Chapter 1

Psychoactive drugs: introduction and overview

Overview

Psychoactive drug use is not just a phenomenon of the 20th century; many different types of drug have been used throughout recorded history. In this chapter we will outline the main classes of psychoactive drug. We are able to do this in a single chapter because, despite there being thousands of different drugs, they can be classified in a few main groups (Table 1.1). The crucial role of neurotransmitters will also be described because psychoactive drugs alter mood and behaviour by modifying nerve activity in various ways. Thus, a basic understanding of neurotransmitter actions is vital in order to understand how drugs can affect behaviour. Tolerance and addiction may also develop, when regular drug use causes long-term changes in neurotransmission activity. Next, we will emphasise that all drugs have a range of positive and negative behavioural effects. Positive or desirable effects, such as feelings of pleasure, are the reasons people take drugs. But drugs also cause negative effects, which is why drug taking can cause so many psychosocial problems.

Psychoactive drugs over the ages

Since before the dawn of civilisation, humans have used drugs\(^1\) to alter their mood and behaviour. Opium poppy (*Papaver somniferum*) seeds have been found by archaeologists in Neolithic burial sites. Some of the earliest writing on clay tablets from Mesopotamia described laws to control the alcohol consumption in local taverns. Many societies have discovered that different species of plant and fungi can induce powerful hallucinations. Native Americans have used the peyote cactus (*Lophophora williamsii*) (containing mescaline) to foster spiritual insights during their religious ceremonies. Vikings used the *Amanita muscaria* mushroom for its hallucinogenic and excitatory effects, before raiding and pillaging

\(^1\) Boldface terms are defined in the Glossary.
in their longboats. In ancient Greece, Homer’s epic poem *Odysseus* describes how the hero and his crew were drugged by the sorceress Circe, a skilled “polypharmakos”, or drug user, who laced their wine with drugs that stunned their memories and ensnared their minds. The wary Odysseus managed to avert this only because he had taken the precaution of taking an antidote beforehand (Caldwell, 1970; Palfai and Jankiewicz, 1996).

Many drugs are taken for their curative or medicinal effects. In South American silver mines, for many centuries the miners have chewed coca leaves (containing cocaine), to aid their physical and mental vigilance working high in the oxygen-poor Andes (Chapter 4). Tea, which contains caffeine, was recommended as a general tonic by sages in Ancient China (Chapter 4). In the Indian subcontinent the Indian snake root *Rauwolfia serpentina* was used as a treatment for people suffering manic excitement, or hallucinations and delusions. Its effectiveness at reducing the symptoms of schizophrenia has been scientifically confirmed in the 20th century. *Rauwolfia* contains reserpine, a powerful psychoactive drug that depletes dopamine stores; this is how it leads to calmer and more manageable behaviour. In some ways, reserpine displays properties similar to more modern antipsychotic drugs. However, its broad spectrum of effects in deleting the stores of several neurotransmitters means that it can also cause feelings of severe depression. Thus, reserpine is not used clinically, since modern antipsychotic drugs do not have this unwanted side effect (Chapters 3 and 11).

Psychoactive drug use remained popular throughout the 20th century. Several drugs are legal, and their use has grown during the past 100 years. The advent of machines to produce cigarettes at the beginning of the 20th century led to a marked increase in tobacco consumption. By the end of the second world war, helped by the free distribution of cigarettes to the armed forces, around 70% of the male population in the UK were regular nicotine users. In global terms the world consumption of

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**Table 1.1. Psychoactive drug groups.**

<table>
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<th>Chapter</th>
<th>Drug group</th>
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<th>Examples</th>
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<td>4</td>
<td>CNS stimulants</td>
<td>Increase alertness, intensify moods</td>
<td>Amphetamine, cocaine, caffeine</td>
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<tr>
<td>5–7</td>
<td>Recreational drugs</td>
<td>Various disparate effects</td>
<td>Nicotine, cannabis, LSD, MDMA</td>
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<td>8</td>
<td>Opiates</td>
<td>Reduce pain, increase pleasure</td>
<td>Heroin, morphine, codeine</td>
</tr>
<tr>
<td>9–10</td>
<td>CNS depressants</td>
<td>Increase drowsiness, relax moods</td>
<td>Alcohol, barbiturates, benzodiazepines</td>
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<tr>
<td>11</td>
<td>Antipsychotics</td>
<td>Reduce hallucinations and delusions</td>
<td>Chlorpromazine, haloperidol, clozapine</td>
</tr>
<tr>
<td>12</td>
<td>Antidepressants</td>
<td>Relieve sadness and depression</td>
<td>Imipramine, fluoxetine</td>
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<tr>
<td>13</td>
<td>Nootropics</td>
<td>Slow cognitive decline in dementia</td>
<td>Aricept, tacrine</td>
</tr>
<tr>
<td>3, 14</td>
<td>Other drug types</td>
<td>Various disparate effects</td>
<td>Herbal and other medications</td>
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tobacco is still increasing, despite reductions in a few Western countries where its adverse health effects have been emphasised. Yet, even where marked reductions have occurred, particularly in the USA, Britain and Australia, this decrease in consumption has not been maintained. Recent years have shown a resurgence of cigarette smoking among the young, particularly adolescent females (Chapter 5). Alcohol use also shows no sign of reduction, and at the same time the age of first drinking continues to fall. In the USA many high schools offer formal programmes to help their teenage pupils to quit smoking, or reduce excessive alcohol consumption (Chapters 9 and 10). Another legal drug – caffeine – is consumed by over 90% of the adult population in their daily tea and coffee. Caffeine is also present in the fizzy soft drinks and chocolate bars consumed by children each day (Chapter 4). Many other psychoactive drugs are deemed illegal, yet even the threat of long prison terms does not halt their popularity. Around 50 million Americans have smoked cannabis (marijuana), although only 49,999,999 admit to inhaling since former President Bill Clinton admitted to having tried marijuana but without inhaling! (Chapters 7 and 15). The use of amphetamine, cocaine and heroin has increased in recent decades, while new recreational drugs have also been specifically “designed” for their mood-altering effects (Shulgin, 1986). Ecstasy (MDMA, or methylenedioxyamphetamine) first became popular in the mid-1980s and since then its use has steadily increased, with young people trying it at an increasingly early age (Chapter 6).

One of the most dramatic changes for modern society was the advent of effective psychoactive medicines in the 1950s. The first antipsychotic drug chlorpromazine was developed in 1950, and since then the management and treatment of schizophrenia has been transformed, with most patients now seen as outpatients and the majority of “mental hospitals” being closed (Chapters 11 and 15). The advent of antidepressant drugs in 1957 led to a similar change in the treatment of people suffering from depression (Chapter 12). Thus, we now have a range of drug treatments for two of the most severe psychiatric disorders. It should be emphasised that the advent of these drugs has not been entirely beneficial. Numerous schizophrenics now suffer greatly, because society has failed to provide the support mechanisms. Antipsychotic drugs are only partially effective on their own. To maximise their effectiveness, they need to be complemented by behavioural therapy, or social skills training. This is expensive, and in most Westernised countries this support structure is generally lacking. Another contentious area is the treatment of “hyperactive” young children with CNS (central nervous system) stimulant drugs. The clinical diagnosis of Attention Deficit Hyperactivity Disorder (ADHD) is a very recent phenomenon, but since the early 1980s an increasing number of young children have been given this diagnosis. Is it defensible to label continuous fidgeting or poor concentration on school work as clinical symptoms in 5 and 6-year-olds and then administering them with powerful psychoactive drugs, especially when it is the parents and teachers who are “suffering” the most? This issue will be critically examined in Chapter 4. Pharmaceutical companies are now attempting to develop nootropic drugs for Alzheimer’s disease and other disorders associated with ageing (Chapter 13). If effective drugs for the elderly are successfully developed, the impact on society could become even more marked than was the development of antipsychotic and antidepressant drugs in the 1950s. Finally, there have been numerous attempts to produce cognitive enhancers that modulate cell metabolism and brain activity in various ways (Chapter 14).
How many types of psychoactive drug are there?

There are hundreds of different drugs that can affect mood and behaviour, although they can be categorised into a few basic drug types. Table 1.1 outlines the main categories of psychoactive drug. This classification system also reflects their psychopharmacological effects. Thus, CNS-stimulant drugs, such as amphetamine and cocaine, generate feelings of alertness and lead to faster behavioural responses; indeed, this is why they are banned in sport (Chapter 4). CNS-depressant drugs generate feelings of sleepiness and impair skilled psychomotor performance; this is why piloting a plane or driving a car are so dangerous under the influence of alcohol, with numerous road deaths being caused each year (Chapter 9). Opiate drugs, like heroin and morphine, are again similar in their effects, leading to feelings of euphoria and reduced pain, in relation to both physical and mental pain (Chapter 8). Many other drugs are not categorised so readily. Thus, cannabis is unlike many other drugs (Chapter 7), while LSD (lysergic acid diethylamide) also has many unique properties (Chapter 6).

The reasons some drugs have similar behavioural effects is that they have similar pharmacological effects. Take amphetamine and cocaine as an example. Their origins are quite dissimilar: cocaine is extracted from the leaves of the coca plant (*Erythroxylon coca*), whereas amphetamine is artificially manufactured in the laboratory; amphetamine is an amine, whereas cocaine is an alkaloid. However, they each stimulate the release of the neurotransmitter dopamine and inhibit its inactivation; this explains why their psychoactive effects are so similar, in terms of boosting mood and alertness. In fact, most CNS-stimulant drugs boost dopamine and/or noradrenaline, which is why they have broadly similar behavioural effects (Chapters 3 and 4). Let us now consider another drug group – the opiates. Different drugs in the opiate class all tend to have similar types of effect on other types of neurotransmitters, such as the neuropeptides, which is why they have similar behavioural effects (Chapter 8). In an equivalent fashion, CNS-depressant drugs all seem to affect the GABA (γ-aminobutyric acid) receptor – again helping to explain why they all tend to have similar effects on behaviour (Chapter 9).

Drug effects on neurotransmission

Normal behaviour is dependent on a complex system of chemical messages passed between neurons in the brain. Each nerve cell or neuron communicates with the next neuron by means of chemicals called neurotransmitters (e.g., dopamine, noradrenaline, serotonin, acetylcholine, histamine, GABA). Psychoactive drugs exert their effects by increasing or decreasing the activity of these neurotransmitters, this is why a basic understanding of the CNS and neuronal activity is essential for a psychoactive drugs textbook (Chapter 2). Only then will it become clear how drugs can modify neurotransmission and thus alter behaviour (Chapter 3). Hence, a thorough understanding of these two introductory chapters is necessary before attempting to read the other sections. This knowledge also helps to explain related phenomena like drug addiction (Chapter 10). The very first time a drug is taken it has a different effect on neurotrans-
mission than when it is taken a hundred times later. The first ever cigarette will lead to nausea and sickness, because nicotine stimulates the neurons in the vomiting centres of the brainstem. However, the 100th cigarette no longer induces feelings of nausea, because neuronal tolerance has developed. In a similar way a small amount of alcohol will induce feelings of light-headedness and tipsiness in a novice drinker, whereas a heavy regular drinker would have no perceptible response. Tolerance explains why heavy drinkers need to binge-drink in order to feel drunk (Chapters 9 and 10). Neurons tend to adapt and change following regular drug use and neuronal tolerance reflects these adaptive changes in neurotransmitter systems. Neuronal tolerance also helps explain why it can be so easy to become addicted to certain drugs, although many non-pharmacological factors are also important; these will all be described in Chapter 10, where they will illustrate how and why heroin addiction, nicotine dependency and alcoholism have become such enormous problems for society.

Positive and negative drug effects

Psychoactive drugs modify behaviour by altering neurotransmission. However, each neurotransmitter system generally underlies various diverse aspects of behaviour; this means that any one drug will generally have a wide range of behavioural effects. Some of these may be pleasant, but others may be unpleasant. Recreational drugs are taken for their pleasant effects. Alcohol can release social inhibitions and help foster feelings of closeness with other people. The caffeine in tea and coffee can help regular users maintain feelings of alertness. Similarly, psychoactive medicines are taken for specific purposes. Antidepressant drugs can help relieve feelings of profound sadness. Anti-psychotic drugs can reduce delusions and hallucinations and can enable those suffering from schizophrenia to lead more normal and contented lives. Every psychoactive drug has some positive uses – which is why they are taken (Chapters 4–15). Yet, these same drugs also produce a range of negative effects. Alcohol can lead to increased aggression and antisocial behaviour, while its disinhibitory effects cause many individuals to commit crimes that they would not have undertaken if they had remained sober. Most antidepressant and antipsychotic drugs generate unpleasant side effects, such as drowsiness and dry mouth. Therefore, the main focus of many pharmaceutical company research programmes is to develop new drugs that are more specific in their effects, so that they relieve the target symptom while causing the fewest side effects (Chapters 11 and 12). Other problems include tolerance and dependence (see above and Chapter 10). Cigarette smokers soon develop nicotine dependency and gain no real benefits from their tobacco; they just need nicotine to function normally (Chapter 5). Opiate users similarly develop drug dependency. One reason for these negative effects is drug tolerance. The basic mechanism behind the development of tolerance and dependence are described in Chapters 3 and 10. Therefore, most drugs have a balance of positive and negative effects. Thus, cocaine can make people feel alert, dynamic and sexy ... all pleasant or desirable effects. Yet, it can also make them anxious, aggressive and suspicious and reduce their inhibitions. This combination of behavioural changes can be dangerous: initially, they may want to socialise with their friends but soon argue, leading in extreme cases to their committing murder on the spur of the moment (some examples are given in Chapter 4). There is marked individual...
variation in the development of drug-related problems; this is best understood in relation to the diathesis stress model, where any behavioural outcome is seen as the result of an interaction between internal factors (e.g., genetic and biochemical predispositions) and environmental events (abuse, poverty, stress, psychoactive drugs). This model is debated more fully in Chapters 6 and 10.

However, every chapter will describe both positive and negative drug effects. One core aim will be to assess their cost–benefit ratios (Chapter 15). Most psychotherapeutic drugs have an advantageous ratio, with the benefits outweighing the unwanted side effects (Chapters 11 and 12). Estimating the cost–benefit ratio for recreational drugs can however be more difficult, since their positive and negative effects are influenced by numerous factors including dosage, frequency of use and duration of use. There is often little correspondence between the legal status of each drug and the amount of harm it causes. Thus, two of the most widely used drugs in society, nicotine and alcohol, have numerous deleterious consequences. In the UK tobacco smoking causes around 350–400 deaths each day, but regular cigarette smokers get no genuine psychological benefits from nicotine dependency (Chapter 5). The regular use of illicit recreational drugs, such as cannabis, opiates and CNS stimulants, are also linked with numerous problems (Chapters 4–10). The notion of cost–benefit ratios will be debated more fully in the final chapter.

Questions

1. Is drug taking just a phenomenon of the 20th century?
2. Explain how you might categorise psychoactive drugs into just a few groups.
3. Provide examples of psychoactive drug use from earlier periods.
4. Why is knowledge about neurotransmission necessary in order to understand psychoactive drug effects?
5. Do all psychoactive drugs have a mixture of good and bad behavioural effects?

If you have just started this book your answers to these questions may be rather brief. Try answering the same questions after you have read the whole book, and compare your answers!

Key references and reading

Palfai T and Jankewicz H (1996). Drugs and Human Behavior. Wm. C. Brown, Madison, WI.