

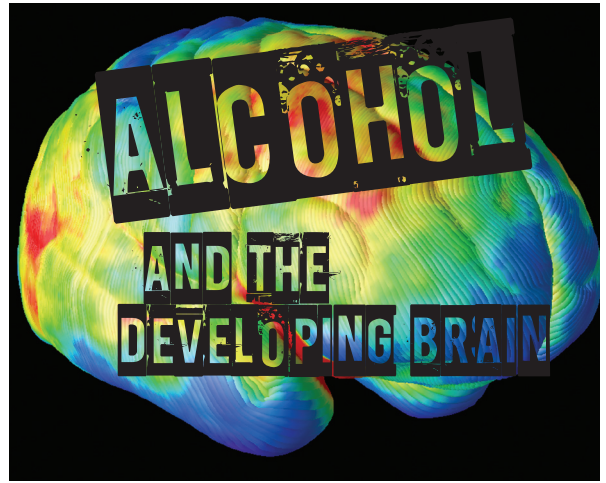


**ALCOHOL**

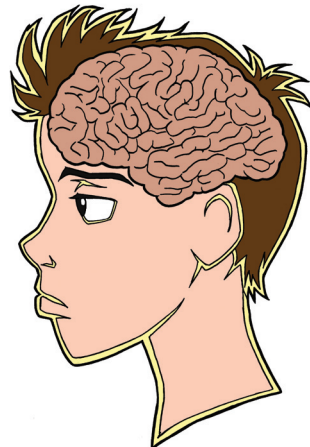
**AND THE  
DEVELOPING BRAIN**



## ADOLESCENCE AND THE DEVELOPING BRAIN



In recent years we have learnt a great deal about the developing brain. It was once believed that this complex organ finished developing around the age of 15 years but we now know that it takes much longer and that during adolescence, in particular, the brain undergoes many changes. As the brain is still developing, it is more vulnerable to damage and, in addition to the range of short-term risks that we are already well aware of, drinking alcohol can also cause problems that are long-term and potentially irreversible.



# ALCOHOL AND THE DEVELOPING BRAIN

Adolescence is the transitional stage of development between childhood and young adulthood. Biologically, the teenager is in many respects an adult, but emotionally not at full maturity. Through history this has always been a difficult time for both parents and their teenage child. Some of the characteristics of adolescence are as follows:

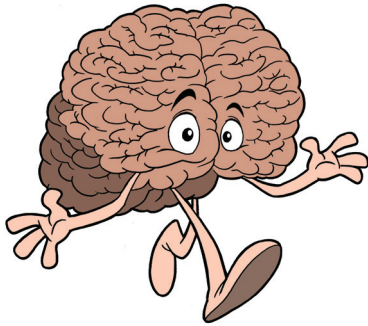
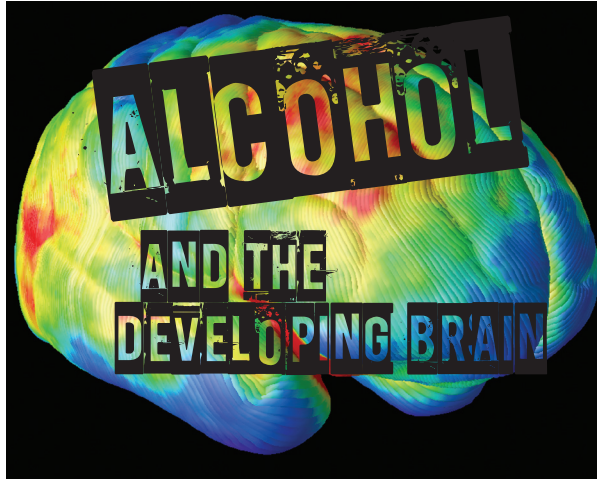
- ▶ **seeking and exploring new experiences**
- ▶ **unpredictable attitudes and opinions**
- ▶ **increased expression of emotion**
- ▶ **greater social interaction with peers**
- ▶ **risk taking**

However, where we once believed that it was simply raging hormones associated with puberty causing these changes, we now know that it also has to do with their developing brain.

Full brain development does not occur until the mid 20s, with females' brains maturing at a slightly earlier age than their male counterparts. While many adolescents complete their physical development during their teen years, certain parts of the adolescent brain continue to be underdeveloped. The final part of the brain to fully mature is the prefrontal cortex which is associated with the following:

- ▶ **judgement and decision-making**
- ▶ **selective attention**
- ▶ **problem solving and reasoning**
- ▶ **planning and impulse control**





When teens make decisions they rely on information from the amygdala (the 'emotion' part of their brain) which is more sensitive to novelty and reward and reaches maturity earlier. Adolescents have adult-like impulses but are unable to process the possible consequences of their actions. This results in a decrease in reasoned thinking and an increase in impulsiveness. Even when teens are aware of the potential risks of activities, they are ruled by their emotions. Put simply – 'if it feels good, they'll do it!'

Increased risk taking behaviour is often the change that causes the most concern for parents. We now know that young people don't take part in risky behaviour because of the danger and it's not that they don't understand the risk - it's just that when they make choices around risky activities, their brains weigh risk versus reward differently than do adults.

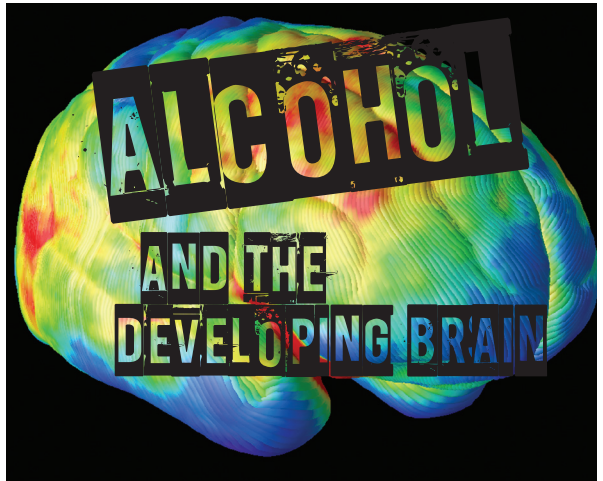
# ALCOHOL AND THE DEVELOPING BRAIN

For example, when an adult considers going bungee jumping, it is likely that they firstly think of all the things that could go wrong. Those thoughts may go through a teen's brain, but it is the anticipated thrill they will experience that will be number one in their thoughts. The reward outweighs the risk. This has been found to be particularly true when adolescents are around their peers - i.e., if their friends are around, the reward seems greater.



Young people are 'wired' to engage in risky behaviour during this period of their life so that they 'leave the village and find a mate' - it's an evolutionary feature!





This behaviour is not exclusive to humans. Rodents, primates and even some birds demonstrate behaviour such as seeking out same-age peers and fighting with parents during their 'adolescence'.

## IMPORTANT MESSAGES

- ▶ **full brain development does not occur until the mid 20s**
- ▶ **adolescent brains are 'wired' in a different way to adult brains**
- ▶ **risk taking behaviour is part of adolescence and assists them in the transition between childhood and adulthood**

## ALCOHOL AND THE DEVELOPING BRAIN

Like other drugs, alcohol produces its effects by affecting the brain and the actions of particular neurotransmitters. Two major neurotransmitters are affected and they are:

- ▶ **GABA**
- ▶ **glutamate**

# ALCOHOL

## AND THE DEVELOPING BRAIN

As these are found throughout the brain, alcohol has widespread effects on the drinker. For example, when you drink alcohol the cerebellum is affected, causing changes to balance and movement, and changes to the frontal lobe can cause your speech to become slurred. In adulthood, as the brain has fully developed, the effects of moderate alcohol drinking are not usually permanent, but this is not the case during adolescence.

Two parts of the brain are particularly vulnerable to the effects of alcohol during this adolescent phase:

- ▶ **the prefrontal cortex**
- ▶ **the hippocampus, which plays an important role in learning and memory**

In these two particular areas, brain development is still taking place and this has three stages:

- ▶ **proliferation of pathways – often referred to as the ‘growth spurts’ stage, this is where the brain is creating many new neurons and synapses. This makes the brain versatile and able to adapt to different environments**
- ▶ **pruning of these pathways – the brain does not need to keep all that has been produced and so, with experience, the unused pathways are eliminated. This is often referred to as the ‘use it or lose it’ stage**
- ▶ **myelination – a process where a fatty layer called myelin accumulates around neurons, enabling them to transmit information faster and more effectively**





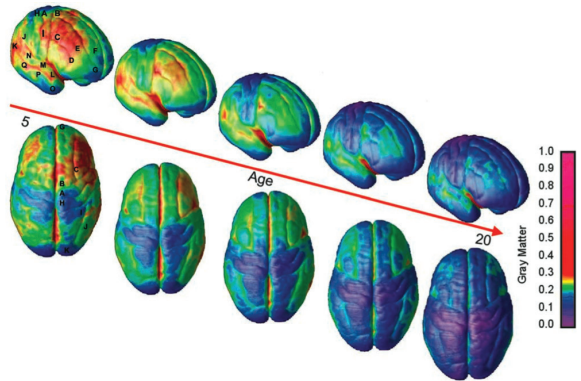
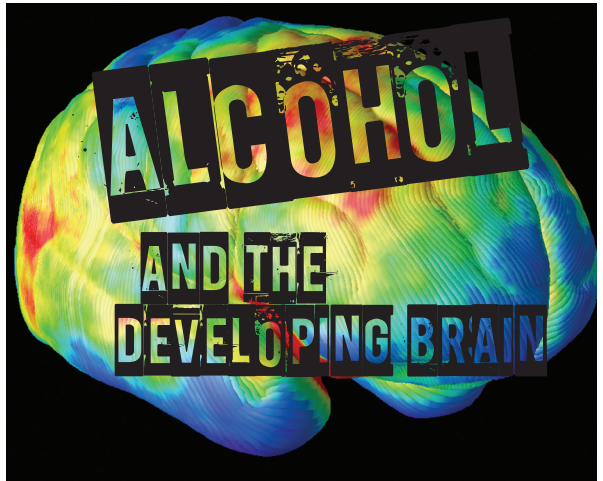


Image courtesy of Paul Thompson,  
Professor of Neurology, UCLA School  
of Medicine, Los Angeles, USA

Unfortunately, research has shown that drinking alcohol during adolescence affects two of these vital stages. Firstly, it inhibits the growth of neurons and secondly, it decreases the process of myelination, therefore alcohol has a much greater effect on a developing brain than on that of an adult.

In terms of impact, research has found that adolescent drinking may cause severe changes in the formation of adult personality, as well causing up to a 10% reduction in the size of the hippocampus,

# ALCOHOL AND THE DEVELOPING BRAIN

reducing memory and learning capacity. It is now believed that young people who drink regularly and who are affected in this way may never be able to catch up in adulthood.

Studies now suggest that drinking alcohol at intoxicating levels during adolescence may produce permanent brain changes. 'Plasticity' is the term used to describe the brain's ability to physically change its internal structure when learning new things. During peaks of plasticity the brain must make key neural connections to wire us to become fully functioning adults. It is now believed that drinking alcohol during peak periods of plasticity may damage this 'brain wiring'.

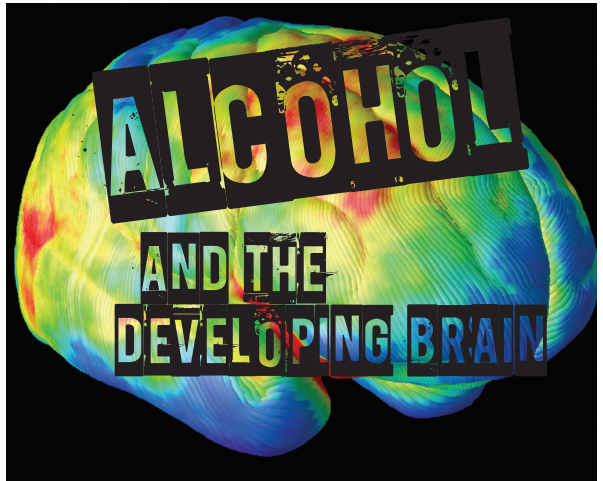
## IMPORTANT MESSAGES

- ▶ **the adolescent brain is much more susceptible to damage than the adult brain**
- ▶ **certain regions of the brain are much more at risk than others, particularly those dealing with learning and memory**
- ▶ **teenage drinking can result in changes to the brain that may be permanent**

## WHAT DOES THIS MEAN?

The message is clear - alcohol and the developing brain do not go together. Unfortunately, many in the community have difficulty accepting this information and continue to provide alcohol to their teens, often believing that this may 'protect' their child in some way. Many Australian parents drank alcohol during their adolescence and believe that it has not caused them significant problems in their adult life. Most





are fully-functioning adults, they have positive relationships with family and friends and they have a good job – drinking alcohol when they were a teenager certainly did not appear to affect their brain development.

It is important then to clarify what we mean by ‘affect on brain development’.

Certainly, heavy regular drinking during adolescence can cause permanent brain damage, serious enough that it would affect the future day-to-day life of the young person, e.g., they may have a reduced ability to learn, problems with verbal skills, depression or alcohol dependence. For most, however, the ‘damage’ is likely to be far more subtle and most importantly lead to the teen ‘diminishing their potential’. They may still be successful and fully functioning, but their alcohol use during adolescence may result in them not ‘being the best they could be’.

## IMPORTANT MESSAGES

- ▶ we now know so much more about alcohol and the developing brain than we did in the past
- ▶ when we say that 'alcohol affects brain development', the changes may be subtle in many cases, but they may still lead to the young person not reaching their full potential

## WHAT ABOUT THE 'MEDITERRANEAN MODEL' AND PROVIDING ALCOHOL TO PROMOTE RESPONSIBLE DRINKING?

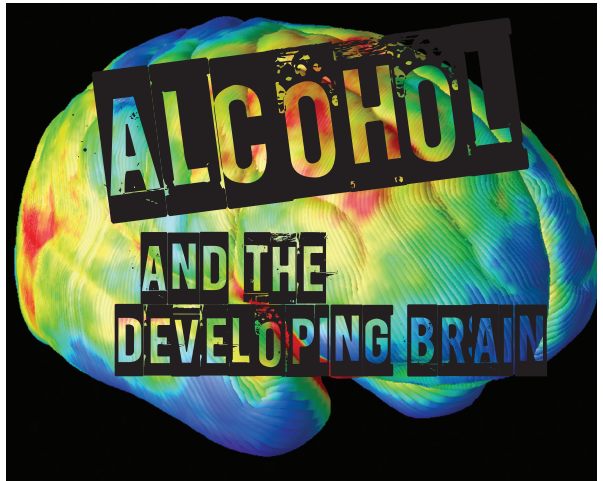
Some parents believe that it is important that they introduce alcohol to their child in the home, preferably with a meal, to promote responsible drinking. This is commonly referred to as the 'Mediterranean Model', due to the prevalence of this practice within certain cultural groups in that region.

The evidence is mixed on this practice and the recommendations from research vary considerably and are quite contradictory.

- ▶ some research suggests that parents can have a positive influence on their child's drinking behaviour by allowing them small amounts of alcohol and trusting their child's ability to act responsibly and drink in moderation. If parents do not set clear rules and boundaries around drinking at the same time, however, their child is likely to drink more
- ▶ other studies suggest that introducing your child to alcohol at an early age, even in a family context, could lead to future binge drinking.

Of course, what this research does not take into account is the effect of alcohol on brain development.





If parents make the decision to serve alcohol with a meal to their child, clearly this should not be done with very young children (as is often the case) and it should not be provided on a regular basis.

## IMPORTANT MESSAGE

- ▶ the evidence is mixed on whether providing alcohol in a family context with a meal promotes responsible drinking in the future



# KEY MESSAGES FOR PARENTS

## ALCOHOL AND THE DEVELOPING BRAIN

- ▶ Alcohol and the developing brain do not go together
- ▶ Even though the effect may be subtle, the impact of alcohol on the developing brain can be permanent and, at the very least, lead to your child not reaching their full potential
- ▶ Evidence clearly indicates that young people should not, if possible, drink at all, however if a young person is going to drink during this period they should drink as little as possible and they should certainly not drink regularly. Parents should try to delay their child's first drink of alcohol for as long as possible
- ▶ If a parent believes that alcohol should be provided to their child in a family context with a meal, careful consideration should be given to the age at which this practice is started and it should not be provided regularly



This booklet was written by Paul Dillon in 2013.  
Peer review by Dr. Janette Smith, NDARC.

This booklet was produced by the National Drug and Alcohol Research Centre Education Trust (NET)

Disclaimer: All information contained in this booklet was correct at the time of publication © 2013

Cartoon artwork created by John Horvath

Front cover and Page 9 images used courtesy of Prof Paul Thompson, Professor of Neurology, UCLA School of Medicine, Los Angeles, USA: *NIMH/UCLA Project Visualizes Maturing Brain*

This booklet was designed by: nineteen ninety nine • design

For a list of other booklets available and more information on the work of NET, visit [www.neteducate.org](http://www.neteducate.org)

Copies of this booklet can be purchased online by order on the website [www.neteducate.org](http://www.neteducate.org)

NDARC Education Trust (NET), PO Box 21, Randwick NSW 2031

Ph: (02) 9385 0333 Fax: (02) 9385 0222

ISBN 978 0 7334 3294 1





**ALCOHOL**

**AND THE  
DEVELOPING BRAIN**