

Beating the odds of addiction

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In 2011 eight US soldiers in Afghanistan died of heroin overdoses. Widespread opiate use has become a major concern for soldiers fighting overseas, with drug-related offences steadily rising during the last five years, and over 11,000 incidents reported in 2011 alone ('US probes troops' drug use', 2012). Under the incredibly stressful circumstances of war, it is no wonder some turn to drugs to ease the pressure, pain and intermittent boredom (McCanna, 2007). And with 90 per cent of the world's opium coming from Afghanistan, this trend is fuelled by cheap and easy access to the drug.

Heroin is a highly addictive drug, and opiate dependency can have devastating consequences, raising the alarm on what will happen to these veterans once they return home. This is not the first time tales of drug abuse have emerged from an international combat mission, though. During the Vietnam War, nearly 50 per cent of soldiers reported having tried heroin while overseas, with 20 per cent developing a full-blown dependency (Robins, 1993). Remarkably though, of these men, only 5–10 per cent continued using heroin after returning to the US, while the others were able to stop largely of their own accord, without the use of rehabilitation services and seemingly without much difficulty. This is compared to relapse rates of up to 85 per cent in civilian heroin users.

What was different in these men that prevented them from continuing their drug habit on home soil? At the time, it

was believed that stress, boredom, easy access to drugs and associated environmental cues 'in theatre' kept these men using while abroad, and that the absence of these triggers helped them to stop after their return. However, we now know that there are also crucial differences in the brain that make an individual more or less susceptible to drug dependence; and the 90 per cent of soldiers who were able to easily give up heroin after returning home roughly matches the percentage from the general population of individuals who have used drugs without becoming dependent on them (UNODC, 2012).

An addiction can be thought of as a habit gone wrong. In the early stages, behaviour is reward-driven; our actions are targeted at obtaining a certain goal, whether it is the hedonic pleasure of a drug-induced high or the stress relief that comes from smoking a cigarette. Over time, though, these initially goal-directed behaviours can become automated and habitual. This transition is thought to be mediated by a shift in how the neurotransmitter dopamine acts in two key areas in the brain. Both lie in the striatum, a region crucial for learning, movement and feelings of reward, and the shift occurs between the ventral and dorsal sections. At first, dopamine acts predominantly in the ventral striatum, signalling reward and reinforcing behaviours associated with drug use. However, after prolonged use dopamine activity can transition from ventral to

dorsal striatal control, a region more involved in movement and learned automated responses. Drug taking now becomes habitual; cues associated with drug use, like certain people or places, can cause feelings of craving and create a compelling urge to use, despite a desire not to (Everitt & Robbins, 2005; Volkow et al., 2006). Instead of our actions being goal-directed or driven by a motivation, they become automatic responses to these associated cues. These habitual behaviours may be maladaptive, preventing us from obtaining a new goal like staying sober, or they can be compulsive, continued in the face of punishments like losing family and friends, or causing poor health.

Not everyone is prone to these types of behaviours, though. While we all give in to our personal vices from time to time, most of us will not lose control or become dependent on these indulgences, and we are able to resist temptation if need be. Successful inhibition of these urges depends on the strength of our self-control, which is linked to activation in the prefrontal cortex (Goldstein & Volkow, 2002). However, some individuals, particularly those who are high in the personality traits of impulsivity and sensation-seeking, do have a greater risk for developing drug addiction. These individuals seek out novel experiences, making them more likely to initiate drug use, and struggle to inhibit their behaviours. The desire for an immediate reward wins out over working towards longer-term goals (Belin et al., 2008; Kirby et al., 1999).

Additionally, people who behave more compulsively are at greater risk for habitual, ritualistic drug taking, persevering in their actions despite negative consequences, and even after a loss in pleasure experienced from the drug (Friedman et al., 2000). Drug-dependent individuals have also been shown to have reduced prefrontal cortex volume, suggesting they have fewer resources for self-control and less capacity to stop their behaviours (George & Koob, 2010). However, while these impulsive and

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compulsive tendencies are commonly associated with addiction, it is unknown whether these traits are pre-morbid risk factors for dependence or are the consequences of prolonged drug abuse.

One recent study from Dr Karen Ersche's lab at the University of Cambridge attempted to answer this chicken-or-egg question. It looked at people dependent on stimulants, like cocaine and amphetamine, and their non-dependent biological

siblings, who shared 50 per cent of their genes and a family environment growing up (Ersche et al., 2012). When compared to healthy control volunteers, both drug-dependent participants and their non-dependent siblings had similar brain and behavioural traits, including more volume in the dorsal striatum and amygdala, key brain areas involved in reward learning and habit formation central to addiction. They both also had less grey matter in the cortex, something that has been linked to poorer self-control and inhibition. Additionally, both the siblings and the drug users had higher ratings of the key personality traits of impulsivity and compulsivity (Ersche et al., 2010). However, when compared to their siblings, the drug dependent participants reported greater sensation-seeking – an interest in searching out new experiences, even if they are risky or potentially dangerous. This suggests that there are certain risk factors, potentially stemming both from our genes and environment during development, that can put us at a greater predisposition for drug dependence.

However, it is important to recognise that these at-risk characteristics do not predetermine an individual for addiction. There were probably protective factors in the sibling participants that prevented them from developing drug dependence, despite sharing many of the same personality traits and growing up in the same household as their dependent brothers and sisters. These might include

different peer groups, a closer relationship with their parents, higher priority placed on school, or participation in after-school clubs or religious groups (Best et al., 2005; Kodjo & Klein, 2002; Piko & Kovacs, 2010). These crucial differences in the siblings' upbringings, as well as the relative decrease in sensation-seeking, could have protected them from initiating drug use, thus preventing them from ever starting on the path towards addiction.

Therefore, while the study provides strong evidence for a personality type that places an individual at an increased risk for drug dependence, it also

importantly demonstrates that these traits are not deterministic and do not automatically lead to addiction.

Additionally, it appears that there are some people who can take addictive substances recreationally without developing dependence (even heroin: see Shewan & Dalgarno, 2005). A follow-up study by our group investigated regular occasional users of cocaine who had been using the drug for a minimum of two years without demonstrating the behavioural patterns of dependent users (Ersche et al., in press). Instead, these individuals maintained control over their drug taking, only using in social situations and without sacrificing other important facets of life, such as school and work responsibilities, or ties to family and friends. They also had significantly lower levels of impulsivity and compulsivity than both the addicted drug users and their siblings, though they did score similarly highly on sensation-seeking as dependent users. Additionally, they had a greater amount of cortical volume in the orbitofrontal gyrus, a prefrontal region associated with emotional decision making and reward valuation, and an area commonly seen to be deficient in dependent drug users.

These key differences in brain structure and corresponding decreases in impulsivity and compulsivity in the recreational users suggests that there is a distinct group of

individuals who have protective factors against developing compulsive drug-taking tendencies, despite their use of the same substances. However, these individuals may also have had some of the social protective factors listed above, their personal and professional priorities preventing their drug use from devolving into dependence. Exemplifying this, the recreational users on average had higher levels of educational achievement than the dependent individuals, a known protective factor against addiction.

The surprisingly low number of Vietnam veterans who maintained their heroin dependence after returning home from war may then have been due to underlying differences in brain structure and personality type. Those who did continue using were reportedly the soldiers who had had problems with antisocial behaviours and a history of drug use before enlisting (Robins, 1993). Thus, continued addiction appeared to have been more determined by the traits and behaviours of the individual using the drug, rather than a consequence of the substance itself. An additional factor may also have been the lack of cues associated with drug taking in these men's home environments. As most had never used heroin before leaving the States, there were no reinforcing prompts when they returned to trigger feelings of craving, potentially precipitating a relapse.

The question then remains: will the soldiers who are using heroin in Afghanistan now have a similar fortune to the men who returned home from Vietnam, able to put down the drug when the availability and need for self-medication are no longer present? Or will they be part of the other 10 per cent?



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“certain people or places, can cause feelings of craving”

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