

**Topical publication**

**Mind sports and doping - An investigation of pharmacological substances that may enhance performance in mind sports**

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## Summary

### Introduction

As a result of the ratification of the Anti-Doping Convention in 1995, the Dutch government has increasingly compelled the national sports federations to pursue an active anti-doping policy. As a minimum, these federations must have anti-doping regulations. However, mind sports (chess, draughts, bridge, and Go) have provisionally been exempted from this ruling because there are doubts about the relevance of this policy to these sports. In response to a request from the Dutch federations of various mind sports, the Dutch Ministry of Health, Welfare, and Sport has asked the Netherlands Centre for Doping Affairs to investigate whether pharmacological substances can be used to enhance performance in mind sports.

### Methods

The foremost purpose of this investigation was to determine whether there are pharmacological substances that may enhance performance in mind sports. In addition, it was studied whether the use of such substances is detrimental to the user's health. In the context of this study, a substance that both enhances performance and is detrimental to health is considered a doping agent. The issue of whether a certain substance might harm the image of a sport was not addressed.

Since there is little literature available on the direct pharmacological manipulation of performance in mind sports, it was decided to consult experts. These experts were (former) top mind sport competitors, representatives of the Dutch federations of various mind sports, and neuroscientists. These experts were first consulted individually and then they took part in an expert meeting to bring the available expertise together.

### Results

Mind sports require completely different skills than physical sports do. The main difference lies in the major role of mental processes in determining performance in mind sports. This primary role of cognitive factors is the same for the sports of chess, draughts, bridge, and Go. This justifies a special position for these mind sports within the existing anti-doping regulations.

The experts from the world of mind sports had the impression that pharmacological substances were used only sporadically to enhance performance. The general belief is that these substances are more harmful than beneficial to performance in mind sports. However, on the basis of the proven effects of such substances, it can be assumed that they could be used to improve performance in mind sports.

As far as it is known, it is not possible to enhance mind sport performance directly with pharmacological substances; however, it is probably possible to achieve this in an indirect manner. Pharmacological substances can be used to improve several cognitive functions, such as, alertness, attention, vigilance, memory, information processing, speed of thought, and the ability to perform a certain cognitive task for a long time. These cognitive functions support the performance of cognitive processes, which in turn determine the way complex tasks, such as playing mind sports, are performed. Statements about this final step can only be based on assumptions because of a lack of sufficient knowledge regarding the relationship between cognitive processes and performance in mind sports.

Since the cognitive effects of pharmacological substances are generally minor, the effects on mind sport performance are expected to be minor as well.

In consultation with the experts and with reference to the scientific literature, a list was drawn up of substances that might be expected to enhance performance in mind sports. This broad approach was chosen in order not to exclude any potentially relevant substance. Because of the difference in the factors that determine performance in mind sports and physical sports, this list differs from the existing list of prohibited substances and methods prepared by the International Olympic Committee (IOC).

The potential performance-enhancing substances in mind sports have been classified into three categories. The first category incorporates substances and substance groups that can be expected to enhance performance in mind sports and whose use is accompanied by harmful effects on health. These

substances are nicotine and other cholinergics, amphetamines, ephedrine, cocaine, beta blockers, and substances that increase the availability of oxygen in the brain. On the basis of the definition of doping used in this study, these substances should be regarded as doping agents.

The substances caffeine, MDMA-analogues (such as ecstasy, or XTC), cannabinoids, opiates, alcohol, and benzodiazepines do not meet the definition of doping used in this study.

At the moment, scientific knowledge is not clear as to whether certain substances, for example, 5-HT<sub>1A</sub> agonists, the neuropeptides, and the hormones growth hormone, oestrogens and testosterone, can improve performance in mind sports. Thus, it is currently not possible to determine whether these substances should be regarded as doping agents in the context of mind sports.

## **Conclusions**

- The factors that determine performance are substantially different between mind sports and physical sports, and this justifies separate anti-doping regulations.
- In the world of mind sports itself, the impression exists that pharmacological substances are used only sporadically to enhance performance.
- It can be expected that performance in mind sports can be enhanced by means of pharmacological substances; however, the expected effect of such substances is minor.
- Some of the possible performance-enhancing substances may be harmful to health, which means that these substances should be considered as doping agents.
- It is recommended that the mind sports federations formally prohibit doping and that these federations draw up regulations that enable sanctions to be imposed when prohibited substances are used in mind sports.
- If the decision is taken to prohibit doping in mind sports, it is recommended that a specific list of prohibited substances be drawn up. The current (IOC) list of prohibited substances should not be used unadapted.
- It is important that national and international anti-doping regulations concerning the mind sports are consistent. This investigation may contribute to the harmonisation of these regulations.

## 1. Introduction

### 1.1 Introduction

In 1995, the Dutch Government ratified the Anti-Doping Convention of the Council of Europe. As a consequence, the Government is obliged to pursue an active policy against the use of doping in sports. To this end, the Government has compelled all sports federations that are affiliated with the Dutch Olympic Committee/Dutch Sports Federation (NOC/NSF) to draw up, and when necessary enforce, anti-doping regulations as of 1 January 1999. As of the same year, federations that do not comply with this will receive a reduced subsidy from the Dutch Ministry of Health, Welfare, and Sport.

However, it is unclear whether these regulations apply to certain sports federations, namely, the chess federation, the draughts federation, the bridge federation, and the Go federation. At the moment, these Dutch federations do not have anti-doping regulations. These federations query whether, given the specific characteristics of mind sports, the general regulations concerning physical sports are applicable to their branch of sport or whether they need to have their own anti-doping regulations. The issue is thus whether mind sports are sufficiently different from other sports that mind sports federations are justified in claiming a different status with regard to anti-doping regulations. In order to determine this, it is first necessary to ascertain whether there are substances that can be considered as doping in the context of mind sports and what these substances are. The Ministry of Health, Welfare, and Sport has asked the Netherlands Centre for Doping Affairs (NeCeDo) to carry out an investigation designed to answer these questions.

### 1.2 Assignment

The task assigned by the Ministry of Health, Welfare, and Sport is to determine whether there are pharmacological substances that may enhance performance in mind sports.

### 1.3 Interpretation of the assignment

The assignment has been broadly interpreted. The underlying question is whether or not Dutch mind sports federations should enforce current anti-doping regulations. In order to be able to draw conclusions about whether certain substances should be considered as doping agents, it was also necessary to investigate the effects of these substances on health. In addition, a small group of involved parties were consulted about the opinion of the mind sports world concerning doping and anti-doping regulations.

## 2. Definition of terms

In this chapter the terms “mind sport”, “doping”, and “pharmacological substance” are explained in order to avoid confusion.

### 2.1 Mind sport

The sports chess, draughts, bridge, and Go are termed mind sports. The term “mind sport” implies a contrast to physical sports. In physical sports, there is more emphasis on physical activity than in mind sports, although this distinction is not absolute. Physical activity is also necessary in mind sports and mental activity in physical sports. The difference lies in the fact that, in physical sports, the way in which physical movements are performed is a determinant of the success of the competition or match. This is not the case in mind sports, where the physical manner in which pieces are moved or cards are played is irrelevant to the result of the competition.

This distinction between mind and physical sports is used in this report. The mind sports encompass chess, draughts, bridge, and Go. The federations of these sports are temporarily exempted from the obligation to draw up anti-doping regulations by the Ministry of Health, Welfare, and Sport.

### 2.2 Pharmacological substances

In this report, the term “pharmacology” is used in a broad sense, which means that attention is paid not only to medicinal drugs but also to chemical substances in general. Certain pharmacological substances are referred to as being members of a group when they show very similar effects and mechanisms of action.

### 2.3 Doping

The use of doping goes against the spirit of fair play that should be inherent to all voluntary competition between people. This feeling is shared by many; however, before such a feeling can be incorporated in regulations it is necessary to define the term doping further. The term is defined mainly on the basis of the three arguments put forward to ban doping.

The first argument is based on unfair improvement of performance. The use of performance-enhancing substances is seen as unfair competition. The second argument concerns the health of the sports man or woman. Some sports are dangerous in themselves, but the use of certain substances or methods can be unduly harmful to the player’s health. The third argument that could play a role in whether a certain substance or method is considered to be doping is the image argument. Some instances or bodies involved in sport emphasise the “clean” character of the sport and for this reason forbid the use of substances and methods that they do not want to be associated with.

In this report, emphasis is laid on the answers to the questions related to the first two arguments, namely, whether a certain substance can improve performance in mind sports and whether it is deleterious to the health of the user. The third argument, the image argument, is not considered. The questions concerning the first two arguments will be answered on the basis of current scientific knowledge. If the two questions are answered affirmatively, then this report will recommend that these substances be considered as doping agents in the context of mind sports.

### 3. Investigation protocol

The issue of doping is new to mind sports. Although there is anecdotal information about players who have used substances to improve their performance, to date the mind sports federations have never had a reason to draw up anti-doping regulations. However, the international agreements made by the Dutch Government has confronted the Dutch mind sports federations with the issue of anti-doping regulations in their sports.

The question arose whether the mind sports chess, draughts, bridge, and Go have such an unusual position compared to other sports that the mind sports federations do not need to meet the requirements laid down for other Dutch sports federations. In order to answer this question, more knowledge is needed as to the possibility to enhance performance in mind sports by means of pharmacological manipulation.

#### 3.1 Research questions

The following questions have been formulated in order to gain insight into whether performance in mind sports can be improved by means of pharmacological substances:

1. Are there data in the scientific literature about potential performance-enhancing substances for the sports chess, draughts, bridge, and Go?
2. Which pharmacological substances can improve human functions to such an extent that they could improve performance in the above-mentioned sports?
3. What are the harmful effects on health of these potential performance-enhancing substances?

#### 3.2 Research strategy

This investigation makes use of the framework of existing anti-doping regulations for physical sports. This framework is based on a list of prohibited substances, groups of substances, and methods. This investigation has taken into account the specific differences, namely, the functions that determine performance, between the two types of sport (see chapter 5).

The investigation is divided into three components: a search of the literature, consultations with experts, and documentation of the findings. The investigation took place between October 1999 and March 2000.

##### *a. Literature search*

As a first step, the literature was searched for relevant scientific studies of the effect of pharmacological substances on performance in mind sports. Only one relevant study was found, which investigated the effect of two substances on the chess-playing performance of six volunteers. Both substances had variable effects. Nothing was found in the literature about the other mind sports. This provided an answer to the first research question. However, it is clear that the other two research questions could not be answered on the basis of this single study.

##### *b. Consultation with experts*

The lack of sufficient scientific literature on the direct effect of pharmacological substances on mind sport performance made it necessary to adopt an indirect approach in order to be able to answer the second and third research questions. This indirect approach was focused on determining the factors that play a role in mind sports. Then it was investigated which pharmacological substances have a positive effect on these factors. In addition to accessing the relevant literature, it was decided to request the assistance of experts.

The experts consulted were either involved in mind sports or were scientists. The experts from the mind sports were (former) top players and members of federation executive boards. The scientists mainly had a background in the neurosciences, with specialisation in neurophysiology, psychopharmacology, and related fields. An overview of the experts who were consulted is given in Appendix 1.

The opinions of the experts concerning the research questions were first determined in individual interviews. Then a joint meeting was held with all experts to discuss the topic and to bring the available expertise together. During this expert meeting, the (former) top players and the members of the executive boards of the mind sports federations gave an overview of the extent to which doping plays a role in mind

sports. This was followed by a discussion with the scientists about the physiological functions that are important for mind sports. The scientists then indicated to what extent it would be possible to influence these functions pharmacologically.

The discussion on the potential for pharmacological improvement of performance was based on an overview of substances that might be expected to improve mind sport performance. This broad approach was chosen so as not to exclude any potentially relevant substances. It was based on the existing list of prohibited substances and methods of the International Olympic Committee (IOC), but was adapted in consultation with the experts.

It was the aim to reach consensus during this meeting. The minutes of the meeting were sent to all participants for their approval.

*c. Documentation of findings*

On the basis of the available literature and the opinions of the experts involved, it was possible to get a good picture of the potential to improve mind sport performance by means of pharmacological substances. This information is presented in this report, which concludes with recommendations for the Dutch Ministry of Health, Welfare, and Sport.

## 4. The current situation

This chapter gives a brief overview of how the world of mind sports looks at doping and anti-doping regulations. A distinction is made between the Dutch and the international situations.

### 4.1 The Dutch situation

At the meeting of experts it became clear that the mind sports representatives do not consider doping to be a problem in their sport, either now or in the past. A few players use sedatives on doctor's prescription and others may use alcohol or marijuana for the same purpose. One chess player is known to drink the energy drink "Red Bull" during matches because he is convinced that it keeps him alert. This is not a cause of surprise or unrest in the chess world. The main ingredient of "Red Bull" is caffeine, which is also found in coffee. Chess players do not consider caffeine as an "unnatural" way of improving performance, or players who drink coffee as being unfair.

Another argument advanced as an indication that there is no doping in mind sports is the conviction that pharmacological substances are more likely to have a negative than a positive effect on performance. Moreover, if a substance or method could improve performance, players would use it openly. There are no rules that forbid this, and the aim of every player to perform at his or her best would make the use of such a substance or method a matter of course.

These arguments have led to a certain scepticism in the mind sports world about the need for anti-doping regulations. It is also feared that mention of doping in the context of mind sports may create a problem, by focusing attention on the topic. However, it is generally recognised that mind sports are now confronted with the current anti-doping regulations of other branches of sport. This is a consequence of the Dutch ratification of the Anti-Doping Convention of the Council of Europe and the inclusion of the Netherlands in the group of countries that have signed the International Anti-Doping Arrangement (IADA). This means that the Dutch government has agreed to implement an anti-doping policy for all sports. Thus, these international agreements have led to a doping problem, namely, that there are no anti-doping regulations for the mind sports.

### 4.2 The international situation

The unfamiliarity of the mind sports world with anti-doping regulations is not only a problem in the Netherlands. Several countries have ratified the Anti-Doping Convention of the Council of Europe, and in some of these countries the question about the extent to which mind sports federations should comply with current anti-doping regulations has also arisen. Thus, the mind sports federations of Spain, Italy, and Finland are also confronted with the issue of anti-doping regulations. The national bridge federation in Italy and the national chess federation in Finland carry out doping controls on the basis of the current IOC doping list. These countries have not attempted to adjust the list according to the specific characteristics of mind sports. The Spanish chess federation has not yet replied to a request to indicate in what way it interprets the anti-doping regulations in the context of mind sports.

The international federations are also confronted with the current anti-doping regulations for physical sports. Both chess and bridge want to be recognised as Olympic sports and the international federations have already approached the IOC. The International Draughts Federation has joined the General Association of International Sports Federations (GAISF), which is a first step to recognition as an Olympic sport. Similar steps may be taken by Go federations in the future.

Affiliation with the IOC means that federations must comply with the anti-doping regulations of the IOC. Spokesmen/women of the international federations for chess and bridge have indicated that they have pointed out the special position of their sports to the IOC. To date, it is not clear how the IOC and the international mind sports federations will deal with the matter. During the world bridge championships held early in 2000, all players were tested for all substances listed on the IOC doping list.

It is important that, in the future, the Dutch situation and the international situation be harmonised. This will be made difficult if there is a difference of opinion between Dutch and international policy makers regarding anti-doping regulations. According to international anti-doping regulations, potential performance-enhancing substances should be considered as doping agents if they improve performance *or*

if they are harmful to health. The Dutch government considers that a substance should be considered a doping agent if it improves performance *and* is harmful to health. It is not desirable that, in the future, a situation could arise in which Dutch participants of international mind sports competitions would have to comply with regulations that are different from those that are valid for national competitions. As indicated in section 2.3, this investigation is based on the Dutch point of view because the investigation was primarily performed for the Dutch situation.

## 5. Factors determining performance in mind sports

There are clear differences between the factors that determine performance in mind sports and physical sports. This is the main reason why mind sports federations consider that they are in an unusual position with regard to current Dutch anti-doping regulations. This chapter describes the factors that determine performance in chess, draughts, bridge, and Go.

Many factors determine mind sport performance. For example, the player's experience, talent, mental well-being at the time of the match, and physical fitness. The physical fitness of the player is of great importance during tournaments, when matches are held every day. However, under normal circumstances, the physical fitness of the player is not of decisive importance. The most important factor for good performance in mind sports is the way in which a player, at the moment of the competition, knows to unite knowledge and skills to make the right move or to play the right card. This is determined by the way the brain is functioning at that moment, in other words, by the level of "cognition". If mind sport performance is to be improved, it will be necessary, more than anything else, to improve the player's cognitive functioning. The experts agreed that this was the essential difference between mind sports and physical sports.

### 5.1 Cognitive functions, cognitive processes, and mind sport performance

Theoretically, many cognitive functions can be expected to be important to the playing of mind sports. Examples of these functions are alertness, attention, vigilance, memory, information processing, speed of thought, and the ability to perform a certain cognitive task for a long time. The latter could be termed "cognitive stamina" or "mental condition". The scientific experts agreed that it would not be possible to make a list of all cognitive processes that are important to mind sport performance. Moreover, it is possible that functions that have not yet been identified may be important during complex cognitive processes.

There has been considerable psychological research into the cognitive functioning of players of mind sports, with emphasis on the difference between top and intermediate chess players. The Dutch scientist A.D. de Groot has done much pioneering work in this field. It has been shown that top chess players are much better than intermediate players at recognising positions and at matching patterns; their visual acuity is also much better. Interestingly, these are more cognitive processes than cognitive functions.

During the expert meeting it became clear that cognitive functions do not necessarily determine cognitive performance. Several cognitive functions are addressed at the same time during thought. Although it is difficult to determine the exact interaction between these functions during the thought process, it is clear that the processes that play a role in this ultimately determine cognitive performance. It is thus better to refer to cognitive processes rather than cognitive functions when discussing cognitive enhancement. Cognitive functions do affect cognitive processes. But, while an improved cognitive function will lead to a more efficient course of the entire process, the implementation of cognitive processes ultimately determines cognitive performance.

The use of the term "cognitive processes" has another advantage over the use of the term "cognitive functions". It facilitates and clarifies the discussion of the effects of pharmacological substances on mind sport performance. The question of which pharmacological substances can influence human functions to such an extent that they could improve mind sport performance can best be answered in terms of cognitive processes. These processes do not necessarily have to be identified. The experts agreed that it is possible to draw conclusions about the potential to affect cognitive processes without necessarily having to specify the relevant processes.

The last step that needs to be taken is to extrapolate the possibility to influence cognitive processes to the possibility to improve mind sport performance. This is difficult because there is not yet enough knowledge available on which to base an unequivocal conclusion. Statements about the potential to improve mind sport performance are always based on assumptions. The conclusions of this investigation reflect what can be expected on the basis of current scientific knowledge concerning the manipulation of cognitive processes. These conclusions are based on the general opinion of several expert neuroscientists (see Appendix 1).

## 5.2 Chess, draughts, bridge, and Go

Chess, draughts, bridge, and Go differ from each other, not only in the use of different objects (chess pieces, draughts, cards, and Go stones respectively) but also in the organisation, implementation, and duration of competitions. These differences justify questioning whether these sports can be grouped together with regard to doping issues.

An important difference is the distinction between individual and team sports. Bridge is a team sport in which communication between partners is essential for the results of the match. Chess, draughts, and Go are played by individual players. Another difference is how long a single game lasts. With bridge, several games are played in one day, whereas with the other sports one game may last the entire day. In fact, games are sometimes scheduled over two days. This means that the loss of one game in bridge is less serious than the loss of a game in the other sports.

Despite these differences, at the meeting of experts the representatives of the mind sports were unanimous that the four mind sports should be treated similarly with regard to doping and potential pharmacological manipulation. This is because cognitive processes are equally important to all four mind sports.

## 6. Potential performance-enhancing substances for mind sports

The aim of this investigation was to provide an overview of pharmacological substances that might enhance performance in mind sports. To this is coupled the question whether these substances should be considered as doping by mind sports federations. This chapter starts with a review of the basic principles of the investigation, which have been explained in the previous chapters. A detailed overview of pharmacological substances and groups is then presented.

### 6.1 Basic principles

In this investigation, two criteria were used to determine whether a certain substance or group of substances should be considered as doping in the context of mind sports. These criteria are that a substance

1. improves performance and
2. is harmful to health.

Both criteria have to be met before a substance or group of substances can be considered as doping. If there is no improvement of performance, then the substance is of no relevance to players of mind sports and thus it is not relevant to ban the substance. If a substance improves performance, but is not harmful to health, then the recommendation of this report is that the substance or group of substances should not be considered as doping.

These two criteria make it possible to identify, on the basis of scientific evidence, certain substances or groups of substances as doping agents. It is possible that, even though a substance does not meet both criteria, it may be desirable to consider that substance as a doping agent on the basis of yet another criterion. Substances can also be banned for ethical reasons, for example, to protect the image of the sport; however, this investigation has not taken this aspect into consideration. This investigation has focused on the scientific information that enables the two above-mentioned questions to be answered.

The first question is difficult to answer. There has been only one study of the direct effect of pharmacological substances on performance in mind sports (see section 3.2), and it is difficult to extrapolate “improvement of cognitive processes” to “improvement of mind sport performance”. For this reason, statements are always based on assumptions.

Another difficulty in determining the effects of pharmacological substances is the inter-individual variation. Pharmacological substances influence many systems, and the precise effects can be very different in different individuals. This makes it difficult to provide a general answer to the second question because the dangers to health can vary substantially between different individuals. It is important to be aware of these difficulties when looking for answers to the two questions. With these limitations in mind, an attempt has been made to make generalisations about the various substances.

### 6.2 Overview of potential performance-enhancing substances

This overview was prepared on the basis of the IOC list of substances considered as doping agents. This list was adapted and extended during the discussions with the experts. Final modifications were made after the expert meeting and subsequent evaluation. This review gives a complete picture of the pharmacological substances that, on the basis of currently available scientific knowledge, might be expected to improve mind sport performance.

Currently, there is no single substance known that can directly improve human thought or other cognitive processes; however, this does not mean that cognitive processes cannot be affected. All cognitive processes are based on cognitive functions such as, for example, alertness, concentration, vigilance, memory, information processing, speed of thought, and the ability to perform a certain cognitive task for long periods of time. Improvement of one of these cognitive functions will lead to more efficient cognitive processes. In this way, pharmacological substances may have an indirect effect on the execution of cognitive processes and as a consequence lead to better performance in mind sports.

Experience shows that pharmacological substances generally have a minor effect on cognitive functions. Research has seldom documented more than a marginal improvement. Thus, such substances are

generally expected to have only a minor effect on mind sport performance.

### 6.2.1 Caffeine

Caffeine is probably the most commonly used stimulant in modern society. It is found in coffee, tea, cocoa, soft drinks, and other foods. Caffeine stimulates the central nervous system and in this way influences several bodily functions. The most frequently reported effects are increased alertness and vigilance, diminished fatigue, shorter reaction times, and increased availability of blood sugars and fatty acids.

The effects of caffeine are highly dose and task dependent. Task dependence is revealed by the diminishing favourable effect of caffeine as task complexity increases. With complex tasks, a dose of 75 to 250 mg leads to cognitive improvement after about 30 minutes. Higher doses (250–500 mg) first lead to a worsening of cognitive performance and then, after 90 minutes, to an improvement. With still higher doses the negative effects are predominant. A cup of coffee contains about 90 mg of caffeine and a cup of tea contains about 40 mg of caffeine.

The increased alertness and vigilance seen after a low dose of caffeine in particular will facilitate various cognitive processes. Thus, it can be expected that caffeine will improve mind sport performance. Players will obviously try to avoid the negative effects that high doses of caffeine (higher than 250 mg) have on complex cognitive processes.

Caffeine has numerous effects on health. In high doses, caffeine leads to nervousness, restlessness, sleeplessness, and tremor of the limbs. Headache and stomach-ache are among the side effects. Caffeine stimulates the heart and is a diuretic. It is addictive and tolerance can develop. The doses at which these effects occur and their severity depend strongly on the individual, as do all side effects of medicinal drugs. On the basis of the daily consumption of coffee, tea, and chocolate, it can be concluded that the negative effects of “normal” caffeine usage are not that serious.

It can be concluded that caffeine in low doses (less than 250 mg) will probably improve mind sport performance. At this dose, the effects on health are negligible. Higher doses are detrimental to performance in both the short and long term. Caffeine, irrespective of the dose used, thus does not meet the criteria to be considered doping in the context of mind sports.

### 6.2.2. Nicotine and other cholinergics

Nicotine is best known for its presence in cigarettes and other tobacco products. It can also be obtained in pills and patches, from which it is taken up through the skin. The route of administration does not influence the effect of nicotine. Nicotine acts via the nicotinic acetylcholine receptors, which are distributed throughout the body. Several other substances can affect cognitive processes directly or indirectly via acetylcholine. These substances are called cholinergics, and they can be subdivided into cholinesterase inhibitors, cholinergic precursors, and muscarinic receptor agonists. These substances have effects similar to those of nicotine, although not all their potential effects have been investigated as yet.

Nicotine is a stimulant and has several proven effects on various cognitive processes. It increases the efficiency of information processing and improves the performance of vigilance and other cognitive tasks. These effects occur within 30 minutes to an hour after nicotine administration. These substances can be expected to improve mind sport performance.

Besides its effects in the brain, nicotine also affects the endocrine system, the heart and blood vessels, and the gastrointestinal tract. Moreover, it is highly addictive. It gives rise to mental and physical dependence and tolerance. These side effects are also seen, to a greater or lesser extent, with the other cholinergics, especially with the cholinesterase inhibitors. The addictive potential of the other cholinergics is less strong.

Given the deleterious effects on health and the expected performance-enhancing effects of nicotine and the other cholinergics, these substances should be considered doping agents in the context of mind sports.

### 6.2.3 Amphetamines

Amphetamines belong to the group of psychostimulants. As such, they have several effects, some of which can be considered harmful to health.

Amphetamines suppress feelings of fatigue while the body and mind use up their reserves unnoticed. They can increase blood pressure and heart rate, diminish feelings of hunger, and cause abdominal pains, acute liver failure, mood changes, headache, and dizziness. Overdose can dysregulate body temperature and cause sleeplessness, depression, cerebral infarction, and acute cardiac arrest. Amphetamines have the potential to be strongly addictive on repeated usage.

Amphetamines have two effects that are important to mind sports. The suppression of fatigue makes it possible to carry on cognitive processes at a certain level for longer. Thus, attention can be sustained for longer. This is true for both tired and rested individuals. The other effect of amphetamines is on mood. They cause euphoria in the short term, which results in the user taking risks sooner than he or she would otherwise do. The feeling for danger is gradually lost.

This dual effect makes it difficult to determine the effect of amphetamines on mind sport performance. Although the longer attention span is positive, overrating the ability to make judgements can have serious consequences if a threatening situation is not recognised as such. The potential dangers of amphetamines to health are evident.

Given that amphetamines have the potential to improve mind sport performance and are clearly deleterious to health, it is recommended that they should be considered as doping agents in the context of mind sports as a preventive measure.

### 6.2.4 MDMA-like substances

MDMA stands for methylenedioxymethamphetamine, the active agent of so-called “party drugs” such as ecstasy, or XTC. The MDMA-like substances are derived from amphetamines but the two groups of substances have different actions.

MDMA-like substances increase euphoria and give the user a feeling of energy, so that he or she is less aware of being tired. At the same time, the person is more aware of his or her surroundings and loses social inhibitions. The addictive potential of MDMA-like substances is not yet known. There is evidence that long-term use of these substances can severely affect the neurotransmitter systems of the brain.

On the basis of the similarity between MDMA-like substances and amphetamines, it can be expected that MDMA-like substances will have a positive effect on cognition; however, such an effect has never been demonstrated, not even after once-only usage. The available studies mainly report negative effects, so that performance-improving effects in mind sports are not to be expected.

Given that the scientific literature describes only negative effects on cognition, the MDMA-like substances do not meet the definition of doping used in this investigation.

### 6.2.5 Ephedrine

Ephedrine, which is obtained from plants of the genus *Ephedra*, has been used in Chinese herbal medicine for more than 5000 years. It can be used against, for example, the common cold because it reduces oedema of the nasal mucosa. Ephedrine also has effects on the central nervous system.

Ephedrine is a weak stimulant. In certain individuals, even low doses of ephedrine can lead to shaking limbs, panic attacks, and sleeplessness. Higher doses can cause dizziness, episodes of profuse sweating, heart rhythm disturbances, and even psychoses. Ephedrine can theoretically be addictive, but this has not yet been proven.

The effects of ephedrine on cognitive processes can be compared to those of amphetamines, but the effects of ephedrine are weaker. Its effect on mind sport performance would be expected to be marginal.

The side effects of ephedrine can be harmful to health, especially those of high doses.

Given the theoretical potential of ephedrine to improve mind sport performance and its deleterious effect on health when given in high doses, ephedrine should be considered a doping agent in the context of mind sports.

#### 6.2.6 Cannabinoids

Cannabinoids are derived from the *Cannabis sativa* plant. Depending on the manner in which the plant is harvested and processed, the end product is referred to as cannabis, marihuana, or hashish. The pharmacologically active component of cannabinoids is delta-9-tetrahydrocannabinol.

Cannabinoids can have an analgesic action, but can also cause panic attacks, delusions, fear, sleepiness, and visual problems. Their effects on cognitive functions are solely negative. Attention, concentration, and memory are diminished and the ability to make judgements declines. This makes it extremely unlikely that cannabinoids can improve mind sport performance. It is thus pointless to use these substances before or during competitions to improve performance; indeed, they may have the opposite effect on performance.

Given the lack of potential beneficial effects on mind sport performance, cannabinoids cannot be considered as doping agents in the context of mind sports.

#### 6.2.7 Morphine and other opiates

Morphine is extracted from the dried milky exudate of the seed capsule of the opium poppy. It is an opiate, as are methadone, heroin, and codeine. The opiates bind to receptors that are found, among other places, in the central nervous system. Although morphine and the other opiates have many potential effects, they are not known to have beneficial effects on cognitive processes. It is thus not worthwhile to use these substances to improve mind sport performance.

Because morphine and other opiates do not improve performance, they should not be considered as doping agents in the context of mind sports.

#### 6.2.8 Cocaine

Cocaine is obtained from the coca plant. It is a relatively strong stimulant and was used before the First World War as a local anaesthetic. Cocaine is a “hard drug”, which means that in the Netherlands it is illegal to produce, trade, and possess it.

Cocaine is mostly used because of its short-acting euphoric effect. It stimulates the central nervous system, increases the heart rate and respiration, and increases the blood pressure. These effects are clearly harmful to health. Nervousness, restlessness, sleeplessness, shaking limbs, and headache and stomach-ache often result from cocaine use. The urge for euphoria can be very addictive. With repeated use, cocaine can lead to chronic fatigue, extreme weight loss, and a poorly functioning immune system.

The stimulant effect of cocaine increases alertness. Once-only usage of cocaine can be expected to improve cognitive processes and hence mind sport performance. With repeated use, as occurs with addiction, the cognitive processes are negatively affected.

The effects of cocaine on cognitive processes lead to a dual conclusion, depending on the frequency of cocaine use. According to the guidelines used in this report to determine whether a substance should be considered doping or not, once-only usage of cocaine should be considered as doping, whereas repeated use of the drug is irrelevant in this context.

At doping controls it is difficult to determine whether cocaine has been used once or repeatedly. To prevent misunderstanding, it would be better to consider cocaine as a doping agent in the context of mind sports.

### 6.2.9 Alcohol

Alcohol is a well-known and much-used stimulant. It has a short-lasting stimulant effect, and thereafter generally has a relaxant effect. Alcohol also affects the ability to assess and evaluate situations. It thus has a negative effect on cognitive functioning. Cognitive processes are often affected by only one glass of alcohol, even though the user perceives this differently. It is especially the combination of diminished cognitive functioning and the lack of awareness of this that can have dire consequences for mind sport performance. Players of these sports are strongly advised not to use alcohol.

Alcohol should not be considered as a doping agent in the context of mind sports.

### 6.2.10 Benzodiazepines

Benzodiazepines can be prescribed as anxiolytics (they repress anxiety) but also as antipsychotics (they diminish psychotic symptoms) and soporifics (they induce sleep).

The sedative effect of benzodiazepines is characterised by muscle relaxation and sleepiness. This often results in loss of concentration. Because the benzodiazepines overlap with soporifics, they always have a stupefying effect. This is disadvantageous to cognitive processes and for the playing of mind sports.

Benzodiazepines should not be considered as doping agents in the context of mind sports.

### 6.2.11 Beta blockers

Although they are not true anxiolytics, beta blockers are often considered as such. The term beta blocker describes their specific action: they block the beta receptors of the adrenergic system, thus rendering adrenaline and similar substances ineffective. Beta receptors are distributed throughout the body, but especially in the heart and circulatory system and in the airways.

Beta blockers are prescribed for heart problems, hypertension, and sometimes for migraine. They reduce shaking of the hands and thus are very effective against the visible consequences of fear and tension. Although beta blockers generally do not have a direct effect on the central nervous system, a central, albeit indirect, action cannot be excluded. It is plausible that this central effect may make cognitive processes more efficient, but there is no evidence for this. Thus it is not improbable that beta blockers have a beneficial effect on mind sport performance.

As side effects, beta blockers may produce asthmatic symptoms, cold hands and feet, dizziness, and headache. The heart rate can be slowed and blood pressure can decrease.

Theoretically, beta blockers can improve cognitive processes and hence improve mind sport performance. They are also harmful to health. Thus, beta blockers should be considered as doping agents in the context of mind sports.

### 6.2.12 5-HT<sub>1A</sub> agonists

5-HT (5-hydroxytryptamine) is the chemical name of the neurotransmitter serotonin. This transmitter plays a role in many cognitive processes.

Because of their serotonergic action, 5-HT<sub>1A</sub> agonists can be expected to influence cognitive processes. Although there is some evidence for this beneficial effect of 5-HT<sub>1A</sub> agonists on cognitive processes, this evidence is relatively new and is not yet generally accepted.

5-HT<sub>1A</sub> agonists are prescribed for the short-term treatment of symptoms of panic. As side effects, they cause dizziness, headache, nervousness, increased sweat production, nausea, and gastrointestinal disorders.

The evidence that 5-HT<sub>1A</sub> agonists improve cognitive performance is not generally accepted. For this reason, it is not yet necessary to consider these substances as doping agents in the context of mind sports.

### 6.2.13 Neuropeptides

Neuropeptides are naturally occurring peptide hormones that are synthesised by neurones. They influence communication in the nervous system, among other ways by affecting various transmitter systems in the brain. The same systems mediate the effects of caffeine, amphetamines, and nicotine.

Some of these neuropeptides, such as oxytocin, vasopressin, and adrenocorticotropin (ACTH), can promote cognitive processes, especially when the same task has to be performed for a long time. This is the case in mind sports. However, they have a small effect, and it is doubtful whether this effect results in a substantial effect on mind sport performance.

Relatively little is known about the dangers of neuropeptides to health. Theoretically, the administration of additional neuropeptides could disturb the hormonal balance in the body, which could lead to, among other things, dysregulation of the fluid balance and to mood disturbances. Changes in neurotransmitter levels can ultimately lead to psychoses and other psychic disorders.

It is highly questionable whether neuropeptides can really improve mind sport performance. Given the reasonable doubt about the efficacy of neuropeptides on mind sport performance, it is not yet appropriate to consider neuropeptides as doping agents.

### 6.2.14 Substances that increase the availability of oxygen in the brain

It is recognised that the brain functions better when the amount of oxygen available is higher than normal. This has been shown in studies in which volunteers took several breaths of pure oxygen. It is plausible that mind sport performance will also improve. The availability of oxygen in the brain can be increased by increasing the capacity of the blood to transport oxygen, for example, by blood transfusion or by administration of erythropoietin or perfluorocarbons.

Increasing the availability of oxygen in the brain is associated with health hazards. An increased oxygen concentration in the brain is potentially harmful because an increased concentration of oxygen radicals (oxygen can react as a free radical) may damage the structure of the brain. Use of alternatives to the existing red blood cells to transport oxygen often results in flu-like symptoms. Finally, the use of erythropoietin may increase the risk of myocardial and cerebral infarction because of the increased viscosity of the blood.

Increasing the availability of oxygen in the brain will probably improve mind sport performance. The extent to which health is adversely affected depends on the method used to achieve this increase in oxygen availability. The use of substances that increase the availability of oxygen in the brain should be considered as doping.

### 6.2.15 Growth hormone, oestrogens, and testosterone

Growth hormone, oestrogens, and testosterone are naturally occurring hormones in the body. It was suggested that these hormones be considered during the evaluation of the expert meeting, but they were not discussed at the meeting.

The scientific literature on the effects of hormone therapy on cognitive performance is limited. Recent studies indicate that these hormones may have beneficial cognitive consequences. If this is the case, then mind sport performance could also be improved with these substances. However, there is no evidence that these cognitive effects actually occur.

Given the uncertainty of the potential of growth hormone, oestrogens, and testosterone to improve performance, it is not yet appropriate to consider these substances as doping agents.

## 7 Conclusions and recommendations

In this chapter, the research question is answered, supplemented by conclusions that are applicable to the interpretation of the assignment. This chapter ends with several recommendations.

### 7.1 Answer to the research question

The central question of this investigation was whether it is possible to enhance mind sport performance by means of pharmacological substances. This can be answered affirmatively, even though the enhancement of performance will generally be limited. This enhancement of performance occurs in an indirect manner and is based on the assumption that mind sport performance will be enhanced if cognitive processes are improved.

### 7.2 Other conclusions

The factors that determine performance in mind sports are different from those in physical sports. As a consequence, pharmacological manipulation of performance occurs in a different way in the two types of sport. This means that, with regard to anti-doping regulations, the current IOC list of prohibited substances and methods cannot be applied unchanged to mind sports. For the purposes of this investigation, a separate list of potential performance-enhancing substances was drawn up for the mind sports chess, draughts, bridge, and Go.

The impression was gained that the use of pharmacological substances to improve performance occurs only sporadically in mind sports. The prevalent opinion inside the mind sports world is that such substances are more likely to have a negative than a positive effect on performance.

### 7.3 Doping or not

For the purposes of this investigation, a substance was considered as a doping agent if it both improves performance and is deleterious to health. The argument that certain substances should be considered as doping agents in order to protect the image of the sport was not used in this investigation.

In this overview, potential performance-enhancing substances have been divided into three categories. The first category includes substances and groups of substances that should be considered as doping in the context of mind sports, in accordance with the criteria used in this report. The second category includes substances and groups of substances that should not be considered as doping in the context of mind sports. The third category includes substances for which there is currently too little information available on which to base a decision about whether these substances can affect mind sport performance.

#### a) Pharmacological substances that should be considered as doping

- Nicotine and other cholinergics
- Amphetamines
- Ephedrine
- Cocaine
- Beta blockers
- Substances that increase the availability of oxygen in the brain

#### b) Pharmacological substances that should not be considered as doping

- Caffeine
- MDMA-like substances
- Cannabinoids
- Morphine and other opiates
- Alcohol
- Benzodiazepines

#### c) Pharmacological substances of which the effect is not yet clear

- 5-HT<sub>1A</sub> agonists

- Neuropeptides
- Growth hormone, oestrogens, and testosterone

#### 7.4 Recommendations

The following recommendations can be made, based on the findings of this investigation into the possibility of improving performance in mind sports by means of pharmacological substances:

- It is recommended that mind sports federations should formally prohibit the use of doping and that they draw up regulations that enable sanctions to be taken against those that use such prohibited substances in the mind sports.
- It is recommended that, should doping be prohibited in the mind sports, a specific list of substances to be banned should be drawn up and that the current IOC list of prohibited substances should not be used unadapted.
- It is important to harmonise national and international regulations for mind sports. This document may contribute to this harmonisation of anti-doping regulations.

## Appendix 1. Experts consulted

The following people were consulted during this investigation. They are thanked for their input and time.

### *Mind sports representatives:*

Mr A. de Vries	President, Royal Dutch Chess Federation (KNSB).
Mr A. Schuering*	Member of the executive board, KNSB.
Mr H. Grooten*	Top chess player; top-sport co-ordinator KNSB.
Mr J. Haijink*	President, Royal Dutch Draughts Federation (KNDB).
Mr D. de Jong*	Member of the executive board, KNDB; former top draughts player.
Mr H. Wiersma*	Top draughts player; trainer/coach KNDB.
Mr G. van der Scheer*	President, Dutch Bridge Federation (NBB).
Mr F.J. Vergoed*	Former top bridge player.
Mr J. van Rongen*	Chairman Dutch Go Federation (NGoB).
Mr F. Janssen*	Top Go player.
Mr W. van Beek, PhD*	Chairman Fédération Mondiale du Jeu de Dames (FMJD; international draughts federation).

### *Scientists:*

Mr J. Adam, PhD	University of Maastricht, lecturer in experimental psychology.
Mr B.G.J. Bohus, PhD*	University of Groningen, professor of animal physiology and neurobiology.
Mr J.K. Buitelaar, PhD	University of Utrecht, professor of biopsychosocial determinants of behaviour.
Mr A.R. Cools, PhD*	Catholic University of Nijmegen, professor of psychoneuropharmacology.
Mr R. Hijman, PhD*	University of Utrecht, lecturer and neuropsychologist.
Mr J.L. Kenemans, PhD*	University of Utrecht, senior lecturer in psychopharmacology.
Mr E.R. de Kloet, PhD	University of Leiden, professor of medical pharmacology.
Mr F.H. Lopes da Silva, PhD	University of Amsterdam, professor of animal physiology.
Mr B. Olivier, PhD	University of Utrecht, professor of CNS pharmacology; Yale University School of Medicine, professor of molecular psychiatry.
Mr C.M.A. Pennartz, PhD	Netherlands Institute for Brain Research, electrophysiologist.
Mr W. Riedel, PhD*	University of Maastricht, lecturer in neuropsychology.
Mr J. Snel, PhD	University of Amsterdam, senior lecturer in psychonomics.
Mr F.J.H. Tilders, PhD	Free University, professor of pharmacology.
Mr T.B. van Wimersma Greidanus, PhD**	University of Utrecht, professor of experimental neuroendocrinology; chairman of the board of the Netherlands Centre for Doping Affairs.
Mr M.P. Witter, PhD	Free University, professor of anatomy and embryology.

### *Representatives from the Netherlands Centre for Doping Affairs:*

Mr F. Hartgens*	Head, scientific department; doctor specialised in sports medicine.
Mr O. de Hon*	Staff member, scientific department.
Mr R. van Kleij*	Head, communications department.
Mr P. van der Kruk*	Director.
Mr F. Stoele	Staff member, information and documentation.
Mr S. Teitler	Staff member, legal affairs.

### *Representative from the Ministry of Health, Welfare, and Sport:*

Mr M. Koornneef\*

Senior staff member; doctor specialised in sports medicine.

\* Present at the expert meeting.

\*\* Chairman of the expert meeting.

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### Appendix 3: Abbreviations

ACTH	Adrenocorticotropin
FMJD	Fédération Mondiale du Jeu de Dames
GAISF	General Association of International Sports Federations
HT	Hydroxytryptamine
IADA	International Anti-Doping Arrangement
IOC	International Olympic Committee
KNDB	Koninklijke Nederlandse Dam Bond [Royal Dutch Draughts Federation]
KNSB	Koninklijke Nederlandse Schaak Bond [Royal Dutch Chess Federation]
MDMA	Methylenedioxyamphetamine
NBB	Nederlandse Bridge Bond [Dutch Bridge Federation]
NeCeDo	Nederlands Centrum voor Dopingvraagstukken [Netherlands Centre for Doping Affairs]
NGoB	Nederlandse Go Bond [Dutch Go Federation]
NOC*NSF	Nederlands Olympisch Comité * Nederlandse Sport Federatie [Dutch Olympic Committee*Dutch Sport Federation]