# Chapter 1 Introduction

In May 2001, the Dutch government published a note outlining its intention to intensify efforts to decrease ecstasy-related harm [1]. Although this intention was primarily based on the observation that large quantities of ecstasy were produced in and exported from the Netherlands, and accordingly most proposed intensifications regarded law enforcement, a need for development of health promotion interventions targeting ecstasy use was also asserted. A health promotion intervention is any non-juridical incarnation of a deliberate effort to change people's behaviour to improve their health and/or quality of life.

Because behaviour is the outcome of a person's reactions and thoughts in a particular situation, behaviour can be influenced by changing the situation and/or the relevant thoughts. An effective health promotion intervention targets the aspects of a situation and/or thoughts that actually determine the behaviour that is intervened upon [2]. Knowing which variables determine behaviour is therefore prerequisite to developing an effective intervention. The current thesis comprises eight chapters reporting the results of studies conducted to synthesise and extend the knowledge about the determinants of ecstasy use and related behaviours. Before outlining these chapters, the context of this thesis will be described. First, the relevance of intervening on ecstasy use is explained; then, the theoretical background of the research to enable such interventions is explained.

## Ecstasy

In 1912, a German pharmaceutical company called Merck wished to evade a competitors patent on a blood clotting agent called Hydrastinin [3]. It succeeded, and on the 24th of December 1912, Merck patented a number of chemical reactions, mentioning a chemical called Methylsafrylamin as an

intermediate step to ultimately synthesise Methylhydrastinin, Mercks newly developed blood clotting agent. This chemical received only cursory attention until the United States army sponsored a secret animal study at the University of Michigan in 1953 and 1954, where the toxicity and behavioural effects of Methylsafrylamin and seven other drugs were compared [4], and Merck re-synthesised it in 1959 because of an interest in the production of stimulants. Although no records could be found, it is likely that the effects on humans were studied during this period, and that this somehow inspired non-scientific interest. Eleven years later, tablets were seized in Chicago that contained this same chemical, now referred to as 3,4-melthyldioximethamphetamine (MDMA). In 1978, a chemist called Alexander Shulgin and his co-workers synthesised and used MDMA, and their reports of its effects further popularised the drug. In 1984, MDMA's street name 'ecstasy' was coined in California, and shortly thereafter, most countries started banning ecstasy [3]. The basis for banning ecstasy appeared to be that it was a drug, used by drug users who also use other illegal drugs. There was no evidence supporting any of the three criteria for banning a drug (illegal use, similarity to other illegal drugs, and potential for addiction or harmful effects) [5].

The potential positive effects of ecstasy are euphoria, increased energy, tenderness/closeness, feeling peaceful/calm, increased sensual awareness, and changes in visual perception [6]. Ecstasy also has negative effects, but these are less frequent and less intense than the positive effects [6]. Potential negative effects are teeth grinding, thirst, muscle tightness, accelerated heartbeat, nausea and/or vomiting, body temperature changes, fatigue or mental fatigue, headache, dizziness, nervousness, depression, fear and/or paranoia, and confused thought. Other potential effects are sweating, numbness/tingling, sleeplessness, and decreased appetite. In their own words, users describe ecstasy's effects as "ecstasy makes everything seem like it's perfect", "you love everyone and everything", "music feels better", "you can say what is on your mind without worrying what others will think", and you feel more connected to others and able to emotionally bond [7]. This experience has been described as "the peak of human experience" [8]. Because ecstasy's effects of inducing tenderness, closeness, peace and calm are quite unique, and indeed, its human psychopharmacology is dissimilar to that of most other known drugs, it has been argued that ecstasy should be pharmacologically categorised as an 'entactogen' (roughly meaning 'touching within'), a previously nonexistent category [9].

Ecstasy use has always been linked strongly to a relatively young musical genre that also greatly gained in popularity during the eighties. In the Netherlands this genre is currently known as 'dance'. Dance was born out of disco and the electronic music of Kraftwerk in the early eighties in Chicago ('house'), Detroit ('techno') and New York ('garage') [10]. Now, in 2008, this musical genre is the centre of a 'dance scene' that encompasses huge dance events with ten-thousands of visitors, clubs playing dance, organisations, DJ's, dance music producers, and of course visitors. In the Netherlands, this dance scene is estimated to encompass over 11 000 jobs, organising over 30 dance events, catering to over 700 000 adolescents and young adults and generating over € 500 000 000 a year [11]. It is not known to what degree dance and ecstasy contributed to each others popularity, but it is clear that the dance scene has two characteristics which are exceptionally compatible with ecstasy's effects. First, especially during the eighties and early nineties, those popularising dance generally propagated the ideals of peace, love, unity and respect. These ideals reflect the experience induced by ecstasy's entactogenic effects. Second, a distinguishing characteristic of dance is a strong focus on rhythm, enabling the mixing of different 'dance tracks' into one continuous set. Dancing is usually not done in pairs as was customary until dance evolved, but in a way that can be interpreted as either individually or collectively, and often for hours on end. The energising effects of ecstasy enable dancers to do this.

Regardless of any cause-consequence relationship between ecstasy's effects and the way the dance scene evolved, currently, ecstasy is linked strongly to the dance scene. In the Netherlands in 2005, 4.3% of all men and women between 15 and 64 had ever used ecstasy, 1.2% had used the past year, and 0.4% had used the past month [12]. In 2001 and 2002, at four Dutch dance events, on average 76% of the visitors had ever used ecstasy, and 45.6% had used ecstasy at the party [13]. In other countries, similarly high percentages are found. For example, in New York, 45.2% of club and lounge visitors had ever used ecstasy [14]. The millions of people taking ecstasy every weekend would not be a cause for concern if ecstasy use would be harmless. However, ecstasy is potentially damaging to health.

The potential neurotoxic effects of ecstasy are controversial. This controversy is related to the exceptional difficulty of studying potential harmful effects of ecstasy. The expected neurotoxicity renders it ethically unfeasible to administer ecstasy to a random sample of participants in varying dosages. Those using ecstasy of their own accord are often poly-substance users, making

it very hard to distinguish the effects of ecstasy of the effects of the other substances. Finally, if differences are found between non-users and ecstasy users, there is no way to know whether these differences will have been caused by ecstasy, whether these differences have caused the ecstasy use, or whether another variable is responsible for both the differences and the ecstasy use. Further, in 2002, Science published a paper demonstrating severe MDMA neurotoxicity in primates [15]. This paper received a lot of media attention and had a great influence on the public opinion regarding ecstasy. However, in 2003, the paper was retracted, because it turned out that the primates had accidently received methamphetamine instead of MDMA [16]. This increased the controversy further.

A number of recent reviews and meta-analyses have summarized the growing body of research, finding ecstasy use associated to poorer neurocognitive functioning in a number of domains [17-21], although the methodological issues remain [22], and it is not yet clear to which degree neurological effects of ecstasy are reversible. However, a recent large-scale Dutch study, the Netherlands XTC Toxicology (NeXT) study, has been initiated that addresses many methodological problems [23]. The first results imply that other drugs such as amphetamine may have played a role in prior studies reporting negative health effects of ecstasy [24], and that a small dose of ecstasy may be harmless [25]. In time, this study and studies with similar designs may be able to answer the question of ecstasy's neurotoxicity. Regardless of neurotoxicity, many users report negative effects that they attribute to their ecstasy use, such as decreased concentration, depression, insomnia and fatigue [26]. Thus, in all, although the current evidence is largely circumstantial, it seems wise to consider ecstasy as potentially damaging.

Ecstasy's prevalence and potential harmfulness justify the regulation of ecstasy use to minimize the damage ecstasy causes. There are basically two ways to influence any given behaviour: by force or by inducing volition (or by a combination of these two). In modern society, if a government wants to influence behaviour by force, it can do so mainly through legislation, and the Dutch Government has utilised this tool by outlawing ecstasy use. However, the high prevalence of ecstasy use evidences the inefficacy of this approach. This inefficacy does not seem specific to ecstasy: the Netherlands chose to adopt a less prohibitionist policy concerning cannabis, which is legally available in the Netherlands; yet, life-time and current use figures for, for example, the strictly prohibitionist United States, are significantly and substantially higher [e.g. see

27]. Thus, legislation seems insufficient to regulate drug use, and this leaves the possibility of influencing drug use by inducing volition. Such a non-juridical incarnation of a deliberate effort to change people's behaviour to improve their health and/or quality of life is a health promotion intervention based on voluntary behaviour change and/or environmental changes that facilitate the health promoting behaviour.

## Intervention Mapping

Bartholomew, Parcel, Kok and Gottlieb [2] have developed a protocol that can guide development of such health promotion interventions, appropriately called Intervention Mapping. The research described in this thesis is based on a project proposal that the Dutch government subsidised to enable intervention development regarding ecstasy use, and this research proposal follows the Intervention Mapping protocol. Intervention Mapping encompasses six steps: needs assessment, matrices, theory-based methods and practical strategies, program development, adoption and implementation plan, and evaluation plan. Although this orderly presentation in steps suggests consecutiveness, these steps have an iterative nature. A very brief description of these steps will be provided here.

The needs assessment, step 1, comprises mapping what the problem is exactly, which behaviours and environmental factors cause this problem, among whom, and in what context. During this step one also aims to gain an understanding of the community in which the intervention is to be implemented. In step 2, the specific sub-behaviours constituting the targeted behaviours or *performance objectives* are established and crossed with personal and external determinants in matrices, resulting in a list of *change objectives*: concrete objectives for the intervention. In step 3, theory-based methods are matched to the relevant change objectives. Being theory-based, these methods have a generic character, and they can often be translated into practice in several ways. Matching the selected theory-based method to a practical strategy allows adequate translation to the context at hand in a way that enables coherent integration of all selected methods in a program. In step 4, program development, the strategies specified at step 3 are integrated into one program that carefully considers the intended participants and context. In this step, the program producers (e.g. web designers and graphic artists) are informed of their tasks, and the program is pretested and piloted.

Although step 5 and step 6 are finalised in the last stages of intervention development, they are actually initialised simultaneously with step 1. In step 5, adoption and implementation, potential users of the program and those who need to take decisions to ensure successful implementation are identified. Then, interventions are developed to ensure that these users and decision-makers implement the intervention successfully: performance objectives underlying their desired behaviour are hypothesised; these are crossed with hypothesised determinants in matrices similar to those from step 2; the thus generated change objectives are matched to methods and strategies; and an integrative program is developed. In the final step, step 6, the evaluation plan in completed. This plan allows evaluation of whether the decisions, made at each step of the intervention mapping process, were correct. This can then inform future intervention development, regardless of whether the intervention is successful.

Intervention Mapping guides the string of decisions that accompanies the development of a theory and evidence-based intervention. Being theory and evidence-based, these decisions should be made on the basis of adequate information. Intervention Mapping proposes to gather this information through the so-called core processes of using evidence, theory, and new research. New research is used to answer questions left unanswered by the available evidence and theory when a decision needs to be made. Of course, the more research and interventions have been published in any given area, the more questions will have been answered, and the less new research is necessary to develop an intervention for any given behaviour, target population, and context, that fall within that area. Likewise, when research, theory development, and published interventions are scarce within an area, Intervention Mapping requires a lot of new research to provide the information that the necessary decisions need to be based on.

The current thesis was initially intended to describe a complete Intervention Mapping project from start to end, with each chapter corresponding to one or several Intervention Mapping steps. However, as the initial literature studies were completed, it became clear that regarding ecstasy use, research and theory development are scarce. It followed that, in order to be able to develop a theory and evidence-based intervention addressing ecstasy use, a lot of new research was required, to the extent that the research required to enable progression to steps 3 and further was so substantial that this thesis focuses exclusively on reporting the results of this research. Thus, the studies

reported here have all been conducted to allow generation of the matrices required in step 2 of the Intervention Mapping protocol.

## Step 1: Needs assessment

The needs assessment (step 1) was conducted to assess what needs to be done to minimise the damage that ecstasy causes. Because ecstasy cannot do damage if it is not used, starting and stopping ecstasy use are both behaviours that are potential intervention targets for an intervention aiming to minimize harm. However, these behaviours are not the only potential intervention targets. If ecstasy is used, the amount of potential damage is related to the way in which it is used. Application of so-called harm reduction strategies (HRSs) can minimize the damage that ecstasy causes. The needs assessment concentrated on identification of these HRSs. This was done through the available literature and through consultation of the linkage group. This linkage group was a group of experts on ecstasy use patterns and implementers of the prospective intervention that was consulted at various stages of the project (see

**Table 1.1: Behaviours resulting from the needs assessment**

| Activity or harm reduction strategy | Associated behaviour |
|---|---|
| Regarding the use itself | |
| Starting ecstasy use | Trying out ecstasy |
| Ceasing ecstasy use | Ceasing ecstasy use |
| Moderating frequency of use | Not using more than once every four to six weeks |
| Moderating intensity of use | Not using more than 1.5 mg MDMA per 1 kg body weight |
| Before any instance of use | |
| Ascertaining pill contents | Bringing pill to a testing facility |
| Sleeping sufficiently | Sleeping at least 8 hours in the three nights before use |
| Ensuring sufficient hydration of body before use | Drinking 2 litres of water on each of the three days before use, and compensating for consumption alcohol or caffeine |
| During any instance of use | |
| Preventing dehydration and hyponatraemia | Drinking half a litre of water hourly |
| Regulating body temperature | Chilling out for at least twenty minutes every two hours |
| Not combining with other drugs | Not combining with alcohol<br>Not combining with cocaine<br>Not combining with speed<br>Not combining with GHB |

Appendix 1.i). It was found that no studies have addressed the effects of HRSs in a controlled environment. However, there is a small body of qualitative literature [28] where ecstasy users report the HRSs they apply. In addition, evidence concerning these strategies has been generated through visits to first-aid posts at dance events and in hospitals. The linkage group provided insight in this data. The resulting list of harm reduction strategies will be briefly reported here.

The most well-known HRS is preventing dehydration during use. Users usually put this into practice by drinking water during use, and closely related to that is another well-known HRS: preventing an imbalance in the proportion of water and natrium in the blood resulting from excessive water intake called hyponatraemia. Another HRS is regulating one's body temperature. It has been shown that body temperature is positively associated to damage [29]. These HRSs can all be applied during use. There are also HRSs applicable before use and after use. Before use, the exact pill contents can be determined. This allows a user to regulate the dosage and to avoid ingesting other drugs. In addition, before use, users can minimize the risk of acute damage by sleeping sufficiently, eating properly, and ensuring that the body is properly hydrated. Moderating frequency and intensity of ecstasy use can also minimize ecstasy-related harm. Finally, combining with other drugs can substantially increase acute risks.

Harm reduction strategies such as 'preventing dehydration' express conceptual goals rather than actual behaviours that can be targeted by an intervention. Often, such a goal can be achieved through several behaviours, but for the current purposes, one behaviour is selected for each HRS, except combining with other drugs, where the four most prevalent party drugs in the Netherlands were selected. The harm reduction strategies and the corresponding behaviours that resulted from the needs assessment are listed in Table 1.1. These behaviours are potential intervention targets. To determine which of these behaviours are the most adequate intervention targets, information is required as to what causes each behaviour.

## Step 2: Determinants

Any behaviour is the outcome of a person's thoughts in a particular situation. If the thoughts and situational elements that determine whether a behaviour will be conducted are known, attempts can be made to influence these. The

particular thoughts that lead to a certain behaviour are the consequence of a number of psychological variables. Those psychological variables that determine a particular behaviour are called *personal determinants*. Similarly, those situational elements that determine a particular behaviour are called *external* or *environmental determinants*. An intervention can address one or both types of determinants. To study the relevance of external determinants, ideally one would compare a situation where they are present with a situation where they are absent. However, such experimentation was not feasible regarding ecstasy use (e.g. testing ecstasy at parties is not legal; the resources to provide free water lacked, etc). Therefore, the current project concentrated on identifying personal determinants of behaviour, and this are the findings that will be reported in the following chapters (though perceived effects of the environment are included in certain personal measures like subjective norm and perceived control, as will become clear below). Therefore, to illustrate this concept of personal determinants, a theory on social-cognitive determinants of behaviour that has successfully been applied to several health behaviours will be described: the Theory of Planned Behaviour, based on Ajzen and Fishbein's Theory of Reasoned Action [30-33].

The Theory of Planned Behaviour (TPB) postulates intention as main proximal determinant of behaviour. Thus, according to the TPB, whether a person performs a particular behaviour in any given situation is largely determined by that persons intention to perform that behaviour in that situation. Measuring intention is quite straightforward. An example is the question "Do you intend to try out ecstasy at a dance event in the next three months?", with answer options from "absolutely not" to "absolutely". This specification of context ("at a dance event in the next three months") is important because, for example, attitude regarding ecstasy use at a dance event may be different from attitude regarding ecstasy use at the birthday party of one's mother. Intention itself has three determinants.

The first is attitude. A person's attitude expresses the likelihood and desirability of all potential consequences of that behaviour. The combination of likelihood and desirability of each specific consequence is called an attitudinal belief. Attitude can be measured in two ways. First, all attitudinal beliefs can be measured and aggregated, for example: "trying out ecstasy will make me more sociable" with answer options from "very unlikely" to "very likely", combined with another question "For me, being more sociable is . . ." with answer options from "very undesirable" to "very desirable". Alternatively, attitude can be

measured directly. This method traditionally uses so-called 'semantic differentials', for example: "I think trying out ecstasy is . . ." with answer options from "unwise" to "wise" or from "unpleasant" to "pleasant".

The second determinant of intention is subjective norm. Subjective norm expresses the perceived approval of disapproval of a person's social referents (referred to as normative beliefs), weighed with a person's motivation to comply with the relevant social referent. Subjective norm can also be measured in two ways. First, the normative beliefs relating to all social referents can be measured, for example: "regarding me trying out ecstasy at a dance event in three months, my best friend . . ." with answer options from "strongly disapproves" to "strongly approves", including an "I don't know" option (which will be referred to as the nescience option). This is multiplicatively combined with "regarding trying out ecstasy, for me, the opinion of my best friend is . . ." with answer options from "very unimportant" to "very important". Alternatively, subjective norm can be assessed directly with the question "regarding me trying out ecstasy at a dance event in three months, people who are important to me . . ." with answer options "strongly disapprove" to "strongly approve", again including a nescience option. Although the nescience option is recoded to signify absence of normative influence, the proportion of nescient participants can be useful information when developing an intervention.

The third determinant of intention is perceived behavioural control (PBC). PBC expresses the degree of control one perceives to have over performing a given behaviour in a variety of situations. The degree of control one perceives to have over performing that behaviour in one specific situation is called a control belief. PBC differs from the other two determinants of intention, because perceived control is a function of perceived barriers or facilitators and perceived skills, which are usually functions of actual barriers or facilitators and skills. For example, perceived control over drinking sufficient water at an event where no water can be obtained will be low, given the fact that the behaviour is practically impossible. Regardless of one's intention, the behaviour would not be conducted. Accordingly, of the three determinants of intention, PBC is the only one that is also a direct determinant of behaviour. PBC can be measured for example by "for me, getting my ecstasy tested before using it in the next three months would be . . ." with answer options from "very difficult" to "very easy" (because this measurement, and PBC itself, are very similar to

self-efficacy [30], a variable postulated in Bandura's Social Cognitive Theory [34], the words are often used interchangeably).

Thus, by measuring intention, attitude, subjective norm, and perceived behavioural control, a behaviour's determinant configuration, the relative relevance of each determinant, can be established. For example, if many participants indicate unawareness (nescience) regarding their friends' approval or disapproval of them trying out ecstasy, while most people disapprove of their friends trying out ecstasy, an intervention could aim to encourage discussion of the topic. On the other hand, this seems a less prudent aim if few participants indicate nescience, and most participants' friends appear to approve of them trying out ecstasy.

Over the years, a number of additions to the TPB have been suggested, such as the descriptive norm, a variable expressing the perception of the behaviour of social referents (as opposed to their approval or disapproval). These will be explained where they are relevant. Likewise, although the TPB is but one of many theories and models developed to aid explanation of human behaviour (another is, for example, Bandura's Social Cognitive Theory [34], which was mentioned above), not all these theories and models can be explained here. Nonetheless, this example can hopefully also facilitate understanding of these other theories by conveying the implicit logic that most theories share. Finally, it is important to note that the Theory of Planned Behaviour addresses the *explanation* of behaviour, not *how to change* any of the postulated variables. Thus, the TPB (and many other theories that can aid in explaining behaviour) can help mapping a behaviour's determinant configuration; but once the determinant configuration has been identified, other theories and models have to be invoked to decide how the most relevant determinants can be changed. However, as this thesis reports studies that deal with identification of determinant configurations, theories and models of change will not be considered presently (but see chapter 7 of Bartholomew et al. [2]).

## Structure of the thesis

In Intervention Mapping, the answer to any question is first sought in the existing literature, and subsequently, on the basis of the found information, the need for new data is assessed and addressed. And indeed, when aiming to develop an intervention that targets the behaviours listed in Table 1.1, it makes

sense to first assess whether determinant configurations for these behaviours are already available in the literature. Chapter 2 describes a meta-analysis that does exactly this, by synthesising quantitatively all studies into the determinants of ecstasy use and related behaviours [35]. Ideally, had sufficient research been conducted, this meta-analysis would have resulted in a list of determinant configurations that could then have served as input for steps 2 and further of Intervention Mapping. However, this was not the case. Because meta-analyses' quantitative nature necessitates very severe inclusion criteria, it was plausible that studies that contain valuable non-quantitative information about potential determinants of a behaviour were excluded from this meta-analysis. To address this possibility, a qualitative review into the reasons of ecstasy use and related behaviours was conducted, the results of which are reported in chapter 3. Thus, together, these two studies provided a complete overview of the literature regarding determinants or reasons for ecstasy use and related behaviours.

However, none of the quantitative studies synthesised in chapter 2 addressed any of the behaviours from Table 1.1. Although a number of the qualitative studies synthesised in chapter 3 did, none of these qualitative studies had been conducted in the Netherlands. Additional research was required. First, to assess whether Dutch ecstasy users had similar reasons as their American, English and Australian counterparts, an interview study was conducted among non-users, users, and ex-users of ecstasy recruited at Dutch dance parties. The results are reported in chapter 4. Then, a largely quantitative online survey was conducted among Dutch dance scene members, which allowed identification of the determinant structure of each of the behaviours inTable 1.1. Of this survey, the results pertaining to using ecstasy are reported in chapter 5, the results pertaining to trying out ecstasy are reported in chapter 6, and the results pertaining to ceasing ecstasy use are reported in chapter 7, after which the comparison of these results is reported in chapter 8. Results pertaining to the behaviour of getting one's ecstasy tested are reported in chapter 9, and the results of the studies reported in chapters 2 to 9 will be synthesised in chapter 10.

**Appendix 1.i: The members of the linkage group: experts regarding ecstasy use patterns and implementers of the intervention that were consulted during various stages of the project.**

| Name | Organisation |
|---|---|
| Floor van Bakkum | Unity, JellinekMentrum Preventie |
| Linda Bolier | Uitgaan en drugs, Trimbos Instituut |
| Lonneke van Deursen | Unity, JellinekMentrum Preventie |
| Ninette van Hasselt | Uitgaan en drugs, Trimbos Instituut |
| Jaap Jamin | Unity, JellinekMentrum Preventie |
| Roel Kerssemakers | Unity, JellinekMentrum Preventie |
| Jan Krul | EducareGroningen |