TRANSITION TO ADULTHOOD

UNIVERSITY OF EXETER

REPAIRING SHATTERED LIVES:

Brain injury and its implications for criminal justice

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Who is this report for?
The audience for this report is broad, but will be of particular interest to commissioners and practitioners working in the fields of criminal justice, health and social care. It is also of great relevance to policy-makers with an interest in crime prevention and health improvement.

What is the Transition to Adulthood Alliance?
The Transition to Adulthood (T2A) Alliance is a coalition of 12 of the leading organisations in the criminal justice, youth and health sectors. Convened by the Barrow Cadbury Trust in 2008, the Alliance has conducted research and demonstrated practice to support the development of a more effective approach for young people in the transition to adulthood throughout the criminal justice process. A 2012 report, Pathways from Crime, set out ten steps to delivering a T2A approach (**www.t2a.org.uk/pathway**). Three T2A pilot projects, running since 2009, have demonstrated that the holistic integrated approaches that support desistance from crime, and improve employability, health and family relationships.

The Transition to Adulthood Alliance's work on maturity and criminal justice
In 2011, T2A began a specific work stream to look at the concept of maturity in a criminal justice context. At a meeting hosted by Lord Keith Bradley, experts from neurology, psychology and criminology all confirmed that research supports the T2A position that developmental maturity should be taken into account throughout the criminal justice process. Indeed, maturity can be a better indication of adulthood than reaching a particular chronological age.

A subsequent poll for T2A by Com Res found public and political support for this position, with 7 in 10 members of the public agreeing that the maturity of a young adult should be taken into account in sentencing. 8 out of 10 MPs thought the same. A literature review by Birmingham University for T2A in 2011 found that the adult brain is not fully mature until at least the mid-20s, and that temperance and impulse control are among the last areas of the brain to develop fully. Later in 2011, the Sentencing Council for England and Wales included, for the first time, 'lack of maturity' as a mitigating factor in sentencing guidelines for adults. The Crown Prosecution Service is currently consulting on including 'lack of maturity' as a factor reducing culpability in its new Code of Conduct.

Given the prominence of research findings from neurology in T2A's work on maturity to date, this report sets out more clearly the key issues related to brain functioning and development, with a focus on the impact of brain injury and its association with offending.

About the author: Professor Huw Williams
Huw Williams is an Associate Professor of Clinical Neuropsychology and Co-Director of the Centre for Clinical Neuropsychology Research (CCNR) **www.psychology.ex.ac.uk/rescntr/ccnr.shtml** at the University of Exeter. He gained his PhD and his Doctorate in Clinical Psychology from the University of Wales, Bangor. He trained in Neuropsychology at Walton Centre for Neurology and Neurosurgery in Liverpool and then worked at a number of Clinical Neuropsychological services in London. He was on the founding staff team of the Oliver Zangwill Centre (OZC) for Neuropsychological Rehabilitation in Ely and was a Visiting Scientist at the Cognition and Brain Sciences Unit in Cambridge. He has also been a visiting scholar at key Australian centres of excellence in brain injury: The Rehabilitation Studies Unit, University of Sydney and the Monash-Epworth Rehabilitation Centre, Melbourne.

He has been a frequent key note speaker nationally and internationally. He has published widely in Neuropsychology, from assessment and management of the effects of Mild through to severe TBI - in children, adults and in particular populations such as athletes and offenders. He has honorary positions with the OZC and the Royal Devon and Exeter Hospital's Emergency Department. He is past Chair of the Division of Neuropsychology of the British Psychological Society. He has worked with a range of charity sector organisations, such as Headway UK and the Encephalitis Society. He recently worked with the Child Brain Injury Trust to establish the Criminal Justice and Acquired Brain Injury Group (CJABIG) as an umbrella organisation for a range of law and brain injury charities for working on brain injury issues within the justice system. His has had funding for research in the area of crime and brain injury from the Economic Social Research Council (ESRC), UK Brain Injury Forum (UKABIF), the Big Lottery Fund, Barrow Cadbury Trust and the Office of the Children's Commissioner.

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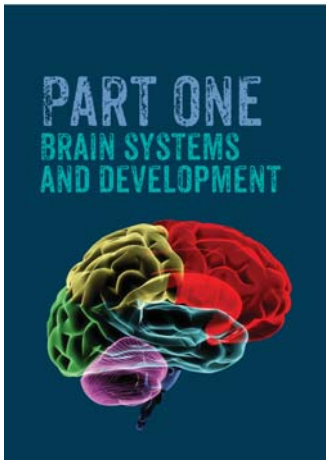
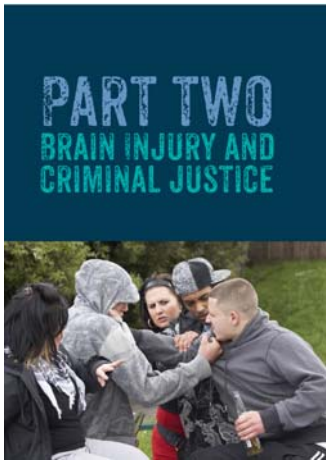
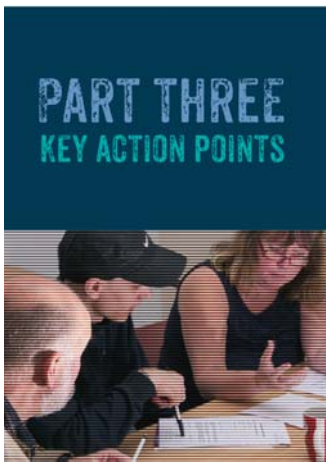






FOREWORD

The concept of managing youth to adult transitions in the criminal justice process has been around for many decades. I remember it was part of the discussions in the early days of the Youth Justice Board. Many of us were concerned that there was too great a divide between youth justice and adult justice, resulting in many young people, who were being steered away from crime by the youth justice system, suddenly having the help pulled from under them and ending up deep in the adult system post 18.

At that time there was insufficient academic, practitioner or political backing for substantial change. Trying to discuss the concept of transition and the need to treat young adults differently to older adults, whether with the media, policy makers or even friends was usually met with similar responses based on a belief that young people: 'know what they are doing'; 'should think of the consequences'; 'have to be taught a lesson'; 'there are no excuses for their behaviour'. Reasoning on my part about the developmental process of maturity, impulsive and risk taking behaviour and brains that were still forming were met with raised eyebrows.

For the last few years this has begun to change, with increasing interest in concepts of maturity and brain development. What excellent timing then for this report by the University of Exeter's Centre for Clinical Neuropsychology Research. Its findings, into the effects of brain injury, and the recommendations add significantly to the knowledge and practice research that the Transition to Adulthood (T2A) Alliance has been amassing since 2008. This growing body of knowledge supports the T2A's view that young adults, at every stage in the criminal justice system, need a distinct, focused and flexible approach if we are going to reduce reoffending and improve social outcomes for the young adults themselves, their families and our communities. We need to get the message of this report out far and wide.

In 2011, research by the University of Birmingham highlighted that there were lessons from neurology that supported T2A's work. It showed that the human brain is not fully developed or 'adult' until the early or even mid-20s. Aspects such as impulse control and forward planning are the last elements in the brain to develop fully, and these directly correspond to the behaviours we often see (or remember having) in young people in the transition to adulthood.

In this report the University of Exeter goes further and details the impact that a brain injury can have on a young person's behaviour and life, and highlights the relationship between receiving an acquired brain injury and involvement in the criminal justice system. It draws together the important research from the UK and abroad to show that there is a high prevalence of acquired brain injuries among those in the criminal justice system, many of whom have received little or no treatment, and whose injury has not been taken into account at any stage of the process.

The transition to adulthood is difficult enough for all of us even when we have family and friends to rely on. The process gets longer and longer as we take on those markers of adulthood, such as employment or starting a family of our own, later and later. Our developing brains can lead to behaviours 'not expected of adults'. For those who lack the family support and rely on services that are not geared to their particular needs the result can be poor indeed. Add to this the effects of acquired brain injury that this report sets out for us and it becomes clearer and even more important that agencies and practitioners, who will come across such young people within the criminal justice system, know and understand what can and should be done.

The report makes clear recommendations for service commissioners and providers in the health and criminal justice sectors as to how they should work together to respond appropriately, ensuring that acquired brain injuries are picked up early, treated effectively, and taken into account throughout the criminal justice process. It outlines some simple steps that can be taken by practitioners, which, if implemented, would have a major impact on the lives of people with acquired brain injury, and to our efforts to reduce offending amongst young adults.

Joyce Moseley OBE,
Chair of the Transition to Adulthood Alliance

INTRODUCTION

Brain Injury is a major cause of death and disability in children and working age adults [1]. **Acquired Brain Injury** (ABI) may occur for many reasons, but most commonly it is a result of trauma, infection, or stroke. **Traumatic Brain Injury** (TBI) is the biggest cause of injury. TBI may affect around 8.5% of the population during their lifetime. Prevalence of ABI among certain populations is much higher – such as those involved in contact sports, victims of domestic violence, and adolescent males who drink.

In recent years, repeated calls have been made for better means of meeting the mental and physical health needs of prison populations [2-4], not only to improve individual wellbeing, but also as a way to divert those with underlying health problems into appropriate services at multiple stages in the criminal justice process, to reduce reoffending among this 'revolving doors' population, and importantly to reduce costs.

Yet it is rare that brain injury is considered by criminal justice professionals when assessing the rehabilitative needs of an offender. Recent studies from the UK have shown that prevalence of TBI among prisoners is as high as 60%, and brain injury has been shown to be a condition that may increase the risk of offending. It is also a strong 'marker' for other key factors that indicate risk for offending.

Brain injury is largely neglected in recent policy documents (see for example [4, 5]). This report provides an overview of developments in understanding of TBI in relation to crime, with a particular focus on its impact on developmental maturity. The links between TBI and crime may be complex, but three key themes have emerged in recent research:

1. **There is growing evidence of links between incurring a TBI and subsequent offending. This indicates a need to reduce injuries and to manage consequences of injury to enable rehabilitation to be at its most effective;**

2. **There is compelling evidence of a very high prevalence rate of TBI in offenders in custody relative to the general population. Moreover, such injury may be linked to earlier and more frequent custodial sentences, and to more violent offending; and**

3. **TBI in childhood and young adulthood may be particularly associated with offending behaviour. Earlier and more effective means to assess and manage the consequences of TBI in the offender population, and those at risk of offending, may lead to improved outcomes for affected individuals and for society.**

Such findings underlie calls for increased awareness of TBI throughout the criminal justice process and, indeed, related areas of health, social, and educational provision.

> **Brain injury has been shown to be a condition that may increase the risk of offending".**

This report is in three parts:

Part one outlines a brief overview of the brain – its structures and functions, and how it develops – how the brain may be injured, who is at risk of injury, and the consequences of injury.

Part two explores the links between TBI and offending behaviour.

Part three provides a summary of key action points to enable more effective management of brain injury in children and young people, people at risk of offending, and those already in the criminal justice process.

A full **glossary of terms (where written in bold)** is provided at the end of the report.

Repairing Shattered Lives © Barrow Cadbury Trust

EXECUTIVE SUMMARY

This report explains the connection between acquired brain injury (ABI) and increased contact between children, young people and young adults with criminal justice processes, with a particular focus on the impact of ABI upon developmental maturity. This report combines a review of current studies on the subject with recommendations for commissioners and practitioners.

RESOURCE

- **University of Birmingham literature review on maturity and criminal justice 2011**
  http://www.t2a.org.uk/wp-content/uploads/2011/09/Birmingham-University-Maturity-final-literature-review-report.pdf

WHAT IS TRAUMATIC BRAIN INJURY?

Traumatic Brain Injury (TBI) is the leading form of **Acquired Brain Injury** (ABI) and is considered a silent epidemic. The condition most frequently occurs in young people, resulting predominantly from falls, sporting injuries, fights and road accidents, and is the major cause of death and disability amongst this group. Both sexes are equally affected when very young, however males are much more at risk than females in teenage years and adulthood.

The consequences of brain injury include loss of memory, loss of concentration, decreased awareness of one's own or others emotional state, poor impulse control, and, particularly, poor social judgment. Unsurprisingly behavioural problems such as conduct disorder, attention problems, increased aggression, and impulse control problems are prevalent in people with ABIs.
The brain during childhood, adolescence and young adulthood is rapidly growing and its connections are shaped and strengthened by experience. It is these developing connections and pathways which enable it to pass information and drive the processes necessary to respond to and sustain life. An injury to the brain before these areas have fully developed may cause them to never entirely evolve or 'misfire'. Recent research has shown that skills that are developing at the time of injury may be the most vulnerable to being disrupted, while already established skills may be more robust.

For example, *a literature review by Birmingham University on maturity and criminal justice in 2011* found that temperance and impulse control, located in the **frontal lobes** at the front of the brain, are among the last areas of the brain to develop fully, often as late in life as the mid-twenties.

An injury to this part of the brain during its development can result in long-term problems with impulse control and decision-making, both of which are factors associated with anti-social and violent behaviour. Consequently, while those without a TBI are likely to grow out of immature and antisocial behaviour by their mid-twenties, those with TBI are likely to continue to grapple with these issues throughout young adulthood and beyond.
The most damaging brain injuries are those that are classified as moderate (more than 30 minutes unconscious) and severe (more than 6 hours). It is worth noting, however, that even a mild TBI can result in changes in brain function and can have lasting effects.

While the brain is resilient, it is not always able to repair the damage done. When a TBI occurs during childhood or adolescence, the brain will attempt to compensate for the damage or disruption caused to it structures and find a way of rerouting functions. However this compensation is not the same as the brain being able to regenerate in the same way as skin or muscle. There may be some '**neuro-plasticity**', particularly in younger brains, but even though some functions may be 're-routed', problems can still emerge.

WHY BRAIN INJURY IS RELEVANT TO CRIMINAL JUSTICE?

In a review of the research, in this report, it is shown that the level of brain injuries amongst offenders in custody is much higher than in the general population. A recent study in England found that 60 per cent of young people in custody reported experiencing a traumatic brain injury, a finding consistent with others from around the world.

Despite their prevalence, it is rare for criminal justice professionals to consider whether an offender may have a brain injury, or for neuro-rehabiliation services to be offered. Consequently it is common for related health and mental health needs of children, young people and young adults go unmet, while appropriate care and treatment that could divert away from the criminal justice process or help to manage the factors that contribute to criminal behaviour is not provided.

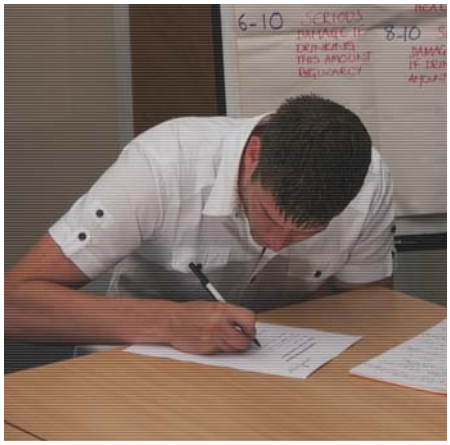
Such findings indicate the need for increased awareness of ABI throughout the criminal justice process and beyond, in related areas of health, social care, and educational. The recommendations of this report have been written with commissioners and practitioners in mind, identifying steps that can be taken to assess, manage and divert people with brain injuries earlier before they enter into the criminal justice process, support desistance for those within prison, and to improve the effectiveness of rehabilitation services.

While the links between brain injury and criminal justice are evident, it should be noted that the research found that there is a two-way link between brain injury and criminal justice, in that risk-taking individuals may be at particular risk of impulsive criminal behaviours, and similarly, at greater risk of engaging in thrill-seeking behaviours where injury is more likely. Furthermore, being involved in crime may put individuals into situations where injury is more probable. Finally, in younger people and children, there is a link between deprivation and brain injury, while in women there is a clear link between victimisation from domestic violence and brain injury.

Conclusion

There is already a substantial body of evidence that defines why younger offenders up to their mid-twenties require a distinct and more effective approach throughout the criminal justice process. The transition to adulthood is a critical time, where the right intervention can lead to a life free of crime, and the wrong one to a criminal career. However, the need for a distinct approach is even more acute for offenders with a brain injury, where the severity of the injury and the developmental stage at which the injury occurred will dictate the extent to which skills and brain functions may have been lost. Importantly, the effects of injury in a young person may not be fully realised, given that functions that may be developing may be compromised. This underlines the importance of assessment and management of brain injury in young people.

This research shows that people with brain injury are substantially overrepresented in prison, and that brain injury is associated with earlier, repeated, and greater total time spent in custody. Given that brain injury is largely neglected within the criminal justice process, both as a health issue and as a factor in offending, it is clear that addressing the rehabilitative needs resulting from brain injury would deliver significant benefits in terms of reducing offending, improving lives and saving money to public services.



KEY FINDINGS:

1. **There is compelling evidence of a very high prevalence rate of TBI in offenders in custody relative to the general population.**
Studies of TBIs amongst offenders in custody show a high prevalence. A study of young people in a Young Offender Institution in England found that 60% reported some kind of 'head injury', with 46% of the sample reporting loss of consciousness. These findings are consistent with other studies undertaken in Europe and the United States.

2. **There is growing evidence of the links between an TBI and subsequent offending**
Studies have shown that the rate of TBI is much higher in offenders compared to society as a whole. As well as much higher prevalence rates of TBI among prisoners, a recent Swedish study found that 8.8% of people with an TBI later committed a violent crime, compared with 3% of the general population. Young offenders with a history of TBI were 2.37 times more likely to commit a serious violent crime. This further increased if the young person had lost consciousness. Research has also shown that there are certain factors that make brain injury and offending more likely, such as social deprivation, risk-taking behaviour and addictions.

3. **Injury in childhood and young adulthood may be particularly associated with offending behaviour.**
Offenders who acquired a head injury younger than age 12 were found to have committed crimes significantly earlier than those who acquired a head injury later in their lives. TBI in adult offenders seems to be associated with younger age of first imprisonment.

4. **TBI, mental health and drug problems**
People with an TBI are at risk of greater mental health problems and adults who were younger when the acquired their head injury had higher rates of depression or mood disorder and /or childhood developmental disorders including Attention Deficit Hyperactivity Disorder (ADHD) or disruptive behaviour difficulties. Research in Finland found that a brain injury acquired during childhood or adolescence was associated with a fourfold increased risk of developing later mental health problems in adult male offenders.

5. **TBI increases the risk of offending in women**
Studies suggest that the prevalence of TBI may be even higher in female prisoners than in males. An analysis of women offenders found that 42% who had committed violent offences had suffered an average of two TBIs. Further analysis revealed that three factors were significantly associated with current violent convictions: the number of years since their last episode of receiving domestic violence, the number of prior suicide attempts, and traumatic brain injuries with loss of consciousness.

KEY ACTION POINTS:

Early intervention

1. Brain injury is a chronic health condition with associated on-going symptoms, and this should be recognised throughout service delivery

2. There should be improved management of brain injuries in the immediate period following the incident

3. There should be improved monitoring of the symptoms of brain injuries amongst children and young people in their developing and adolescent years

4. Training for education staff should be routine, particularly head-teachers, to raise general awareness of brain injury

Criminal justice responses

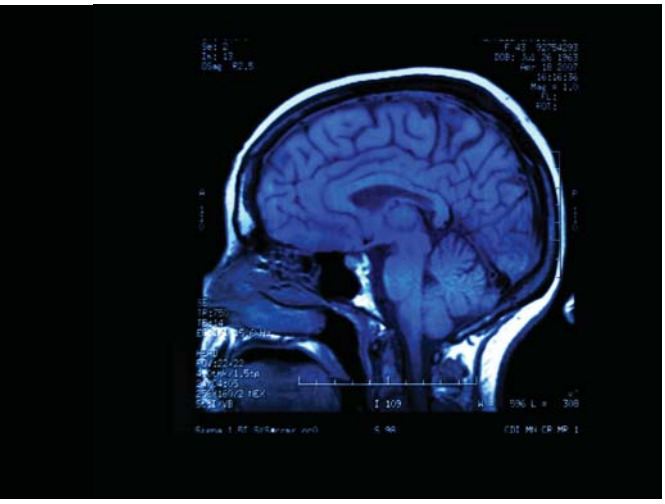
1. As part of comprehensive health assessments, there should be standardised screening of young people for brain injury when they come into contact with criminal justice process, particularly pre-sentence and in custody

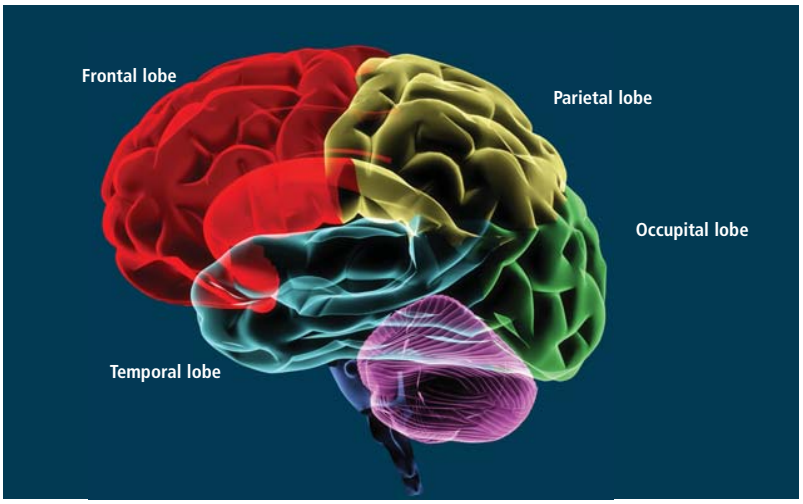
2. There should be increased awareness for criminal justice professionals about the prevalence of brain injury among offender populations, and an understanding of the need for assessment and management within the justice system, in both community (e.g. Youth Offending and Probation Teams) and custodial settings

3. There should be reference to brain injury history in pre-sentence reports, which should be considered as a factor in decision-making in the same way that maturity and mental health are already considered.

PART ONE
BRAIN SYSTEMS AND DEVELOPMENT

BRAIN SYSTEMS AND DEVELOPMENT





BRAIN SYSTEMS AND FUNCTIONS

The brain can be viewed as being constructed in layers. The inner layer of the brain, and most basic in terms of function, is the **brain stem**. This is responsible for the tasks necessary to sustain life, including breathing, heartbeat, and blood pressure.

Above this is the **limbic system** that deals with 'primitive motivation drives' (such as sleep, pleasure, fight-or-flight, and 'habits').

Finally, the more sophisticated forms of complex decision making are dealt with in the peripheral layer, the cerebral cortex. These different layers are split into two, linked, hemispheres each containing four lobes.

For the most part, particular functions can be linked to each hemisphere and lobe, although many of these, especially complex functions, involve whole networks across the brain.

The **occipital lobes** (back of head) are dedicated to processing visual information. The **parietal lobes** (upper posterior area) relate visual and spatial information (in three dimensions), whilst the **temporal lobes** (behind the ears) are, for the most part, a memory store. The **left lobe** for language-based material, and **right lobe** for visual (such as places and faces). The **frontal lobes** (above and behind the eyes), by far the largest, are associated with most high-level conscious and non-conscious processing. Typically thought of as the areas where the 'executive' system lies, their functions include setting up searches of memory, holding information 'in mind', and decision-making.

These 'neurocognitive abilities', particularly when coupled with emotion processing systems, are critical in social behaviour. The '**frontal**' (executive) systems along with parts of the **limbic system** (**amygdala, hippocampus** and **insula**) are involved in responses to situations which require such important capabilities as impulse control, empathic responding and consideration of consequences of action [6-8]. For example, when seeing a facial expression that is sad, to be moved to feel and show sympathy; or, when seeing anger, to take appropriate evasive action. Critically, then, the brain is a processor of varied, diverse and intermingling data streams.

Early development and pruning

The brain is made up of 100 billion brain cells (**neurons**), largely present at birth. These communicate with each other by releasing electrical and chemical messages via **dendrites** and **axons**. See *Figure 1*.

Dendrites are branchlike structures of the neurons that typically act to receive electrochemical stimulation from other neurons. **Axons** are projections from a neuron that send impulses away. The electrical impulses are insulated by a **myelin sheath** that surrounds the axon. In between neurons are **synapses** that allow communication across the gap between neurons. These involve the release of '**neurotransmitters**' such as **serotonin**, **dopamine**, and **melatonin** [9].

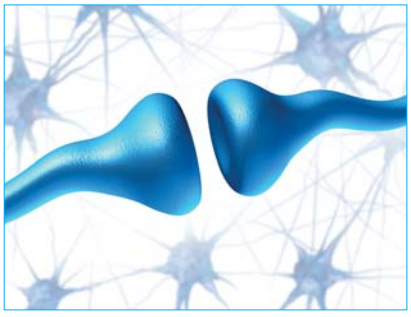


Figure 1: The synapses-connection point between neurons

BRAIN DEVELOPMENT IN CHILDHOOD AND ADOLESCENCE

Connections between **neurons** get shaped and strengthened by experience. The brain evolves rapidly over early childhood and continues to evolve over the first two decades of life. In the first three years neurons migrate, differentiate, and build up synaptic strength.

After age three, the brain is constantly sculpted (a critical process known as **cortical pruning**) and the strength of the connections in a child's brain improved (becoming increasingly **myelinated**) [10]. The different brain systems thus become more fully evolved towards being 'adult-like'.

Developmental peaks

Across childhood and adolescence there are peaks in brain development – at age 3, 8, 11 through to 15 and even later at 19 [12]. Such 'peaks' are – like iceberg tips - only a small indication of the complexity of the underlying changes happening in brain systems and their related cognitive and emotional functions. The frontal system begins to assume control over socio-emotional and purposeful behaviour from 3-4 years. A four year old child may understand how more 'smiley faces' on a chart could be linked to a trip to a play park and an ice cream and decide (or not) that the trade-off is worth sharing a toy for.

This capacity to link behaviour and consequence accelerates rapidly in development from around 7 to 11, with language skills allowing logical deduction and more abstract thought [12]. See ***Figure 2***. The consequences of such cognitive changes, in terms of control of behavior, can be seen in the ability to resist distraction being relatively matured by 6 years or so and impulse control becoming established by age ten, and these abilities continue to evolve over early adolescence, with planning and dual attention improving with age [13].

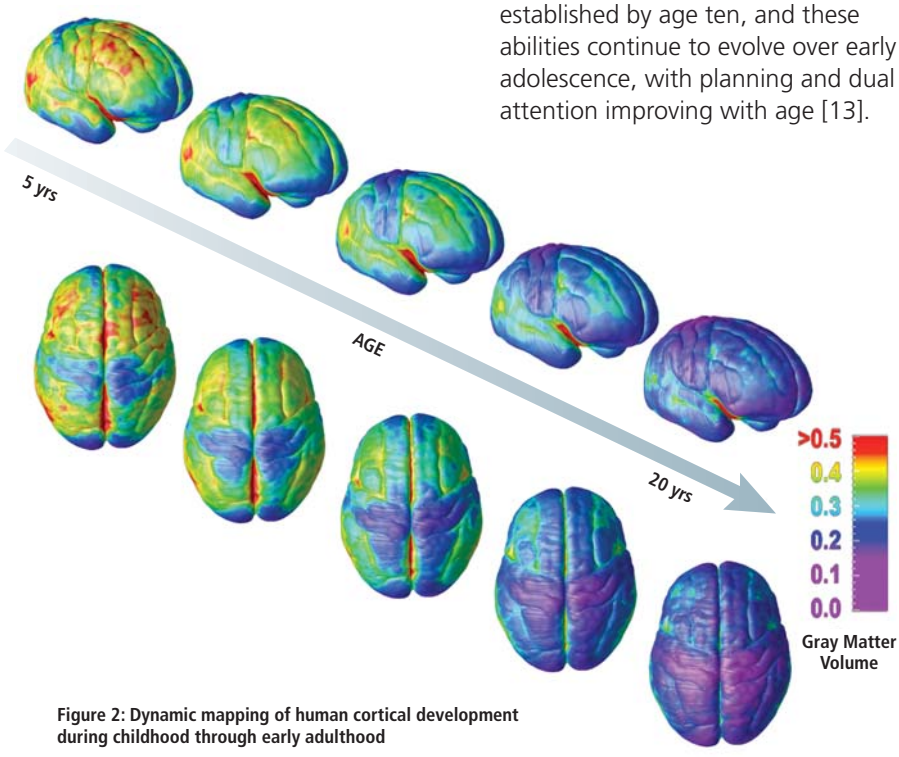


Figure 2: Dynamic mapping of human cortical development during childhood through early adulthood

© Gogtay, N., Giedd, J.N., Lusk, L., Hayashi, K.M., Greenstein, D.,Vaituzis, A.C., Nugent III, T.F., Herman, D.H., Clasen, L.S., Toga, A.W., Rapoport, J.L., Thompson, P.M., 2004. Dynamic mapping of human cortical development during childhood through early adulthood. *Proceedings of the National Academy of Sciences of the United States of America* 101 (21), 8174–8179.

> **"Each one of our perceptual, cognitive, and emotional capabilities is built upon the scaffolding provided by early life experiences"**
> **(Fox [11] p. 28)**

> **..biologically speaking it's like starting the engines without a skilled driver behind the wheel"** [15]

Impulsivity for short-term reward in adolescence

Importantly, over late childhood and adolescence, there seems to be a lack of synchrony in the development of two of the critical brain systems that enable fully adaptive behavior.

The 'rational' cognitive system, which allows for understanding a problem and arriving at a solution, appears to be well formed at age 16.[14] This seems in step with the maturation of **frontal cortex**, and on testing a child may give appropriate, adult-like, answers.

However, the system for effective use of information in context – balancing long term consequences with immediate social and emotional concerns – does not develop in synchrony with such rationality [14], and so there is a 'gap' between the 'systems'.

Studies show that adolescents and young adults become poorer at responding on problem solving tasks when the complexity of emotion is added [14]. Such tasks would likely involve the interaction of functions across a range of brain areas (including **limbic, thalamo-amygdala pathway** and both **left and right frontal systems**) [8].

Furthermore, this 'gap' between reason and emotion is exacerbated by an underlying susceptibility for responding to immediate rewards that emerges early in adolescence. In the 'teenage brain' there is a surge of an infusion of reward-oriented **neuro-transmitters** (**dopaminergic activity**) and an associated increase in reward-seeking behavior.

It appears, therefore, that the brain system related to rewards (the **meso-limbic** area) is developing rapidly relative to the other systems. Especially, it seems, compared to the **frontal system** that is supposed to regulate it, and the social and emotional systems that will, in time, moderate it.

Changes in brain systems configuration – as connectivity improves with increased **myelination** and ongoing **cortical pruning** - has been shown in long-term neuro-imaging research. This work shows that the areas responsible for high level thinking such as control of impulses and making judgments about the longer term (the **dorso-lateral- prefrontal cortex**) only reach adult levels of 'cortical thickness' in the late teenage years [16].

The teenage brain, therefore, has an adult-like ability to reason, but with a heightened need for basic reward, and a lowered capacity to buffer immediate influences and potential short-term rewards for greater, longer-term gains – especially in contexts involving peers. This sets the scene for risky decision-making. As one commentator described, biologically speaking it's like 'starting the engines without a skilled driver behind the wheel'.[15]

BRAIN INJURY

Around 8.5% of the general population at one point in their lives suffer an acquired brain injury (ABI), the most damaging of which is Traumatic Brain Injury (TBI). The condition most frequently occurs in young people, resulting predominantly from falls, sporting injuries, fights and road accidents, and is a major cause of death and disability amongst this group. Both sexes are equally affected when very young, but males are much more at risk than females in teenage years and adulthood.

The consequences of brain injury include loss of memory, loss of concentration, decreased awareness of one's own or others emotional state, poor impulse control, and, particularly, poor social judgment. Unsurprisingly behavioural problems such as conduct disorder, attention problems, increased aggression, and impulse control problems are prevalent in people with ABIs [17].

Consequently, while those without a TBI are likely to grow out of immature and antisocial behaviour by their mid-twenties, those with TBI are likely to continue to grapple with these issues throughout young adulthood and beyond. Such issues are critical to consider when assessing and managing the long term effects of brain injury from childhood.

'Open' and 'Closed' Traumatic Brain Injury

There are two main types of TBI; '**open**' and '**closed**'. Open injury is where the skull is penetrated and the brain is exposed such as from a bullet or knife wound, and typically leads to **focal** damage (injury to a specific area of the brain).

More common are closed TBIs, such as from assaults or road traffic accidents [18]. In these injuries there is an insult to the brain from an external mechanical force but the brain is not penetrated or exposed. They may involve a blow to the head, or a car coming to a sudden halt in a crash. These injuries lead to lacerations and bruising of the brain structures, especially around areas where there are bony protrusions on the inner surface of the skull, typically in the base of the skull [19, 20]. See *Figure 3* below.

Internal bleeding may occur as blood vessels are injured, which leads to further injury from compression and loss of oxygen to brain areas [21]. Various studies have shown that the **frontal** and **temporal** areas are the most common sites of injury [22]. Furthermore, injuries from such TBI's tend to lead to **diffuse** (widespread) injury across the brain with damage or disruption to the white matter tracts that communicate across the brain [17, 23].

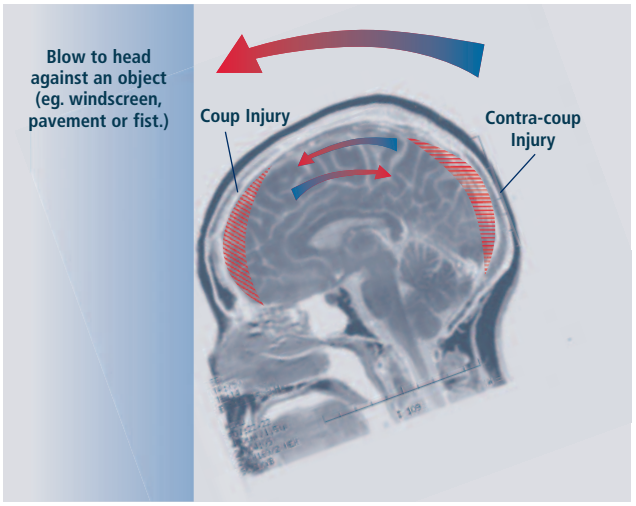


Figure 3: Brain injury may occur for example, when the brain hits the inside of the skull (coup injury) and is then jarred backwards (contra-coup). The diffuse white matter tracts (bundles of axons) may also be sheared by rotational forces.

RESOURCE

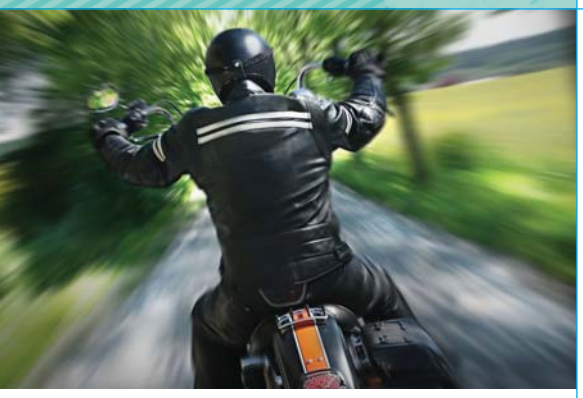
Brain development through childhood and adolescence:

- **for stages of brain growth see**
  http://www.internationalbrain.org/?q=node/112
- **for neuroimaging findings see**
  http://www.loni.ucla.edu/~thompson/DEVEL/dynamic.html

RESOURCES

Traumatic Brain Injury (TBI):

- **Centre for Disease Control and Prevention for an overview to TBI and helpful factsheets, advice and areas of research**
  http://www.cdc.gov/TraumaticBrainInjury/index.html
- **Centre for Disease Control and Prevention for an overview to TBI in prisoners**
  http://www.cdc.gov/traumaticbraininjury/pdf/Prisoner_TBI_Prof-a.pdf
- **National Institute for Health and Clinical Excellence (NICE) guidelines for what should be done when someone has, or is suspected to have, suffered a head Injury**
  http://guidance.nice.org.uk/CG56
- **Headway, the brain injury charity**
  http://www.headway.org.uk/home.aspx



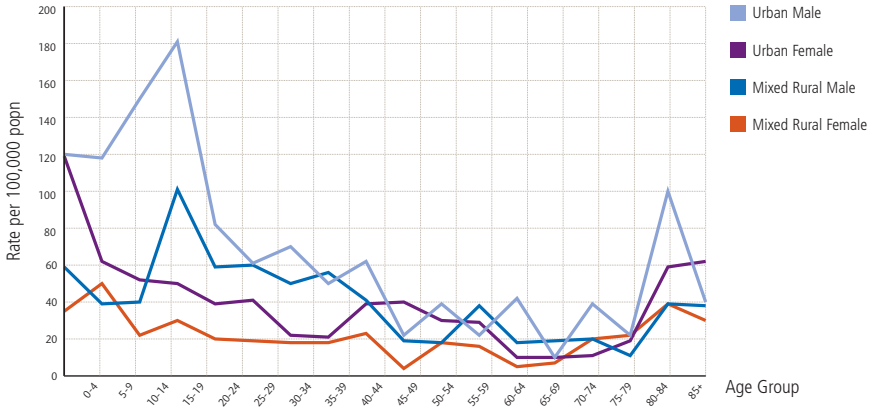
Prevalence

TBI is the most prevalent form of brain injury [24]. In a general ('community') population, the number of people that are estimated to have suffered a TBI of some form (from mild to severe) is approximately 8.5% [30]. In males, a range of 5 – 24% of prevalence for TBI of all severities has been given across studies [31].

The yearly incidence of TBI ranges from 180–250 per 100,000 people in the US [25] to 91 – 419 per 100,000 people (variation is across health authorities) in England [26] A study conducted by Exeter University showed that the incidence was 430 per 100,000, with 40 per 100,000 categorized as moderate to severe injuries (see ***Table 2*** for definitions of severity and ***Figure 4*** for age trends of attendence to an emergency department) [27].

In general terms, then, this suggests that around 80-90% of all TBIs are mild [28]. The global effect of TBIs as a disease, with various degrees of severity, and therefore burden, is thought to be greatly underestimated and to be likely to increase substantially in the future [29].

Figure 4: Rates of moderate to severe head injury per 100,000 of the population, by 5 year range, gender and area of residence, UK.



© original figures: An epidemiological study of head injuries in a UK population attending an emergency department. P J Yates, W H Williams, A Harris, A Round, R Jenkins. *J Neurol Neurosurg Psychiatry* 2006; 77:699–701. doi: 10.1136/jnnp.2005.081901

Causes and risk factors

The main causes of TBI include road accidents, falls, sporting injury, and assaults. Age is a major risk factor for injury, with the very young being most at risk, particularly from falls. Adolescents and younger adults are then the most at risk group, from road accidents, assaults etc. In the very young both genders are at equal risk, but in teenage years and throughout most of adult life, males are much more at risk than females [27]. Other factors that can substantially increase risk include:

- Being from a deprived socio-economic group;
- Geographical location, with urban dwelling youth being more at risk [27]; and
- Use of alcohol and or other drugs, particularly in adolescence and young adulthood [32].

Severity of injury

The severity of a TBI can be classified from 'mild' through to 'severe', although any TBI may be sufficient for actual changes in brain integrity and function. In essence, the level of severity indicates the level of impact that an injury will have on an individual's functioning. A very mild injury – typically referred to as a 'concussion' (where there may be some disorientation or

confusion at the time but no loss of consciousness or other symptoms) would rarely lead to any permanent brain changes. However, with greater signs of 'dosage' (such as being knocked out for longer period and/or a 'deeper' level of unconsciousness), actual changes in the brain may be expected.
TBIs are often classified according to initial level of loss of consciousness using the Glasgow Coma Scale (GCS; [33]; see ***table 1***). A GCS score of 13 or above denotes mild 'Head Injury'; a score of 9 – 12 is moderate; 8 or below is severe. The duration of Post-Traumatic Amnesia (PTA), the period of time after an injury that a person is alert but unable to take on new information, is also used to grade severity [22]. Severity can also be assessed by length of loss of consciousness following injury. (See ***table 2***).

In determining whether there are actual changes in the brain after an injury, and/or risk of on-going or emerging problems, neuro-imaging is undertaken. In the acute period, '**Computed Tomography**' (CT) is routinely used to identify such problems as collections of blood (**hematomas**) and swelling of the brain that can lead to raised pressure inside the skull (**intracranial pressure**). Such investigations are important for immediate management of injury and can guide prediction of outcomes [35-37]. 'Magnetic Resonance Imaging' (MRI) is also becoming routinely used and gives a more accurate – fine grain – analysis of injury. In particular, MRI can show whether there are changes in the diffuse white matter tracts - which can be common after a TBI [38].

Injury at younger age

Outcomes after brain injury in children and young people are hard to quantify or predict because their brains are undergoing phases of dynamic change. Recent work has shown that skills that are developing at the time of injury may be the most vulnerable to being disrupted compared to established skills [39]. Also, injury at various times points in early childhood may lead to very different profiles difficulties (**neuro-cognitive dysfunction**) such as planning and problem solving, in later childhood [17].

Furthermore, in children the effects of impairments are particularly detrimental, as the cognitive abilities that children rely on to learn new information may be compromised. For example, an attention problem after injury in adulthood remains an attention problem, but children who develop attention problems are at risk of additional learning difficulties, such as in language ability.

To some degree, the brain's ability to adapt to injury (**neuro-plasticity**) confers some protection of functions [40]. For example, if a child suffers a stroke during the period prior to language development (typically in the **left temporal lobe**), language functions might develop in the right hemisphere. However, this area is not pre-disposed to take on ('home') language functions, and so full recovery is improbable.

To make matters more complicated, this may also mean there is less capacity for this 'host' site to develop its own functions. For example, the right hemisphere is associated with the 'prosodic' qualities of speech – e.g. rhythm, intonation, and emotional tone. These skills may then be compromised, or crowded out [8]. Unfortunately, injury in developing brains is particularly complicated. Brain cells and systems do not regenerate in the same way as skin or muscle and, even if there may be some 'plasticity', and some functions may be 're-routed', problems can still emerge.

It is important, therefore, to be mindful of a need for monitoring for problems that might be expressed over time, particularly of abilities that a child or young adult may have been developing at the time of injury.

Table 1. Glasgow coma scale

Feature	Sale	Score
Eye opening	Spontaneous	4
	To speech	3
	To pain	2
	None	1
Verbal response	Orientated	5
	Confused conversation	4
	Words (inappropriate)	3
	Sounds (incomprehensible)	2
	None	1
Best motor response	Obeys commands	6
	Localises to pain	5
	Withdraws from pain	4
	Abnormal flexion	3
	Extension	2
	None	1
Minimum score		3
Maximum score		15

Table 2. Classification System

There are various classification systems for use of loss of consciousness as a measure of severity. In general:	
Up to 10 minutes	Considered a mild TBI
Between 10-30 minutes	Considered mild but caution is needed as patients may typically be admitted to hospital for observation in case of complications [20]
Between 30 minutes and 6 hours	Considered to be a moderate injury
Over 6 hours	Considered severe [34]

RESOURCES

- **For general information see Child brain injury trust homepage**

http://www.childbraininjurytrust.org.uk/index.html

- **For brain injury at developmental stages see:**

http://www.internationalbrain.org/?q=node/112

Consequences of TBI

The consequences of injury ('pathology') can result in impairments in processing within the brain that relate to functioning in daily life. After moderate to severe TBI there are often 'neuro-cognitive deficits' such as:

- poor memory (particularly after a delay of a few minutes or more);
- reduced concentration capacity;
- reduced ability to attend to different streams of information; and
- disorders of the executive system ('dys-executive syndrome' – typically poor initiation and planning, lack of self-monitoring and poor judgement [8]).

A resultant de-coupling of 'cognition and emotion' after injury can be expressed as:

- decreased awareness of one's own or others emotional state;
- poor impulse control; and particularly
- poor social judgments.

Not surprisingly, then, behavioural problems are common, such as conduct disorder, attention problems, increased aggression, and impulse control problems.

Unfortunately, mental health problems, especially anxiety and depression are very common after TBI. Loss of social roles is an endemic issue, with survivors often unable to return to work, having problems in forming and maintaining relationships, and subsequent family and social disruption [41, 42]. The net effect of such stresses and strains is that severe mental health disorders are common, with a high risk of suicide [43].

Milder forms of injury can lead to symptoms that are usually short-lived (days or weeks) for most survivors, but some will experience Post Concussion Symptoms (PCS), which can persist for over 3 months, with symptoms such as headaches, poor concentration and irritability [44]. This may be due to neurological changes reflecting a more complicated injury and/or psychological response to trauma [28, 45, 46]. There does, however, seem to be a risk of younger age being associated with less optimal outcomes. In school age children, recent research has indicated that 13.7% have PCS symptoms at three months, dropping to 2.3% by one year post-injury [47].

There is accumulating evidence that repeat concussive injury has a detrimental effect on cognitive and behavioural functions (such as the ability to pay attention, or inhibit behaviour). That is, some form of greater 'dosage' of injury may occur, particularly in younger people [48]. Furthermore, long term follow up studies have shown that mild injuries, where there was some indication of greater Post-Traumatic Amnesia, are linked to forms of subtle neurocognitive inefficiencies in children and adolescents, relative to adults, over 20 years post injury [49]. Such research underlines the need for monitoring of potential problems post brain injury in immature brains.

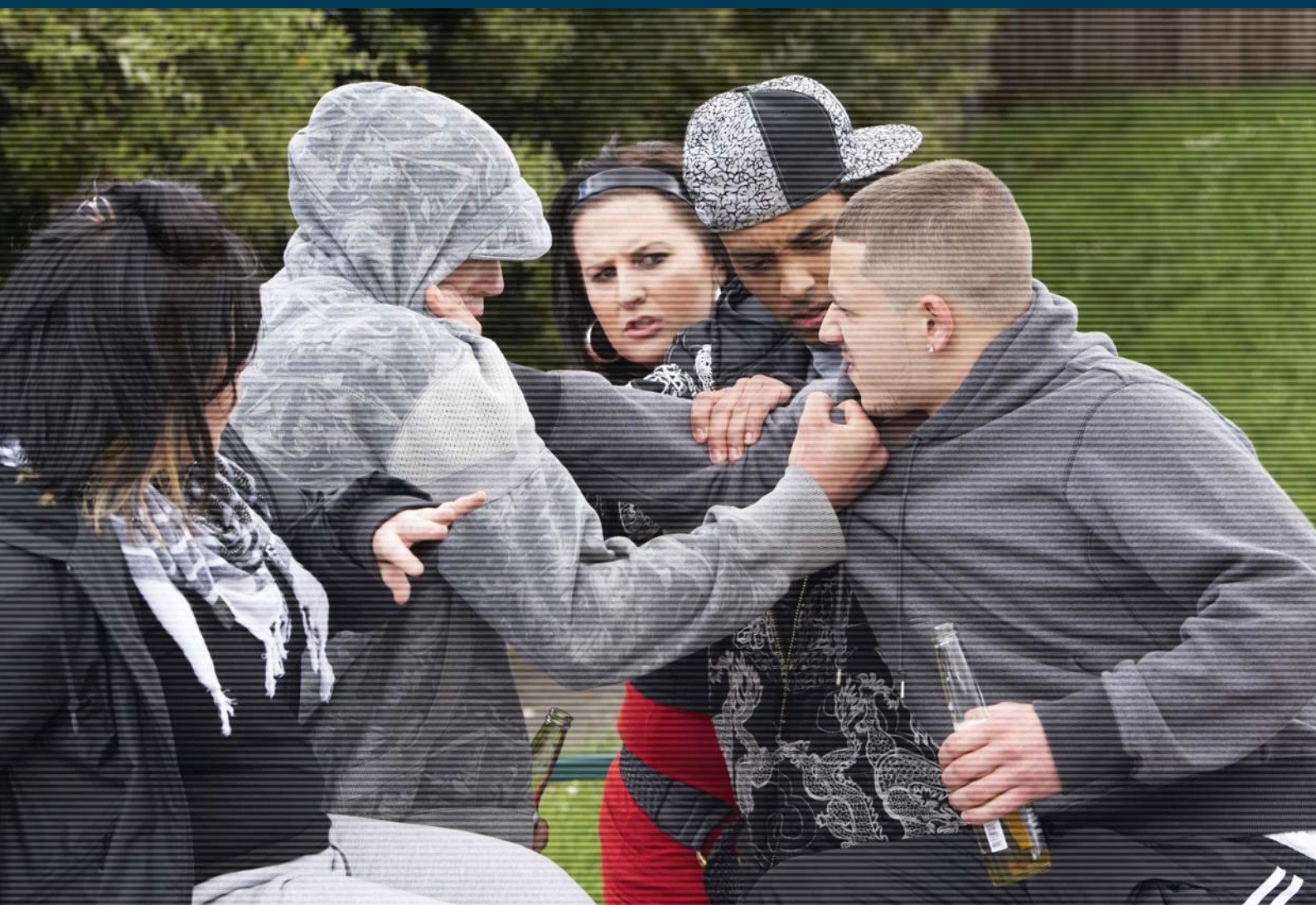
RESOURCES

--• **Executive functions and decision making after TBI**

http://www.ozc.nhs.uk/default.asp?id=105

PART TWO

BRAIN INJURY AND CRIMINAL JUSTICE



BRAIN INJURY AND CRIMINAL JUSTICE

This chapter comprises a literature review of national and international research on both the links between brain injury and offending, and the prevalence of brain injury among people in custody.

The 'cognitive', 'behavioural' and 'neuropsychiatric' consequences of TBI described in theprevious chapter might be expressed in terms of inappropriate ('dys-regulated') behaviour.

Brain injury may lead to particular social problems, such as being less able to de-escalate threats, and acting without considering consequences of action [50]. Moreover, it is likely that problems with attention, memory, and executive functions (**neuropsychological sequelae**) would limit capacity to fully engage in forensic rehabilitation to enable behaviour change, such as the ability to pay attention, remember, and follow through on advice about new ways to manage a problem situation

RESEARCH LINKING BRAIN INJURY AND OFFENDING

There are a range of studies that have indicated possible links between TBI and offending. Longitudinal studies (where people are 'tracked' over many years) have shown that there is a link between TBI and later offending. Studies of groups of young offenders also seem to indicate a specific contribution that TBI can make to increasing the risk of offending over a lifetime, as well as increasing the severity of the crime.

Importantly, however, there is a co-morbidity for such outcomes. Risk taking individuals, who may have a high need for novelty seeking and a low level of harm avoidance, may be at particular risk of impulsive actions (including criminal behaviour), and are therefore at greater risk of engaging in thrill seeking behaviours where injury is more likely. Furthermore, being involved in crime may put individuals into situations where injury is more probable.

Brain injury dysfunction in **frontal areas** has been linked to violent and criminal behaviour and, in particular, increased risk of impulsive aggression [51, 52]. Interestingly, persistent offenders are often described as impulsive and lacking affective empathy [53, 54].

For example, a study of cognitive differences between adolescent boys who would go on to be long-term ('life course persistent') offenders compared with those who stopped after adolescence ('adolescent limited') found that both groups had neurocognitive deficits. However, adolescent-limited offenders had significantly fewer 'knock out' head injuries than those who were life-course persistent [55]. As the study noted, 'This [absence of TBI with loss of consciousness] may explain why...they avoid a negative antisocial outcome in later life' (p.46). These findings come not just from the UK, but from across the world.

RESOURCES

- **Podcast on brain injury & crime**
  http://www.bbc.co.uk/programmes/b00vrvx3
- **BBC News article on brain injury and offending behaviour**
  http://www.bbc.co.uk/news/health-11718241
- **Child brain injury trust on brain injury in young offenders**
  http://www.childbraininjurytrust.org.uk/services_training_youthoffending.html
- **Brain injury information for professionals in the CJS**
  http://psychology.exeter.ac.uk/research/centres/ccnr/professionals/braininjury/

USA

A study with veterans from the Vietnam war indicated that injury to frontal systems could put survivors at risk of crime [56]. Patients with injuries to the area involved in decision making (**frontal ventromedial system**) [57] were consistently reported to show greater aggression and violence compared to non-injured controls and to patients with lesions in other brain areas. In another study, Blake, Pincus and Buckner [52] assessed thirty-one individuals awaiting trial or sentencing for murder, and found evidence of frontal dysfunction in 20 of them (64.5%).

Finland

In a population based cohort study in Finland involving more than 12,000 subjects, TBI during childhood or adolescence was found to be associated with a fourfold increased risk of developing later mental disorder with coexisting offending in adult males [58]. The type of injuries sustained were generally in keeping with other reported trends (see [27]), with the substantial majority (93.8%) in the form of concussion. Those who had a TBI earlier than age 12 were found to have committed crimes significantly earlier than those who had a head injury later, which may suggest a degree of causality between TBI and crime.

Sweden

More compelling evidence for the risk of violent crime after a TBI comes from a recent study from Sweden [59]. Researchers had previously shown that TBI was a moderate risk factor for violence [60]. In this total population study, the hospital records of Sweden from 1973 to 2009 were examined for associations of TBI with subsequent records for violent crime (convictions for homicide, assault, robbery, arson, sexual offenses, and illegal threats or intimidation). Of TBI cases (a total of 22,914), 8.8% committed violent crime, compared with 3% in the population controls. This corresponded to a substantially increased risk of violent crime in the TBI population. Importantly, the researchers then examined the risk of violent crime in siblings (who would be likely to have shared similar social and economic backgrounds), and found that risk was still greater among TBI cases when compared with their unaffected siblings. People with TBI therefore committed more violent crimes compared to other people, including their own siblings.

Australia

Links between TBI, and severity of TBI, and crime have also been reported for youth offenders. In a study of 242 young offenders in Australia, the contribution of the severity of injury, and of harmful alcohol use, were assessed in relation to violent offending [61]. Violent offences were rated as 'low' (common assault), 'moderate' (robbery with weapon), or 'serious' (homicide).

They found 85 participants had a history of TBI, and that the young offenders with a history of TBI were 2.37 times more likely to have committed a serious violent crime. When the young offender had lost consciousness (indicating greater severity of injury) this ratio was increased to 2.82. A hazardous alcohol drinking history also increased risk of severe violent offending. The risk of serious crime was most elevated when offenders had a history of TBI combined with hazardous alcohol abuse.

Spain

Leon-Carrion and Ramos [79] undertook a study of the links between head injuries (in childhood and adolescence) in adult prisoners, violent and non-violent. There was a trend for both groups to have had behavioural and academic problems at school. Head injury in addition to prior learning disability/school problems increased the risk of having a violent offending profile. They noted that violent offending was 'associated with non-treated brain injury'.

These findings therefore indicate a risk of offending, particularly violent crime, post TBI. Importantly, these links appear for TBI in general, including mild TBI, and to particular types of injury, especially involving frontal areas, and across gender. However, it is important to note the potential role of other key factors that may increase the risk of offending and TBI.

Focus on women offenders

TBI has been shown to play a significant role in increasing the risk of offending in women. In a study of 113 female prisoners in the USA, Brewer-Smyth et al. [62] found that 42% had TBI histories, and those who had committed violent offences had suffered an average of two TBIs. Further analysis revealed that the number of years since their last episode of domestic abuse, the number of prior suicide attempts, and traumatic brain injuries with loss of consciousness, were significantly associated with current violent convictions.

PREVALENCE, AND ASSOCIATED FEATURES, OF TRAUMATIC BRAIN INJURY IN OFFENDER GROUPS

The studies above show that TBI is indicated to be a factor which may be linked to offending. What follows are the key studies across various jurisdictions that show that the rate of TBI is much higher in offenders compared to society as a whole. **While less than 10% of the general population has experienced a head injury, studies from across the world have typically shown that this is between 50-80% in offender populations**. Moreover, there is evidence of TBI being linked to being in custody at an earlier age, incarceration for longer sentences, greater reoffending, and committing more violent crimes.

Studies of TBI prevalence in offender groups either rely on medical records available for analysis or self-report. Prevalence estimates of self-reported brain injury within a forensic (secure) context vary considerably, with 25% to 87% of inmates reportedly experiencing a 'head injury' [63-65]. Medical records may, potentially, provide under-estimates of injury as such issues are not being routinely examined for. Self-reports may be over-estimated due to response biases. However, it is worth noting that recent work on the veracity of self-reports of offenders indicate that such reports are largely valid [66].

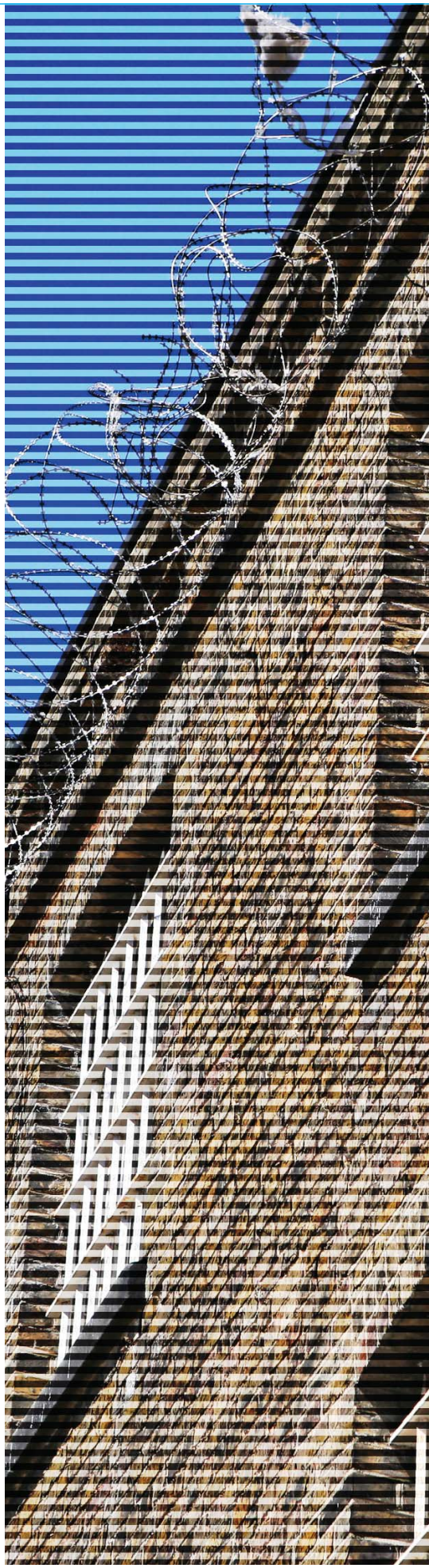
A recent analysis that compared frequencies of lifetime prevalence of TBI in incarcerated groups (across all ages and both genders) with the general population showed that the rate of TBI in the incarcerated group was significantly higher [67]. The un-weighted average for TBI was 51.1%. Importantly, the systematic review revealed only one 'female-only' study and eleven that were 'male-only'. The remaining 9 studies in the review reported data from both genders, although the percentage of women, relative to men, in samples was very much lower.

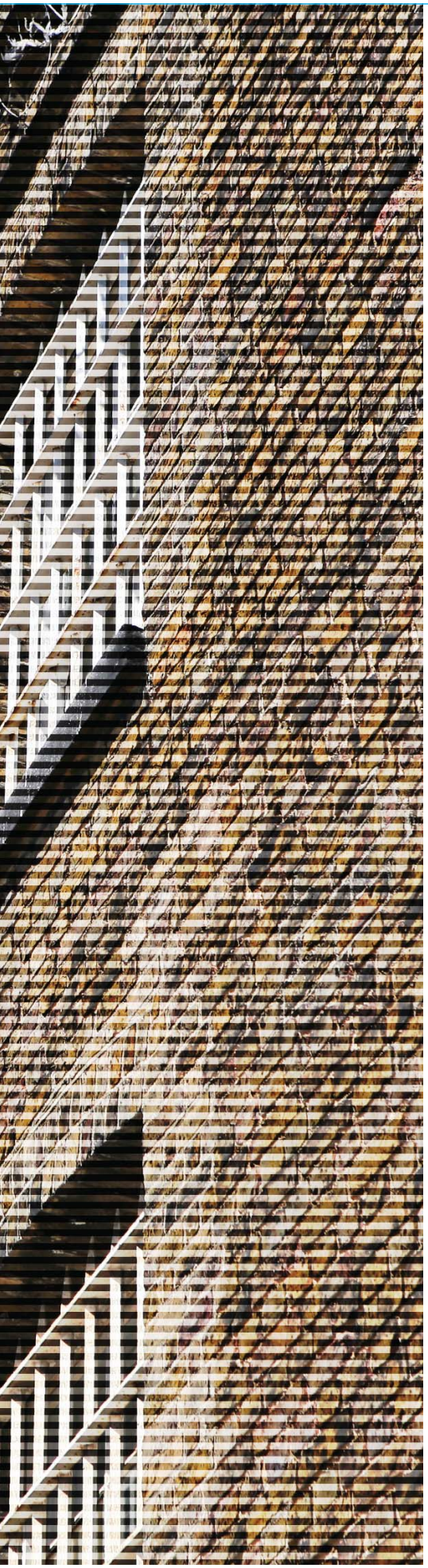
United Kingdom

In a UK study of 200 adult prisoners (all male), 60% claimed to have suffered a TBI of some form [70]. Moderate to severe TBI was reported by 16.6%. Those with a self-reported history of TBI were, on average, five years younger at the age of first prison sentence than those who did not report such a history (age 16 compared to 21). Those reporting TBI also reported higher rates of entry into custody.[70]

New Zealand

Barnfield and Leathem [69], in New Zealand, had 118 respondents (gender not reported, but implied as all male) to a questionnaire survey of prisoners of which 86.4% reported some form of 'head injury' with 56.7% reporting more than one blow to the head. There were concomitant reports of difficulties with memory and socialization. TBI was also associated with higher levels of drug misuse.





USA

Slaughter, Fann, and Ehde [64] investigated the presence of TBI (as defined by whether they had ever had an 'injury to the head which knocked [them] out or at least left [them] dazed, confused or disoriented') in inmates in a county jail in the USA (91% male and 9% female). They found 87% had suffered a brain injury during their lifetime, with 36% experiencing injury in the previous year. Those with a TBI in the previous year had worse anger and greater psychiatric disturbance than those who had not.

A recent US based study of the lifetime prevalence of traumatic brain injury showed that TBI is highly prevalent in both male and female prisoners. The state-wide study grouped prisoners into categories that reflected whether they would be scheduled for release imminently or not. It was found that 65% of male prisoners (releases and non-releases), and 72% and 73% of female 'releases' and 'non-releases' reported at least one TBI that had resulted in an 'alteration of consciousness' [68]. Forty-two per cent of male releases and 50% of non-releases, and 50% of female releases and 33% of non-releases, reported at least one TBI with a loss of consciousness.

When asked whether they experienced on-going symptoms of TBI 35% of male releases and 42% of non-releases, and 55% of female releases and 58% of non-releases, reported that they did. These symptoms included headaches, problems with memory and/or concentration. Moreover, they found a dose response relationship where longer loss of consciousness was associated with more symptoms. These findings suggest that the prevalence of TBI may be even higher in female prisoners than in males, and that TBI may lead to on-going symptoms in both groups.

"While less than 10% of the general population has experienced a head injury, studies from across the world have typically shown that this is between 50-80% in offender populations."

Children and young people are at particular risk of TBI, and TBI in adults who offend seems to be associated with younger age of first imprisonment".

YOUNG OFFENDERS

As noted above, children and young people are at particular risk of TBI, and TBI in adults who offend seems to be associated with younger age of first imprisonment. There have been a number of studies recently that have shown how TBI is a particular concern within youth who offend, with a high prevalence rate of typically at least 50%, and up to 90%.

Williams [34] interviewed 197 young male offenders in a prison about head injuries, their crime history, mental health problems and drug usage. Of those contacted, 94% took part. They were, on average, 16 years of age. Around 60% reported some kind of 'head injury', but, importantly, the study found a TBI with a loss of consciousness in 46% of the sample. The main cause of injury in the young offenders was violence. Repeat injury was common with a third reporting being 'knocked out' more than once. Self-reporting three or more TBIs was associated with greater violence in offences. Those reporting TBI were also at risk of greater mental health problems and misuse of cannabis.

In a related study Davies et al. [71] showed that, in a group of 61 participants, over 70% had TBI histories, and, importantly, that there was a relationship between TBI and current concussion symptoms – those with more serious mild injuries reported a greater degree of on-going problems. Drug and alcohol use did not confound these findings. This indicates that those with TBI are likely, depending on the severity of injury, to have brain injury related problems that may interfere with their ability to engage in forensic rehabilitation.

Perron and Howard [72] examined the period prevalence and correlates of TBI in 720 residents of offender rehabilitation facilities (average age of 15.5 years and 87% male). TBI was defined as having sustained a head injury causing unconsciousness for more than 20 minutes. 18.3% reported such an injury. Male gender, psychiatric diagnosis, and earlier onset of criminal behaviour and substance use were associated with brain injury.

A limitation of these studies is a lack of control groups. There has, however, been some work in the area of youth who offend where control groups have been used. A study comparing non-offending and offending youths showed that, in the group of offenders, there was a higher level of injury (50% versus 40%), and that the non-offender group were typically injured in sporting events whilst the offenders had a range of equally occurring causal events including fights, road traffic incidents, falls and sports [73].

Farrer [74] recently conducted a meta-analysis of traumatic brain injury in juvenile offenders. The majority of the studies related to males only. They identified four studies without control groups and 5 with. They reported that the rate of TBI (which appears to include at least a knock out history) across 9 studies was approximately 30%. This is consistently high relative to the general population. In the five studies that used a control group, they calculated that juvenile delinquents were significantly more likely to have a TBI compared to controls.

COMPLEXITY OF NEED

From the studies reported thus far, a trend emerges is that TBI is one of many factors that has been found to be much more prevalent among offenders than the general population. It is important, therefore, to explore how TBI may be linked to other problems.

Mental health problems, drug and alcohol misuse and learning difficulties

Mental health issues are very common in offender groups [3, 4]. For example, a systematic review of 62 surveys by Fazel and Danesh [75] identified that prisoners were seven times more likely to have psychosis and major depression than the general population, and ten times more likely to have anti-social personality disorder. Importantly, they note that the burden of treatable serious mental health disorder is substantial.

Grann and Fazel [76] found that 16% of all violent crimes committed in Sweden from 1988-2000 were committed by people who had previous diagnoses of alcohol misuse and that 11% of all violent crimes were committed by patients diagnosed as having misused drugs.

Mental health and drug misuse issues may well be independent of TBI but may also be a result of TBI (see [42] re: mental health post-TBI). Even if such issues are separate from TBI in terms of causation, it is very likely that they are particularly relevant in the context of TBI. Drug and alcohol abuse and levels of mental health problems (depression, anxiety and suicidality) have been shown to be elevated in prisoners who have a TBI history, and a person's capacity in coping with such mental health issues would be compromised in the context of a TBI [77].

Despite the links found in research, mental health practices often neglect to assess patients for TBI. De Souza [78] examined the existence of TBI in a forensic psychiatric population in Brazil. The authors were interested in whether the TBI occurred prior to incarceration and whether such injury was recorded by service providers. Of 3,233 offenders there were 133 cases of TBI reported (39 'mild' and 94 'moderate or severe'). In the majority (111 cases) there was no account taken of the injury by service providers.

In Canada, Colantonio et al. [53] investigated whether adults with a documented history of TBI differed from non-TBI in a forensic population with respect to demographic background and psychiatric diagnoses. A review of all consecutive admissions to the forensic psychiatry programme revealed that history of TBI was ascertained in 23% of 394 eligible patient records. Those with a TBI history were less likely to be diagnosed with schizophrenia but more likely to have an alcohol/substance abuse disorder. They recommend routine screening for a history of TBI in forensic settings.

Forrest, Tambor, Riley, et al. [84] report that in the USA, 5.5% of all youths aged 10 or older are referred to juvenile court. They showed that those in custody had much worse health status in terms of perceived well-being, self-esteem and other issues such as family involvement, than those not in custody.

ADHD and PTSD

Fazel, Langstron, Grann & Fazel [80] investigated psychopathology in adolescent offenders (15 - 17 years) and young adults (18 -21 years) as reported in a national database in Sweden. Data on 3,058 offenders was analysed. Those who were younger had higher rates of depression or mood disorder and/or childhood developmental disorders including Attention Deficit Hyperactivity Disorder (**ADHD**) or disruptive behaviour difficulties. Lower rates of psychosis, bipolar disorder, and substance misuse were found in comparison with older groups.

It is particularly interesting to note that ADHD appears to be a factor in the profile of younger offenders. A recent study by Max, Lansing, Koele, Castillo, Bokura, Schachar et al. [81] showed that ADHD is a commonly occurring syndrome after TBI during childhood or adolescence. It is also a risk factor for TBI [82], therefore likely to contribute to problematic behaviour. A recent consensus review from the UK Adult ADHD Network provided a helpful overview to how such neurodevelopmental disorders can be managed within the criminal justice process [83].

In a recent study of the mental health needs of 301 young offenders in the UK (aged 13 to 18), Chitsabesan, Kroll, Bailey, et al. [85] reported that one in five had significant depressive symptoms, one in ten had anxiety or Post Traumatic Stress Disorder (**PTSD**) symptoms and one in ten reported self-harm in the past month. One in ten had alcohol problems and one in five had drug problems. Aggressive behaviour towards people and property was reported in one in four and one in five respectively.

Evidently, then, the needs of younger offenders are different, and require specific management, compared to older groups. Importantly, in the context of TBI, the effects of injury may not be fully realised, given that functions that may be developing may be compromised. This underlines the importance of assessment and management of TBI in such groups.

INTERNATIONAL AND EUROPEAN LAW FOR CHILDREN AND YOUNG PEOPLE WITH BRAIN INJURY IN THE CRIMINAL JUSTICE PROCESS

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This report has a number of implications for policy and practice, and there are also implications for legislation. In addition to central legislation that applies the UK (or England and Wales in a criminal justice context), there is a multilevel system of rights and obligations applicable to people throughout the criminal justice process with which the UK is obligated to comply. The system exists on three levels: international, Council of Europe, and European Union. The UK is bound by international law under a number of conventions and rules, including the 1985 Beijing Rules, the 1989 UN Convention on the Rights of the Child and the 1990 Riyadh Guidelines and Havana Rules.

Implications of international and EU law on UK legislation

While the UK may be under obligations in international law, the reality is that such rights and assurances are not always fully or even adequately protected at national level – a fact acknowledged by international organisations. The interaction of international and national law can be complicated and all too often the recommendations and proposals made by international organisations have no real teeth. Indeed, compliance with international law itself is often difficult to achieve in practice, particularly when rights are formulated and discussed in rather general terms.

However, such compliance can be more easily assured in the context of European Union law. European Union law differs from broader international law in a number of ways. Most importantly, unlike traditional international law which binds states in the international arena, European Union law actually becomes part of the law of its member states, binding not only states, but giving rights to individuals that can be relied on within the national legal system.

RESOURCE

'Towards an EU strategy on the rights of the child', published by the European Forum on the Rights of the Child. This is a permanent group for the promotion of children's rights in the EU's internal and external action, which focuses on child-friendly justice and effective participation of children in the criminal justice system
http://ec.europa.eu/justice/fundamental-rights/rights-child/index_en.htm)

'Child-friendly justice' and 'Effective participation'

Many international law obligations have been framed in terms of rights for children and young people. Since the mid 2000s, however, there has been a shift in focus from a more general rights discourse to one that is more focused on 'effective participation', which has particular implications for the criminal justice process.

The arguments put forward in the case study above were key in the development of the law in this area and, as a result, the European Court of Human Rights set out that a condition for a fair trial the 'effective participation', meaning that the defendant must have a broad understanding of the nature of the proceedings and will be assisted if necessary. This requirement has since been promulgated by the Council of Europe in the 2010 Guidelines on Child-Friendly Justice.

Most importantly, as part of the European Union's 'Procedural Rights Roadmap', the Council of Ministers has recently put forward a legislative proposal on special safeguards in criminal procedures for suspected or accused persons who are vulnerable. There is little question whether children suffering from TBI will from part of that group. There is clearly a role for neuroscience when it comes to determining the level of understanding of a child and young person with TBI – a level of understanding that, under international law, has to be assured right through the legal process, from contact with police or social services, through to dealings with solicitors and barristers and understanding of the court process and language used throughout the legal procedure.

International disparity in the protection of vulnerable people in the criminal justice process

The Council of Ministers has noted that at present there appears to be a disparity in protection across EU member states with regards to protection for children and other vulnerable suspects and accused persons in criminal proceedings. This lack of common standards has been recognised by the Council as an obstacle to mutual trust between judicial authorities in member states and to mutual recognition of judicial decisions in criminal matters. While member states do have minimum standards for children, in line with the UN Convention on the Rights of Child (which has been signed by all EU Member States), these are not always enshrined in legislation and practice.

Furthermore, there appears to be very little legislation in member states protecting young and vulnerable adults, who represent a considerable proportion of defendants in the criminal justice system. The Council therefore has asked the European Commission to propose further EU action on this specific issue and member states themselves have called upon the Commission to put forward a legislative proposal in this area. That potential proposal is currently under consideration and at the very early stages of drafting at the Commission. It is therefore important that recommendations to improve protection of rights for people with brain injury are put forward to policy-makers at EU level so that they may be incorporated into the eventual EU legislation, which in turn will form part of UK law.

CASE STUDY: EFFECTIVE PARTICIPATION IN COURT PROCEEDINGS

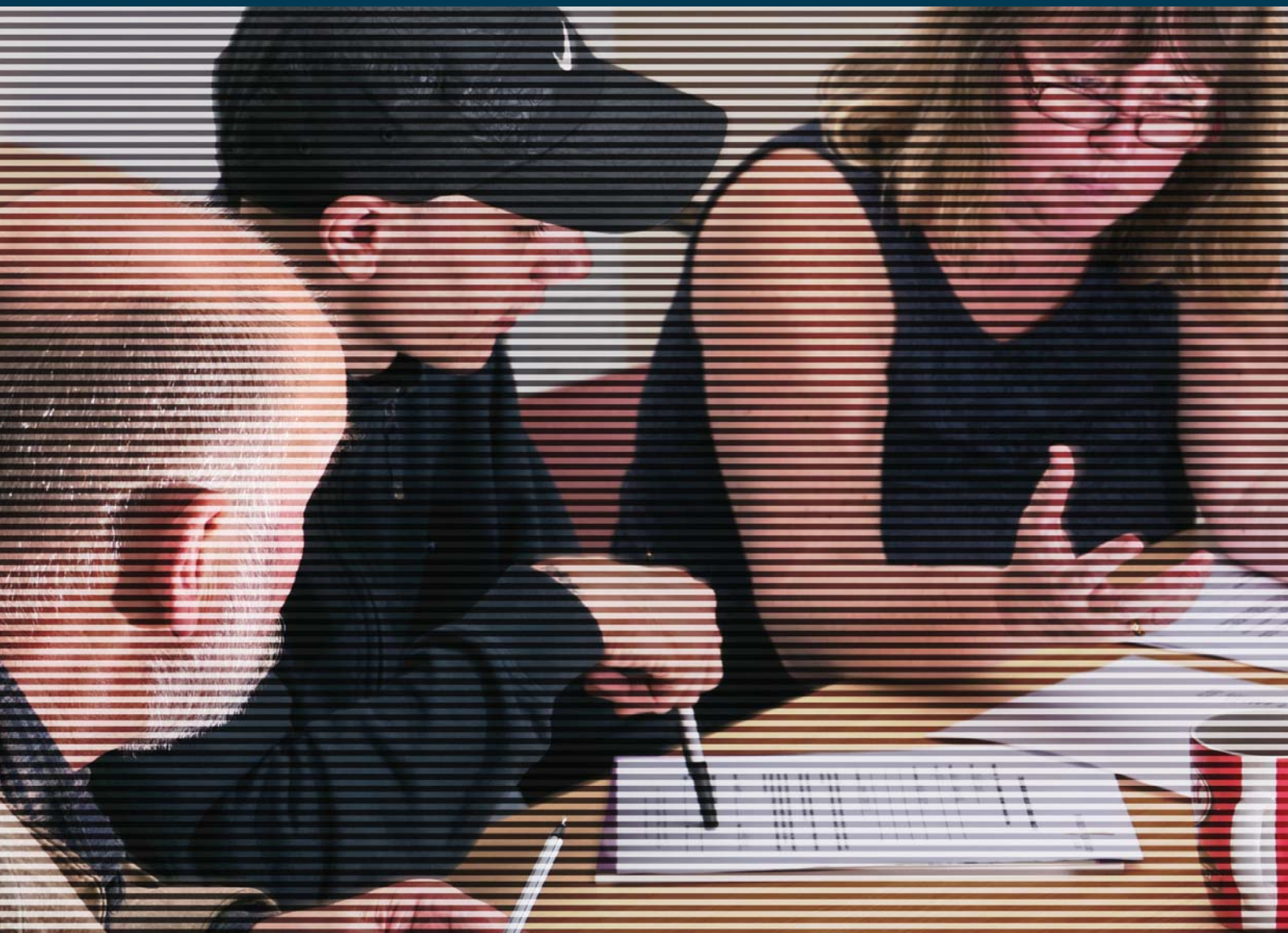
In the 2004 case of SC v UK, the European Court of Human Rights held that there had been a violation by the UK of Article 6 of the European Convention on Human Rights (ECHR). A child, aged 11, was charged with attempted robbery and stood trial in the Crown Court where he was convicted and sentenced to two and a half years' detention. All appeals in the case were refused. The lawyer for the child in question then took the case before the European Court of Human Rights complaining that he had been denied a fair trial because of his low age and limited IQ and submitted that he was unable to participate effectively in his trial.

RESOURCE

- **Council of Europe 2010 'Child friendly justice guidelines**
http://www.coe.int/t/dghl/standardsetting/childjustice/default_en.asp)

PART THREE

KEY ACTION POINTS



KEY ACTION POINTS

TBI should be viewed as a chronic health condition with associated, on-going, symptoms. These range from the somatic (e.g. headaches) through to the emotional (e.g. anxiety and anger), behavioural (e.g. impulse control and aggression), and cognitive (distracted and forgetting easily). Each area of symptoms is, to some degree, related to changes in the brain. Furthermore, the evidence indicates that TBI is associated with earlier, repeated, more serious and longer-term offending.

Given that TBI has been largely neglected within a criminal justice context – either as a health issue and as a factor in offending – it would be reasonable to assume that, by attending to TBI, there would be benefits in terms of reducing the burden and distress of injury, but also the likelihood of offending. It is, moreover, important to note that offenders are poor at accessing, and often have limited access to, primary care health services or attending specialist appointments. Subsequently, admission to secure care, either in prison or mental health settings, may provide an opportunity to deliver routine health screening as well as engaging young people in specialist services interventions.

More widely, there is a lack of services to ensure that those who are injured are enabled to develop appropriate skills to participate fully in society. Neuro-rehabilitation is potentially very effective in enabling survivors to act appropriately according to social roles, but is not readily accessible in the UK.

This section details some **key action points to enable more effective management of brain injury in children and young people, people at risk of offending, and those already in the criminal justice process**.

1 CRIMINAL JUSTICE SCREENING AND ASSESSMENT

As part of comprehensive health assessments, there should be standardised screening of young people for brain injury when they come into contact with criminal justice process, particularly pre-sentence and in custody.

TOP TIPS FOR INITIAL SCREENING

- Initial screening tools need to be brief so as to be appropriate for use in custody suites, courts, prison and probation services
- Screening assessments should be at the earliest contact with the criminal justice process
- Screening could be undertaken by a range of criminal justice professionals, such as police officers, court staff, probation officers and prison reception teams.
- Screening assessments should identify relevant TBI history (e.g. severity of injury and presence of neuro-behavioural problems) and it would be important to follow this up with advice regarding management and/or referral for further assessment by relevant practitioners.

TOP TIPS FOR DETAILED SCREENING

- Detailed assessments would need to take account of: History of TBIs (frequency and severity); other forms of Acquired Brain Injury; corroborative information; pre-morbid functions (possible intellectual disabilities and or learning difficulties); and for identifying neuropsychological dys-function (for example, for dys-executive syndrome, planning problems, and deficits in social emotional processing)
- Such assessments would require oversight from suitably qualified professionals (with relevant medical and/or psychological training)

RESOURCE

- For an example of screening for TBI in prisoners and further assessment see:

http://www.brainline.org/content/2008/11/traumatic-brain-injury-among-prisoners.html

2 CRIMINAL JUSTICE RESPONSES

Probation pre-sentence reports

Assessments for TBI could be used to aid recommendations and decision-making regarding possible offender management so as to take account of brain injury. This could serve to identify particular needs that could be addressed within probation or prison settings. It may be necessary to explore what additional advice and input may be needed for most effective management of the individual's needs.

Court process and sentencing

At court, a person with TBI will may have problems with memory, planning, and managing emotion, and would have particular difficulty in following proceedings and providing appropriate evidence. It would be vital that when a relevant TBI is identified measures to enable access to justice and 'effective participation' (see above). It may be necessary that intermediaries are identified and provided to support the defendant throughout the process.

RESOURCES FOR COURT PROFESSIONALS:

- **Prison Reform Trust report 'Fair Access to Justice: support for vulnerable defendants in the criminal courts'**

http://www.prisonreformtrust.org.uk/Portals/0/Documents/FairAccesstoJustice.pdf

- **CPS 'Special Measures' for vulnerable witnesses**

http://www.cps.gov.uk/legal/s_to_u/special_measures/

- **Operational Guidance for CPS Staff and Managers: Implementing and complying with the Witness Charter**

http://www.cps.gov.uk/legal/v_to_z/witness_charter_cps_guidance/

- **Prison Reform Trust report 'Vulnerable Defendants in the Criminal Courts: a review of provision for adults and children'**

http://www.prisonreformtrust.org.uk/Portals/0/Documents/vulnerable%20defendants%20in%20the%20criminal%20courts.pdf

Custody and probation settings

Within custodial and/or probation systems it would be important for front line staff to have sufficient knowledge of TBI and its consequences so that they may take account of any TBI based issues in their day-to-day management of offenders. Specialist training, advice and support would need to be provided where there is clear evidence of significant TBI related behavioural and/or psychiatric needs. This would necessitate referral arrangements to clinical supervision and specialist multi-disciplinary assessments.

Forensic services

Forensic rehabilitation needs to be enhanced according to the evidence base in neuro-rehabilitation for interventions that can be provided to manage the health, cognitive and behavioural issues stemming from TBI. There should be access to clinical supervision and multi-disciplinary approaches with referral to a Clinical Neuropsychologist, or a clinical/forensic psychologists with access to supervision from a Clinical Neuropsychologist.

RESOURCES

- **For experts in Psychology, as listed by the British Psychological Society, see:**

http://www.bps.org.uk/psychology-public/find-psychologist/find-psychologist

- **For the Division of Neuropsychology of the British Psychological Society, which provides oversight for the profession and training in the UK, see:**

http://www.bps.org.uk/networks-and-communities/member-networks/division-neuropsychology

3 TRAINING FOR CRIMINAL JUSTICE PROFESSIONALS

Training for front line staff (such as for Youth Offending Teams, prison and probation staff) is necessary for improved identification and management of TBI, and should include:

- understanding what a TBI is
- how prisoners with TBI may be affected
- what they may do for day-to-day management of such problems (e.g. how to manage memory, communication and attention problems by modifying how staff ask an offender with TBI to follow instructions or manage impulsivity.)
- how the TBI may impact on engagement in offender treatment programmes (particularly group programmes)
- where to access advice and support if problems are more extensive
- who to refer to the individual on to if necessary

Training of solicitors to take account of TBI is recommended, as is training of magistrates and judges, so that they are aware of the potential for TBI issues in offending, 'effective participation' in the criminal justice process and rehabilitation

RESOURCE:

- **For a summary of helpful advice for front-line criminal justice professionals see:**

http://www.brainline.org/content/2010/03/traumatic-brain-injury-a-guide-for-criminal-justice-professionals_pageall.html

4 MANAGING YOUNG PEOPLE WITH BRAIN INJURIES IN CUSTODY AND PROBATION SETTINGS

There should be good awareness and training of staff in TBI (screening) in assessment and management within the justice system, within both community (e.g. Youth Offending Teams) and custody, and for those working with 'at risk' client groups e.g. specialist educational placements, looked after children and alcohol and drug services, and those who deliver evidence-based family interventions aimed at reducing offending (such as through the Troubled Families agenda).

There should be access to clinical supervision and multi-disciplinary approaches relevant to this group that would, for example, include Child and Adolescent Mental Health Services (CAMHS) to manage mental health co-morbidity and educational psychology for general learning profile. Some young people may need to access specialist neuropsychology assessments, either by referral to a Clinical Neuropsychologist or educational, clinical and forensic psychologists with access to supervision from a Clinical Neuropsychologist.

5 COMMISSIONING APPROPRIATE AND EFFECTIVE SERVICES

It is vital that commissioners of social and health care services for offenders ensure that there are packages of care being developed and delivered that addresses the range of issues related to TBI.

To ensure this, outcomes should be assessed with reference to quality standards for social and health care. Data on neuro-disability - including TBI - should be collected and reviewed to identify the level of severity and consequential needs that may arise (see forthcoming report from the Office of the Children's Commissioner).

Services should be commissioned based on a 'pathway' approach to effective practice (as described in the Bradley report on mental health and criminal justice [4] and the Transition to Adulthood's 2012 report 'Pathways from Crime'.

RESOURCE

- **Pathways from Crime: Ten steps to a more effective approach for young adults in the criminal justice process'**

http://www.t2a.org.uk/pathway

6 EARLY RESPONSES TO CHILDREN AND YOUNG PEOPLE WITH BRAIN INJURY

Services must work together more effectively to deliver proactive measures to reduce risk of crime following a brain injury. There should be early identification of TBI in children and young people as it may lead to problems in school and to socialisation which commonly leads to exclusion and social isolation.

Thorough screening and assessment of TBI in children and adolescents attending Emergency Department should be standard practice. This should be both focussed on immediate medical care, but also on identifying factors that may indicate complicated recovery which may interfere with schooling. This could be linked to a system for alerting GPs and school nurses for post-injury monitoring when indicated.

There is a need for those with oversight to children's health (e.g. GPs and school nurses) to monitor whether an injury may be linked to emerging problems in behaviour and educational engagement over time. This is critical for when the child may be facing both a transition from structured schooling (primary) to less structured environments (secondary). This is especially important as there may be an issue relating to deficits becoming more apparent over time.

There should be training for education staff, critically head-teachers to raise general awareness of the issues, and those coordinating and providing support such as Special Educational Needs Coordinators (SENCOs) and teaching assistants. In general, Teachers should be made aware, e.g. through school staff in-service training, for these issues. This will help address behavioural problems and enable teachers top better understand learning needs of any affected children. There should be identification of areas where support for parents or relevant guardians would be appropriate, particularly where the TBI is more consequential.

7 RESEARCH

While the research in this area is growing at a fast pace, further studies to explore the links between brain injuries and offending behaviour are needed so that assessment and management practice can be improved. For example, a better understanding of the role of frontal systems – especially in developing brains – might offer insights into treatment of impulse control which could be linked to social violence.

More research is needed on women who offend, as they may present with different risk factors for injury (for example as a result of higher levels of being victims of domestic violence). It is vital that research that addresses the causes and consequences of TBI in women who offend is conducted so that a better understanding of women offenders' health and social care needs are developed. For example, factors for offending differs between the genders, with socio-economic and child-raising factors playing a more important role for girls and parental characteristics (such as education and mental health) being more of a risk for boys.[86]

Research is needed to develop and test screening measures for identifying TBI throughout the criminal justice process. Health and criminal justice economic modelling is needed to establish the degree of saving from earlier, more systematic, assessment and management of TBI in offenders.

8 IMMEDIATE OPPORTUNITIES

Some of these recommendations are already being developed and may enable implementation in the short term. Two immediate opportunities that may have a lasting impact are described below.

Screening for TBI: The Comprehensive Health Assessment Tool

Currently, in England, new screening processes are being developed for assessing neuro-disability and informing practice. The Youth Justice Board and Department of Health have commissioned the development of a Comprehensive Health Assessment Tool (CHAT). This contains a first night reception screen - to assess for immediate risks in physical health, mental health, substance misuse and safety risks (part 1)- and subsequent measures of physical health, substance misuse and mental health (parts 2, 3 and 4) [87].

In view of the prevalence of neuro-disability identified in young offenders, a new section of the CHAT (part 5) has been developed. This addresses neuro-developmental disorders such as learning disability, autistic spectrum disorders and speech, language and communication needs, and also includes assessment for brain injury with a section on TBI. This section is being validated on a sample of young offenders in secure custody, with the aim that all parts of the CHAT will then be used routinely across the secure estates by April 2013. A community version of the CHAT has also been developed and currently in the process of being piloted within community youth offending services.

The successful implementation of any screening tool requires it to be embedded within local pathways for further specialist assessment for young people who screen positive. It should also be supported by appropriate staff training and supervision of youth justice staff on how to both identify young people with neurodisabilities and health needs and how best to support them through a robust care plan Importantly, the CHAT could allow for more accurate data on the prevalence of TBI in turn leading to better informed commissioning decisions and resultant care pathways. This may also be a model for how services for adults may be developed in future. Within this context it is worth noting that the Disabilities Trust Foundation has a pilot programme underway at an adult prison with a specialist brain injury linkworker providing assessments and developing care pathways for offenders with a brain injury. The outcomes are being monitored and this model may be transferable to a youth justice setting. See **www.thedtgroup.org/foundation** for further details.

The Criminal Justice and Acquired Brain Injury Interest Group

Given the importance of addressing the needs of those with brain injury in the Criminal Justice and Acquired Brain Injury Interest Group (CJABIIG) was formed in 2011. CJABIIG works to raise awareness and means for addressing brain injury throughout the criminal justice process. In particular to identify how rehabilitation of offenders may take account of the specific needs associated with brain injury (through training, awareness raising, partnership working and parliamentary briefing). This group currently provides a forum for a range of stakeholders – from private, public and charity sectors - to review progress in this area. In July 2012, Lord David Ramsbotham, former Chief Inspector of Prisons, became the group's chair see **http://www.childbraininjurytrust.org.uk/information_criminaljustice.html**. The group's secretariat is provided by the Child Brain Injury Trust, which is supported to undertake this work by the Barrow Cadbury Trust.

FINAL THOUGHTS

Over the last two decades, there have been calls for developments to improve access to mental health services for young and adult offenders with mental health problems in the UK. Many of the issues identified are amenable to psychological and psychiatric intervention [80], and significant progress has been made following the Bradley Review of 2009 [4].

There have also been a number of important advances in the past few years in our understanding of brain systems, their development, and what may happen after injury. Critically, that certain neurological systems are important for decision making that takes account of long term consequences of behaviour, particularly under pressure. Such systems would therefore seem crucial in areas important for functioning relevant to crime – such as impulse control and consequential thinking.

Indeed, they are heavily implicated in the fast and accurate processing of social demands – dealing with others. As children develop, their brains become evolved to manage more complexity, and skills, such as these, come 'on line'. Children and young people therefore have a degree of neurologically-based immaturity relative to adults. Unfortunately, this is a time-period also where risk of TBI is very high – the impact of which limits maturity still further.

Not surprising, then, TBI in early life seems to be a major issue within offender groups. It is associated with earlier onset, more serious, and more frequent offending. Of course, it is important to note that it is not possible to know for certain how brain injury increases likelihood of offending, and there may be underlying risk factors for TBI and offending behaviour, including deprivation, lack of life opportunities, low concern for self-care, and even being a person who 'takes risks'.

The research, however, seems to show that TBI is a very strong 'marker' for these other factors. It is fair to say that the cognitive and behavioural problems noted here are commonly observed within the young and adult offender cohorts. Early recognition and intervention when there is a TBI in childhood and adolescence, as well as in adults, could help to reduce crime.

There may well be critical 'windows' of opportunity that may be targeted for diverting those with brain injuries at risk of greater offending into non-offending lives, but those at most risk of injury are often those that are furthest from appropriate support. The delivery of services to these groups will therefore require close cooperation between criminal justice, health, social, and educational systems and, in working together, shattered lives can be repaired.

“TBI in early life seems to be a major issue within offender groups. It is associated with earlier onset, more serious, and more frequent offending”.

REFERENCES

1. Fleminger, S. and J. Ponsford, *Long term outcome after traumatic brain injury.* BMJ (Clinical research ed.), 2005. 331(7530): p. 1419-20.
2. The Lancet, *Health care for prisoners and young offenders*. The Lancet, 2009. 373(9664): p. 603.
3. Sainsbury Centre for Mental Health. *Diversion: A better way for criminal justice and mental health*. 2009 22.06.12]; Available from: http://www.centreformentalhealth.org.uk/pdfs/Diversion.pdf.
4. Bradley, K.J.C., *The Bradley report : Lord Bradley's review of people with mental health problems or learning disabilities in the criminal justice system*. 2009, Department of Health. p. 173 pages in total.
5. HM Government. (2008) *Youth Crime Action Plan*.
6. Raine, A., et al., *Selective reductions in prefrontal glucose metabolism in murderers*. Biol Psychiatry, 1994. 36(6): p. 365-73.
7. Birbaumer, N., et al., *Deficient fear conditioning in psychopathy: a functional magnetic resonance imaging study*. Archives of general psychiatry, 2005. 62(7): p. 799-805.
8. Tonks, J., et al., *The development of emotion and empathy skills after childhood brain injury*. Developmental Medicine & Child Neurology, 2009. 51(1): p. 8-16.
9. Connors, B.W. and M.A. Long, *Electrical Synapses in the Mammalian Brain*. Annual Review of Neuroscience, 2004. 27(1): p. 393-418.
10. Brouwer, R.M., et al., *White Matter Development in Early Puberty: A Longitudinal Volumetric and Diffusion Tensor Imaging Twin Study*. PLoS ONE, 2012. 7(4): p. e32316.
11. Fox, S.E., P. Levitt, and C.A. Nelson Iii, *How the Timing and Quality of Early Experiences Influence the Development of Brain Architecture*. Child Development, 2010. 81(1): p. 28-40.
12. Savage, R., *The child's brain - injury and development*. 1999, Wake Forrest, NC: Lash and Associates Publishing.
13. Anderson, V., *Cognitive Development, in Developmental Neuropsychology: A Clinical Approach*, V. Anderson, Northam, E, Hendy, J and Wrennall, J, Editor. 2001, Psychology Press: Hove & New York. p. 69-100.
14. Steinberg, L., *A social neuroscience perspective on adolescent risk-taking.* Developmental Review, 2008. 28(1): p. 78-106.
15. Dahl, R., *Affect Regulation, brain development, and behavioral/emotional health in adolesence*. CNS Spectr., 2001. 6: p. 1-22.
16. Lenroot, R.K. and J.N. Giedd, *Brain development in children and adolescents: Insights from anatomical magnetic resonance imaging*. Neuroscience & Biobehavioral Reviews, 2006. 30(6): p. 718-729.
17. Anderson, V., et al., *Childhood brain insult: can age at insult help us predict outcome?* Brain, 2009. 132(1): p. 45-56.
18. Kraus Jf, R.A.H.P., *Brain injuries among infants, children, adolescents, and young adults*. Archives of Pediatrics & Adolescent Medicine, 1990. 144(6): p. 684-691.
19. McLernon, S., *Management of Patients with Traumatic Brain Injury, in Neuroscience Nursing: Evidence-Based Practice*, Woodward S and M. A-M., Editors. 2011, Wiley-Blackwell. p. 531 - 555.
20. Sanders, K.L., *Head injuries, in Accident and emergency theory into practice*, B. Dolan and L. Holt, Editors. 2008, Elsevier: London. p. 47 - 78.
21. Gennarelli, T.A., L.E. Thibault, and D.I. Graham, *Diffuse Axonal Injury: An Important Form of Traumatic Brain Damage*. The Neuroscientist, 1998. 4(3): p. 202-215.
22. Lishman, W.A., Organic Psychiatry: *The Psychological Consequences of Cerebral Disorder*. 1998: Blackwell Science.
23. Crowe, L.M., et al., *Intellectual, Behavioral, and Social Outcomes of Accidental Traumatic Brain Injury in Early Childhood*. Pediatrics, 2012. 129(2): p. e262-e268.
24. Fleminger, S. and J. Ponsford, *Long term outcome after traumatic brain injury.* BMJ, 2005. 331(7530): p. 1419.
25. Bruns, J., Jr. and W.A. Hauser, *The epidemiology of traumatic brain injury: a review*. Epilepsia, 2003. 44 Suppl 10: p. 2-10.
26. Tennant, A., *Admission to hospital following head injury in England: Incidence and socio-economic associations*. BMC Public Health, 2005. 5(1): p. 21.
27. Yates, P.J., et al., *An epidemiological study of head injuries in a UK population attending an emergency department*. Journal of Neurology, Neurosurgery & Psychiatry, 2006. 77(5): p. 699-701.
28. Williams, W.H., S. Potter, and H. Ryland, *Mild traumatic brain injury and Postconcussion Syndrome: a neuropsychological perspective*. Journal of Neurology, Neurosurgery & Psychiatry, 2010. 81(10): p. 1116-1122.
29. Hyder, A.A., et al., *The impact of traumatic brain injuries: a global perspective*. NeuroRehabilitation, 2007. 22(5): p. 341-53.
30. Silver, J.M., et al., *The association between head injuries and psychiatric disorders: findings from the New Haven NIMH Epidemiologic Catchment Area Study*. Brain Injury, 2001. 15(11): p. 935-945.
31. McGuire, L.M., et al., *Prevalence of traumatic brain injury in psychiatric and non-psychiatric subjects*. Brain Injury, 1998. 12(3): p. 207-214.
32. Stephanie A. Kolakowsky-Hayner, J.S.K., *Pre-injury crime, substance abuse, and neurobehavioural functioning after traumatic brain injury. Brain Injury*, 2001. 15(1): p. 53-63.
33. Teasdale, G. and B. Jennett, *Assessment of coma and impaired consciousness. A practical scale*. Lancet, 1974. 2(7872): p. 81-4.
34. Williams, W. H, et al., *Self-reported traumatic brain injury in male young offenders: A risk factor for re-offending, poor mental health and violence?* Neuropsychological Rehabilitation, 2010. 20(6): p. 801-812.
35. Hutchinson, P.J. and P.J. Kirkpatrick, *Acute Head Injury for the Neurologist*. Journal of Neurology, Neurosurgery & Psychiatry, 2002. 73(suppl 1): p. i3-i7.
36. Wardlaw, J.M., V.J. Easton, and P. Statham, *Which CT features help predict outcome after head injury?* Journal of Neurology, Neurosurgery & Psychiatry, 2002. 72(2): p. 188-192.
37. National Institute for Health and Clinical Excellence. (2007) *Head injury: Triage, assessment, investigation and early management of head injury in infants, children and adults.*
38. Coles, J.P., *Imaging after brain injury.* British Journal of Anaesthesia, 2007. 99(1): p. 49-60.
39. Anderson, V., et al., *Children's executive functions: are they poorer after very early brain insult*. Neuropsychologia, 2010. 48(7): p. 2041-50.
40. Cramer, S.C., et al., *Harnessing neuroplasticity for clinical applications*. Brain, 2011. 134(6): p. 1591-1609.
41. Ponsford, J.L., J.H. Olver, and C. Curran, *A profile of outcome: 2 years after traumatic brain injury.* Brain Injury, 1995. 9(1): p. 1-10.
42. Williams, W.H. and J.J. Evans, *Brain injury and emotion: An overview to a special issue on biopsychosocial approaches in neurorehabilitation.* Neuropsychological Rehabilitation, 2003. 13(1-2): p. 1-11.
43. Fleminger, S., et al., *The neuropsychiatry of depression after brain injury.* Neuropsychological Rehabilitation, 2003. 13(1-2): p. 65-87.
44. King, N.S., *Post-concussion syndrome: clarity amid the controversy?* The British journal of psychiatry : the journal of mental science, 2003. 183: p. 276-8.
45. King, N.S., *PTSD and traumatic brain injury: Folklore and fact?* Brain Injury, 2008. 22(1): p. 1-5.

46. Mounce, L.T.A., et al., *Neurogenic and Psychogenic Acute Postconcussion Symptoms Can Be Identified After Mild Traumatic Brain Injury.* The Journal of Head Trauma Rehabilitation, 9000. Publish Ahead of Print: p. 10.1097/HTR.0b013e318252dd75.
47. Barlow, K.M., et al., *Epidemiology of Postconcussion Syndrome in Pediatric Mild Traumatic Brain Injury*. Pediatrics, 2010. 126(2): p. e374-e381.
48. Wall, S.E., et al., *Neuropsychological dysfunction following repeat concussions in jockeys*. Journal of Neurology, Neurosurgery & Psychiatry, 2006. 77(4): p. 518-520.
49. Hessen, E., K. Nestvold, and V. Anderson, *Neuropsychological function 23 years after mild traumatic brain injury: a comparison of outcome after paediatric and adult head injuries*. Brain Inj, 2007. 21(9): p. 963-79.
50. Turkstra, L., D. Jones, and H.L. Toler, *Brain injury and violent crime*. Brain Injury, 2003. 17(1): p. 39-47.
51. Brower, M.C. and B.H. Price, *Neuropsychiatry of frontal lobe dysfunction in violent and criminal behaviour: a critical review*. Journal of Neurology, Neurosurgery & Psychiatry, 2001. 71(6): p. 720-726.
52. Blake, P.Y., J.H. Pincus, and C. Buckner, *Neurologic abnormalities in murderers.* Neurology, 1995. 45(9): p. 1641-1647.
53. Colantonio, A., et al., *Brain injury in a forensic psychiatry population*. Brain Injury, 2007. 21(13-14): p. 1353-1360.
54. Jolliffe, D. and D.P. Farrington, *Empathy and offending: A systematic review and meta-analysis*. Aggression and Violent Behavior, 2004. 9(5): p. 441-476.
55. Raine, A., et al., *Neurocognitive impairments in boys on the life-course persistent antisocial path*. Journal of abnormal psychology, 2005. 114(1): p. 38-49.
56. Grafman, J., et al., *Frontal lobe injuries, violence, and aggression*. Neurology, 1996. 46(5): p. 1231.
57. Fellows, L.K. and M.J. Farah, *The Role of Ventromedial Prefrontal Cortex in Decision Making: Judgment under Uncertainty or Judgment Per Se?* Cerebral Cortex, 2007. 17(11): p. 2669-2674.
58. Timonen, M., et al., *The association of preceding traumatic brain injury with mental disorders, alcoholism and criminality: the Northern Finland 1966 Birth Cohort Study*. Psychiatry Research, 2002. 113(3): p. 217-226.
59. Fazel, S., et al., *Risk of Violent Crime in Individuals with Epilepsy and Traumatic Brain Injury: A 35-Year Swedish Population Study*. PLoS Med, 2011. 8(12): p. e1001150.
60. Fazel, S., et al., *Neurological disorders and violence: a systematic review and meta-analysis with a focus on epilepsy and traumatic brain injury.* Journal of Neurology, 2009. 256(10): p. 1591-1602.
61. Kenny, D.T.L.C.J., *The relationship between head injury and violent offending in juvenile detainees*. Contemporary Issues in Crime and justice, 2007. 107.
62. Brewer-Smyth, K., A.W. Burgess, and J. Shults, *Physical and sexual abuse, salivary cortisol, and neurologic correlates of violent criminal behavior in female prison inmates*. Biological Psychiatry, 2004. 55(1): p. 21-31.
63. Schofield, P.W., et al., T*raumatic brain injury among Australian prisoners: Rates, recurrence and sequelae*. Brain Injury, 2006. 20(5): p. 499-506.
64. Slaughter, B., J.R. Fann, and D. Ehde, *Traumatic brain injury in a county jail population: prevalence, neuropsychological functioning and psychiatric disorders*. Brain Inj, 2003. 17(9): p. 731-41.
65. Morrell, R.F., et al., *Traumatic Brain Injury in Prisoners*. Journal of Offender Rehabilitation, 1998. 27(3-4): p. 1-8.
66. Schofield, P., et al., *Are prisoners reliable survey respondents A validation of self-reported traumatic brain injury (TBI) against hospital medical records*. Brain Injury, 2011. 25(1): p. 74-82.
67. Farrer, T.J. and D.W. Hedges, *Prevalence of traumatic brain injury in incarcerated groups compared to the general population: a meta-analysis*. Prog Neuropsychopharmacol Biol Psychiatry, 2011. 35(2): p. 390-4.
68. Ferguson, P.L., et al., *Prevalence of Traumatic Brain Injury Among Prisoners in South Carolina*. The Journal of Head Trauma Rehabilitation, 2012. 27(3): p. E11-E20 10.1097/HTR.0b013e31824e5f47.
69. Barnfield, T.V. and J.M. Leatham, *Incidence and outcomes of traumatic brain injury and substance abuse in a New Zealand prison population*. Brain Injury, 1998. 12(6): p. 455-466.
70. Williams, W.H., et al., *Traumatic brain injury in a prison population: Prevalence and risk for re-offending*. Brain Injury, 2010. 24(10): p. 1184-1188.
71. Davies, R.C., et al., *Self-reported traumatic brain injury and postconcussion symptoms in incarcerated youth*. J Head Trauma Rehabil, 2012. 27(3): p. E21-7.
72. Perron, B.E. and M.O. Howard, *Prevalence and correlates of traumatic brain injury among delinquent youths*. Criminal Behaviour and Mental Health, 2008. 18(4): p. 243-255.
73. Hux, K., Bond, V., Skinner, S., Belau, D., Sanger D., *Parental report of occurrences and consequences of traumatic brain injury among delinquent and non delinquent youth*. Brain Injury, 1998. 12(8): p. 667-681.
74. Farrer, T.J., R.B. Frost, and D.W. Hedges, *Prevalence of traumatic brain injury in juvenile offenders: A meta-analysis*. Child Neuropsychology, 2012: p. 1-10.
75. Fazel, S. and J. Danesh, *Serious mental disorder in 23 000 prisoners: a systematic review of 62 surveys*. The Lancet, 2002. 359(9306): p. 545-550.
76. Grann, M. and S. Fazel, *Substance misuse and violent crime: Swedish population study*. BMJ, 2004. 328(7450): p. 1233-1234.
77. Walker, R., et al., *Head Injury Among Drug Abusers: An Indicator of Co-Occurring Problems*. Journal of Psychoactive Drugs, 2003. 35(3): p. 343-353.
78. Crespo de Souza, C.A., *Frequency of brain injury in a forensic psychiatric population*. Rev Bras Psiquiatr, 2003. 25(4): p. 206-11.
79. León-Carrión, J. and F.J.C. Ramos, *Blows to the head during development can predispose to violent criminal behaviour: rehabilitation of consequences of head injury is a measure for crime prevention*. Brain Injury, 2003. 17(3): p. 207-216.
80. Fazel, M., et al., *Psychopathology in adolescent and young adult criminal offenders (15–21 years) in Sweden*. Social Psychiatry and Psychiatric Epidemiology, 2008. 43(4): p. 319-324.
81. Max, J.E., et al., *Attention Deficit Hyperactivity Disorder in Children and Adolescents Following Traumatic Brain Injury.* Developmental Neuropsychology, 2004. 25(1-2): p. 159-177.
82. Keenan, H.T., et al., *Early Head Injury and Attention-Deficit/Hyperactivity Disorder: Retrospective Cohort Study*. BMJ: British Medical Journal, 2008. 337(7680): p. 1208-1210.
83. Young, S.J., et al., *The identification and management of ADHD offenders within the criminal justice system: a consensus statement from the UK Adult ADHD Network and criminal justice agencies.* BMC Psychiatry, 2011. 11: p. 32. 32 http://www.biomedcentral.com/1471-244X/11/32
84. Forrest, C.B., et al., T*he Health Profile of Incarcerated Male Youths*. Pediatrics, 2000. 105(Supplement 2): p. 286-291.
85. Chitsabesan, P., Kroll, Leo., Bailey, S., Kenning, et al., *Mental health needs of young offenders in custody and in the community*. The British Journal of Psychiatry, 2006. 188(6): p. 534-540.
86. Farrington, D.P., et al., *Gender differences in risk factors for offending*. 2004, London: Home Office. Research, Development and Statistics Directorate.
87. Bailey, S., et al. (2008) *Health need identification and assessment in the custodial youth justice system*. Youth Justice Board.

GLOSSARY

Acquired brain injury
An acquired brain injury (ABI) is brain damage caused by events after birth

Amygdala
An almond-shaped structure made of a groups of neurons located deep within the medial temporal lobes.

Axons
Projections from a neuron/nerve cell to carry messages.

Brain stem
Part of the brain that connects the motor and sensory systems from the main part of the brain to the rest of the body – crucial for respiration and cardiac functions.

Cerebral cortex
Outermost layer of the brain, about 2-4 mm thick, which plays a key role in cognitive functions.

Computed Tomography
A medical imaging procedure that uses X-rays to produce cross sectional images (or 'slices') of specific areas of the body.

Cortical pruning
Synapses in the cerebral cortex are progressively reduced throughout childhood and adolescence. The elimination of synapses in prefrontal cortex continues for a particularly long period of time, extending into late adolescence. It may be viewed as a way the brain "sculpts" itself into being.

Cortical structures
Brain systems – typically in layers.

Dendrites
Projections of a neuron that conduct the electrochemical stimulation from other neurons.

Diffuse
Refers to a "wide area" – such as diffuse white matter injury.

Dopamine
One of the key neurotransmitters - chemical released by nerve cells to send signals to other nerve cells - in reward systems.

Dorso-lateral- prefrontal cortex
The anterior part of the frontal lobes of the brain, lying in front of the motor and premotor areas which has been implicated in planning and social behavior.

Focal
Describing injury as being to one specific area of the brain.

Frontal cortex
The front part of the brain.

Frontal lobe
The front of each cerebral hemisphere which is positioned in front of the parietal lobe and superior and anterior to the temporal lobes.

Frontal ventromedial system
A section towards the central (medial) central (ventral) areas of the frontal lobes – typically involved in decision making involving emotion.

Haematoma
Commonly called a bruise, a localized collection of blood outside the blood vessels usually in liquid form within the tissue.

Hippocampus
This is a brain area located in the medial temporal lobe and plays an important role in the consolidation of information from short-term memory to long-term memory and in spatial navigation.

Insula
A deeply set section of the brain between the temporal lobe and the frontal lobe, and plays role in diverse functions from emotion to homeostasis.

Intracranial pressure
Pressure inside the skull and thus in the brain tissue and cerebrospinal fluid

Limbic system
A set of brain structures, which may be cortical (e.g. orbito-frontal cortex) and sub-cortical (e.g. hypothalamus and amygdala), for serving functions to do with "feeling and reacting" rather than "thinking". Therefore particularly important in level of arousal and motivation, and also particular types of memory.

Magnetic Resonance Imaging
MRI is a technology that uses a magnetic field to construct an image of the scanned area of the brain. The MRI scanner's magnetic field interacts with atomic nuclei in the brain and this information is then recorded to construct an image.

Melatonin
A neurotransmitter that regulates circadian rhythms and the sleep-wake cycle.

Meso-limbic
Then mesolimbic system is a pathway that seems to involve linking up brain systems involved in reward

Myelin sheath
This is a layer of cells, usually around the axon of a neuron, which are essential for the proper signaling along the tissue. It acts as an "insulator" of the signal.

Myelination
The process by which axons become sheathed in myelin - and so speed of processing improves.

Neuro-cognitive dysfunction
When the cognitive system – which is housed in the brain – starts to become inefficient or impaired. Such as poorer memory, trouble concentrating etc.

Neurons
Cells that processes and transmits information by electrical and chemical signals. They are the core components of the nervous system – that is, the brain and the spinal cord.

Neuro-plasticity
Changes in neural pathways and synapses due to changes, for example, in behavior and environment. Neuroplasticity occurs on many levels, from cellular changes (learning) through to cortical remapping in response to injury – where a host site takes on a role of an injured area.

Neuropsychological sequelae
The cognitive and affective changes that may occur subsequent to a brain injury, such as problems in decision making, attention, memory, and emotion processing (e.g. of facial expressions).

Neuro-transmitters
Chemicals used by nerve cells to communicate – they are released and absorbed at the junctions (synapse) between cells – one to cell therefore "triggers" activity in the other cell. There are a number of such neurotransmitters, such as dopamine, serotonin etc.

Thalamo-amygdala pathway
An important area in the brain for the relaying of strong emotions, such as fear, and for memory, therefore very important for learning and survival.

Traumatic Brain Injury
A TBI occurs when an external force (coming to a "fast-stop" in a car accident or being kicked in the head in an assault) traumatically injures the brain. TBI can be classified on the basis of severity, mechanism (closed or penetrating) etc.

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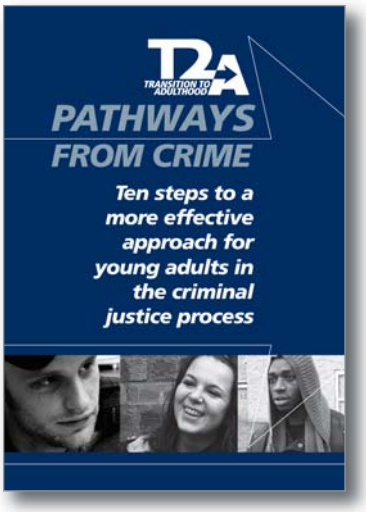
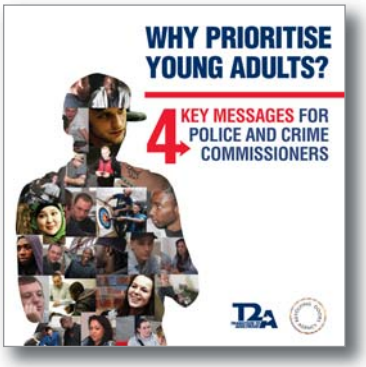


PATHWAYS FROM CRIME

Ten steps to a more effective approach for young adults in the criminal justice process

This report identifies ten points in the criminal justice process where a more rigorous and effective approach for young adults and young people in the transition to adulthood (16-24) can be delivered (see the full recommendations below). The audience for this report is broad, but it should be of particular interest to commissioners, practitioners and policy makers who work to support the criminal justice process. It is hoped that professionals at all levels and across multiple sectors will act on this body of evidence to adapt and adopt the T2A pathway to ensure that all areas deliver an effective approach for young adults throughout the criminal justice process.



WHY PRIORITISE YOUNG ADULTS

Key Messages for Police and Crime Commissioners

Young adults (18-24) are only 10% of the population but account for a third of all crime, and are also the most likely group to be a victim of crime. This group will be a vital consideration for Police and Crime Commissioners (PCCs) as they set their local policing priorities and commission services to reduce crime and reoffending. This briefing has been prepared for PCC candidates to explore how they can commission services differently for young adults, and embed a more effective approach to young adult offenders in their local area. It brings together the most recent research and practice to demonstrate what works and how reoffending rates can be reduced while achieving cost benefit.

GOING FOR GOLD

Developing effective services for young adults throughout the criminal justice process

This guide sets out how to develop services for young adults throughout the criminal justice process. It is based on a set of guiding principles and rules of engagement which can be applied flexibly within different local contexts. Demographics, offender profiles, types of crime, resources and available services will vary from place to place. But while the detail of how the service is delivered can change, the approach remains consistent: evidence-based, holistic, supportive and voluntary.

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