australian newspapers, examining how the concept of baby brain is presented as a natural and sometimes even an advantageous part of motherhood, before systematically analysing the types of evidence reported upon.

The concept of baby brain functions as shorthand for the apparently natural and biological rationale for women's subordinate position in the public sphere. It explicitly connects reproductive function with cognitive capacity. In this way, it revisits historical medical understandings of hysteria. Hysteria, in which the dysfunctional uterus was blamed for inducing a vague list of symptoms, was a popular diagnosis applied to women of child-bearing age in Europe and the United States up to the nineteenth century (Ehrenreich & English 1973 [2011 edition], p. 86)<sup>10</sup>. The concept of baby brain can be connected to nineteenth century fears concerning the dangers of education for women. This again is concerned with the connection

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<sup>10</sup> Hysteria can itself be traced to earlier medical diagnoses. Sabine Arnaud (2015) argues that in the late 1700s, a group of male physicians unified many different afflictions of the female reproductive system into the condition of hysteria.

between the brain and the uterus; with male scientists and educators cautioning that too much education would ruin women's reproductive capacities (Ehrenreich & English 1973 [2011 edition]). Echoes of this concept continue in the twenty-first century, with suggestions school curricula should be tailored for the naturally different interests of boys and girls (Tooley 2002). These nineteenth century ideas predated the discovery of hormones. The concept of baby brain can be regarded as a descendant of scientific ideology linking the uterus to mental function, with the addition of relatively more recent scientific developments such as hormones, evolutionary theory, and neuroscience.

Scientific discourses are not confined to the research community, diffusing into popular media and folk understandings of the body. Much has been written about how endocrinology (the study of hormones in the body) in particular is used to diminish women's intellectual capacity and emotional stability. Nelly Oudshoorn contends that since the discovery of hormones in the first decade of the 1900s, they have been cast as the essence of femininity and masculinity (Oudshoorn 1994, p. 22). She observes that endocrinology characterises the female body in terms of cycles, compared to the supposed stability of men's bodies (Oudshoorn 1994, p. 146). Despite hormones and their cycles playing an important role in male bodies (Faiman & Winter 1971), the effects of hormones are paid special attention when female bodies are concerned, as suggested by 'hormonal' being a gendered epithet. Oudshoorn argues that this idea descends from pre-hormonal understandings of hysteria as a female affliction. Hormones continue to be enlisted in explaining women's feelings and behaviour, often with the implication that women of child-bearing age can be medicated in order to smooth out hormonal fluctuations. Holly Grigg-Spall (2013) goes so far as to suggest the contraceptive pill is utilised to create more productive subjects in a neoliberal economy by erasing (what is regarded as) the inconveniences of menstruating women's bodies. The menopausal body is also subject to scrutiny and hormonal management; from the 1960s, hormone replacement therapy was marketed as a way of preserving women's youth, sanity, and sexual function (Foxcroft 2009, p. 30), until it fell out of favour in the early 2000s due to the discovery of a litany of health risks. Hormones are thus used to explain away women's emotions at many different stages of life. However, hormonal explanations of baby brain have not been subject to the degree of scrutiny feminist writers have applied to scientific explanations of menstruating and menopausal women's behaviour.

Baby brain as an ideological construct has been subject to little analysis. I have identified two authors who dissect baby brain rhetoric; Nicole Hurt (2011) and, to a lesser extent, Davi



Thornton (2014). Hurt (2011) investigates how the concept of baby brain was given legitimacy in scientific sources and news media, focusing on a particular piece of scientific research heralded as proof of baby brain. She isolates the dubious use of the word ‘significant’ as behind the surge of news coverage. She argues that, due to the authors dropping the qualifier ‘statistically’, the reader is enticed to interpret ‘significant’ in the general sense of the word despite the modest results of the study. She also briefly discusses how baby brain encompasses the contradiction between motherhood and being in the workforce. Forgetfulness at crucial moments is incompatible with the ideal worker, who delivers consistent performance and is unconstrained by family responsibilities (Hurt 2011, p. 380). Hurt’s article offers an incisive analysis of how the concept of baby brain is used to shore up sex roles. While Hurt focused on a single study and its news reporting, her findings apply to many of the articles investigated in this chapter.

Thornton focuses on the next iteration of baby brain, which is in some ways its opposite: the super mum who is conferred new mental powers during pregnancy. Thornton (2014) devises the concept of ‘mommy economicus’, a neoliberal and postfeminist figure of idealised motherhood, who leverages her new brainpower for self-improvement and corporate gain. Her account of ‘mommy economicus’ draws its roots from Foucault’s implicitly male or gender-neutral neoliberal subject, the ‘homo economicus’. She argues that ‘mommy economicus’ derives value from her versatility in applying her new mental powers to the home and to the workplace; however, the empowerment afforded to ‘mommy economicus’ is illusory as she is a new manifestation of gender roles. This concept builds on Thornton’s earlier work (2011), in which she argues that the trend towards neuroscientific parenting advice, directed at women, couched in terms of empowerment and freedom, encourages a kind of entrepreneurialisation of the self. She situates this trend within the context of American neoliberalism, that is, the philosophy in which individuals are believed to be empowered by participation in the free market (Harvey 2005). In this chapter, I draw upon Thornton’s work when discussing news articles promoting the mental benefits of pregnancy.

The application of popular neuroscience to motherhood is discussed by Cordelia Fine (2008). She highlights how neuroscientific language is used to justify women’s role in child-rearing and relationship management, while excusing men’s comparative lack of involvement with caring for their own children. In particular, Fine eviscerates the claims made in Louann Brizendine’s book *The Female Brain* (2006), which applied a hardwiring metaphor to women’s brains, representing the maternal brain as an overloaded computer. Part of Fine’s argument,

which appears throughout her body of work on neurosexism, is that some explanations peppered with scientific sounding language are actually circular and have no explanatory power, which becomes apparent once the buzzwords are removed (Fine 2008, p. 70). While Fine does not discuss the baby brain stereotype, her discussion of how neuroscience can be used to argue for child-rearing as a woman's role is relevant here. Her arguments about circular reasoning are particularly salient when discussing brain imaging studies claiming to have found evidence for baby brain.

Baby brain represents a microcosm of the essential difference line of reasoning, complete with hormonal and evolutionary arguments that uphold women's purpose as mothers at the expense of a rich intellectual life. Unlike many other brain-based arguments for female inferiority, the baby brain concept does not apply generally to all women, and targets women who are either pregnant or raising young children. This concentrated beam of gendered rhetoric produces a relatable caricature of a frazzled woman whose hormone-scrambled brain can only cope with thoughts relating to care of her infant.

The concept of baby brain is imbued with messages about the supposed purpose of women's bodies as determined by evolution (to successfully raise children). From this, it follows that it is in some way natural and even beneficial for women to be performing the majority of child care and to make sacrifices, that are not required by men, for the purpose of raising children. Accounts of biological reasons for women's supposedly greater empathic abilities encourage women to accept their greater share of emotional labour (Fine 2008, p. 71). The idea of baby brain furthermore has implications for women's ability to engage and progress in the public sphere. Due to these implications, a news article declaring baby brain to be scientifically proven does not need to explicitly lay out traditional gender roles in order to promote them.

Baby brain is regarded as only applying to mothers, regardless of what mechanisms are anticipated to be its cause. The reporting sampled here is conspicuously silent on what may happen to fathers' brains. This is an essential part of how the rhetoric functions. Failing to mention men has two key consequences for the concept of baby brain. Firstly, the absence of a baby brain equivalent for fathers may suggest that men's brains are robust enough to be unaffected by the stresses of parenthood. This sets up a rational male norm against which to measure women who appear to suffer from baby brain. Secondly, as is salient throughout this chapter, it contributes to transforming the problem of an unequal division of child-rearing from a largely social issue into a purely biological issue. Baby brain is cast as a women's problem,

even when the cause is speculated as fatigue, which should affect both sexes equally under similar circumstances.

For the remainder of this chapter, I utilise a sample of mainstream Australian news articles reporting on the scientific status of baby brain in order to illuminate the endurance and substance of popular constructions of essential differences. I first divide the sample into three broad types of article, which are used to guide the discussion that follows.

## Reporting on ‘baby brain’ in Australian newspapers

### Decades of the baby brain

In this section, I briefly outline key features of the sample and discuss the historical context of the time period from which articles were sampled. Further details on how sampling was conducted for this case study may be found in chapter two, which outlines the research design.

In order to conduct this case study, I obtained 103 Australian news articles reporting scientific research on the effects of pregnancy on the brain. The sample consists mostly of print articles, but also contains some newswires and online news articles, and one radio broadcast transcript. Articles from specialist publications (such as a science website) were excluded. Articles that discussed personal experiences with forgetfulness during and after pregnancy were excluded, unless they referred to specific scientific studies. Articles were found in 32 different publications (with Sunday newspapers counted independently of their weekday versions), including regional, national, and metropolitan newspapers, and both small and large circulation publications. The earliest article was from November 1999, and the most recent article was from December 2016 (the articles were collected in December 2016).

To provide context for this seventeen-year timeframe, a number of key scientific developments occurred in this time, holding promise for uncovering the secrets of the human body and mind. The 1990s birthed a number of new developments and technologies in addition to the aforementioned significant efforts to boost public awareness of biomedical science. As discussed in Chapter Four, the 1990s were designated as the Decade of the Brain, which aimed to enhance public awareness of neuroscientific research. This was followed by the Decade of Behaviour, and then the Decade of the Mind. All sought to discover the working the workings of the brain and mind, and engage the public in this process. Of particular relevance is the invention and widespread use of functional magnetic resonance imaging (fMRI) in the early 1990s. While many articles sampled describe older scientific methods (such as memory tests), fMRI studies made some appearances (e.g. Galletly 2008; Walsh 2016).

This section has provided an outline of key features of the articles sampled for this chapter, and referred to key scientific developments that characterise the time period from which the articles were drawn. Along with the previous section, this provides context for the rest of the chapter, which consists of in-depth analysis of the articles sampled. I argue that hormonal explanations for baby brain are privileged over the parsimonious sleep deprivation explanations, and investigate how evidence for and against baby brain is treated unequally to systematically promote the ideology of baby brain.

### Types of reporting on baby brain

In this section, I discuss the division of the articles sampled into three categories. I have found that reporting of scientific findings on baby brain falls into three types, that are not mutually exclusive. There are the two opposing frames: those stating that baby brain has been scientifically proven ( $n = 55$ ) and those stating that baby brain has been scientifically shown to be a myth ( $n = 32$ ). Myth is used here to mean a falsehood or illusion, rather than in the anthropological sense of a culture's understanding of its own history. There is a third category of articles presenting evidence for mental advantages that manifest as a result of brain changes during pregnancy ( $n = 37$ ). There is some overlap between these three frames; for example, an article discussing mental improvements experienced during pregnancy may also present the finding as either validating or invalidating baby brain. These categories and their overlaps are depicted in Figure 3 below<sup>11</sup>.

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<sup>11</sup> Three articles from the sample do not appear in Figure 3 as they did not fall into any of these categories.

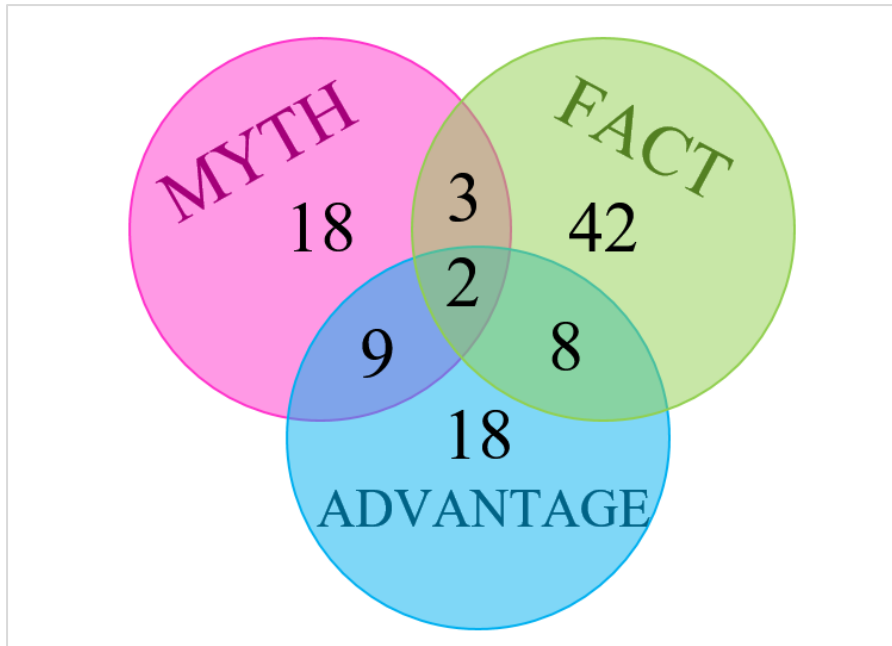


Figure 3: Venn diagram representing the overlaps between categories of baby brain reporting

I will now briefly discuss the content of articles presenting brain changes during pregnancy as an advantage. The diagram shows that reporting of mental advantages due to pregnancy can be framed either as a proof or a disavowal of the existence of baby brain; both possibilities have been realised in comparable quantities. To explain how an article can simultaneously present the mental benefits of pregnancy and the existence of baby brain; some articles reconcile evidence for mental advantages with the detrimental effects of baby brain by comparing women to nutty professors: absent-minded but possessing extreme talents in the domain of infant care. Otherwise, articles reporting on the advantages conferred by pregnancy frame the results as disproving the phenomenon of baby brain. Just over half of articles that expound on how pregnancy increases one's mental powers do not explicitly refer to the concept of baby brain as being either proven or disproven. This diagram also indicates that articles construing baby brain as a proven fact mostly do not offer maternal advantages as a consolation prize. The vast majority of articles (93 percent<sup>12</sup>) reporting on evidence for baby brain present the condition as a handicap, usually in regards to memory.

The confusing picture painted by news reporting can be partially understood by the types of evidence used in each category of reporting. This point is taken up in detail later in this chapter. In summary, the majority of articles reporting that baby brain is a myth are based on a

<sup>12</sup> I also recorded articles fitting into a fourth frame, 'baby brain as a disadvantage', which is not shown here as it largely overlaps with the 'baby brain as fact' category, in which baby brain is understood as inherently disadvantageous state.

longitudinal study of memory testing; reporting that baby brain has been proven are mostly based on snapshot memory testing of pregnant women and neuroimaging studies; and reporting on baby brain as an advantage is mainly based on rat studies. These contradictory results are sometimes reconciled by journalists with the explanation that a pregnant woman's cognitive function is akin to Albert Einstein, with boosted capacity in some areas while suffering from forgetfulness. There is a simpler interpretation for the differences in results, which does not appear in news reporting: improved mental abilities observed in animal studies, while presented by journalists as having relevance to humans, are not borne out in testing on pregnant women.

In all accounts of baby brain being 'proven' or shown to confer advantages, changes to the physical brain or its workings are presented as natural, inevitable, and universal; and are usually explained with reference to pregnancy hormones (as will be discussed later in this chapter). Cultural and social explanations are absent, and mentions of lifestyle factors are rare. There is no acknowledgement of how the experience of baby brain may differ across cultures, possibly because many of the studies were performed on rats or mice.

Each report of a study on baby brain is taken as ultimate proof of its conclusion, ignoring findings to the contrary that were previously reported in the news media. Thus, reporting on baby brain largely consists of switching between the binary possibilities of baby brain being declared a real phenomenon or a myth. This occurs over the entire time period encompassed by the articles sampled. There is no sense of progress as neither conclusion is converged upon over time. This lack of consistency is indicated by Figure 4 below. The failure of news reporting on baby brain to contextualise findings in light of previous results is consistent with literature on biomedical reporting that shows newspapers fail to adequately report on disconfirming evidence (Conrad 2001; Petersen 2001; Mercurio & Elliott 2009). As Peter Conrad (1999) asserts, journalists reporting on science stories assume that they do not need to incorporate balance, in the form of opposing viewpoints, as this has already been considered by the peer review process. He quotes a journalist he interviewed as explaining this by saying 'if somebody says they discovered a gene, there usually is not somebody else sitting out there that knows they haven't' (Conrad 1999, p. 293). However, as this case study demonstrates, the assumption that peer review has taken care of opposing viewpoints is not always valid.

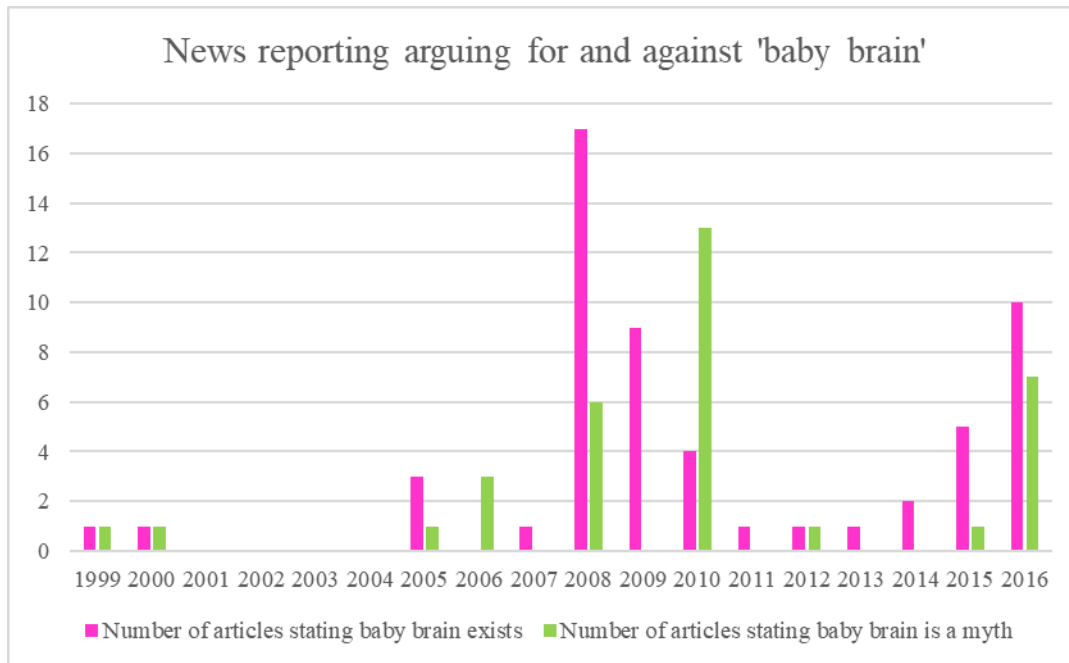


Figure 4: Number of articles from categories 1 and 2 of reporting on baby brain

This chart does not reflect the full set of articles contained in the sample, as some did not explicitly present themselves as containing an argument about the existence of baby brain. Also, five articles are counted twice (in that they appear in both columns); these articles either present a finding as somehow both proving and disproving baby brain, or bring together several contrasting studies and endorse both possibilities.

While the sample is dominated by articles interpreting a study as proof of baby brain, it contains a number of articles presenting the exact opposite argument: that baby brain is a myth. Articles with opposite conclusions often appear in the same publication at different times, with no mention of previous studies, creating a confusing picture when all articles are considered together. The *Townsville Bulletin* is taken as a detailed example to illustrate this point, as it is the publication with the highest number of articles, partially due to a recurring parenting column. The *Townsville Bulletin* is a regional tabloid newspaper distributed in Northern Queensland. It has a circulation of 18,000 and a readership of 89,000 for their weekday editions, which is comparable to other regional newspapers in Australia (News Corp Australia 2017). Despite being owned by News Corp, which syndicates articles across publications, not all of the *Townsville Bulletin* articles are published in multiple newspapers. The *Townsville Bulletin* contains five articles stating baby brain exists, and two stating it does not. A further two articles present the author’s account of her latest baby brain episode, and state there is

research both supporting and disproving the phenomenon, without reference to any specific studies. Two articles, appearing one year apart, report on the same book (Ellison 2005) that explicates the ways that pregnancy makes women more intelligent. However, one of the articles presents Ellison's book as debunking baby brain (Unknown author (Townsville Bulletin) 2006) before citing research on the mental benefits of motherhood, while the other (Unknown author (Townsville Bulletin) 2005) draws on common experiences of baby brain for the first half of the article, before stating Ellison's book demonstrates that the forgetfulness is indicative of a growing brain gaining new capabilities. This illustrates how the same evidence can be used to promote entirely opposite conclusions in the news; and highlights the lack of continuity even within the same publication. The *Townsville Bulletin's* hard news articles reporting on baby brain research invariably fail to mention the conflicting results that have come before it. In the parenting column, there was a little more discussion of the shifting picture that can be constructed using scientific studies on memory during pregnancy, however, the author implicitly endorses the baby brain narrative by attributing her vividly described memory lapses to baby brain<sup>13</sup> (Warburton 2010; 2012; 2015; 2016).

Now that I have discussed the division of the sample of articles into three types, I will delve further into the significance of each framing. In the next two sections, I focus on the first and third frames to demonstrate how baby brain is cast as a purely biological phenomenon. This is undertaken through showing, firstly, how hormonal accounts of baby brain are given precedence over other possible explanations, and secondly, how baby brain is presented in some instances as an evolutionary adaptation.

### The privileging of hormonal explanations for baby brain

In this section, I discuss how reporting on studies purporting to establish the existence of baby brain emphasises hormonal explanations for the phenomenon, while minimising the impact of sleep deprivation as a possible explanation. This investigation contributes to my contention that news reporting on baby brain promotes explanations that are located within the body rather than external to the self. The argument in this section follows the analysis performed by Nicole Hurt (2011), who argues the notion of baby brain serves to reinforce gender stereotypes and obscures likely explanations of the memory lapses experienced by women with young children, such as sleep deprivation and stress due to taking on a disproportionate share of childcare.

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<sup>13</sup> Bettina Warburton's four articles referred to here are strikingly similar in content and all begin with variations on the sentences 'Baby brain: is it a myth or is it reality? I'm not so sure any more'. However, they are all distinct articles appearing in the same newspaper over a six-year period.



Sleep deprivation, both during pregnancy and when looking after young children, is one possible factor implicated in forgetfulness. Given the possible importance of fatigue in explaining cognitive difficulties (Williamson & Feyer 2000), it is remarkable scientists have chosen to investigate memory lapses during pregnancy independently of considering fatigue. Even where scientists have considered fatigue in their investigations, their results are still reported on as being essentially about baby brain. This is not to say that it would be in some sense correct for these studies to instead be about fatigue, but to draw attention to an alternative way in which the research could have been framed. Considering alternative framings illuminates how the frame that has been used is in fact a choice, which imparts ideology rather than merely information.

The significance of sleep deprivation is de-emphasised in reporting on baby brain, often only considered at the end of the article. Sleep deprivation was mentioned in some articles, but references to sleep loss did not appear in the headline of any articles in the sample<sup>14</sup>. The headlines are largely about proving that baby brain exists (which would be obviated by the sleep deprivation explanation) or that it is a myth.

I will now discuss several articles implicating tiredness in baby brain that demonstrate how framing is used to minimise its involvement. An article entitled ‘Memory fades in pregnant women’ reports on a study that hypothesised sleep deprivation as the cause of memory difficulties experienced during pregnancy (Unknown author (Sunday Tasmanian) 2009). This study involved a memory performance test administered to pregnant women, so the journalist cannot be accused of exaggeration in the headline. However, given that sleep deprivation was supposedly the main factor involved in baby brain, it is noteworthy that this did not appear in the headline. The message is that pregnancy is tied to forgetfulness; however, the message equally could have been that pregnancy is tied to fatigue, or that fatigue is tied to forgetfulness. Similarly, an article investigating the effects of sleep deprivation in mice was framed as being about baby brain (Unknown author (Gold Coast Bulletin) 2011). The study, which involved waking up mice at sixty second intervals then observing their behaviour the next day, was reported as confirming ‘what exhausted parents have long suspected, with the headline ‘Babies can drain the brain. It contains quotes from the lead study author discussing her own experience of ‘mumnesia’. The original journal article contained no reference to pregnancy or parenting whatsoever; the mice were not pregnant during the study and the sex of the mice is not specified

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<sup>14</sup> This cannot be dismissed as selection bias, as I searched for keywords appearing in the full text rather than in the headline only.

(Rolls et al 2011). The imposition of a baby brain framing was drawn from what the study authors wrote in their journal article. A framing consistent with the journal article would be focused on the effect of tiredness or poor sleeping patterns on behaviour.

The focus on baby brain at the expense of other possible frames was most apparent in the headline for an article about sleep deprivation during pregnancy, which did not include any mention of memory or other cognition testing. The article, reporting on a study establishing the number of hours of sleep lost by new parents, was given the headline ‘‘Mumnesia’ a scientific fact’ (Unknown author (Logan West Leader) 2008). Of course, there was no mention of a corresponding ‘Dadnesia’ despite the study reportedly being on parents rather than specifically mothers<sup>15</sup>. The same article was even recycled into an advertorial in a separate publication, promoting a shopping centre produced booklet that ‘is helping combat the side-effects of mumnesia’ by containing useful tips and community information (Unknown author (Albert & Logan News) 2008). The preceding examples illustrate how studies on tiredness and memory are deployed to bolster the concept of baby brain. According to these studies, baby brain is attributable to fatigue; however, this is not revealed in the headlines that elevate baby brain to being an independent and empirically established condition.

In many articles reporting on findings relating to baby brain, the sleep deprivation explanation is conspicuously absent. The journalist may then instead refer to hormones as the primary or sole reason for baby brain:

Forgetfulness and slips of attention are phenomena commonly reported by pregnant women, but scientists have yet to identify a specific mechanism by which this memory impairment might occur,’ says lead study author Diane Ferrar. Experts now believe it can be traced to the effect of pregnancy hormones on the brain. (Conville 2010)

A study found that pregnant women show increased activity in the area of the brain related to emotional skills. It suggests hormones activated in pregnancy fine-tune the intuition which helps a woman understand her baby’s needs when the child is born. (Unknown author (The Advertiser) 2014)

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<sup>15</sup> I cannot confirm this as the information provided in the news article was insufficient to locate the original study. While the main finding (that new parents lose 450 to 700 hours of sleep in the first year) appears elsewhere online, following the patchy trail of citations failed to yield a primary source. Louann Brizendine’s 2006 book *The Female Brain* was the most likely source of this claim (p. 143), though it does not provide a citation or calculation. Additionally, it predates the news article by two years.

Studies have shown that elevated levels of the hormone oestradiol that occur with pregnancy and, to a lesser extent, menstruation, cause extra growth of nerve cells within the hippocampal region of the brain. Perhaps these or other brain changes lead to the behavioural changes that are observed. (Robert 1999)

These articles present hormonal explanations of a speculative nature, with none suggesting alternative explanations for baby brain. These articles fail to illuminate how hormones may impact the brain; with the first two examples not specifying which hormones, leaving the reader to assume that they are likely referring to sex hormones and particularly oestrogens. The mechanism causing baby brain is supposedly fully contained within the word ‘hormones’. As discussed in Chapter Four earlier, the effects and mechanism of action of sex hormones on the brain and behaviour have not been established by scientists. This is particularly the case for female sex hormones, with more studies focusing on the behavioural effects of testosterone. I noted that the vagueness in scientific knowledge of how sex hormones influence behaviour, combined with the clear sexual dimorphism in sex hormone levels, entails that behavioural sex differences can be ascribed to the mysterious impact of hormones in popular sources. If hormones are supposed to be understood as the seat of femininity or masculinity (Oudshoorn 1994), explaining away baby brain as being due to ‘hormones’ then carries the meaning that the condition is actually caused by femaleness, particularly when compared to a supposedly more consistent male norm.

Some explanations for baby brain are more anachronistic. In the following article, a statement about brain size, reminiscent of nineteenth century arguments against women’s suitability for education due to having smaller brains than men (Gould 1978b, p. 365), is taken as the entire explanation:

There has long been debate over whether the sudden and strange behaviours among pregnant women and new mothers are the result of hormones, shock or the overwhelming rush of love to the brain. A new book, *The Female Brain*, published this week in Britain by Bantam Press, says the truth is less romantic: the female brain shrinks by as much as 8 percent during pregnancy, leaving once capable women sobbing helplessly at home, unable to get out of their dressing gown before noon. (Overington 2007)

Leaving aside the feeble caricature painted by the author, this statement lacks explanatory power as it fails to illuminate the mechanism linking brain shrinkage to stereotypical

behavioural changes. This is an example of the circular logic highlighted by Diane Beck (2010), who argues that popular depictions of neuroscience label MRI images of the brain as an explanation of how a particular behaviour occurs; and Cordelia Fine (2008), who presents a similar argument, that neuroscientific sounding explanations are often circular. However, an image or a buzzword on its own cannot explain how the brain came to be in the state depicted, nor can it bridge the gap between the brain and the mind. Furthermore, in this example, the author has selected one explanation at the expense of all others – *The Female Brain* also presents hormonal reasons for maternal brain changes (Brizendine 2006), yet this article dismisses the possibility and selectively cites Brizendine’s book. This allows the article to propagate an uncomplicated picture of the science behind baby brain, but at a cost of implying baby brain is an entirely biological and inevitable phenomenon for pregnant women.

This section has investigated how, in news reporting on the existence of brain or behaviour changes during pregnancy, hormonal explanations are given undue prominence while alternative explanations such as fatigue are understated. In the next section, I discuss how news articles present brain changes heralded by pregnancy as evolutionary adaptations designed to promote the survival of infants.

### Baby brain as an adaptation

This section demonstrates how baby brain is framed as an evolutionary adaptation. This utilises examples from the first category of reporting (that baby brain has been proven to exist) as well as articles falling into the third category of reporting, that there are beneficial changes to the brain in pregnancy. Such articles typically promote brain changes as having consequences for maternal behaviour. This line of reasoning is not new, despite gaining renewed support from the use of novel brain imaging methods – articles in this category spanned the entire range of the sample (1999 to 2016). Most studies in this category measured some way in which mothers or pregnant females enjoyed enhanced performance on a test as compared to the control group (it is sometimes revealed partway through an article that the mothers were actually rat rather than human). This advantage is then interpreted in light of the demands of motherhood. Less common were articles that reported on brain changes observed during functional MRI scans. While linking the results of fMRI scans to behaviour is deeply problematic (Beck 2010; Vul, Harris, Winkielman, & Pashler 2009), the reportage proceeded to do exactly that. There were no articles in which beneficial brain changes were viewed as being incidental to the needs of an infant.

Where the advantages of baby brain are emphasised, it also plays into notions of motherhood as the purpose of a woman's body (Shchurko 2012). Reporting of beneficial brain changes focuses on how hormonal processes prepare a pregnant woman for motherhood, with emphasis on growth in regions of the brain relevant for emotions and empathy. Nurturing behaviour is therefore cast as a biological inevitability, controlled by hormones, rather than something that women deliberately cultivate as they prepare for their child's arrival. Any brain changes observed in pregnant women are explained as being the unfolding of a natural process:

The brain changes were likely an adaptation for motherhood boosting the ability to recognise the needs and emotional state of a baby and decode potential threats to its health and safety, said the researchers. (Unknown author (9 News) 2016).

She [Dr Williams] says baby brain is most likely there for a reason — to help you focus on what's the most important job in your life — raising your baby. 'While others around you may be frustrated by your forgetfulness, just remember that nature has found a way of making sure that mum is directing her attention to the newest member of the household!' she says. (Unknown author (Daily Telegraph) 2015)

But now scientists have confirmed that not only does so-called 'baby brain' exist — it actually has a purpose. According to psychologists, changes in the brain during pregnancy are designed to help mothers prepare for bonding. (Unknown author (The Advertiser) 2014)

Louann Brizendine<sup>16</sup>, a neuropsychiatrist, said the condition could be attributed partly to the new mother's focus on the welfare of her baby to the exclusion of all else. 'New mothers are dedicated to serving that little infant, determined to keep him or her alive, no matter what,' she said. 'That's their number one priority. 'Consequently less important matters get forgotten, or at least put into a less active area of the brain.' (Unknown author (Blacktown Advocate) 2008)

As the above examples demonstrate, articles in this sample presented a variety of unrelated improvements to maternal abilities as being caused by hormonal changes. These advantages are related only in that they can all be applied to infant care. Speculation about the adaptive purpose of maternal brain changes runs the risk of devolving into convenient yet unprovable

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<sup>16</sup> As mentioned in Chapter Five, Louann Brizendine features heavily in news articles providing brain based explanations for gender stereotyped behaviour. She has written two books on essential differences, called 'The Female Brain' (2006) and 'The Male Brain' (2010).

explanations. Evolutionary biologist Stephen Jay Gould (1978a) famously charged such sociobiological explanations with being ‘Just So stories’, after Rudyard Kipling’s 1902 children’s book that constructs fanciful accounts of how animals developed their distinctive features (such as the leopard and its spots). Gould wrote this repudiation at the height of sociobiology’s popularity following the publication of EO Wilson’s influential 1975 textbook on the subject. Forty years later, his criticism remains relevant. Not only are the explanations in the above articles underdetermined by the evidence they present, but they warrant extra scrutiny for being conveniently aligning with a system in which fathers do not make comparable sacrifices to those made by mothers<sup>17</sup>.

Now that I have discussed how baby brain is regarded as having evolved for the benefit of the infant and therefore reinforces notions of motherhood as the ultimate purpose of the female body, in the next section I will argue that studies finding evidence against the existence of baby brain are undermined in news reporting, before investigating how brain changes are also presented as having incidental benefits for mothers.

### The undermining of studies opposing baby brain

As shown in the previous sections, reporting on studies presenting evidence for brain changes during pregnancy aligns with gender stereotypes. This holds both for articles claiming that becoming a mother has adverse effects on the brain and its workings, and for articles that assert that pregnancy precipitates cognitive benefits. However, as I will discuss in this section, the converse (that articles reporting on studies repudiating baby brain likewise argue against gender stereotypes) was not borne out in the articles investigated here. I contend this is reflective of a bias towards gender stereotypes in news reporting.

Most articles claiming to disprove the existence of baby brain do not discuss why baby brain is so widely believed. For those that do include commentary explaining the persistent myth of baby brain, it is invariably couched in personal terms, and is never explicitly connected to gender roles:

Writing in the *Journal of Clinical and Experimental Neuropsychology*, Prof Larson said the expectation of baby brain may be so strong that a pregnant woman was extra-alert to memory lapses. And I couldn’t agree more. I don’t doubt that all my forgetful moments during pregnancy and early motherhood were more to do with feeling

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<sup>17</sup> Of course, proponents of evolutionary explanations would argue that a patriarchal system exists precisely because of sexually dimorphic behaviour, rather than the other way around as is implied here.

overwhelmed, the lack of sleep and the constant worrying about my new baby than being afflicted with the so-called baby brain. I found it helpful to acknowledge all the things that I did accomplish as a new mother, rather than beat myself up about the times when I wasn't as mentally alert as I would have liked. (Warburton 2016)

In the example above, parenting columnist Bettina Warburton does not expand on the implications or origin of a strong expectation for baby brain. Instead, she adds to the expert comment with her own personal take on baby brain. The solution she presents is implemented by the individual, rather than on a societal level, and functions through the individual convincing herself that she is coping. It creates another obligation for an exhausted and stressed new mother: the practice of gratitude. This is typical of a postfeminist approach to problems, in which the individual may address her failings through working on her confidence (Harris 2004, p. 33). There is no place for acknowledging women's disproportionate share of child-rearing in Warburton's account. Her description of feeling overwhelmed and sleep deprived is missing any discussion of a male partner's role in infant care, serving to locate the problem solely with the mother and her ability to withstand the demands of child-rearing (Hurt 2011). Moreover, this account of new mothers' forgetfulness is contradictory with other stereotypical discourses around domestic labour; as discussed in the previous chapter, men are presented as forgetful in this context, with women presented as naturally superior at household management.

Other than the above example, the only instances of baby brain being attributed to external factors came from quotes attributed to Professor Helen Christensen, who led a longitudinal study that tested women's memories both before and during pregnancy and compared changes over time. Her most incisive example originated in a newswire:

'Part of the problem is that pregnancy manuals tell women they are likely to experience memory and concentration problems, so women and their partners are primed to attribute any memory lapse to the hard to miss physical sign of pregnancy,' Prof Christensen said. (Rose 2010)

This quote was picked up by two newspapers (Wallace 2010; Watson 2010), while an additional eleven newspapers reported on this story, using other aspects of the press release, but failed to use this quote.

Studies claiming to disprove baby brain are challenged by journalists on the basis that they defy common sense. Some articles reporting on research debunking baby brain contrast the study with women's experiences, often in a humorous way. The implication is that laboratory

conditions are not representative of real life (but only when it comes to studies arguing against baby brain being a real phenomenon). For example, one article on a memory study challenging the existence of baby brain ended with the quip:

I'll bet Professor Christensen's subjects had no sooner returned to their cars than they found themselves lost in contemplation of childcare options, while attempting to feed the lipstick into the ignition. (Lewis 2010)

Another journalist reporting on the same study used most of the article to joke about his wife's experience of baby brain:

When asked whether she had washed fish on the auto cycle with rinse aid in her days before children, Mrs W refused to comment, instead flinging a fillet of salmon at the questioner's head, leading to suspicions that important neurons had short-circuited in the brain and she was confusing fish with frisbee. I resolved to take video footage next time and send it to the ANU researchers. (Webster 2010)

Journalists do not necessarily resolve the contradiction between women's experiences and the scientific dispelling of baby brain. For example, in a parenting column, the author dedicates most of her article to describing a scatterbrained moment she experienced and providing background information suggesting baby brain is a normal experience (Du Plessis 2010). Next she discusses then-recent longitudinal research article that argued baby brain is a myth, before providing tips on dealing with baby brain, which reifies the condition's existence. This contradiction is not resolved in the column, save for a brief quip that 'new research suggests that it's all in our head'. This implies yet another failing of the mental abilities of pregnant women, yet its meaning is not teased out by the journalist.

Despite this, it is noteworthy that there are a comparable number of articles proving and disproving baby brain. This is despite the 'file drawer problem' (Rosenthal 1979; Fine & Fidler 2015) – that null results are less likely to be published in scientific journals. Furthermore, a similar effect extends to news reporting. As noted earlier, there is some literature on journalists failing to report on disconfirming evidence of earlier stories (Conrad 2001; Petersen 2001; Mercurio & Elliott 2009). This is in some ways an analogous issue to the file drawer problem; the main difference is that it is concerned with the printing of disconfirming evidence after initial reporting of a positive finding. In contrast, the file drawer problem is concerned with the failure of scientific journals to publish null results, regardless of whether a positive result was reported earlier.



It is plausible that null results are generally less newsworthy than positive findings, leading to them being reported less often or being not as prominently placed within print publications. Evaluating the former would involve identifying scientific findings pertaining to proving or disproving baby brain, and reconciling this with the news reporting. An investigation of this matter is outside the scope of this chapter. However, I did undertake some efforts to explore the placement of articles presenting evidence against baby brain, and did not find evidence of a bias in terms of page number placement. I calculated the median and mean page numbers of print articles presenting baby brain as myth and those presenting baby brain as fact (for articles for which information on page number was available, and excluding those published in lift-out magazines). The mean and median page numbers were comparable for both types of article (a median of page fourteen for those reporting that baby brain exists, and page thirteen for those reporting that baby brain has been disproved). This analysis is limited in that it does not take into consideration the placement of the article on the page. Nevertheless, from these rudimentary observations, it is apparent that the bias against studies arguing that baby brain is a myth does not extend to relegating articles arguing against baby brain to the latter pages of newspapers.

In this section, I have argued that while newspapers do give space to scientific studies claiming to disprove the existence of baby brain, these articles fail to contextualise findings and undermine evidence against baby brain through contrasting studies to personal experiences.

### Baby brain goes to work

In opposition to the implicit incompatibility of baby brain with workforce participation is another strand of thought that contends women gain some abilities during pregnancy; the sharpening of a list of talents can then be presented as being advantageous in the workplace. The implication is that while nature may have intended for brain changes to improve the infant's chance of survival, a resourceful woman can capitalise on her newfound powers in a corporate setting. The workplace benefits of brain changes caused by pregnancy are extolled by some relatively recent articles, such as these three that report on the same study:

The study, published in *New Scientist*, found that after giving birth, the brain expands and is capable of improved thinking, resilience, empathy and stress management. This ties in with a report by Ernst & Young for the Workplace Gender Equality Agency, which found women in flexible roles, mostly mums, wasted less time on the job than the rest of the workforce. (Sundstrom 2016)

Mothers are also more assertive, better able to cope with stress and may be better at multitasking. All of this could make them better workers. (Unknown author (The Sunday Times (Perth)) 2016)

In the last three months of pregnancy women's bodies learned how to be less stressed in order to cope with imminent increased demands. Ultimately, their employability and performance spiked. (Sinnerton 2016b)

The new talents promoted in these excerpts are a mix of stereotypically male traits (thinking and resilience) and female traits (empathy and multitasking ability). Women's improvements in these areas (assuming any such improvements exist) are presented as being dictated by bodily processes, rather than through women gaining new experiences and perspectives upon having a child.

More importantly, the above examples run counter to prevailing discourses around work and motherhood. While 'having it all' is seen as an impossible goal, with motherhood and work interfering with each other, this creates a way in which engagement in both spheres is not only possible but also efficient for women with young children. However, it also fails to take into consideration structural circumstances that compromise women's ability to participate in the workforce while also parenting, such as workplace discrimination (Australian Human Rights Commission 2014, p. 26), inability to access childcare (Australian Human Rights Commission 2014, p. 47), and performing a disproportionate share of child rearing (Australian Bureau of Statistics 2012). If mothers are better able to cope with stress, as some journalists have claimed, then this creates the expectation that they are able to negotiate practical difficulties and successfully juggle both a career and primary care of their children. Societal obstacles thus become re-cast as individual failings.

My findings based on news articles explicating how maternal brain changes confer advantages for the working woman should be compared here to Davi Thornton's account of 'mommy economicus'. According to Thornton, 'mommy economicus' must take advantage of the brain changes wrought by motherhood in order to receive the benefits (Thornton 2014, pp. 279 - 280). 'Mommy economicus' is therefore afforded some limited agency, though, as Thornton emphasises, experts write that failing to follow their directions will have dire consequences for a mother's developing brain (p. 279). However, this was not reflected in the articles sampled here. There is no sense that women must embark on a program of brain exercises; rather, the brain is conceived of as shaping itself in preparation for motherhood with no action taken by

the pregnant woman, as discussed in the above section on baby brain as an evolutionary adaptation. The sample of news articles includes several reporting on the book which Thornton dissects, Katherine Ellison's *The Mommy Brain* (2005), yet this evidence was reported differently to what Thornton observed in her neoliberal North American context. In these articles, the concept of neuroplasticity was entirely absent; nor were women instructed on how to take advantage of the brain changes experienced during pregnancy. All took a similar angle, contrasting narratives of baby brain with the evidence drawn together by Ellison's book, and presenting the improvements heralded by motherhood as a universal experience. However, other aspects of Thornton's arguments held true for the articles sampled here. She asserts that 'mommy economicus' can leverage her new mental capacities in the workplace (p. 282), which is the main claim made in the above excerpts from December 2016 articles.

This section has discussed how beneficial brain changes during pregnancy are framed as giving women advantages in the workplace. In the next section, I use the same examples as provided above to investigate the use of evidence in articles about the cognitive effects of pregnancy, before returning to the entire sample of articles to evaluate the types of evidence used in reporting.

### Quality of evidence

While assessing the available evidence on baby brain is outside the scope of this thesis, it is instructive to compare the weighting of different types of evidence in news reporting. This line of investigation echoes a body of literature examining exaggeration in news reporting of medical research, as discussed earlier in Chapter Three. Of particular interest is that newspapers are biased towards reporting on poor quality medical research. Newspapers disproportionately report on studies with methods regarded as less robust in the field of medicine (Selvaraj, Borkar & Prasad 2014; Yuk Yeu Lai & Lane 2009). The use of methods lower in the hierarchy of evidence entails that these results have a higher probability of emerging through pure chance. This ties in with the file drawer problem (which was discussed earlier) – that null results are less likely to be published.

Evaluating the evidence used is one way of judging the quality of news reporting. For baby brain reporting, in which two opposite conclusions are recurring in the news, considering the types of studies that receive traction in the news helps to illuminate if journalists give disproportionate emphasis to one possible conclusions. A concern with this type of analysis is

that it relies on hierarchies of evidence from science and medicine, denigrating the role of qualitative research as used in the social sciences (Hayek 1952).

In the previous discussion, I provided excerpts from articles reporting on brain improvements due to pregnancy, dated from 2016. In total there are five articles in the sample reporting on this story, three of which are variations of each other. While this is a small number of articles from which broader conclusions cannot be drawn, I have selected this story for discussion as it is an extreme example of misleading reporting based on exaggerated evidence. This will be used as an in-depth example, including with comparisons to the original source, before proceeding to a discussion of more general patterns of how evidence is used within the sample.

In regards to the three categories of reporting on baby brain discussed earlier in this chapter, these articles fall under the topic of pregnancy conferring an advantage to an individual's mental abilities. Four of the five can also be categorised as stating baby brain is a myth; however, their main contention is that pregnancy causes some sort of super-brain customised to the demands of motherhood.

As some of the news reporting provided information on where the study was published, I was able to locate the original article, which appeared in *New Scientist* (Young 2016)<sup>18</sup>. *New Scientist* is a British weekly science magazine written for a popular (though scientifically curious) audience. Some mainstream media outlets treat it with the same weight as an academic journal (Egan 2006). *New Scientist* has been criticised for being sensationalist and even publishing articles that contain information contravening fundamental laws of physics (Egan 2006). The original article referred to by the press, entitled 'The Real Baby Brain', is a feature article that brings together many different pieces of research and contains a wealth of expert quotes. It contains a brief description of a study that had not yet been published (this was a null result and was not mentioned in the news articles canvassed here), and other than that it does not present any new results. The article essentially tells two intertwined stories; a literature review in which a succession of studies converges on the mental benefits of pregnancy, and the story of how this research was produced by scientists intrigued about the changes they observed in their own lives. While I would evaluate the article as a first-rate piece of scientific journalism in that it is very clear and balanced recounting of recent research, it does not constitute 'a new academic paper' as it was referred to in the news (Sinnerton 2016a; 2016b; Sundstrom 2016).

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<sup>18</sup> The information from one of the articles discussed here, in combination with further details found in international news reporting on the same story, allowed me to find the original article.

I argue here that news reporting on Young's article is misleading. A *Gold Coast Bulletin* article misrepresents the article as being a single neuroscientific study that found pregnancy leads to a sundry list of improvements to women's abilities: 'improved thinking, resilience, empathy and managing stress' (Unknown author (Gold Coast Bulletin) 2016). The findings of improved resilience and stress management derive from two different studies (by different authors) canvassed in Young's article. 'Improved thinking' is vague enough that it could have been derived from almost any of the studies summarised in the feature article. Improved empathy, however, was not a finding of any of the studies. Rather, Young (2016, p. 38) writes that a brain region linked to empathy was found to grow in the months after giving birth; she does not speculate on what this may mean for the behaviour or abilities of mothers. In the absence of supporting behavioural data, conclusions about the behavioural effects of physical brain growth are underdetermined (Beck 2010). It is furthermore noteworthy that the journalist for the *Gold Coast Bulletin* selected empathy, a stereotypical female strength (Fine 2008, p. 70), to report on, when there were other behavioural results contained within the feature article. News articles appearing in *The Courier Mail* and *The Daily Telegraph* were longer versions of the *Gold Coast Bulletin* article, tailored for the locations of their respective audiences. Both reported the results as coming from a single study, and contain the same dubious list of mental improvements (Sinnerton 2016a; Sinnerton 2016b). A *Sunshine Coast Daily* article similarly refers to the feature article as a (single) study, and interviews a highly accomplished 'working mother' as proof of baby brain not existing.

Only an article appearing in *The Sunday Times (Perth)* is a (mostly) accurate depiction of Young's article (Unknown author (The Sunday Times) 2016). It reports that the information originated from *New Scientist*, and asserts that there is 'growing evidence' for several positive brain changes. There is no mention of the article being a new development or a study, though perhaps a reader may assume this as it is unconventional for a feature article to be reported elsewhere as a scientific development. The article did, however, report that mothers 'may be better at multi-tasking'; while this is technically true<sup>19</sup>, it refers to a study that planned to administer multi-tasking tests and is not based on any evidence even of a preliminary nature.

This example illustrates how the nature of evidence is overstated in the popular press. In these articles, the results themselves are embellished, and these inflated results are themselves made to seem especially trustworthy by implying they have come from a peer-reviewed source

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<sup>19</sup> Mothers 'may' also be worse at multi-tasking. This is essentially a meaningless statement, though this is not transparent to the reader who has not also read Young's article and realised there is no evidentiary basis.

written by a scientist, rather than a feature article contributed by a scientific journalist. This is an example of what Robert Entman (2007) calls distortion bias, in which news reporting exaggerates the original knowledge-claims.

I now perform a more general assessment of how evidence is used in news articles reporting findings on the effects of pregnancy and motherhood on the brain, taking into consideration all articles in the sample (except for those discarded, as described below). This investigation of the types of evidence utilised in news reporting on baby brain reveals a bias towards reporting on comparatively weaker forms of evidence in order to justify the existence of baby brain.

To perform this analysis, I identified six distinct types of evidence used in articles reporting on baby brain. These categories were: rat or mouse study, expert opinion or book, cross-sectional memory testing, longitudinal memory testing, neuroimaging, and meta-analysis of memory testing. Some articles were also categorised as having an unclear evidence type, or bringing together several types of evidence (the articles in the above *New Scientist* example fell into this category). These articles were discarded for the purpose of this analysis. Three articles were designated as other types of evidence, such as two articles reporting on a study to be conducted in the future for which the method was not described. These articles were also discarded. The presence of anecdotal evidence was not considered here, as this was usually used as either supporting evidence or as a counter-point. Note that the designation of evidence as being used for a particular type of article refers to how the evidence was utilised by the journalist. For example, there were two articles using a longitudinal study of memory that heavily promoted the conclusion that baby brain exists; however, this is an entirely opposite conclusion to the longitudinal study's findings.

The first two categories of reporting (that baby brain exists, and that baby brain is a myth) have been here treated separately from the third category, discussed later. This is to focus on determining the quality of evidence used for each of these two opposite conclusions. The results of this analysis are shown in Figure 5 below.

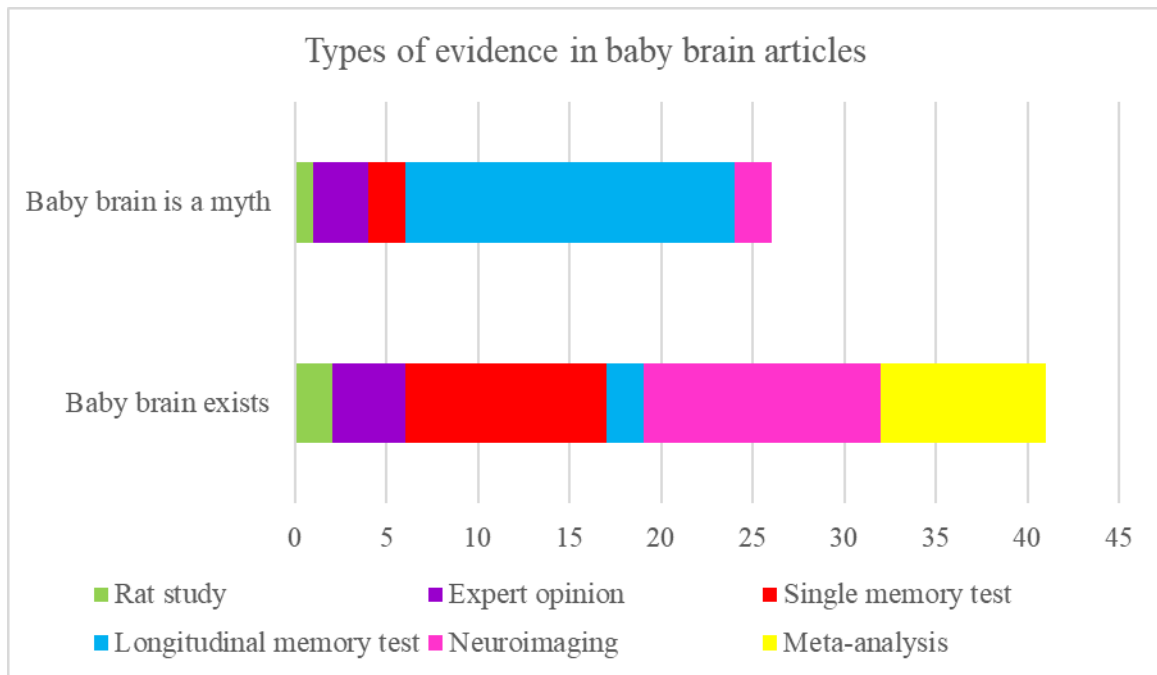


Figure 5: Bar graph indicating the six most common types of evidence used in articles that argue for and against baby brain

This graph demonstrates that the majority of reporting on baby brain as a myth is based on evidence from a longitudinal study, generally regarded as a robust method. Articles reported on two different waves of the same longitudinal study that sought to use a representative sample with participants recruited before they became pregnant (Christensen, Leach & Mackinnon 2010). It is noteworthy that this was an Australian study, while evidence presented in articles promoting baby brain was drawn from a range of international sources. An earlier longitudinal study from the United Kingdom, which administered memory tests to pregnant women, found they did not perform worse than the control group of non-pregnant women, despite the pregnant women rating their own performance as worse (Crawley, Dennison & Carter 2003), was not reported on in the articles sampled here. This hints that strong forms of evidence from overseas studies go unreported in Australian news media, while weak forms of evidence from overseas studies are reported on (a full systematic investigation of this possibility is outside the scope of this chapter).

In contrast to articles reporting that baby brain has been disproved, those reporting that baby brain has been established as a fact mainly rely upon evidence from neuroimaging studies and memory tests administered at a single point in time. Criticisms of neuroimaging studies, including a lack of explanatory power and issues with the methods used, were discussed earlier in this chapter. The type of memory tests used in baby brain studies have been criticised by Christensen, Leach and Mackinnon (2010) as containing non-representative convenience

samples, only recruiting women after pregnancy, which may bias samples to those who are concerned about the cognitive effects of pregnancy, failing to investigate long-term effects, and having small sample sizes. A sizeable minority of proof for the existence of baby brain derives from a meta-analysis, which is a more reliable form of evidence. Nevertheless, the majority of articles reporting on baby brain used weaker evidence types than those reporting baby brain has been shown to be a myth.

This pattern demonstrates newspapers require a higher standard of evidence if they are to report that baby brain has been shown to be an illusion. In contrast, more contentious methods are accepted in order to promote the existence of baby brain. This shows that news reporting is inclined towards promoting gender stereotypes, and moreover presenting gender stereotypes as scientific, even where based on limited evidence. The reader may wonder if this could actually be reflective of the type of research being undertaken, rather than of a systematic bias initiated by journalists. If this is the case, a bias towards baby brain is still indicated. This bias would be occurring at both the levels of scientific endeavours (wherein weaker methodologies are employed for studies proving baby brain) as well as in news reporting. Journalists and editors could elect not to publish weak evidence for baby brain, particularly in light of more robust evidence against baby brain.

I will now examine the type of evidence used in articles promoting the cognitive benefits on pregnancy. As foreshadowed earlier in this chapter, most of these articles relied upon rat or mouse studies. This is shown in Figure 6 below.



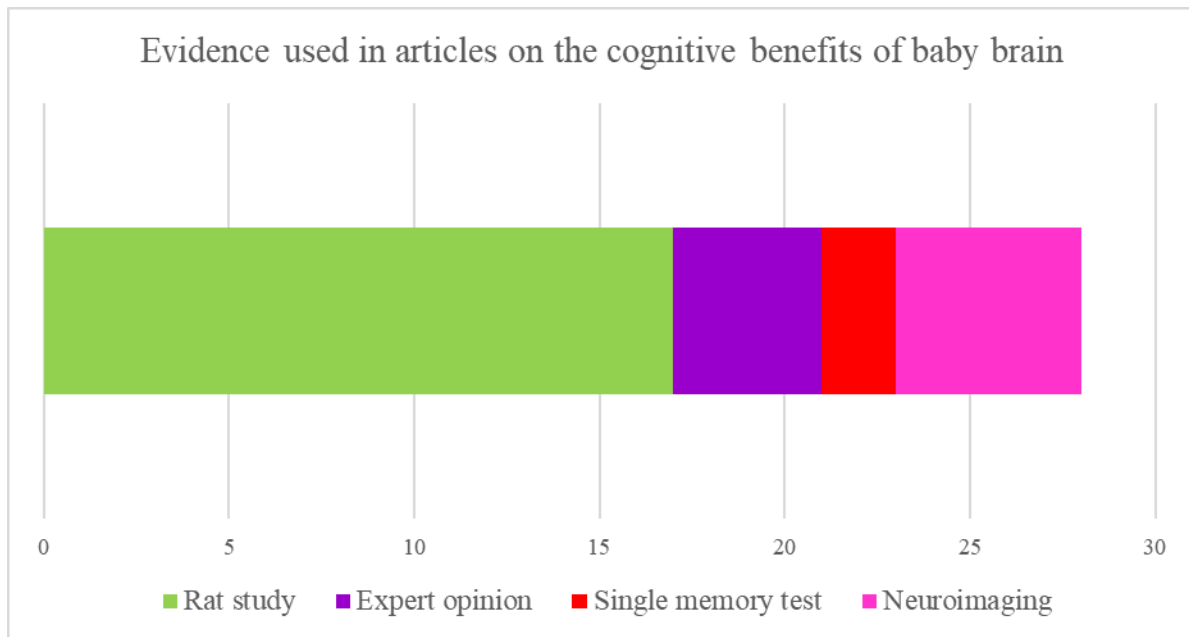


Figure 6: Bar graph indicating the types of evidence used in articles promoting the positive effects of pregnancy on the brain

While animal studies are often assumed to apply to humans, this is not always the case. Problematically, in the articles sampled here, inferences are drawn to human mothers, as has been discussed earlier in this chapter. This is consistent with findings from the literature on exaggeration in news reporting of medical research, in which studies on animal reporting frequently claim relevance to humans (Sumner et al 2014; Woloshin et al 2009). Use of mouse or rat studies to draw conclusions about human mothers suggests nurturing is innate, entirely removing the cultural aspects of motherhood. The experience of parenting is thus held to be universal, not only for all human mothers, but across species lines. Understanding that news articles reporting on cognitive improvements during pregnancy are derived from rat studies, while articles reporting on studies claiming to prove cognitive declines characteristic of baby brain rely on different types of evidence, provides some clarity to the ambivalent picture presented by newspapers. Overall, this suggests the promising findings of rat studies are not applicable to human women, at least with the methods currently being used.

In this section, I have investigated how news reporting relies on weak evidence that is then presented as ‘proof’ for either the experience of baby brain or for the existence of mental improvements due to pregnancy. The weak methodology of studies reported on as proving that baby brain is a real phenomenon is contrasted with the relatively stronger methodology of studies reported to claim the opposite conclusion. This indicates that news reporting is biased towards publishing material on the existence of baby brain. Combining the analysis performed here with earlier sections of the chapter discussing how baby brain encapsulates traditional

gender roles, this confirms that newspapers are inclined towards the promotion of traditional gender roles.

## Conclusion

In this chapter, I have conducted an in-depth exploration of Australian news reporting on the phenomenon of baby brain to demonstrate how news reporting is inclined towards presenting biological explanations for traditional gender roles. The topic of baby brain was identified as of interest as it explicitly connects beliefs about women's psychological function to motherhood. Three categories of reporting were identified: firstly, articles reporting on studies purporting to prove the existence of baby brain; secondly, articles reporting on the studies claiming the exact opposite, that baby brain is a myth; and thirdly, articles reporting on studies establishing an intellectual boost conferred to pregnant women. I have argued that news reporting on changes in the maternal brain gives heavy emphasis to the influence of hormonal and evolutionary factors, while reporting on studies that disavow 'baby brain' not only fail to provide an explanation for the widespread belief in the phenomenon but also undermine the studies' conclusions using non-science criteria, namely personal anecdotes. Structural factors implicated in baby brain are not discussed; while fatigue is sometimes mentioned, it is never placed in the context of women taking on more child-rearing duties than men. Scientific explanations that place the blame on hormones reinforce the perception that baby brain is an inevitable process for a pregnant woman, and therefore remove accountability for behaviours from social and cultural influences. A discussion of the quality and type of evidence used in articles sampled here further underscores that there is a bias towards including weaker forms of evidence to endorse the concept of baby brain.

This case study has contributed towards the overall thesis aim of demonstrating how scientific developments pertaining to sex differences are reported for consumption by a lay audience. This builds upon some of the previous chapter's findings, including that folk knowledge is legitimised as science in mass media, that the belief in a scientific basis of gender stereotypes persists over time, and that scientific claims which provide evidence of gender roles are subject to little scrutiny in news reporting.

## Chapter seven: The case of gender and multi-tasking

### Introduction

The previous chapters have demonstrated how scientific research can be represented to perpetuate the sexual division of labour. I now focus upon popular understandings of multi-tasking. Multi-tasking is stereotypically considered to be a female strength, providing a convenient rationale for women's greater responsibility for the private sphere, including for women in paid employment outside the home. As argued in Chapter Five, the use of science knowledge in news reporting to justify and make sense of the sexual division of household labour is remarkably enduring over time. This case study investigates reporting from a 2015 scientific finding, cited in some publications as providing evidence of women's relative advantage over men in multi-tasking. This provides a recent, in-depth example of how scientific knowledge is buttressing existing gender stereotypes. In this case study, the multi-tasking result was not apparent in the scientific research, and emerged in news reporting due to exaggeration. This case study contributes to our understanding of how metaphors communicate scientific knowledge on gender, in this case, the computer metaphor of the brain from which the concept of multi-tasking emerges.

This chapter focuses upon news reporting resulting from a single brain imaging study (Hahn et al 2015a). Hahn et al.'s (2015a) study used functional magnetic resonance imaging (fMRI) to visualise brain structure changes in trans men (i.e. female-to-male transgender, those who were assigned female at birth and currently identify as men) who were administered testosterone. Hahn and colleagues' findings prompted international news coverage proclaiming that testosterone masculinises cognition, even though the authors did not examine cognition. The news coverage was notable for its embellished claims. Some coverage included the false claim that women given testosterone experienced a decline in their multi-tasking ability. These news articles erroneously attributed this result to the study, which did not examine multi-tasking.

I have selected this case study as it exemplifies how mainstream news reporting of a scientific study can, through exaggeration and fabrication, perpetuate stereotypical sex differences. By investigating a comprehensive sample of news reporting on Hahn et al.'s (2015a) study, I have been able to make inferences about key points in the news reporting at which the story changed. I use the case study as a vehicle for critically discussing the stereotype of women being better than men at multi-tasking. This builds on the previous chapters' findings that scientific content deviates from the initial meaning to promote and legitimise the sexual division of labour, and

the material canvassed earlier in Chapter Four showing how science has been utilised historically to promote gender roles.

The background section of this chapter chronicles the association of multi-tasking with femaleness and explores how this association buttresses the sexual division of labour. After defining multi-tasking, I draw upon a range of literature to examine the stereotype of greater female multi-tasking ability and discuss how this stereotype is presented as scientific in popular media despite the poor evidentiary basis. The second half of this chapter then dissects the news coverage of Hahn et al.'s (2015a) study, first tracing broad features of the sample before critically examining exaggerated claims made by journalists. I establish that substantial worldwide news coverage originated from a small number of initial articles, some of which are misleading or contain new and unsubstantiated claims. Syndication of news articles permitted these false claims to propagate through many different publications.

## Multi-tasking as a gender stereotype

### Defining multi-tasking

In this section, I outline the contentious concept of multi-tasking, and explain its origins. This lays the groundwork for a critical discussion of the gender stereotype of multi-tasking. I draw on the work of authors who have studied stereotypes, as well as several popular sources, to argue that there is a robust stereotype that women possess inborn multi-tasking ability. I show that proponents of the stereotype selectively call upon neuroscientific explanations, ignoring contrary scientific evidence. Finally, I argue the belief in women's heightened multi-tasking ability is utilised to provide a biological imperative for an unequal division of domestic labour in heterosexual households.

Multi-tasking can be defined (and measured) as toggling between two or more tasks. Multi-tasking includes switching between tasks every few seconds (concurrent multi-tasking), or performing two or more interspersed tasks over a period of minutes or even hours (sequential multi-tasking) (Salvucci & Taatgen 2011, pp. 8 – 9). The definition of multi-tasking is problematic as there is no distinct point at which sequential multi-tasking is no longer considered multi-tasking. True multi-tasking, where the individual performs two tasks simultaneously (such as driving while talking), is known in the literature as 'dual-tasking' (Strayer & Johnston 2001). The ability of humans to dual-task is controversial, with some believing that the person is in fact rapidly switching between tasks (Fischer & Plessow 2015). The first complication with the gender stereotype relating to multi-tasking, then, is that multi-

tasking is itself a slippery concept. Throughout this chapter, I will use the term ‘multi-tasking’ to apply to all its incarnations.

Research on human performance while task-switching (e.g. Jersild 1927; Spector & Biederman 1976) represents a precursor to later studies on sequential multi-tasking that became popular in the 1990s and 2000s (Douglas, Raban, Walter & Westbrook 2017). I have condensed the development of multi-tasking as a concept into the timeline in Figure 7. Over the previous decade (2010s), media multi-tasking has become a topic of much research (Hadlington 2017). Media multi-tasking is the simultaneous consumption of several entertainment media (e.g. playing a video game whilst listening to music) or using entertainment media while performing a more productive task (e.g. writing an essay whilst watching television) (Hadlington 2017).

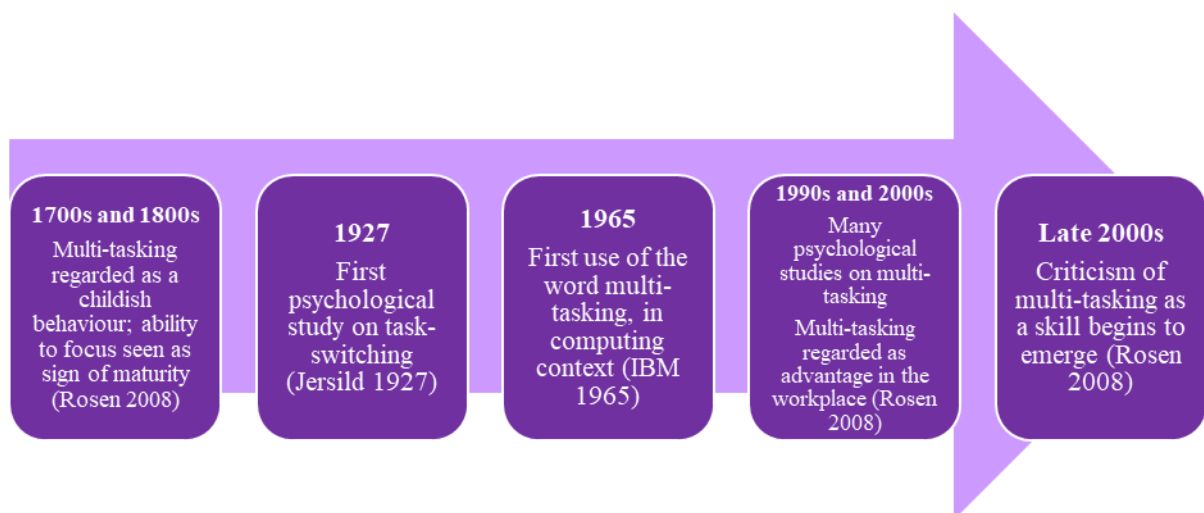


Figure 7: Timeline of the development of the concept of human multi-tasking. Synthesised from several sources, mainly Rosen (2008).

The use of multi-tasking is regarded as a valuable skill and as efficiency within demanding work settings (Hadlington 2017; Rosen 2008). Christine Rosen (2008) argues that in the late 1990s and early 2000s, the concept of multi-tasking gain popularity in wider society as it became a fashionable skill for office workers. In Australia, there was a dramatic increase in demand for employees with multi-tasking skills in the mid-2010s (Foundation for Young Australians 2016, p. 11). The ability to seamlessly multi-task is regarded as an attribute of the ideal employee in the neoliberal workplace.

There are well-established performance costs of attempting multiple tasks simultaneously. A large meta-analysis of multi-tasking studies by Heather Douglas and colleagues concluded that multi-tasking reduces task performance, with efficiency compromised and errors made (Douglas, Raban, Walter & Westbrook 2017). The emergence of this research has created a narrative countering that of multi-tasking as an essential workplace skill. From around 2013 onwards, there has been a flurry of popular media articles declaring ‘mono-tasking’ is the new multitasking (e.g. Dodgson 2017; MacDonald 2014; Vanderkam 2013; von Pfetten 2016). The ascendancy of mono-tasking has gendered implications due to the pervasive stereotype that women are better at multi-tasking and therefore men are better at mono-tasking. I will return to this discussion shortly.

Multi-tasking and information technology are intertwined. The concept of multi-tasking stems from computer science, originally referring to computers’ ability to process in parallel, or give the appearance of doing so (Rosen 2008). The word ‘multi-tasking’ came into use for computing in the 1960s (e.g. Havender 1968; IBM 1965) before being applied to people. Multi-tasking also ideally involves the use of different technologies to maximise productivity (Rosen 2008). The multi-tasking computer becomes an extension of the multi-tasking office worker. Unsurprisingly, multi-tasking and digital literacy have become desirable workplace skills in tandem. Computational approaches to studying multi-tasking in humans, in which a computer program simulates human cognition (e.g. Meyer & Kieras 1997), further complicate the relationship between multi-tasking in computers and multi-tasking in humans. Such an approach suggests that the human brain is analogous to a computer. This is an outgrowth of computing metaphors for the brain, as canvassed in Chapter Three. In summary, the idea of human multi-tasking is modelled on the workings of computers, it may be simulated on computers, and, in the context of office work, it requires the use of computers.

While gender differences have made few appearances in the multi-tasking literature, there is an enduring cross-cultural myth that women have an inborn advantage at managing multiple tasks simultaneously. The construction of this belief is explored in the next section.

### [The gendering of multi-tasking](#)

In this section, I discuss the stereotype of women as adept multi-taskers in comparison to men. I refer to studies that establish the existence of public belief in the stereotype, before tracing its early appearances in popular sources. Next, I draw attention to relatively recent examples of how relationship advice books present the stereotype with reference to sexual dimorphism of

the brain. Finally, I draw upon feminist challenges to this stereotype as it appears in popular media, to situate the findings of this chapter.

A female advantage at multi-tasking is not borne out in the peer-reviewed psychological literature. The task of establishing or quantifying any gender difference in multi-tasking ability has had little attention from researchers. The few studies show either no gender difference, or occasionally a tiny difference that does not always advantage women (Buser & Peter 2011; Hirnstein, Laroi & Laloyaux 2019; Maney 2014; Szameitat et al 2015). Lee Hadlington (2017), in his comprehensive book on multi-tasking, concludes the notion of a sex difference in multi-tasking ability has been ‘debunked’.

Despite the lack of scientific evidence, there is a robust stereotype that multi-tasking is a female strength. Tokuhamma-Espinosa terms invalidated yet persistent beliefs about the brain, such as the multi-tasking stereotype, as ‘neuromyths’. Szameitat et al. (2015) established the existence of widespread belief in the multi-tasking gender stereotype through their large cross-cultural survey. They found that study participants who believe that women are better multi-taskers commonly believe that this is caused either by biological differences or from having to juggle household management with competing commitments. Of those respondents citing the latter reason, three quarters believed women without children are still better multi-taskers than men. The authors argue this indicates a belief in innate differences between the sexes’ multi-tasking abilities. In a German study, Strobach and Wozidlo (2015) have examined the effect of age on belief in the multi-tasking stereotype, finding both young and older people overwhelmingly report that there is a public belief in a gendered multi-tasking stereotype, though not all personally agreed with the stereotype. They found 44 percent of the older people (defined in the survey as 60 to 85 years of age) and 27 percent of the younger people (19 to 29 years of age) personally endorsed the stereotype of women as better multi-taskers (Strobach & Wozidlo 2015, p. 4).

The origin of belief in the multi-tasking gender stereotype is unclear. The few studies on sex differences in multi-tasking cite media representations and query the relative paucity of empirical research. While the multi-tasking stereotype was entrenched by the early 1990s, I have been unable to determine exactly when, how, and where the stereotype emerged. A book on work-life balance (Liss & Schiffrin 2014) states the notion that women are better multi-taskers arose from the belief the female brain has a more developed corpus callosum (fibre bundle connecting the brain’s hemispheres). This locates the stereotype as existing from the

1980s. I have been unable to locate any other sources providing evidence for Liss and Schiffrin's assertion. However, it is possible, conversely, that the supposed difference between men's and women's corpora callosa was added on as an explanation for a pre-existing stereotype of women being superior multi-taskers.

The origin of women's greater multi-tasking ability in a larger corpus callosum is well documented, even though the source of the stereotype itself is unknown. Preliminary findings of a sexually dimorphic corpus callosum were reported in *Science* in 1982, with authors speculating this could be related to sex differences in spatial cognition (DeLacoste-Utamsing & Holloway 1982). According to Anne Fausto-Sterling (2000, p. 118), this finding, in an embellished form, was brought into the public consciousness by American talk show host Phil Donahue. Donahue's book, *The Human Animal*, was a spin-off from his short television series using experts to provide causal, and largely biological, explanations for human behaviour. He declares the finding of a sexually dimorphic corpus callosum to be the 'missing link' explaining differences between the male and female brain, and asserts that the enhanced connectivity between the hemispheres of the female brain engenders more integrated thinking styles and may explain women's intuition (Donahue 1986, pp. 119 – 120). In the early 1990s, sexual dimorphism of the corpus callosum was discussed in popular news and magazine articles, with speculation this difference leads to a miscellany of stereotypical traits such as men's greater propensity for mathematics and women's greater intuitiveness (Fausto-Sterling 2000, p. 116; Rivers & Barnett 2013, p. 27). In a parenting magazine in 2006, multi-tasking was added to the list of stereotypes explained by sex differences in the corpus callosum (Rivers & Barnett 2013, p. 26). There is a poor evidentiary basis for the claim women boast larger corpora callosa (Fine 2010b, p. 281; Eliot 2011, p. 896), despite the promising initial study (DeLacoste-Utamsing & Holloway 1982). Furthermore, it is unclear how a larger corpus callosum would enhance multi-tasking abilities. The usual explanation is that it enables greater cross-talk between the brain's hemispheres, which somehow facilitates multi-tasking (e.g. Maupin 2014). The mechanism for enabling multi-tasking is absent from this vague explanation.

The stereotype of women's multi-tasking advantage is sometimes underpinned by an evolutionary explanation. Ren, Zhou and Fu (2009) posit the Hunter-Gatherer hypothesis as an explanation for women's allegedly superior multi-tasking abilities. They assert that selection pressures in early humans favoured women who could multi-task, as women simultaneously cared for their children and prepared food (Ren, Zhou & Fu 2009, p. 14). Meanwhile, they argue, early men who could concentrate deeply would have more successful hunting



expeditions and thus would be better represented in the next generation. Ren, Zhou and Fu (2009, p. 17) even suggest women perform better with multiple distractions as opposed to one distraction, for evolutionary reasons. This narrative has been absorbed into some popular accounts of the multi-tasking stereotype (e.g. Bratter & Dennis 2008, p. 98). The Hunter-Gatherer explanation for women's claimed superiority at multi-tasking can be considered as a 'Just So story' (Gould 1978a): it provides a plausible yet unprovable explanation for a sex difference of uncertain veracity.

The causality of a female advantage in multi-tasking (if it exists) is unclear. Claims of women's innate propensity for multi-tasking, as in evolutionary explanation above, fail to consider sociocultural reasons for women's greater reliance on multi-tasking. Given the second shift of housework and child-rearing, it may be that women are squeezed into managing several tasks at once and thus some women become better at multi-tasking or at least appearing to multi-task. Instead of supposing that women's advantage in multi-tasking is due to practice, proponents of the stereotype generally believe it is an inborn advantage (Szameitat et al 2015). It is implied women's use of multi-tasking is due to greater talent in this area rather than necessity.

The belief that women possess superior multi-tasking abilities is perpetuated by popular media sources. Multi-tasking is popularly portrayed as relating to working mothers contending with the competing demands of domestic and paid labour (Offer & Schneider 2011, p. 810). This is despite multi-tasking having a broad enough definition that it can be applied to many stereotypical male interests (e.g. team sports) and high-status male dominated professions (e.g. pilots and surgeons). The stereotype is buttressed in books and news articles, with claims about women's advantage in multi-tasking sometimes being supported with brain facts (Buser & Peter 2011, p. 3; Strobach & Woszidlo 2015). This stereotype appears in heterosexual relationship advice books (e.g. Larimore & Larimore 2009; Pease & Pease 2017) as well as in guides for women to succeed in the workplace (e.g. Frankel 2014; Shaw-Hardy, Taylor & Beaudoin-Schwartz 2010). In the 2017 edition of Allan and Barbara's Pease's popular book *Why Men Don't Listen and Women Can't Read Maps*, an updated edition of the book first published in 1998, they point to the corpus callosum as the cause of women's ability to multi-task, while men are optimised for concentrating on a single task at a time (Pease & Pease 2017). This recent edition of their book does not consider the past few years' scientific uncertainty around establishing sexual dimorphism of the corpus callosum. The stereotype of women as

efficient multi-taskers while men are deep thinking mono-taskers is given new life through its popular retellings that selectively call upon scientific evidence to present a definitive picture.

News reporting of scientific studies is a breeding ground for gender stereotypes, as explored in the previous chapters. Several feminist neuroscientists criticise reporting of multi-tasking results specifically, taking issue with the traction and exaggerated interpretation of results. Studies on multi-tasking are able to produce a barrage of popular news articles that show women's superior multi-tasking ability, using this as a rationale to subject the unfounded claims to scientific investigations (e.g. Hirnstein, Laroi & Laloyaux 2019; Szameitat et al. 2015). Donna Maney (2014), who examines some news articles in detail and argues that exaggeration favours gender stereotypes, found opposing neuroscientific facts were used to promote women's superior multi-tasking ability. She cites two popular sources: one reports the finding that men possess more grey matter and women more white matter, while the other reports that men have more white matter and women more grey matter. In the first, white matter is held to be important for multitasking, yet in the second article, grey matter is regarded as cause of greater multi-tasking ability. Two exactly opposite pieces of evidence are used to promote the same, stereotypical conclusion.

One journal article in particular (Ingallhalikar et al. 2014a), and its subsequent news reporting, has been savaged by feminist neuroscientists as providing dishonest scientific evidence for a sex difference in multi-tasking (Joel & Tarrasch 2014; Maney 2014; O'Connor & Joffe 2014; Rippon, Jordan-Young, Kaiser & Fine 2014; Szameitat et al. 2015). O'Connor and Joffe (2014) carefully dissect Ingallhalikar et al.'s (2014a) article and the claims about multi-tasking that were present in the press release and subsequent news reporting. They argue women's supposed inborn advantage for multi-tasking became the 'take home message' of the study despite it not being present in the journal article (O'Connor and Joffe 2014, p. 6). In the press release and news reporting, women's multi-tasking abilities were contrasted with men's supposed advantage in single-task concentration (O'Connor and Joffe 2014, p. 6). Joel and Tarrasch (2014) and Rippon, Jordan-Young, Kaiser and Fine (2014) question the presentation of the study's data, arguing the authors have failed to provide the necessary statistical information for the reader to judge the size of their result, giving a visual image and commentary that highlight the differences between the sexes and therefore suggest distinct male and female brains. Ingallhalikar et al. acknowledged Joel and Tarrasch's article, accusing their critics of 'shooting the messenger' (Ingallhalikar et al. 2014b). News reporting of the same article has been discussed by Maney (2014), who argues the stereotypical claims present in the

press release and an interview given by one of the authors are based upon reverse inferences and are underdetermined by the research. Similarly, Szameitat et al (2015) take the article as an example of the egregious news reporting that is responsible for perpetuating the multi-tasking gender stereotype. Despite these criticisms, Ingahalikar and colleagues' (2014a) article has been applied in several popular books. Its findings have appeared in neuroscience-based guides for teachers that claim the article is evidence of compartmentalised male cognition (Sousa 2017) and of girls learning using 'intuitive processing' with all their feelings linked together, while boys are more action-focused (James 2015). The article has also been cited in a book about the psychology of stock market investors, as proof for men using the 'logical' left side of the brain, in contrast to the emotional, intuitive, multi-tasking female brain (Baker, Filbeck & Ricciardi 2017, p. 231).

The findings later in this chapter contribute to the previous list of examples where evidence is presented in popular media in nonsensical ways to reach conclusions in favour of gender stereotypes. And, as the Ingahalikar et al examples demonstrates, even findings and reportage that have been thoroughly criticised can become part of societal knowledge.

#### How the multi-tasking stereotype reinforces inequality

Believing multi-tasking ability is an innate sex difference has profound consequences for the sexual division of labour. The stereotype that women are inherent better at multi-tasking reinforces conditions that foster male achievement while ascribing supportive domestic roles to women. It thus reinforces the association between woman and reproduction, and man and production.

The multi-tasking gender stereotype is concordant with other beliefs that provide a biological imperative for female mediocrity and male genius. The converse of the multi-tasking stereotype is that men can only concentrate on one task at a time, but perform at a much higher standard than women. This can be deployed as a biological explanation for men's greater achievements in public life. Focused men may produce one project at a time with excellent results, while multi-tasking women may deliver many outcomes at once but with poor performance due to the deleterious effects of multi-tasking (Douglas, Raban, Walter & Westbrook 2017). The recent media interest in mono-tasking, as discussed earlier in this chapter, implicitly positions men as more successful and intelligent due to the stereotype that they are optimised for deep concentration. Multi-tasking, like other stereotypically female strengths, becomes a consolation prize in the 'equal but different' narrative. Interestingly, Liss and Schiffrin (2014)

argue that if the stereotype was reversed such that men were believed to be superior multi-taskers, multi-tasking would instead be cast as an important trait for leaders and used to explain male dominance in the workplace. The implications of the multi-tasking stereotype echo that of the greater male variability hypothesis, which asserts that women's IQ scores cluster towards the average while the male spectrum of abilities is more stretched out, resulting in a greater number of male virtuosos.

The domestic labour undertaken by women must be considered in discussions of women's multi-tasking advantage. The inequality inherent to the current sexual division of labour creates a double handicap for women in the family unit. Due to the disproportionate share of household labour and child-rearing undertaken by women, men with families have the luxury of concentrating on a single task at a time (Adams 2009, p. 78), facilitating male achievement. At the same time, women's performance in her roles outside the home is impacted by her second shift. For example, women's greater exhaustion from performing domestic labour while also participating in paid work has been used to justify women's lower earnings. Katrine Marçal (2015, p. 35) argues economists circularly reason that women get paid less due to poor performance resulting from tiredness, while women perform the majority of domestic labour to compensate for their lower monetary contributions to the household. She asserts that women's greater share of housework is not criticised by economists, who explain the inequality with reference to biological differences, if it is remarked upon at all. The multi-tasking stereotype, especially when dressed in the language of neuroscience, provides a supposedly natural, biological rationale for existing inequalities between men's and women's share of domestic labour. It excuses men from juggling demanding household tasks with professional commitments by asserting only women have the special talents to manage multiple competing roles and responsibilities.

In the first half of this chapter, I have contextualised the stereotypical understanding of multi-tasking as a female strength. This began with providing a definition of the slippery concept of multi-tasking, before establishing the existence of the stereotype that women possess an inborn advantage at multi-tasking. I canvassed feminist criticisms of the stereotype and its appearance in popular media. I have therefore problematised the stereotype in the following ways: multi-tasking is itself a dubious concept; there is little scientific evidence women are better at multi-tasking; and if women are better at multi-tasking, it is not necessarily an innate sex difference. Finally, I have argued that the multi-tasking stereotype works in tandem with, and reinforces, the sexual division of labour.

For the remainder of this chapter, I examine the news reporting on a single neuroimaging study (Hahn et al 2015a). This includes an investigation of how Hahn et al.'s research was deployed to make claims about multi-tasking despite the study being unrelated to multi-tasking.

## Reporting on the brain study

### Source materials

A study by Hahn and colleagues was presented in a poster session at a conference, the European College of Neuropsychopharmacology (ECNP) Congress in August 2015. In summary, Hahn et al examined brain structure changes, as measured by functional magnetic resonance imaging, in trans men who received testosterone injections or patches over a four-week period. Hahn et al.'s presentation was called 'Neuronal plasticity of language-related brain-regions induced by long-term testosterone treatment'. Additional information is contained within a press release on the study (ECNP 2015) and a more detailed journal article that was published the next year (Hahn et al. 2016). Hahn et al.'s study triggered widespread mainstream news reporting, that, as I show here, deviated from the results of their study.

Before examining trends in the news reporting of the study, I first summarise their research and draw attention to aspects that are relevant to the news coverage. The following synopsis is largely based upon the abstract from the poster session, which is publicly available online, and is supplemented with information from the journal article (which was published the year after the study achieved prominence in international news, and therefore did not inform the news reporting). The article abstract and press release were both concise and did not discuss the study's assumptions, rationale, or limitations. More information may be gleaned from the journal article on the study that was published the next year (Hahn et al. 2016). The article contains some discussion of limitations, including that no language tests were performed (Hahn et al. 2016, p. 1745). The extra detail of the article confirms the news reporting was not faithful to what the researchers found.

The study's conceptualisation of transgenderism is quite minimal. Hahn et al (2015a) use dated terminology, describing their research participants as 'female-to-male (FtM) transsexuals'. In other words, the participants were regarded as biologically female and, at the time of the study, self-identify as male. I will proceed to refer to this group of study participants as 'trans men' throughout this chapter, deviating from the descriptor 'transsexual' used in the study, to be in line with current respectful terminology. In their more detailed paper (Hahn et al. 2016), the authors explain that participants were diagnosed with gender identity disorder as defined in the

fourth edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM). While the authors note the terminology was changed to 'gender dysphoria' in the fifth edition in order to reduce stigmatisation, they opted to use the fourth edition (the reason for this is not explained). No mention is made of intersex conditions, so it is presumed all research participants are anatomically and chromosomally female.

The article's interpretation assumes trans men are female-brained individuals, who are transformed into an approximation of male-brained individuals with the addition of testosterone. In the press release, the study is understood as a test of observing the effects of testosterone on the female brain. That the study participants self-identify as male, and may have implemented lifestyle changes or even accessed black-market hormones to reflect this, is not considered as having implications on their brain structure and function prior to the experiment. In another study that year, Hahn et al. (2015b), in a largely unchanged research team with one additional person, investigated brain structure of trans men and women who had not received hormone treatments, finding that both deviated from the control groups including by sharing features of the gender to which the subject identified. In other words, their interpretation is that a biological female who self-identifies as male has some male brain features, and vice versa, as well as there being unique transgender brain features. If the lead author believes that there are distinct transgender brains, whether inborn or achieved through neuroplasticity, it is then curious that in the press release (ECNP 2015), the implications for men and women in general are emphasised through assuming that a trans man has a female brain.

In the introduction of the abstract, Hahn et al. (2015a) assert testosterone affects brain structure and function and therefore impacts behaviour and cognition. They specifically link testosterone to language ability. They summarise their four-week study as an investigation of the brain's response to 'continuous high-dose' testosterone treatment. The study consisted of a group of 18 trans men as well as a control group of 16 women. Due to the expense involved, it is typical for fMRI studies to have a small number of participants. The consequence of a small sample size is that there is an increased chance of spurious findings, particularly when many different variables are being measured (Button et al 2013). This is a well-established issue in neuroscientific research.

Technical details on the use of MRI are provided in the abstract, and results are given as finding negative associations between differences in bio-available<sup>20</sup> testosterone and differences in grey matter volume in Broca's area and Wernicke's area<sup>21</sup>. Meanwhile, they found that connectivity between these two regions increased with higher levels of bio-available testosterone. In the conclusion, authors state that testosterone seems to affect neuronal plasticity in regions of the brain relating to language. The concluding paragraph draws heavily upon other research relating to sex differences in language abilities. No statement of limitations is given.

The press release, entitled 'Research shows testosterone changes brain structures in female-to-male transsexuals', contains a more accessible version of the article abstract. The press release extends the implications beyond those in the article abstract. Rather than the brains of transgender individuals, it is about differences between male and female brains in general. The press release makes no claims that the researchers conducted behavioural or cognitive tests, but instead draws on relevant studies to make inferences. Strong statements about the explanatory power of the study are tempered by the word 'may', for example, a quote declares that the findings 'may explain why verbal abilities are often stronger in women' (ECNP 2015).

Neither the press release nor the abstract contain references to multi-tasking. However, as will be discussed, news articles reported that study participants experienced a reduction in multi-tasking ability. Later in this chapter, I trace the origin of this news result to one of the news articles. While the focus here is more on the news reporting, and the false claims that are propagated within, there are aspects in the original study that encourage stereotype laden reporting.

In any study, it is evident that different choices could have been made about the epistemology, hypotheses, methods, and interpretation. Querying these choices can be instructive particularly where power relations are concerned. In addition to the researchers' outdated conception of transgenderism, as discussed above, there are several components of the study that stand out as containing inbuilt assumptions about gender. The study was conducted from a hard sciences stance, and does not critically discuss concepts of gender and transgenderism. A social understanding of the transgender experience is notably absent. This spills into aspects of the method, most prominently, while previous intake of hormones was an exclusion criterion for

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<sup>20</sup> Bio-availability is the proportion of a drug in circulation in the body (Kwon 2001, p. 243).

<sup>21</sup> Both Broca's area and Wernicke's area are regions of the brain associated with speech.

study participation (Hahn et al 2016, p. 1740) the authors did not discuss if or how they determined that study participants had not previously accessed black market testosterone, as is common for transgender individuals (Metastasio, Negri, Martinotti & Corazza 2018).

One of the unique aspects of the study is that it utilises imaging techniques to develop a visual understanding of brain changes. Brain imaging, and fMRI in particular, has been the subject of much critical literature that calls into question the extent to which the resulting images are essentially photographs. Choices must be made in how to represent the size of differences, and these choices impact how the resultant image is understood. It is interesting that the researchers chose to perform their investigation using expensive and cumbersome fMRI equipment, rather than performing cognitive tests of their participants that are relatively cheap. The former yields insight into the brain's structure while the latter could be used to make inferences about cognition. However, from the press release, it appears that it is the possibility of testosterone impacting cognition the researchers find to be interesting.

Finally, I draw attention to language used to describe the duration of the study. The study was described by its authors as longitudinal, repeated in subsequent media reporting. The study's authors describe the four-week period of testosterone administration as 'long-term'. While this is long-term in comparison to the usual snapshot fMRI studies, it implies a longer period of time, as seen in the news reporting.

### Traction of news reporting

While the study was widely reported online, much of this derives from a small number of unique articles that were reproduced or adapted in many locations. Determining the number of unique articles ceases to become a meaningful task, as many articles were abridged or adapted versions of others. Any decision on when an article is counted as 'unique' would be arbitrary. Due to difficulties with counting articles, the analysis in this chapter is not supplemented with any quantitative findings.

In the sample of 67 articles, there were several categories of articles emanating from a single source. I found that eight online articles were copied from, or closely based upon, the ECNP press release (ECNP 2015), entitled 'Testosterone shows brain changes in female-to-male transsexuals'. In total, 14 articles (three print, 11 online), were closely based on the Press Associations newswire (Radowitz 2015a), with some being identical copies and others being shortened versions, entitled 'Sex change women think more like men after testosterone treatment – study'. A further 15 articles (eight print, seven online) were loosely based on the



newswire (Radowitz 2015a), but with the introduction of the new claim that study participants lost their multi-tasking ability. Three articles (two print, one online) introduced claims relating to verbal expression. A further 27 articles (one print, 26 online) did not fall into any of the above categories.

### Logical structure of the study and its reporting

Donna Maney (2016) characterises the jump between finding a difference in brain structure and a behavioural difference between the sexes as a ‘fallacy’. She states that such arguments have the following form: (i) a structure/hormone X is different across the sexes, (ii) X is related to Y behaviour, and (iii) Y behaviour differs between the sexes; from there, it can be concluded that the difference in X causes the difference in Y (Maney 2016, p. 3). She states that this invokes the false cause fallacy; that is, confusing correlation with causation.

The deceptive reasoning identified by Maney is indeed the logical structure followed by the press release. The authors found that areas of the brain shrunk in participants who were administered hormones. These areas are known to be related to speech. Because there is a known difference in language abilities between the sexes, the authors therefore conclude changes to the brain as experienced by participants may affect their language capabilities. This argument does not consider the other brain change observed in the study (growth of the fibre tract) that may balance out the atrophy of speech areas of the brain. If the growth of the fibre tract was focused upon, the argument could work in a counter-stereotypical direction.

In articles presenting a multi-tasking result, the argument is modified. The logic is not made clear as no details on the multi-tasking result are provided beyond the headline. There is a difference in participants’ brain structure due to testosterone administration, and a supposed known difference that women are better than men at multi-tasking. The link between the brain changes and the ability to multi-task, which would be premise, is not explicated in the articles considered here (because such a link does not exist). While these articles list a number of brain changes found by the study, they do not specify which they believe is related to multi-tasking ability (I have been unable to identify any scientific literature linking Broca’s or Wernicke’s area to multi-tasking). Essential to these arguments is the assumption that administering testosterone to biological females is equivalent to them achieving male brains (which itself assumes that there is such a thing as a male brain).

### A new result: multi-tasking

Some news articles stated Hahn and colleagues found that women's multi-tasking abilities suffered when administered testosterone. This is a spurious claim not grounded in the article abstract or press release. The study authors did not conduct any tests of multi-tasking ability, did not refer to previous studies on multi-tasking, and did not otherwise refer to multi-tasking ability.

News articles that reported a multi-tasking finding do not present any evidence specific to multi-tasking, with the assertion usually appearing only in the headline and not discussed elsewhere in the article. These articles used quotes from the press release, and were not supplemented with any additional quotes. This lack of additional material indicates that the new claim about multi-tasking did not originate from correspondence with the authors.

The articles reporting a multi-tasking result also bear a strong resemblance to the Press Association newswire (Radowitz 2015a), that reported that testosterone makes 'women think more like men', albeit with a new claim introduced. Claims about the study investigating multi-tasking appeared in all fifteen of the largely similar articles categorised here as 'multi-tasking articles', which were mainly attributed to journalist Victoria Ward, who is a senior reporter at the Daily Telegraph. The claim also appeared in twelve of the articles that I have marked as 'other'.

The claim that the study finding related to women's multi-tasking ability appeared in the headline of three quarters of Ward's multi-tasking articles (n=11). The Daily Mail web version of the article, headlined 'Women who have a sex change 'lose the ability to multitask after being exposed to male sex hormones', claim scientists', goes on to state:

And now scientists have discovered that so closely linked is gender – and the ability to take on more than one task at a time – that women undergoing a sex change start to lose the skill. (Parry 2015)

Variations on this sentence appeared throughout this subset of articles. However, none explained how the researchers determined that their study participants went on to lose their multi-tasking ability. The article quoted above, like most others in this subset, goes on to state that the study found reductions in grey matter in Broca's and Wernicke's areas, and that the connection between these two sections was boosted. The author also includes the quotes presented in the press release. The logic connecting the study findings to multi-tasking ability, or any other behavioural changes, is absent. Despite the missing explanation, the author asserts

that the study found scientific evidence in favour of the ‘commonly held, yet widely argued, belief that women are better at multitasking’ (Parry 2015).

It is noteworthy that the title of the Daily Mail article contains the assertion about multi-tasking in quotation marks. This quote is attributed to ‘scientists’, however, it is not a quote from the study authors. The appearance of this information as a direct quote provides the claim with false legitimacy.

Throughout the articles presenting this claim, the study is presented as vindication of folk knowledge that men and women are truly different in stereotypical ways, for example:

We all know the old jokes about men and women – including that women can do two things at once whereas us men can only do one thing and we can only do it when the football’s finished on the telly. It’s a hoary old chestnut but it appears that it may actually be based in fact. (Jackson 2015)

So, turns out exposure to male sex hormones might actually hurt the brain’s ability to multi-task. Men be from Mars, Women from Venus, am I right fellas? Yeah, you guys know what I’m talking about. (Rugg 2015)

Both examples are written in a humorous way, addressing an explicitly male reader, much in the style of 2000s men’s magazines. The former even embraces the study as ‘finally, a scientific grounding for bad 90s stand-up comics’ (Rugg 2015). This style is taken to the extreme in the article on a sports news website:

Chicks ‘multitasking’ is just their inability to sit still for more than 30 seconds. They can’t just do nothing because they are like children. They have the attention span of a goldfish. That’s why they can never understand TV shows or get jokes. Congrats that you can do a bunch of menial tasks at the same time. I just choose to sit here and watch TV or have a drink and enjoy myself and do that stuff later because there’s really no imperative need to get it done right this second. But congrats on saying you can ‘multi task.’ (Clancy 2015)

This makes explicit the implication of the multi-tasking stereotype. Enhanced multi-tasking ability is used to explain women’s lesser intellect, as discussed earlier this chapter. It provides an imperative for being capable only of performing ‘a bunch of menial tasks at the same time’, as phrased by the above excerpt. The claims made about multi-tasking are reminiscent of the early 1990s assertions that the sexually dimorphic corpus callosum drives women’s greater

multi-tasking ability, as discussed earlier in this chapter. Despite the passage of time, women's advantage in multi-tasking has not been borne out in the scientific literature. Both instances, two decades apart, can be identically summarised as: popular media seized upon a small study of brain structure to buttress the stereotype of women's multi-tasking superiority, despite no discussion of multi-tasking in the initial study.

This is consistent with Maney's (2014) argument that brain structure facts are deployed as evidence for gender stereotypes, even when there is no logic or supporting evidence connecting the brain fact to the stereotype. Hahn and colleagues' results can be used to speculate on the gender stereotype relating to language ability (as is mentioned in the press release), due to its findings of areas of the brain that are accepted as related to language. Yet, some publications eschewed or de-emphasised this angle, instead choosing to perpetuate fabricated claims about the multi-tasking stereotype and gendered cognition.

#### Another new result: language ability

Some articles contained the false claim that Hahn et al's study found trans men's language abilities decreased when undergoing testosterone treatment. This claim occurred together with some of the multi-tasking claims, usually in the same sentence. The following is typical:

It transpired that verbal and multi-tasking skills decreased while others increased.  
(Jackson 2015)

Returning to Hahn and colleagues' own words, it can be surmised this belief arose from a misreading of the study abstract. The abstract declares that 'language performance is decreased in men and androgen-treated FtM' (Hahn et al 2015a, p. 2). These are the words the abstract ends on, which may leave the incorrect impression that the study found this result. Both claims in the concluding sentence are attached to footnoted references; that is, these were the results of other studies. A reader may assume that the study involved administering tests of language ability as well as performing brain imaging.

However, no tests of language ability were administered to participants in the study, as confirmed in Hahn et al.'s 2016 journal article. The article states the researchers have linked a known difference in language processing to the physical changes wrought by testosterone (Hahn et al 2016, p. 1743). In other words, the conclusions about language ability have been inferred.

Additionally, the strengthening of the fibre tract connecting Broca's and Wernicke's areas, while explained as compensating for the loss of grey matter (p. 1744), is de-emphasised both in the study and in the news reporting. Hypothetically if the stereotype was reversed such that men were believed to possess greater language ability, one can imagine the increased connectivity between language processing areas of the brain would be used to explain men's natural verbal ability.

### Thinking like a man

A group of news articles stated Hahn and colleagues' study showed 'women given testosterone begin to think like men'. This is a curious claim, as the study did not administer any cognitive tests. However, the claim the study participants began to think like men could be deduced using the false cause fallacy, as discussed earlier. I would characterise this claim as being an exaggeration from the researchers' own account of their findings. As I discuss in detail at the end of this section, the notion of 'thinking like men' fundamentally rests upon the assumption that men think differently from women.

This claim arose in the articles based on the Press Association newswire (Radowitz 2015a). The newswire states in its title and leading paragraph that women given testosterone 'think more like men'. It goes on to state that 'the discovery reinforced the idea that 'men are from Mars and women are from Venus' because of the way their brains are wired', invoking two metaphors in one sentence. Later on, the newswire explains that grey matter was found to deplete in Broca's area and Wernicke's area. The mechanism for a possible change in language abilities is made clear (albeit invoking the false cause fallacy). No further information is provided to substantiate the claim that women began to think like men.

Of the 14 news articles bearing a close resemblance to the Press Association newswire, 13 included references in the title to women thinking like men. Eight had an identical title to the newswire. Four included the claim about male cognition in quotation marks, for example: 'Women given testosterone during gender reassignment process "start to think more like men"' (Radowitz 2015b). As in the case of the multi-tasking articles, the dubious use of quotation marks lends legitimacy to this statement, as the reader may assume the quote is from one of the study authors, rather than from the newswire author.

Beyond the questionable logic linking the study findings to male cognition, and the conceptualisation of trans men as being essentially women, there is a further problematic aspect of the newswire and subsequent articles. The notion of 'thinking like a man' is itself

questionable. Some gendered assumptions are necessary in order to make the assertion that women can think like men. I believe these assumptions permeate news reporting of science relating to the gendered brain, in general, but are made more explicit in this case. This case study provides the opportunity to expose these assumptions.

Firstly, underlying the claim of ‘thinking like a man’ is the belief women and men have fundamentally different ways of thinking distinguishable from one another. There are two incarnations of this belief, either that there are two discrete modes of thinking, or, more recently, that male and female modes of thinking sit on each end of a linear spectrum, as argued in Baron-Cohen’s empathising-systemising hypothesis (appearing in many of the sampled articles in Chapter Five). Both variations of this belief defy the picture of each person possessing a mosaic of gendered traits that are not necessarily correlated with one another (Joel 2011). In the case of these news articles, it is implied that language ability denotes female-type thinking. The newswire also cites multi-tasking as a female skill and spatial ability as a male skill (but does not connect these statements to the study findings). Male and female cognition, in these articles, are based on stereotypes.

Secondly, these gendered modes of thought are assumed to be caused by sexual dimorphism of the brain. As Daphna Joel (2011) notes, it may seem self-evident that a sex difference in brain structure begets a sex difference in behaviour, but this is not borne out by any evidence. The male-typed brain, if there is such a thing, does not necessarily give rise to male-typed behaviour. Cordelia Fine (2010, p. 142) illustrates this with reference to the prairie vole. Voles have sexually dimorphic brain structures, but different hormonal triggers in male and female voles’ brains are used to reach the same behavioural outcomes for vole parenting.

The notion of thinking like a man or woman could be consistent with a social constructionist understanding of gender as performative: one acts like a man, internalises what it means to be a man, and eventually thinks like a man. However, the mechanism of testosterone in Hahn et al.’s (2015a) study demonstrates that thinking like a man or women is understood to be driven by hormones rather than being a consequence of the internalising of the norms of one’s gender. Any interplay between social constructionism and hormones is furthermore erased. The study (and therefore, the reporting) do not specify if the study participants were living as men, and what that could mean. Instead, being a trans man is reduced to the effects of the testosterone injection or patch.

### Significance of exaggerated claims

The appearance of new, stereotypical results in news reporting may have an impact on how readers understand themselves and others. As discussed in Chapter Three, the illusory truth effect occurs when a reader exposed to the same incorrect statement multiple times believes that the statement is true (Begg, Anas & Farinacci 1992). As the multi-tasking stereotype is repeated throughout popular media sources, it develops a facticity not grounded in scientific knowledge. Conceivably, the misleading reporting of Hahn et al.'s (2015a) study may be partially ascribable to the illusory truth effect - the journalist who wrote the first article including the multi-tasking claim may have thought it sounds true due to their prior exposure to the stereotype.

As in many of the articles seen in the main sample in Chapter Five, study results were sometimes used to excuse men's communication in relationships. For example, a relationships blog article on the study links it to evolutionary psychology, discussing how men and women have evolved to communicate in different ways. This is summarised as 'women are emotional speakers, whereas men are rational speakers' which can lead to relationship difficulties (Ruiz 2015). In this article, the scientific research was treated as a vindication of common-sense relationships advice.

News reporting performed the necessary logical leaps to treat the article as scientific proof that communication difficulties in romantic relationships are caused by the sexually dimorphic brain:

Finally, there's a scientific explanation for why men often aren't as talkative as their significant others. If you're having trouble connecting with your wife, girlfriend, or really any woman in your life because she says you aren't willing to talk, biology might be to blame. (Murphy 2015)

The knowledge claims made by news reporting are at risk of becoming 'neuromyths' – incorrect but widely accepted beliefs about the brain, as described by Tokuhamma-Espinosa (2010). In this case study, news reporting has resulted in the creation of new claims that were not found in the original study. These false claims have reached a large number of people through syndication.

### Conclusion

This chapter has contributed a case study of 'multi-tasking' to demonstrate how scientific knowledge is used in news reporting to legitimise gender stereotypes. In comparing the

reportage to materials produced by scientists themselves I was able to confirm that the conclusions presented in news reporting are the result of exaggerated claims. The appearance of new claims was characteristic of the global news reporting on Hahn et al's (2015a) study on imaging the brains of trans men given testosterone. Hahn et al (2015) did not report any results on multi-tasking, yet many of the news articles incorrectly reported they had found evidence for women's greater multi-tasking ability. The belief that women are naturally better at multi-tasking provides a rationale for women performing a greater share of household labour and childcare, similarly to the narratives presented in the previous case study on 'baby brain'. In this case study, there was also rampant exaggeration of claims relating to language ability. The exaggeration and fabrication evident in news reporting of Hahn et al.'s study merits attention because of the earlier discussed issue of repeated statements appearing true by virtue of their familiarity. The headlines reporting exaggerated findings from Hahn et al's study are added to the deluge of pronouncements about women being better multi-taskers and men having difficulties expressing themselves. There is a risk of such false or exaggerated claims lodging in the public consciousness as a 'factoid' or neuromyth. The force of this claim was aided by the use of metaphors, particularly the computer metaphor of the brain from which the concept of multi-tasking emerges.

The reportage follows an established pattern of seizing upon brain imaging studies and imputing a cognitive-based explanation. The news reporting was furthermore able to rely on established scripts of stereotypical gender roles. Crucially, new claims were able to proliferate due to a unique globalised news environment where a small number of unique sources are reproduced and adapted across many news outlets. The politico-economic context of the news environment strongly shapes both what stories are reported in the news, and how these stories are presented.

The next chapter synthesises the themes emerging in the results chapters of this thesis. I draw together four key themes which have developed: the legitimisation of popular knowledge as science, the persistence of scientific understandings of gender stereotypes over time, the pervasiveness of metaphors to convey simplified ideas about science, and finally that news reporting communicates scientific findings as authoritative and without criticism. I conclude with a brief discussion of critical factors contributing to trends in news representations of science: the politico-economic context of news production and of scientific research, as embedded in patriarchal values.



## Chapter eight: Enduring gender stereotypes

This final chapter reflects on the main themes of the preceding chapters and contextualises the thesis contributions within the changing politico-economic environment of news production and scientific research. This thesis explored news reporting of scientific research on behavioural sex differences, focusing on articles published in Australian media between 1990 and 2016. It addressed the question of how these media portray these differences, and in particular how the use of particular frames, reference to scientific authority, and popular metaphors serve to legitimise representations. The thesis also aimed to investigate whether representations had changed over time, and whether there is a bias in news media towards promoting a normative sexual division of labour. This investigation has taken place at the intersection of critical studies of science, gender, and mass media, drawing upon feminist scholarship in the field of science and technology studies. Much feminist literature establishes how science has been used in the past to justify the subordination of women. The unique contribution of this thesis is to find that this use of scientific knowledge to create, sustain, and naturalise the sexual division of labour has endured over time, and is facilitated by selective and simplified reference to science in mass media.

Drawing on data from a framing analysis of Australian news media from the late twentieth to early twenty-first centuries, supplemented with news coverage of specific topics, I investigated how knowledge claims relating to the brain are mobilised to produce and reinforce behavioural differences between the sexes. The themes that have emerged through analysis of Australian news articles published between 1990 and 2016 are the legitimisation of popular knowledge as science; the persistent belief in a scientific basis for gender stereotypes over time; the ubiquity of metaphors to explain and simplify science in mass media, and the uncritical reporting of scientific claims relating to gender. In this final chapter I provide an overview of each of these themes, before taking a more speculative approach to discuss the factors leading to the observations made in this thesis, and suggesting how these factors can be mitigated.

I have found that much of what is presented as ‘scientific’ in mainstream media would not meet internal scientific standards, which require that claims be made based upon empirical investigations, robust meta-analyses, or theoretical works subjected to peer review. As found in Chapter Five, some of the ‘evidence’ presented or explicitly described by journalists as ‘scientific’ amounts to claims made by experts and unsourced factual statements. Certain experts, some of whom as Australian authors may enjoy increased prominence in Australian

publications, appear frequently in news media to make gender essentialist claims. There is bias introduced in how scientific evidence of varying quality or robustness (as judged against scientific standards) is weighted. As found in the baby brain case study, journalists give preference to claims resulting from studies where findings align with existing gender stereotypes, even if methodologies are weak, while findings that challenge gender stereotypes, which tend to be from more methodologically robust studies, are generally disregarded.

A second finding is the remarkable endurance over time of the use of science to legitimise arguments that there is a biological basis for conventional or traditional gender roles. The biological sciences have long created and sustained an authoritative explanation for stereotypical gender roles. As discussed in the chapter on the scientific subordination of women, which draws on material generated by scientists and feminist critiques of science, neuroscience now often provides the source for evidence to justify and explain the essential differences of the sexes. Moreover, there is a long history of scientific understandings of gender roles being reported in mainstream news, with news reporting presenting a simplified understanding of scientific theory. As emphasised in the introductory chapter, uncritical news reporting of the science of gender roles is not new; in Australia at least, it is as old as news reporting itself. It is noteworthy that the use of science to legitimise and defend gender roles persists today, despite decades of feminist critique.

A third finding is the reliance of news reporting on several metaphors to communicate scientific conceptions of gender. In the news articles examined in this thesis, these metaphors are used to communicate complex scientific ideas efficiently to a general audience. Where these metaphors have a gendered element, this further facilitates the use of science to explain normative gender roles. The use of the computing metaphor in descriptions of the workings of the brain particularly emerges in the case study presented in Chapter Seven, in which women are believed to have an innate aptitude at multi-tasking (a concept which emerges from the idea of parallel processing). Another prominent metaphor is that of the caveman, with news reporting suggesting behavioural differences between the sexes are a result of selective pressures on early humans. The caveman is at once a metaphor, allowing the reader to quickly grasp the essential nature of modern gender roles, and a factual claim. Understandings of the sexually dimorphic eye and ear are similarly both factual claims and a synecdoche for gender roles. While sexual dimorphism in the eye and ear are not drawn from a mainstream scientific viewpoint, mass media nonetheless presents these concepts as scientific and relevant to the sexual division of household labour.

Finally, this investigation found that news reporting conveys a simple understanding of gender roles as biologically determined. There is a lack of acknowledgement of the sociocultural factors that shape these roles and that result in women undertaking a greater share of unpaid caring labour, as this is considered by news reporting as reducible to biology. Some news reporting can be characterised as a response to feminist critiques of social structures. Such reporting refers to supposedly misguided ideas about equality, refuting the social constructionist viewpoint with reference to scientific findings.

There are many and diverse factors influencing news reporting of scientific research on behavioural sex differences. Of these factors shaping news reporting, the following are particularly noteworthy: the politico-economic context of news production and of scientific research, and patriarchal values which are potentially reinforced by this context. I will now briefly discuss each of these, which must be understood if change is to occur.

Firstly, the politico-economic context of news production supports the perpetuation of gender-stereotyped news of the kind examined in this thesis. Gender biases are supported in news reporting through a combination of several factors: syndication across multiple publications, news values, the use of frames relying on familiar cultural knowledge, as well as pressures from changing economic conditions such as the need to produce more content with less editorial oversight. Austerity in news production creates an opportunity for the proliferation of scientific-sounding claims, due to a decline in editorial staff and specialist scientist reporters, as discussed in Chapter Three. There is a tension between news values and norms, and accuracy in science reporting, as demonstrated in Chapter Three. While science, in its ideal depictions, is nuanced and tentative, news reporting favours unequivocal conclusions and therefore can present scientific findings in more definite, and sometimes inaccurate, ways. Moreover, much of science reporting appeals to the news value of entertainment, with the content being presented to amuse or titillate the reader. This can take away from the original messaging of the scientific study, which may or may not have implications for understandings of behavioural sex differences.

A further factor is cost cutting and economic constraints within media companies, discussed earlier in Chapter Three. There are increasing pressures on journalists to rapidly write a large volume of articles, in line with the operations of the 24-hour online news cycle. One impact of the resulting newsroom cuts is that journalists are more time-poor and have less scope to check facts. As investigative and in-depth reporting declines due to time pressures, there may be

greater reliance on press releases as a source of news. As found in the multi-tasking case study (Chapter Seven), which investigated news coverage resulting from a single scientific study, much of the news coverage was closely based upon the scientists' press release. The resulting news coverage was not critical of the study's purported relevance to gendered cognition. Pressures on journalists are compounded by cuts to editorial staff. Some news outlets have dismissed their sub-editors and publish stories submitted by journalists with little, if any, editing (Garg 2015), as discussed in Chapter Three. Furthermore, owing to the economic context, there is less specialisation among journalists in recent years. Science reporting is now left to generalist reporters rather than trained or experienced science journalists (Leach 2017).

Secondly, the funding environment of scientific research is such that the creation and publication of research promoting sex differences is privileged. There are several points in the creation of scientific research that contribute to the systemic creation of gender facts through science. This begins at the funding allocation stage and ends with choices on which research is publicised, as explored in Chapter Two. In Australia, research funding allocation privileges the creation of medical and natural scientific knowledge over other types of knowledge. This limits opportunities for the development and media reporting of sociocultural knowledge on gender. Within the natural sciences, publication bias ensures novel results are more likely to be published in scientific journals. As discussed in Chapter Four, there is also a gender bias in funding allocation. Men receive a greater share of public research funding, and this disparity in funding allocation may impact the types of research questions which are asked and how research is conducted. It is also worth mentioning that science and journalism intersect at public relations units of universities and research centres, as noted in Chapter Three. These public relations units are skilled at promoting scientific findings to a mainstream audience, including by aligning research findings to news values, which may involve exaggeration of the significance of findings. This exaggeration may occur because of pressures to attract a higher profile for their institute's research, and hence research funding, and ascend rankings lists. The impact of the Australian research funding environment on news reporting of science could be determined by conducting an international comparison. However, as much of the news reporting is on research conducted internationally, it can be expected that the findings in this thesis would also be relevant to news reporting elsewhere.

Finally, a major factor predisposing the use of gender-stereotypical frames in news reporting is the prominence of these frames in our culture. As highlighted in the introductory chapter, the use of science to promote gender ideology in mass media pre-dates the current economic

constraints of both science and news production, and has in the past supplanted, and worked in tandem with, religion-based understandings of gender roles. There is a wealth of feminist literature that critiques how the biomedical sciences create and reinforce particular conceptions of gender (e.g. Fausto-Sterling 1985; Fine 2010a; Jordan-Young 2010; Tavris 1992). Gender stereotypes are constructed and promulgated through different societal infrastructure, including but certainly not limited to the institutions of science and media.

With recent rapid changes to the politico-economic environment of news production, the future of reporting is unclear and is being shaped by emerging media. The rise of social media has changed how news is consumed. Rather than flicking through a newspaper with diverse stories and perspectives, people can access news tailored to their interests by choosing to follow like-minded outlets on their social media of choice and receiving algorithmically generated suggestions for further content of interest. Social media is increasingly changing how information is shared and interpreted, and news outlets have adjusted accordingly by tailoring their content to perform well on online platforms (Vaidhyathan 2018, p. 98). There is thus an opportunity for future investigations on audience effects to examine how curated media consumption impacts readers' understandings of a scientific basis for essential differences. While there is the appearance of democratisation of news through citizen journalism and mass access to the internet and social media, the majority of internet traffic is held by a small number of large companies. Further consolidation of media outlets carries the risk that there will be less diversity of viewpoints in mainstream media, and that syndicated errors can propagate more widely. Changes to media ownership laws in Australia in 2017, in which the 'two out of three' and '75 percent audience reach' rules were repealed, has cleared the way for media conglomerates to exercise even greater dominance among Australian audiences (Dodd 2017). The regulatory environment of mass media in Australia is minimal (Dwyer 2014). Australian journalists voluntarily abide by a code of ethics that is based on the principles of honesty, fairness, independence, and respect for the rights of others (Media, Entertainment & Arts Alliance 2019). There are presently no specific standards for science reporting in Australia, suggesting the need for guidelines, along similar lines of current advisory guidelines on reporting elections (Australian Press Council 2018) and domestic violence (Australian Press Council 2016). Such guidelines would be a constraint on the politico-economic interests at play. There are some initiatives in this space already, such as the Australian Science Media Centre which issues media briefings and assists journalists in finding experts, and is connected to several other science media centres globally. More broadly, the regulatory environment

relating to content and ownership of mass media requires urgent attention to encourage a diverse, democratic and trustworthy media landscape. This is despite the complexity of effective regulation in a globally interconnected, increasingly online media environment.

Reforms to science reporting would not be a complete solution to preventing the kinds of gender stereotypical reporting illuminated by this thesis. Over time, the promotion of gender stereotypes through societal infrastructure including science and mass media has endured. The communication of scientifically understood gender stereotypes has also become more efficient, as suggested by the final case study chapter, with syndication and online news allowing stories to propagate. Crucially, the endorsement of gender roles is durable over time, regardless of the specifics of the scientific knowledge and of how audiences are reached. The absorption of supposedly scientific facts into common knowledge, including through news media, has continued to be a critical part of legitimising gender roles into the twenty-first century. Scientific explanations for the sexual division of labour provide an authoritative, empirical framework which individuals can draw upon to understand their own circumstances as prescribed by nature, rather than socially constructed under patriarchy.

### Concluding comments

This primary contribution of this thesis is, despite decades of feminist critiques of how science and other institutions embed the subordination of women in Western societies, popular news media continues to promote simplistic understandings of biology as determining the sexual division of labour. When formulating this research, I intended to examine how the idea of gender might be challenged by popular news reporting of science. However, the news articles sampled lacked any critique of gender or science, rather drawing upon heteronormative gender stereotypes and certain metaphors (such as the caveman) to construct an image of men as domestically helpless and emotionally limited, and women as adept at household and emotional labour, capable of doing many simultaneous tasks to a mediocre standard.

This speaks to what sociologist Arlie Hochschild labelled the ‘stalled revolution’ (Hochschild 1989), in which women are expected to undertake unpaid household labour despite and alongside increased workforce participation. A biologically determined explanation for the sexual division of labour implies it cannot be changed by efforts to create a more equitable society. This naturalisation creates additional work for women to perform in their relationships by managing men’s contributions to household labour, as discussed in Chapter Five. This thesis has found depictions of the sexual division of labour as biologically determined have endured

over time in mass media, supported by use of rhetorical devices, which convey scientific knowledge in a simplified and often biased manner. Mass media can be used to reinforce existing knowledge about gender roles, or it can be utilised as an opportunity to dislodge these stereotypes over time. It is only through recognising and questioning current practices in news reporting of science that we can work towards change.

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## Appendix 1 – Types of evidence in Chapter 5 analysis, ordered by frequency

**Expert opinion** – Quotation or book quote from a scientist, medical practitioner or other expert.

**Reference to belief or fact** – No clear link to any particular scientific investigation; rather, a statement of fact (accurate or otherwise) that is labelled in the article as a scientific perspective.

**Brain imaging** – A study based on brain imaging techniques such as function Magnetic Resonance Imaging (fMRI); may or may not involve a task being administered to study participants. These studies are usually, but not always, performed with human participants.

**Behavioural experiment** – Usually a laboratory-based (or, less commonly, field-based) psychological experiment that investigates human behaviour with a change in conditions being the independent variable.

**Hormone study** – Any type of investigation involving sex hormones; for example, measuring of hormone levels with certain medical conditions, measuring hormone levels in the amniotic sac, correlating hormone levels with traits or behaviours, and administering hormones and observing the effects. These studies may be conducted on either human or animal participants.

**Animal study** – A test or trial on animals; usually mice, and occasionally voles, bats, or primates. This category encompasses many types of studies, including behaviour tests, genetic tests or experiments, drug trials, and hormone tests or experiments.

**Survey** – A questionnaire in which participants are asked to respond to topics or ideas.

**Population or statistical study** – Data collected from representative samples of the population.

**Genetics study** – Studies investigating the workings of different genes; may involve humans or animals.

**Anthropometry** – Any investigation associated with measuring the size of body parts, and usually correlating this information with certain traits, sex hormone levels, or both. May involve humans or animals.

**Evolutionary conjecture** – A theory of human development relying upon the logic of evolution by natural or sexual selection.

**Meta-analysis** – A peer-reviewed study bringing together the results of many different experiments, usually with statistical methods.

**Drug trial** – A test of the efficacy and side-effects of a pharmaceutical; may involve humans or mice.

**Planned research** – A research project that has not yet been conducted, but is scheduled to occur.

**Anthropology** – An investigation, usually of a non-Western society, of behaviour and/or culture.

**Interview-based qualitative study** – Any sociological study involving interviewing participants.

**Longitudinal study** – Any type of study that is undertaken over a long period of time or in waves.

**Other type of experiment** – A scientific experiment that does not fit into any of the above categories. Of the two pieces of evidence coded in this category, one was on sex differences in digestion, and the other was on the proportion of female and male offspring produced by attractive couples.