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What is ADHD?

Attention Deficit Hyperactivity Disorder (ADHD) is not one symptom or even two symptoms, as the name might suggest. ADHD is not just deficient attention or excessive activity; it is a cluster of behaviors that are, more often than not, seen together. Thus ADHD is a syndrome comprising of several, presumably connected, symptoms.

The main behaviors observed in an individual with ADHD are *impulsivity*, *inattention*, and *hyperactivity*. These three are the key characteristics of ADHD, but as we shall see when we look at diagnosis (see chapter 2), this triad of behaviors is not always its absolute defining characteristic. For example, ADHD can occur without the hyperactivity being present – so children do not have to be running around and bouncing off of the walls all the time in order to have the condition. Or ADHD can be primarily about impulsivity, which the title of the disorder does not allude to. Impulsivity may be one of the greatest handicaps in the range of behaviors seen in ADHD (see chapter 4). Furthermore, until recently ADHD has been seen exclusively as a childhood disorder – a disorder that the child may eventually grow out of over time. Over the last 15 to 20 years, however, research and clinical experience have been able to challenge this assumption by defining and identifying ADHD in adults.

One could be forgiven for thinking that ADHD is a recent phenomenon emerging during the past 20 to 30 years. Certainly there has been a dramatic increase in the diagnosis and treatment of ADHD, but is it a new disorder? The answer is most certainly *no*. The impact of ADHD may be greater than at other points in time, but it is not new. Indeed, early reports in the medical literature providing accounts of individuals demonstrating the behaviors associated with what we now call ADHD can be found at the beginning of the twentieth century.

Throughout the last century, and especially in the last 30 years, there have been a number of differing perspectives on the cause of ADHD. These perspectives are wide-ranging, including societal causes (typified by such books as *The Ritalin Nation* by Richard DeGrandpre [6]), neurobiological causes (e.g. [7]), through to evolutionary/genetic theories that claim ADHD is a result of behaviors that were useful in our ancestry, but that may now have little relevance in a modern-day westernized world [8].

Most accounts of ADHD in the scientific literature begin with describing the disorder as a complex neurobehavioral problem with a genetic component. The weight of the evidence supports this supposition. However, science is not without bias itself. Some have argued that there is a bias towards funding research that is medically oriented. We must remember that science, like everything else, does not take place in a cultural vacuum. Why, then, does the science not reach the media, the education systems, and even the medical professions? In short, science can be more difficult to comprehend than other explanations, which lend themselves to our own inherent biases and opinions.

So what is ADHD? It is a neurobehavioral disorder of great complexity; it is a disorder with a genetic pedigree; it is a disorder in which environmental conditions can exacerbate or ameliorate the symptoms; it is a disorder which has considerable impact on the life's of those diagnosed with it, but also those who live/work/study/interact with someone diagnosed with the disorder; it is a disorder which can in many cases be treated; it is a disorder that is most likely going to persist into adulthood; it is a disorder which is often seen with other disorders; and it is a disorder that requires further research for a greater understanding.

What Does ADHD Look Like and Who Has It?

One might expect to gain the answer from a review of diagnosis. However, this question is different from the question of clinical diagnosis (see chapter 2). The diagnostic criteria of ADHD do not do justice to a description of ADHD and what it is like to live with the disorder. Diagnostic criteria can be dry lists that lack detailed descriptions. Furthermore, there is a tendency for the symptom lists to be presented to the lay reader without a context or explanation of the process involved in the assessment. ADHD can have positive and negative qualities – although its negative components are the ones that impact most on normal functioning and are the most prominent;

after all, psychiatry is concerned with deviation from normality and therefore they receive the greatest amount of press.

Who has ADHD? Is there a particular type of person who has ADHD? Do they have a certain type of parent? Do they come from rural or urban environments?

Essentially anybody can have ADHD! ADHD has no prejudice; it does not discriminate. It transcends socio-economic groupings, cultural and racial groupings, although some distinct clusters appear in the literature (e.g. in one American study non-Hispanic white males were mainly identified with ADHD [9]). However, there is one group that ADHD tends to select above all others, and that is the male (this is certainly the case in early childhood).

A web-based search reveals a number of notable individuals with supposed ADHD; however, they are not subject to the diagnostic rigor necessary for confirmation. An interesting and recent paper has used several biographies of Che Guevara to identify him as having had the disorder [10].

ADHD – Two Faces of the Same Coin

Two famous cases of ADHD, with different courses of the disorder and outcomes, can be found in Kurt Cobain and Michael Phelps.

Kurt Cobain, the creative backbone and front man of Nirvana, is a case of ADHD with comorbidities (more than just one co-occurring disorder). At 7 years of age, Cobain was prescribed Ritalin (methylphenidate) for ADHD, which he took for the comparatively short time of three months. As a child, he worshiped stuntman Evel Knievel (the excitement, risk, and danger are all seductive to those with ADHD). In third grade, Cobain dived from the deck of the family's house onto a bed of pillows and blankets below. He clearly had no fear and was happy to engage in high-risk behavior typical of ADHD. Despite his troubled childhood he became successful with the grunge band Nirvana. As is often the case within the music industry, the artists avail themselves of drugs. Cobain is known to have had serious drug problems. In one of the many books on Cobain's life and death, his widow, Courtney Love, blamed Ritalin (which she had also been prescribed) for Cobain's later addiction to heroin. Love is quoted as saying, "When you're a kid and you get this drug that makes you feel that [euphoric] feeling, where else are you going to turn when

you're an adult?" [11] (p. 20). This quote and its context are interesting for a number of reasons:

1 Initial reading of it suggests that Ritalin (methylphenidate) was the cause of Cobain's troubles – does taking a powerful stimulant open the door to addiction? There is a body of scientific evidence that suggests this is not the case (see chapter 8).
2 There was little continuity of care in that as an adult he no longer received treatment for ADHD. Perhaps if he had been treated for ADHD as an adult he may not have descended into addiction. This is pure speculation; Cobain had other demons in his psyche such as depression and physical/psychosomatic pain.
3 Finally, the quote indicates a need to feel sensations. As a child Cobain would engage in sensation-seeking behavior, but as an adult those sensations could be found by altering his biochemistry with drugs. A characteristic of ADHD is the need to seek out new experiences [12].

Sadly Cobain killed himself at the age of 28. The role of ADHD in his fate is far from clear and the disorder does not appear to be documented in his later life.

Michael Phelps, the Olympic gold medal-winning swimmer of 2008, is a more jubilant case of ADHD. Phelps was diagnosed with ADHD at the age of 9 and prescribed methylphenidate. Phelps was also supported by his family, most notably his mother, Debbie. According to Debbie, "I was told by one of his teachers that he couldn't focus on anything."[1] She continues, he "never sat still, never closed his mouth, always asking questions, always jumping from one thing to another. But I just said, 'He's a boy.'"[2] This is a common assumption: the child is just being a boy. The question that is important in ADHD is at what point do these behaviors become problematic for the individual. ADHD behaviors can be considered to exist along a continuum, e.g. hyperactivity at one end, normal in the middle, and sedentary behavior at the other end. The experiences with school were also problematic, as Debbie recalls, "In kindergarten I was told by his teacher, 'Michael can't sit still, Michael can't be quiet, Michael can't focus.'"[3] Debbie was not one to accept no for an answer: "I said, maybe he's bored."

[1] http://www.additudemag.com/adhd/article/1998.html.
[2] http://wjz.com/seenon/michael.phelps.adhd.2.777123.html.
[3] http://www.timesonline.co.uk/tol/sport/olympics/article4521576.ece.

The teacher said that was impossible, "He's not gifted," came back the reply. "Your son will never be able to focus on anything."[4] It is surprising, and disheartening, that some teachers have such a defeatist attitude – such attitudes to ADHD need to be addressed. Cases such as Michael Phelps may well help dispel some of the negative assumptions surrounding the disorder.

Debbie Phelps worked closely with the school to ensure he received the extra help he needed. "Whenever a teacher would say, 'Michael can't do this,' I'd counter with, 'Well, what are you doing to help him?'" she recalls.[5]

Examples of her input can be seen in the following extract:

> After Michael kept grabbing a classmate's paper, Debbie suggested that he be seated at his own table. When he moaned about how much he hated reading, she started handing him the sports section of the paper or books about sports. Noticing that Michael's attention strayed during math, she hired a tutor and encouraged him to use word problems tailored to Michael's interests: "How long would it take to swim 500 meters if you swim three meters per second?"[6]

After two years of taking medication, Phelps told her he wanted to stop. He stopped and he did fine, possibly due to the regime of competitive swimming. Phelps's busy schedule of practices and competitions imposed so much structure on his life that he was able to stay focused without medication.

Phelps also had strong support structures that allowed him to succeed in swimming; furthermore, giving up stimulant medication allowed him to compete without fear of drugs testing being positive. Methylphenidate and amphetamine are prohibited substances in sport.

At the Beijing Olympics in 2008, Phelps won eight gold medals, breaking the 1972 record set by Mark Spitz. However, his ADHD can still become evident, as witnessed by his mother: "He still jumps from thing to thing. He's talking to me and texting someone on his Blackberry and I'm like, 'Stop it. It's either me or this.'"[7] More recently he has been implicated, by the media, in recreational drug use, which is very common in ADHD (see chapter 8).

[4] http://www.timesonline.co.uk/tol/sport/olympics/article4521576.ece.
[5] From http://www.additudemag.com/adhd/article/1998.html.
[6] From http://www.additudemag.com/adhd/article/1998.html.
[7] http://wjz.com/seenon/michael.phelps.adhd.2.777123.html.

Table 1.1 The three key symptoms of ADHD

Inattention	*Hyperactivity*	*Impulsivity*
Does not pay attention	Fidgets	Talks excessively
Avoids sustained effort	Leaves seat in class	Blurts out answers
Doesn't seem to listen when spoken to	Runs/climbs excessively	Cannot await turn
	Cannot play/work quietly	Interrupts others
Fails to finish tasks	Always "on the go"	Intrudes on others
Can't organize	Talks excessively	
Loses things		
"Forgetful"		
Easily distracted		

The Negative Impact of ADHD

The symptoms of ADHD are rarely placed in a positive framework (except when considering evolutionary accounts of the disorder – see chapter 5). Whilst the symptoms of ADHD in some cases and situations can be positive (e.g. Michael Phelps), on the whole they have a profound negative effect on the quality of life experienced by the person with the disorder. However, this negative impact is not restricted to the individual with ADHD; it can also extend to those they come into contact with, such as family members and colleagues and fellow students. For this reason the world of psychiatry refers to it as an externalizing disorder.

ADHD, as we shall see in future chapters, is not just one single entity, but rather is a term that encompasses many sub-syndromes with differing symptoms and prognoses. The symptoms of ADHD fall into three categories: (1) inattention, (2) hyperactivity, and (3) impulsivity (see Table 1.1).

What is ADHD Like?

To answer this we need to decide on the perspective: are we patients, parents, siblings, educators, or health professionals? For parents the main feature of ADHD might be the impulsivity and aggression; for the teacher the main feature might be the lack of attention and/or self-control; for the psychiatrist the main problems may the behavioral impact of

the symptoms across several aspects of life; and, most importantly of all, for the person with ADHD the social implications, e.g. the feeling of isolation and peer rejection and the need to fit in, may be the most important.

Clearly there are different agendas for each perspective. The symptoms of ADHD impact on all those they come into contact with, and if the behaviors result in negative interactions, this will only continue to fuel the psychosocial problems the person with ADHD experiences. By minimizing the symptoms, the psychosocial aspects associated with ADHD may reduce. However, there is a time delay between symptoms management and a return of self-esteem – it may take a long period of time for self-esteem to return.

A recent article looking at the views held by adolescents of their own ADHD [13] saw them as "square pegs" being forced into "round holes" (society/school). This study demonstrated that those with ADHD viewed themselves as existing in an imbalanced state and that differences were intensified through interactions with others. The authors argue that the mismatch between the *square peg* that is ADHD and the unmovable *round hole* of society intensifies the squareness of ADHD – the rounder the society, the squarer the ADHD, and then a vicious circle which leads to a feeling of a lack of control. Whilst the *square-peg–round-hole* view may fit well with some of the pop psychology views of ADHD in which society is "wrong," one has to remember that there is a great deal of suffering experienced by the *square pegs*. Furthermore, why are there *square pegs* when there are so many apparently *round pegs* that fit nicely into the *round-holed* world? The answer to this question may lie in evolutionary biology and genetics (see chapter 5).

To get a feel for life with ADHD, the following extracts from the UK's National Institute for Health and Clinical Excellence (NICE) guidelines that were published towards the end of 2008 are illuminating. These accounts provide a touching insight into those who experience ADHD and are full of often instantly recognizable comments – the *square pegs* theme continues. These accounts of ADHD are both depressing, because of the suffering and injustices that have been experienced, but also uplifting, as many have been able to triumph over the adversity of the disorder. For those who wish to see the full transcripts, go to pages 68–89 of the NICE guidelines.[8]

[8] http://www.nice.org.uk/CG72.

To further help identify key features of ADHD or points of interest, comments are made where necessary with reference to chapters or other sources that focus on a particular aspect of the disorder.

Adult male personal account

> My mother comments that she immediately saw many differences between me as a baby and my three older sisters; however she ascribed this to me being a boy. As a baby I used to bite my mum so much that she had bruises all down her arm … .
>
> Starting at my first primary school was a mixed experience. I did not make friends easily and although I was fairly bright I did not apply myself to my work with any commitment or enthusiasm. The older I got the more trouble I got into: answering back to teachers, lying to other children and performing stupid pranks to try and gain credibility … .
>
> I was rude, lazy and aggressive and I lied constantly; as a result I was very lonely … .

In this account the social isolation and a lack of self-esteem as a result of ADHD are abundantly clear.

> When I was 7 years old and had only been in the new school for less then two terms, my parents took me to see an educational psychologist. I completed a few tests and had a short interview with him. He concluded that I had some obsessive tendencies, anxiety and esteem problems … .

Here is a clear case of the need for differential diagnosis (see chapter 2). The symptoms of ADHD appeared similar to other disorders that can actually look like ADHD or coexist with it.

> [The Educational Psychologist] recommended to my parents that I move to a smaller school with smaller classes. This meant going to a private school, where I was relatively happy for 2 years.

This is interesting, and I have a somewhat cynical perspective. The Educational Psychologist, whilst highly professional and governed by a professional body (the British Psychological Society), is often employed by the Local Education Authority (LEA); surely there is case for a conflict of interests in such a role. The Educational Psychologist will know that there are few facilities suitable in UK state education, therefore the problem is

shifted away from the LEA, and the financial implications associated with such a facility, and placed back onto the parents. Whilst I am entirely in agreement with the Educational Psychologist, one cannot escape the fact that the LEA will not be able to provide such a provision (at least not without a struggle). The only way forward is to seek statutory assessment with the intention of obtaining a Statement.[9]

> I enjoyed boarding and found myself able to build good relationships with other children. I also really enjoyed sport, and eventually captained the cricket and rugby teams. I still got into trouble a fair amount, but the headmaster was very patient and not punitive.

In this instance a skilled headteacher was able to modify the behavior without the constant need for punishments, etc., which are not very effective in the management of ADHD. The self-esteem of the child was increased, as he was able to play to his strengths in sports – similar to Michael Phelps.

> My fortunes changed when a new headmaster came to the school. He and I did not see eye to eye from the start. He was a military-styled bully who suspended me on the second day. … His punishments were severe and eventually he took away any self-respect I had left when he forced a confession out of me for something I hadn't done.

The child with ADHD is assumed to be guilty because of his previous history – even a jury does not have access to the accused's previous criminal history! It often appears to be the case that he or she who cries loudest is the victim. It is easy for children to identify a person to blame when there is a precedent set. Furthermore, this new headteacher was not skilled in the use of incentives and only issued punishments. The stark contrast between the two styles of headteacher indicates that with appropriate skills some cases of ADHD can be managed with far greater success.

At the age of 12 the diagnosis of ADHD was given.

> My teacher made a huge difference to my experience of school when he realized that a lot of the time I did not ignore people but in fact did not hear them. I had small plastic drainage tubes [to treat glue ear] inserted into my ears, and this had an immediate and positive impact … .

[9] Guides for statutory assessment can be obtained from http://www.ace-ed.org.uk.

The importance of looking for all explanations for behavior is demonstrated above. Although the glue ear does not mean that he did not have ADHD, it does explain some of the behaviors, e.g. the apparent lack of attention. Given that teachers provide verbal instructions, if the child does not hear them, he cannot respond to them.

> I had also started smoking when I was 11 and this became heavier; I regularly skived off school to smoke, drink or get high … .

Substance abuse is higher in ADHD, and nicotine is often considered to be a starter drug that leads to other drugs (see chapter 8).

> … drugs and alcohol were still an increasing problem. I worked in pubs and clubs and would get drunk most days; I experimented with many drugs – mostly pills and LCD [presumably LSD]. I frequently drove while in a dangerous state … .

The substance misuse problem is exacerbated by the environment in which this person worked. The impulsive nature of ADHD and substance abuse means that it would be very difficult to ignore the temptation to consume drugs and alcohol.

> … and although I had many friends, lying was still a problem. I got bored with the jobs I did very quickly – one lasted only a single day, and the most I managed was 6 months.

Once the novelty of a job wore off, this person appeared unable to sustain the attention required. This may be a by-product of tedious jobs that are unskilled and repetitive, but it could equally be a result of the thrill seeking that can be a part of ADHD.

> I had not thought about my ADHD for a long time, and I had not made the connection between it and dropping out of school, not committing to a job and my extensive drug and alcohol abuse. (Only later did I discover that the disorder was also associated with my frequent trips to casualty: I have broken both my funny bones, have cracked ribs and have fractured my skull, as well as having many injuries from cycling accidents. I also had five car accidents in my first 2 years of driving.) However, signs of my ADHD came back to me in my new job, which was very repetitive laboratory work. After about 2 months my careless mistakes – due to inattention – were causing a problem,

> and I moved departments and left a month later. I fell back on my pub and club experience, which left me short of money and exhausted. I started drinking and using drugs heavily again.

Accidents and the loss of jobs are all too common in adult ADHD (see [14] for a comprehensive review).

A series of fortunate events meant this person re-engaged with education.

> My educational re-birth has taken me through a degree and masters and I am now in the final year of a PhD.

The symptoms of ADHD are not linked to intelligence. This person has succeeded in university education, which is somewhat different to secondary education: university education is able to celebrate differences and creativity; furthermore, at university you choose what you want to do, especially when one engages in PhD work.

> I have never taken drugs for my ADHD, though I have no doubt they would help me.

A family history of epilepsy stopped drug treatment, but this person did have a history of drug use, which may be considered as a form of self-medication (see chapter 8).

> There are many things that I do which help greatly: regular exercise is a must, and without it I get restless and depressed. I also ensure that I reserve plenty of time for creative activities – I have played the guitar for many years and love composing, performing and recording music. I also love writing, something my current work lends itself very well to, and I have already had three papers published. I had a very difficult experience at school and there are many things I would do differently if I could.

In adulthood the symptoms of ADHD can be managed by medication and other actions, as seen in this case, where the excess energy is channeled into constructive activities. Exercise is generally recommended: a recent report indicates the benefit of a walk in the park [15]. School, meanwhile, was difficult for this person, and under the circumstances I feel it is the school and the education system that should have done things differently.

Adult female personal account

> I realised that I was different from other kids when I was at primary school. I remember having both the desire to do really bad things and then acting them out, like poking my mum in the eye with a pencil or ripping up the book she was reading.

Even at an early age she was aware that she was somehow different from the other children.

> I really struggled at school with reading (because of my impulsiveness and also because of dyslexia which was only diagnosed when I was an adult) and used to steal money from my parents to pay other children to read the books I was supposed to so that I was able to tell the teacher the story.

Dyslexia is a common comorbid condition, but the evidence of dyslexia may be masked by the more overt ADHD behaviors. Such comorbidity highlights the need for comprehensive assessments of the child. One also has to admire that this young child had enough intelligence and character to find a solution to her reading problem, albeit a slightly devious one, which would continue to mask identification of dyslexia.

> By the time I entered secondary school I had a reputation as being one of those "bright but naughty" kids, which is what I guess most kids with ADHD were called then. I gravitated towards similar kids and started experimenting with soft drugs and alcohol at around 11 years old.

The reputation of someone with ADHD goes before them. One has to be careful that this does not lead to a self-fulfilling prophecy in which we become a product of our reputation. It is important to start with a clean slate in a new school.

The fact that this person kept company with like-minded children should be of no surprise – we all do this, but membership of delinquent groups is associated with the increased likelihood to experiment with drugs (see chapter 8)

> My only love in life was sport, and I swam, cycled, did athletics and surfed. I enjoyed high-risk activities, and rode around on older boys' motorbikes, started taking hard drugs and had regular sex by the time I was 13.
>
> I … stopped attending school because I found it too difficult and either went to the beach to surf and have sex, or hung around town shoplifting and drinking. I got pregnant but didn't follow it through.

Despite engaging in sports, which would be good for self-esteem, she mixed with older children with a window into a more risky adolescent world. Early sexual experiences are associated with ADHD, along with pregnancies and sexually transmitted infections [16].

> My parents complained that I was too difficult to control, and they now say that they nearly separated because of my bad behaviour.

The problems of ADHD are not restricted to the individual with the diagnosis; ADHD affects all those around them, e.g. the parents. A child with ADHD can put a great strain on the parental relationship, which can lead to divorce, and then the problems of divorce can impact on the child [17–18].

> When I finished school I left home and drifted through a number of manual jobs, not ever being able to complete the tasks required of me.
>
> I made quick and silly decisions: for example, I often stole cars and drove while drunk or drug-impaired. I got involved with credit card fraud and worked in a topless bar when I was sober. I spent a brief time in prison on drugs-related charges too. I had a problem with authority and was consistently defiant in my attitude to life.

Unskilled monotonous jobs are probably not the best jobs for someone with ADHD, but without an education they are unlikely to get anything else. This person also has evidence of Oppositional Defiant Disorder (ODD) and/or Conduct Disorder.

Eventually she was able to go back to education, and to cut a long story short:

> I graduated with a first class degree and went on to study for a masters degree.

As with the first case study a university education was not prevented by ADHD. She continues:

> When our son Isaac was diagnosed with ADHD I realised that I had displayed many of his behaviours as a child myself.
>
> I realise now, from the stories my father has told me about his behaviour (being in trouble with the law, under-achieving at school, oppositional defiance, alcohol abuse, and so on), that he also probably would have had a diagnosis of ADHD if he was a child today.

So many adult cases of ADHD are becoming evident because of the problems they face with their own children who have ADHD. Two phenomena within ADHD become evident: (1) the familial/genetic basis of ADHD; and (2) the changing face of diagnosis across three generations – spanning an undiagnosed grandfather to misdiagnosed mother to diagnosed son.

A personal account (diagnosed at the age of 8 years)

In this account the child was not told much about the disorder and was placed on medication. This is at odds with recent guidelines, which support the use of psychological education (see chapter 9).

> I found that to start with the medication I was given, which was Ritalin, was not effective in controlling my bad habits and behaviour. We had to go back to the clinic more often over the years to try and get my medication sorted and get the right balance and also the right type of medication. After going through all of this process the clinic finally managed to get the medication right when I was about 14 … .

The idea that a dose of methylphenidate can solve the problems this child was experiencing is mistaken. Careful optimization of the dose is required. Furthermore, as the child grows, the dose may need to be modified to compensate for increased weight; the same dose at 8 years old is going to have a smaller effect in a larger child of 14 years (see chapter 7).

> I know I have to take a mixture of different types and strengths of medication.

Methylphenidate comes in different release types and can be used according to the needs of the patient, e.g. slow release during the day whilst at school, and then fast release and short duration of effect in the evening in order to reduce disturbing sleep. There is no need for brand loyalty or sticking with one type of preparation.

> … now I am on the right medication my ADHD has got better in my mind. I have stopped all the tics that I used to do and I find that I am a lot calmer than I was.

After a period of trial and error, the medication is having a positive effect; even the tics, which can be made worse by the drugs, are minimized.

> However, the only problem I have with taking my medication, Concerta XL, is that my body has built up a large tolerance to it because I have been on it for so long, so I have to have come off the tablet every weekend and have medication called Dexedrine.

Like many drugs, tolerance develops to the clinical effects, but note the child also gets bigger. This can be countered by an increase in dose or by changing the pharmacological agent from methylphenidate to amphetamine. They both have clinical efficacy, but different modes of action, which could help reduce the tolerance. There are concerns over the long-term use of drugs in pediatric populations; how these drugs affect a developing nervous system has only recently been studied with the aid of animal models (see chapter 7).

> Due to my medication being an expensive drug and a dangerous one if it is misused, my parents and I had many problems with my GPs … most of the time GPs did not have a clue about ADHD.

The GPs' lack of knowledge should not be surprising. They cannot be experts on everything, but they should know how to refer a patient and they should seek to gain an understanding of the disorder.

> I found that my ADHD had a big effect on my education in many ways. When I was just diagnosed and for a long period of time after, until I managed to get the medication balanced, I used to be aggressive at school. I also used to get in a lot of fights because when I got wound up I became aggressive because of my ADHD and I found it hard to control my aggression.

It is not the lack of attention or indeed the hyperactivity that appears to get this child into trouble at school. It is the aggression, which, when channeled correctly, is useful, but when deployed in an impulsive and uncontrolled way in the playground can be a big problem.

> …as I managed to get the medication right and as I moved into upper school and progressed through year 9 and year 10 I found that all of the disruptive behaviour in the classroom slowly went away. Since then I have had little problems in the classroom.

As the child has got older and the medication has been optimized, he has been able to engage in education with little problem. In the earlier accounts,

exclusion from education meant that the child drifted into delinquency, risk taking, and drug use. This child received medical attention early, and despite the time taken to optimize the medication, this may have been an advantage, as the earlier a case of ADHD is detected and dealt with, the better the outcome.

A parent's view

This is an account of a parent with a child with ADHD. This parent was also diagnosed with ADHD in adulthood.

> At 6 months old he attended a crèche on a part-time basis. When he was 18 months old the crèche began asking if there were any issues at home they should know about because he had become increasingly aggressive towards other children, displaying biting, punching and other violent behaviours.

The evidence of ADHD can clearly be seen very early on, well before the seven-year cut-off in the 4th edition of the US diagnostic guide for psychiatry, the *Diagnostic and Statistical Manual of Mental Disorders* (*DSM-IV*, 2000). Currently there is a great deal of effort being expended trying to identify the symptoms of ADHD in preschoolers [19]. Clearly this is difficult because many children display such behaviors.

They went to a pediatrician in Australia after leaving the UK.

> When I finally mentioned [to the pediatrician] that I had concerns about Isaac's behaviour, he said he'd been waiting for me to say something for a long time. He immediately told us that he thought Issac had ADHD and could refer us to a specialist paediatrician … for an assessment.

Unlike the previous case, the doctor knew about ADHD and that it would require specialist input.

> He constantly moved from one activity to another, and displayed increasingly impulsive and reckless behaviour. He climbed at every available opportunity and would not respond to discipline. His impulsivity presented as punching a dog, running after cars, eating dog faeces or head butting me when I read stories to him.

This child was unable to sustain attention for any length of time and would only focus for short periods on any single activity. Hyperactivity was

evident; objects were often seen as something to climb, even when inappropriate. The impulsivity is the main problem because it is so noticeable when displayed aggressively. Normal behavioral interventions to bring about discipline are of little effect. This is common in ADHD and has a biological basis (see chapters 8 and 9).

> His behaviour was often exacerbated by environments with a lot of stimuli. I lost him several times at the airport, and he even disappeared off the end of the baggage carousel.

Risk-taking behavior is common in ADHD; such children are more likely to leave their parents' side and explore. Busy environments made this child's behavior worse, which is common; there is just too much information to process for these children. The environment has been regarded as the key to ADHD by some authors, who see ADHD in a cultural context of increasing stimulation and overload (e.g. *Ritalin Nation* by Richard DeGrandpre [6]).

Eventually the parents/child received a diagnosis of ADHD; he was described as being at the "extreme end of the ADHD spectrum." I use the phrase "parents/child received a diagnosis" deliberately to make a point – it is not just the child who benefits. Such are the effects of ADHD symptoms that all concerned, aside from the patient, can benefit from a clear diagnosis.

> We spent another year attempting to modify his behaviour, trying as many alternatives as possible to medication. During this year he continued to be impulsive, lacked attention and was violent … .

For most parents, medication is a last resort. Parents will have attempted to modify the behaviors of their offspring by other means. The large number of self-help books is testimony to the need. Behavioral management requires a large amount of time before it is successful – if indeed it is going to be successful (see chapter 9). When confronted by such behaviors, two minutes seems a long time, let alone two months or longer.

> My marriage was becoming increasingly strained, so we decided to try medication and Isaac started taking methylphenidate. It seemed like a "miracle". He was able to focus, remain calm, play without being aggressive and make friends for the first time.
>
> He started on a low dose that was increased after 6 months. He now takes a modified-release preparation.

The relationship between the parents reaches breaking point and, as a last resort, they try methylphenidate. The change is dramatic: with an immediate-release preparation, the change can be seen within about 20–30 minutes. It does indeed appear miraculous. The medical supervision this family received was clearly good, as they started off with low doses and built them up to the optimum dose (a process called titration).

> Since Isaac started the medication we have never looked back. Isaac does continue to be very challenging, and is clearly a very complex child. He has learning difficulties, finding it very difficult to produce legible writing and is significantly below the national average for reading. In addition to ADHD, Isaac also displays some autistic spectrum behaviours, though not enough for a formal diagnosis.

Whilst the medication is beneficial, it has not been a panacea for their problems. Behavioral management may well still be needed, but at least with the medication such techniques stand a far greater chance of being effective. Once the symptoms of ADHD have settled down it is clear that Isaac has comorbid dyslexia and possibly dyspraxia, plus a sub-clinical set of symptoms in the autistic spectrum.

> When I asked about behavioural management strategies, no concrete examples were given, so I bought myself a copy of *1-2-3 Magic*, which has helped a huge amount.

1-2-3 Magic is a very good book on behavioral management by Thomas Phelan [20]. It is noteworthy that the parents had to seek this out for themselves.

> Isaac channels a lot of his excess energy into sport and enjoys rugby, karate, rock climbing, gymnastics and skateboarding. He wants to be a stunt man when he grows up!

Isaac has found a constructive outlet for the hyperactivity, and sporting success is good for his self-esteem. Like Kurt Cobain, he admires stunts, and if he achieves his ambition he will have found a career that harnesses his hyperactivity, risk taking, and need for different experiences.

Another parent's view

This is the account of the mother of a 15-year-old boy with ADHD who also has Oppositional Defiant Disorder, a sleep disorder, and vocal tics.

> As soon as he could crawl he was into everything.
>
> Once he was walking we were unable to leave him unsupervised; he would climb over the stair gate and out of his cot, and would run everywhere. By the time he went to nursery school we had had many trips to casualty with our son for various injuries.
>
> At nursery school he was very disruptive, constantly on the go, never wanting to share anything, playing in an "over-the-top" way, not knowing when to stop, and alienating the other children so no one would play with him … .

The impulsivity and the inability to interact with other children can be isolating for the child with ADHD. They do not understand that their behavior is the root of the problem. Furthermore, the resources a parent needs to cope with the behaviors exhibited by someone with ADHD can prohibit normal communication with other members of the family and friends. Indeed much of the discussion so far has focused on the social isolation the child experiences, but the parent who is avoided due to their child can equally experience this social isolation; this is when support groups such as the UK's National Attention Deficit Disorder Information and Support Service (ADDISS) can provide such valuable help.

> His sleep pattern was totally out of the window – he would be up 15 and more times a night, running round the house barking like a dog. He was physically aggressive to me, kicking, punching and lashing out. He would fly into a rage that would last sometimes 2 hours or more; on some of these occasions we would have to physically restrain him, even resorting to sitting on him, just to try to stop him from harming himself or trashing the house.

In this passage we can see that the behaviors are going to put an increasing strain on the family. If the child is not sleeping, then neither are the parents. Sleep deprivation is incredibly stressful, unpleasant, and dangerous – it is not used as a torture for nothing!

> He became the child of nightmares, the child that you thought you could not possibly have, because we were "sensible" parents!

The parents at this point do not see ADHD as a neurobiological disorder, but rather one that is learnt. They are a short step from considering themselves as bad parents, despite the evidence to the contrary.

> We had great difficulty disciplining him, not because we did not want to, but because we had tried everything and anything that our friends suggested: sitting on the stairs, no toys, no telly, bed early, no playing outside, no treats. Nothing worked, he just shrugged his shoulders at us. We had reached breaking point, our marriage was suffering … .

As we have seen before, punitive discipline is often not as effective as it would be in the average child. At this point the attempts at behavioral control were all punitive, and not the incentive-based positive reward system that appears to be more effective (and nicer to deliver) (see chapter 9). The child appeared to be immune to punishment.

> I was actually relieved that there could be a reason for all of his "problems", and it was not us being bad parents. I showed the book [a book on ADHD] to my son's teacher and she offered to write to my GP supporting my concerns.
>
> The school had requested an educational psychologist to assess him; she agreed that he required further "specialist" assessment, and she supported his referral to the private clinic.

The process of identifying what was wrong with her son came from the parents' own research, and via a process of referrals they got access to a clinic, although new guidelines would preclude the necessity for seeking private medical care.

> Our son was started on Equasym (5 mg every 4 hours), and there was an improvement in his concentration levels almost immediately, and he was also much calmer.
>
> We had difficulties with the school as they refused to give our son his medication, insisting that I went and gave it to him.

The reason for the obstructive behavior by the school is unclear. It could be Health and Safety gone mad, but this goes against current disability acts. If it is because methylphenidate is a controlled substance (like cocaine), then the school have not done their homework. I have had contact with the Home Office and there is a gray area in legislation of the Misuse of Drugs

Act (1971) that does not legislate against holding small amounts of medication. It is pointless if the health service can provide support only for the school to then negate that support. This clearly demonstrates how all agencies that deal with youngsters need to be educated in ADHD. In fact my own experience is that they are not as well informed as they think they are.

> Our son is now 15 and 6 feet tall and we have had to change the medication regime again. He is currently on the following on weekdays: clonidine and Concerta XL on rising; Ritalin after school and clonidine 1 hour before bed. At weekends he takes clonidine and Dexedrine on rising; Dexedrine at lunchtime, Dexedrine at teatime and clonidine 1 hour before bed. This regime is proving extremely effective at present, and he displays no signs of sleepiness, and is doing well at school – far better than we ever thought possible. [I have removed the dosing information from the original account].

Lots of different drugs are being used here (see chapters 7 and 8), but the medication has helped the whole family. It has also been supplemented by behavior management.

> We also learned to try and focus on the good behaviour, to give praise, and to try and ignore as much of the bad/annoying behaviour as possible. By doing this, and also by virtue of the fact that he could concentrate at school, and was not constantly in trouble, we found that his self-esteem slowly increased.

The parents were also heartened by the beneficial role that they believed that diet was playing.

> Our son does not have fizzy drinks, rarely eats chocolate or sweets, and we try to avoid packet/processed food and "E" numbers. He has also taken pure fish oil for several years, and this seems to help with his mood levels; he says that he feels he concentrates better when he is taking it.

The role of diet could be important and there is no harm in modifying it; however, direct links to diet as a cause of ADHD have not been substantiated (see chapter 3).

These personal accounts of ADHD highlight a number of common features in ADHD and the services that are available. These can be summarized as follows:

1 There were often early signs of ADHD in the preschool years, but it was not until the nurseries or schools were involved that the problem dramatically increased. Parents appear to contain the problem in the early years.
2 Impulsivity and aggression are early signs of possible ADHD.
3 The older child is likely to engage in substance abuse.
4 They are at greater risk of accidents.
5 They are not engaged with education, and the education system is too slow to respond to the needs of someone with ADHD.
6 There is a lot of ignorance about the disorder.
7 It places a great deal of strain on family members.

ADHD: Science and Society

From the previous accounts, one cannot dispute the impact of such symptoms, but how do we know anything about ADHD? How do we know what it actually is? How do we know what causes it? And how do we treat it? To answer these questions, and many more besides, is the subject of a great deal of scientific inquiry.

Case studies of individuals are often the first reports to identify a problem. Eventually, when more people are identified with a similar problem like ADHD, the problems raised in the case studies come under systematic scrutiny using scientific methods. Thus, the only way we gain knowledge of ADHD is through research. Research into ADHD can be approached from the different directions of the contributing disciplines. Geneticists will investigate the role of DNA; neuropsychologists investigate cognitive functioning and thought processes; and psychopharmacologists will investigate the neurochemistry of the brain via drug action.

All of the disciplines *try* to bring scientific rigor to the study of ADHD (*try* being the keyword – this is not always the case). However, human behavior does not always obey true scientific rules. In physics and chemistry there are absolutes – the freezing point of water is 0°C and the boiling point is 100°C. In the behavioral sciences there are no such absolutes. When conducting an experiment in chemistry, if you follow exactly the same procedure, you will get the exact same results. In behavioral sciences this is not always the case. People (and animals) have all sorts of different experiences and histories that can affect their behavior. One person will

not necessarily react in the same way as another person, even when the experimental conditions are the same.

Science, whilst using objective measures, is still influenced by society and culture. How scientists view ADHD can be influenced by the prevailing culture, which may explain the differences in opinion between the likes of Sami Timimi and his cultural view of ADHD and the medical model view held by Professor Eric Taylor. Such different views are valuable; it is the differences of opinion that enable the questioning of pre-existing assumptions. Unless assumptions are questioned, there is no move forward towards a comprehensive understanding of ADHD.

People vary greatly, and in order to ascertain if a particular behavior is important, or if a drug works, we have to use many people in the assessment or experiment. The more people we study, the more representative those people are of the issue under investigation. With the classic chemistry and physics experiments we know what is going to happen. With people we do not have that certainty – we have to repeat our experiments, sometimes under the same conditions, other times under different conditions. If the different studies are in agreement, then we can have confidence that our understanding of ADHD is based on solid data. In psychology we use scientific principles on the most unscientific subject matter – people.

Science and proof

When watching television advertisements for cosmetics, health products, or foods, the viewer is confronted with statements of authority such as "clinically proven" or "scientifically proven." They present their product as having clinical powers that are a FACT. But are they a fact? The word *fact* is rarely used in behavioral sciences. A fact tends to lead the reader into assuming that the information is an absolute irrefutable truth; but research can do a lot to change that truth – even in chemistry!

To obtain reliable information on human behavior, groups of people are studied. In the case of ADHD research, people with ADHD may be compared with *normal* people (who are these so-called "normal" people?) or people with other disorders (e.g. autism or depression); the comparison group is called the control group. If we find a difference (and in behavioral studies that is a difference that is deemed significant after statistical scrutiny), then we can discuss it as a true phenomenon. However, that truth needs to be supported by several studies that repeat or modify the first

study. If these studies obtain a similar result, then it helps to provide a more convincing case for an effect.

The use of the word *significant* requires some clarification. In a statement such as "Children with ADHD may be significantly different from normal control children on quantifiable cognitive measures," the use of the word *significantly* refers to a mathematically supported difference – a group of numbers are really different from another group of numbers. The lay use of the word *significance* means there is an *important* difference that sets those with ADHD apart from others.

The statistically significant effect is open to considerable confusion amongst not only the lay population but also professionals. The ramifications of this "statistical illiteracy" are seen in health care and policy making, which can be exacerbated by the media [21]. Consider the effects of a press release to the media that starts off with a portrayal of information that maximizes an effect. The journalist, who is also not adept at statistics, goes on to report this with their usual sensationalism. Suddenly something becomes a fact and not a tentative suggestion, as originally published. The lack of transparency in a report can be seriously misleading. It has been argued that

> statistical literacy is a necessary precondition for an educated citizenship in a technological democracy. Understanding risks and asking critical questions can also shape the emotional climate in a society so that hopes and anxieties are no longer as easily manipulated from outside and citizens can develop a better-informed and more relaxed attitude toward their health. [22] (p. 53)

Thus the understanding of statistical information is important, and to this end I will embark on a whistle-stop tour of some related features in ADHD research. In scientific and statistical terms, *significance* refers to a measure of probability or chance. In an experiment or a study we have a question or hypothesis that we are investigating, e.g. are those with ADHD more impulsive than those with autism? The probability is the estimate of the likelihood of you finding an effect that is real and not down to a chance occurrence. The statistically significant effect is one in which there is a high probability that the finding is a result of ADHD and not a random chance finding that has nothing to do with ADHD.

A statistically significant effect on a measure in people with ADHD does not necessarily translate into a clinically significant or important difference

in ADHD, e.g. those with ADHD may have a slightly longer thumb than autistic children, but is this really an important difference between the two disorders? My guess is that it would not be!

There are many mathematical tests that can be used on data to determine statistical significance. On the whole these tests give what is called a *p* value. The *p* value provides us with a percentage value that estimates if the result is down to chance, or the odds, in gambling terms. In scientific literature the value of *p* that is held as a barrier between either a significant or a non-significant result/difference is $p < .05$ – or the result is down to a 5 percent chance (i.e. not much chance). Although 5 percent is used, and is now almost a holy division within science, it does not necessarily have to be the case. As Everitt and Wessley [23] state, the dichotomy of significance remains appealing to clinicians, students, and scientists, who are pleased when $p = .049$, but are disappointed when $p = .051$. With such a small difference the study will report either a positive effect or a negative effect.

Just to be pedantic and reinforce the point, a statistically significant finding that people with ADHD perform poorly on a test does not translate that it is significant to the clinical picture.

In contrast to the arbitrary deployment of the 5 percent cut-off point for probability, an alternative, and some argue superior, way of increasing the understanding of data is by looking at confidence intervals (CIs) [24]. Confidence intervals are a range of values, and if the CI does not contain the value reflecting that there is *no effect* (a number close or equal to 1), the effect, of a drug for example, is statistically significant. CIs provide extra information on the upper and lower points of the range of effects and tell us how large or small the real effect might be. This additional information is very helpful in allowing us to interpret borderline significance and non-significance that is not captured by the dichotomous *p* value.

Remember non-significance is also very different from insignificance (which is a common mistake students make when discussing their data). Non-significant data are as interesting and just as important as significant data, but due to a bias in publishing positive results they are harder to find in the literature. That is not then to say the data, because they do not prove something, are insignificant – they are still important.

Significance has different meanings to different people, and we need to remember how statistics and significance can be used, misused, and be misleading. The quote attributed to Disraeli, "lies, damned lies, and statistics," springs to mind. In this book I use the word *significant* in the

statistical sense – where a *p* value or CI indicates that the effect is real and not a chance occurrence. The clinical importance of these statistically significant findings in ADHD is up for discussion.

More important than statistics is research methodology, which we will see when discussing clinical trials. Research methodology is all about the design of the study and is critical to answering questions correctly, and therefore critical in forwarding our understanding of ADHD with any degree of confidence. There are numerous research methodologies that can be deployed, and interested readers are directed to Freeman and Tyrer [25] if they want a more detailed account.

The media's portrayal of science is often misleading, as we shall see several times throughout this book. It is true that most scientific papers are difficult to read, as the language that they use is often turgid and technical. Scientific papers are often cautious accounts of what the data suggest, and in the behavioral sciences rarely (if ever) prove anything as a fact. The media often cover science-related information, but the journalists who report on scientific publications have to turn the turgid and technical language into an interesting and entertaining story. Good journalism is valuable and informative, bringing complex ideas to a non-expert audience. Bad journalism is often ignorant and full of misinterpretation and prejudice – which in turn may appeal to the reader's own prejudices. Thus the media can sometimes be guilty of sensationalizing research in a non-critical and authoritative way. A recent example is the reporting of the MMR vaccine for mumps, measles, and rubella and its so-called "link" to autism, in which the poor science was broadcast via the media without a critical awareness. The reporting led to a decrease in the number of parents having their young infants vaccinated and exposing them to the potentially harmful outcomes of these diseases. The fact that the original article on which the subsequent reports were based got published in the first place is worrying. Furthermore, the impartiality of the scientists had also been queried as they received funding from pharmaceutical companies that they failed to disclose. This is a problem as the companies have a financial interest in the direction of the results. It is commonplace for scientists to disclose information about potential conflicts of interest, e.g. a hypothetical cigarette company may not wish the results of a study they fund to link nicotine with addiction – this bias is not conducive to good science. At this point I should state that I have not received any financial benefits from any pharmaceutical company; I have not received any hospitality from any pharmaceutical company; and I have

not spoken on behalf of any pharmaceutical company. However, I am open to offers!

Good science and drug development

Good science is critical for the understanding of ADHD; it is also crucial for the development of new treatments. New drugs need to be tested to ensure they are safe and effective. Before drugs can be used on humans, they have to go through a period of safety evaluation. This can be done in cells that are grown in laboratories and also in live animals.

Once a drug is considered safe enough in incubated cells and animals, it goes to the next stage of development – the clinical trial. Clinical trials are divided into four phases. *Phase I* takes place in a small number of (paid) human volunteers. Small amounts of the novel drug are initially given, and if all goes well the dose is then escalated, and again if all is well, repeated doses can then be given. The drug is compared to a placebo, which is an inert substance that does not contain the active ingredients.

Why are placebos used and why are they so important? Placebo effects are complicated and a more detailed account can be obtained elsewhere [26–29], but essentially the whole experience of being in a study and receiving attention could have effects in their own right which are quite separate from the drug itself. People's expectations, experiences, and emotions may be as big a determinant of an effect as a drug. Some people may get better over time and it may not be due to the drug at all. There is very little point in taking a drug that is no better than placebo. A further benefit of the placebo-controlled study is that it stops the experimenter having a bias in favor of the drug effect; especially if they do not know which patient has received the drug or which patient has received the placebo (such experiments are referred to as double blind – neither the experimenter nor the volunteer knows what they have had).

Phase II trials involve the new drug being given to a small number of the target patient population, e.g. atomoxetine (Strattera) in adult ADHD males. These will be carefully controlled studies. This phase will help identify target populations.

Phase III occurs after the success of the previous Phase II trial, and whilst similar to the earlier trial, the Phase III trial involves many more patients randomly allocated to treatment groups and within the context of how the drug is marketed in terms of efficacy and safety. The success with this trial feeds into the licensing of the new drug and is therefore very important.

Phase IV happens after a product has been licensed and placed on the market. Information gained from such large studies will permit a clearer picture to develop with regard to a drug or intervention. Despite the process of drug development taking around 12 years, the long-term safety is not immediately established in the human population. This is of particular relevance to ADHD and its treatment with methylphenidate. It is often questioned that the long-term safety of methylphenidate has not been established. Certainly there are no direct studies that have followed people over 40 years or so. Such a study would be more miraculous than scientific! Getting people to maintain contact and interest in studies is difficult at the best of times. Out of all the medications that are used in pediatric psychiatry, methylphenidate is the one for which we have the best knowledge. Strangely, such concerns are not as evident with the more recently available atomoxetine. This is perhaps due to the hyperbole surrounding methylphenidate as a drug similar to the notorious amphetamine and cocaine.

Continuing the collection of drug information in the UK is the *Yellow Card system*, which is a process under the auspices of the Medicines and Healthcare products Regulatory Agency (MHRA), which operates a feedback system for drugs that are on the market. The Yellow Card is available for medics and patients to complete and send to the MHRA – and to this extent we are all part of a giant clinical trial if we take a particular drug. One of their aims is then to make more information available on a particular drug.

Clinical trials are in the interest of the public's safety. Given the financial interest of pharmaceutical companies, how can we trust clinical trials? The only way we can trust them is through their publication, demonstrating their good science and replicability. The International Conference on Harmonization of Technical Requirements for Registration of Pharmaceuticals for Human Use (ICH) provides a consensus between European, Japanese, and American regulatory authorities on the scientific and technical aspects of drug registration. The ICH lays out what is termed Good Clinical Practice. In a 59-page document, available from the ICH website,[10] details can be found of international ethical and scientific quality standards for designing, conducting, recording, and reporting clinical trials that involve human subjects. These guidelines include selection of investigators, trial protocols, ethics, and informed consent. Essentially adherence to the guidelines is a statement of the quality of the work, and ultimately

[10] http://www.ich.org/cache/compo/276-254-1.html.

the confidence one can place on the results. Studies with animals fall outside of the ICH remit and are dealt with locally by host countries.

In academic studies, and by Phase II clinical trials, patients are selected for study alongside a control group or groups. The control group is the comparison group, e.g. working memory deficits are evident in ADHD compared to normal controls. Control groups do not have to be healthy, disorder-free people; they can be other patient groups, e.g. those with autism. Comparisons with other psychiatric groups is important as it can help determine if the result found is specific to ADHD or a general phenomenon that is evident across many disorders.

In their studies, scientists will compare ADHD patients with control groups, but they also look at differences in response to a variable that they manipulate (e.g. giving a drug or a placebo). The decision of who gets placed in the experimental group and who gets placed in the control or placebo group is not made by careful selection on behalf of the experimenter; such decisions are made by the random allocation of the participants in the study. Hence we have the Randomized Controlled Trial (RCT), which is operated to avoid contamination by experimenter effects of allocation bias, e.g. the most severe cases get the new drug.

Scientists are only human and are open to bias, even when they think they are not. Certain methodological designs aim to minimize such biases. In a single-blind experiment, the individual participants do not know what group they are in; they have no prior knowledge or expectation that can influence the data. However, the experimenter is aware of the treatment the participant is to receive, and such knowledge can influence the data, albeit unwittingly. In studies that use *good science*, the scientist in direct contact with the participant is unaware of the group to which the participant is assigned. This is common in drug studies, where the design of the experiment is said to be double-blind – neither the experimenter nor the participant knows which group they are in. This aspect of scientific work is crucial for the clinical trial or study to be credible.

Many studies are multi-center trials, which means they take place in many geographically separate locations and the data are pooled at the end with a large number of people involved in such studies.

Practicing *good science* is not only important for evaluating new drugs or treatments, it is as important for evaluating theoretical accounts of ADHD. Theories of behavioral disorders are designed to be thought provoking and have power to explain the symptoms. A theory is not a fact. ADHD, like other psychiatric disorders, has many theoretical accounts of

the symptoms and very few hard facts. Experimentation can either support or refute theories. A publication bias in the literature often means that people try to prove that a theory or hypothesis is correct; the philosopher Karl Popper, who had a lot to say about science, states that one should try to refute the theory. If one fails to refute the theory, then there may well be some credibility to it (see [30]). Unfortunately there is a publication bias in favor of positive results, where the hypothesis is upheld. This is the case for a number of theories surrounding ADHD [31]. Publishers, editors, and funding bodies are not interested in experiments that do not show a difference, despite these studies being of equal importance if they are conducted correctly – perhaps editors etc. also have difficulty and misinterpret non-significant to mean insignificant! Scientists are like other members of society and are interested in extending old ideas to new subjects in what the philosopher Thomas Kuhn calls extending the paradigm. Furthermore, a political agenda and cultural expectation exert an influence over what science is funded, which in turn can determine the results that are found and eventually published.

The large volume of literature on ADHD can be daunting, e.g. there are numerous studies on the efficacy of methylphenidate. This large amount of work can be made into a single sensible account by using meta-analysis. Meta-analysis is a technique that has become more widely used in recent years and consists of an analysis and evaluation of several original research reports; it is a study of the studies. Such meta-analyses use many separate research reports to determine if there is an overall effect or not. These are valuable additions on top of the original investigations and make life so much easier in drawing conclusion from the data. Of course a meta-analysis in only as good as the original studies themselves.

In summary, ADHD has a considerable effect on the individual and the family. Systematic evaluation of ADHD is necessary to gain an understanding of how it arises and how it can be treated. The use of scientific methods is the only way that we can unravel the complexities of ADHD, but even science is subject to prejudices and bias.

Summary

ADHD is a disorder with three primary symptom clusters: inattention, impulsivity, and hyperactivity. Whilst these symptoms when described appear to be minor problems, when they occur as a syndrome they have a

huge impact upon the individual, the family, and society. There is a lot of speculation as to the cause and treatment of ADHD, much of it not based on the science. Science offers the most rigorous accounts of ADHD by using an evidence-based approach, but such evidence requires high-quality studies using robust methodology. Scientific methodology permits the evaluation of theories and their refinement as the data require. Science, despite using objective methods, occurs within a cultural world which influences the questions that we ask. The big question is what causes ADHD … we still need an answer!