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REVIEW

Being stoned: a review of self-reported cannabis effects

BOB GREEN[1], DAVID KAVANAGH[2] & ROSS YOUNG[3]

[1]*Community Forensic Mental Health Service, Brisbane, Australia,* [2]*Department of Psychiatry, Central Clinical Division, The University of Queensland, Brisbane, Australia and* [3]*School of Psychology and Counselling, Faculty of Health, Queensland of University of Technology, Carseldine, Australia*

Abstract

Although there has been considerable research into the adverse effects of cannabis, less attention has been directed toward subjective effects that may be associated with ongoing cannabis use. Examination of self-reported cannabis effects is an important issue in understanding the widespread use of cannabis. While reviews have identified euphoria as a primary factor in maintaining cannabis use, relaxation is the effect reported most commonly in naturalistic studies of cannabis users, irrespective of the method used. Self-reported effects in 12 naturalistic and 18 laboratory studies were compared. Regardless of methodology there was considerable variation in the effects experienced. Variation has been reported in terms of opposite effects being experienced by different individuals, variation of effects by individuals within a single occasion and between occasions of use. Factors that might explain this variation are outlined. Limitations of the available literature and suggested directions for future research are discussed. [Green B, Kavanagh D, Young R. Being stoned: a review of self-reported cannabis effects. *Drug Alcohol Rev* 2003;22:453 – 460]

Key words: Cannabis, subjective effects.

Introduction

It is estimated that 141 million, or 2.5% of the world's population use cannabis [1]. Comprehensive data on cannabis use prevalence are available from the United States of America, Europe and Australia. US data indicate cannabis use peaked in 1979, declined until the 1990s and has increased since, although not to the same level as in 1979 [1]. The 2000 US household survey [2] estimated that 8.3% of the population aged over 12 years had used cannabis in the previous 12 months, while European surveys report 12-month prevalence as ranging from 1 – 9%, with increases in the 1990s [3]. These increases were proportionally less in countries such as Germany or the United Kingdom that had higher prevalence in the early 1990s. The 2001 Australian household survey estimated 12.9% of the population aged over 14 years had used cannabis in the last 12 months [4], while in an earlier survey 31.7% of those who had used cannabis more than five times in the last 12 months met the criteria for a cannabis use disorder [5]. World-wide, significant numbers of people are exposed to possible adverse effects on physical health [6], while there is growing evidence of effects on cognitive functioning [7] and mental health [8,9].

Significant developments have occurred in understanding better the neurobiological action of cannabis and its associated abuse potential. Cannabinoids, the active constituents of cannabis have been found to interact with specific G protein-coupled brain receptors, while endogenous ligands have been identified that bind cannabinoid receptors in the brain, functioning as neurotransmitters or neuromodulators [10,11]. Cannabinoids have been also described as enhancing dopamine synthesis, release and turnover as well as the inhibition of dopamine reuptake in reward-relevant brain loci, activating the reward/reinforcement circuits

Bob Green MSW, Senior Social Worker, Community Forensic Mental Health Service, 42 Albert Street, Brisbane 4001, Australia; David Kavanagh PhD, Associate Professor in Clinical Psychology, Department of Psychiatry, Central Clinical Division, The University of Queensland, Brisbane 4029, Australia; Professor Ross Young PhD, Head of School, School of Psychology and Counselling, Faculty of Health, Queensland of University of Technology, Carseldine 4034, Australia. Correspondence to Bob Green, Community Forensic Mental Health Service, 42 Albert Street, Brisbane 4000, Australia.

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of the mammalian brain like other drugs of addiction [11].

Despite the reported reinforcing effects of cannabis most people who try cannabis do not progress to daily use over protracted periods [12] and the typical level of dependence has been described as mild, with less than a third of cannabis users reporting tolerance or withdrawal [5]. The widespread use of cannabis makes it important to identify more precisely what other factors may be implicated in the use of cannabis. Research into subjectively experienced cannabis effects has a history dating back to at least the 1950s, when it was proposed that becoming a cannabis user involved a process of learning to identify and enjoy the effects of cannabis [13].

Self-reported cannabis effects including expectancies of future effects have been found to predict patterns of cannabis use across a diverse range of groups. Research with college students [14], drug treatment in-patients [15], adolescents [16] and people with schizophrenia [17] have reported statistically significant associations between cannabis expectancies and patterns of cannabis use. Generally, non-users expected more global negative effects or cognitive and behavioural impairment while frequent users had lower expectations of negative effects [14–16]. Further, individual differences in the self-reported effects of cannabis [18,19] and the influence of environmental context [20] highlight the importance of subjective effects as an area requiring more detailed scientific examination.

The purpose of this paper is to examine the frequency of self-reported cannabis effects, so as to more rigorously identify effects that may contribute to continued cannabis use, as well as to discuss factors that may explain the variation in self-reported effects. Accordingly, the focus has been on studies where the frequency of self-reported positive effects of cannabis were available. Better understanding of the phenomenology of cannabis use has importance for developing public education that describes effects that are commonly experienced and relevant to cannabis users. Understanding the experience of cannabis users is also essential to the process of engaging individuals in treatment and promoting critical examination of the benefits and costs of cannabis use.

Method

Extensive literature searches using both academic databases and citations identified 12 studies that provided frequency data on self-reported cannabis effects, in which the sample size was over 30 and there was adequate detail concerning how the data were collected, analysed and reported. Some potentially useful studies did not meet these criteria for the following reasons: difficulties in determining numbers of respondents experiencing an effect [7,21,22]; overly broad effect categories [23–26] and incomplete reporting of effects [27]. Studies incorporating medical patients [28] and medicinal users [29,30] were excluded. As the focus of this review was on factors that may promote continued use, adverse effects were primarily of interest for their frequency among individuals for whom the frequency of positive effects was reported. Studies that only examined adverse effects were also therefore excluded from the analysis.

Open and closed question data were analysed separately because the effects reported and their frequency are likely to be dependent on the respective method used. Different cognitive tasks are required in responding to open and closed questions. Open-ended questions encourage diversity of individual expression [31] and access more salient effects [32]. In contrast, closed questions predetermine the effects that are to be considered [31] and may remind participants of responses that might not have otherwise been endorsed [32].

Three studies asked about cannabis effects via open-ended questions. The participants in these studies were regular cannabis users from the United States [18] and the United Kingdom [33,34], with the participants in the latter study recruited primarily from music festivals. Nine studies utilized a checklist or questionnaire. With one exception that was a study of long-term Greek hashish users [35], these studies were all from the United States. Participants were: students [36,37], students and non-students [38,39], regular [40,41], long-term users [42] or male veterans who were twins [43]. The nine studies that used closed questions described a total of 401 effects (66.3% of these came from two studies [38,40]). In order to provide a concise description in this paper, effects were included for analysis, if (a) the effect was mentioned (using identical or very similar wording) in three or more studies or (b) were the direct opposite in nature to those that had been mentioned in three studies. Inclusion required consensus by all three authors that the wording in different studies did refer to the same effect. The three study criterion led to the exclusion of effects such as 'nightmares' or 'guilty', as well as highly specific effects (e.g. Tart's comprehensive study included 23 items classified as being associated with vision alone).

Another source of data on cannabis effects are laboratory-based studies that utilize rating scales to determine the presence and strength of specified acute effects. These studies are typically conducted in controlled environments, and often have small samples exposed to oral tetrahydrocannabinol (THC) or cannabis. They provide a basis for confirming the data obtained from naturalistic studies. A search of the Embase, PsychInfo and Medline databases was undertaken using the terms 'subjective effects' and marihua-

na, marijuana, hashish or cannabis. Studies were selected for review if the study was relevant to examining the effects reported in the naturalistic studies. They were not included if the only effects reported were 'like drug', 'feel high' or 'want more', or where the focus of the study was primarily on physiological or adverse effects.

Results

Naturalistic studies

Prevalence of reported effects. Table 1 depicts the most frequently reported effects in the studies using open-ended questions. Relaxation was the most frequently reported effect in each study. Mood (variously described as happy, happiness or laughing more) and sensory alteration, as well as insight/thinking more deeply featured in the top 10 most frequently reported effects across the three studies. The percentages reporting negative mental health effects were, respectively: paranoia 6–15%, depression 1–10%, hallucinations 2–14% and anxiety 2–15%.

Frequency data pooled from the studies using closed questions is presented in Table 2. Slowed time perception, increased appetite and increased relaxation were endorsed by over 90% of cannabis users in studies which included these items. Other very commonly endorsed effects included; increased concentration, improved thinking, talkativeness, sleep and laughter. Of interest were the similar proportions reporting increased or decreased talkativeness, sociability and memory. Sexual pleasure was also frequently endorsed, whereas increased irritability was seldom endorsed.

Frequency of experiences. Four studies [38–42] asked cannabis users about the frequency with which an effect was experienced (worded as 'occasionally'/'sometimes' or 'usually'/'frequently'). Effects that were frequently experienced by more than half the study participants were: get to sleep better (76.0%), more relaxed (72.1%), time slows (71.3%), dry mouth (68.9%), increased sexual pleasure (56.4%) and thinking better (52.0%). The following effects were frequently or usually experienced by less than half the study participants: concentration improved (40.1%), more talkative (35.2%), increased sexual arousal (33.2%), more sociable (31.3%), laugh more (29.1%), increased appetite (27.1%), decreased memory (23.6%), drowsy (22.4%), dizzy (22.0%), memory improvement (19.2%), decreased concentration (18.0%), less talkative (17.6%), less sociable (17.6%), think less clearly (14.8%), and harder to get to sleep (13.3%). Effects reported as being usually or frequently experienced when using cannabis, but with an overall low prevalence were: hallucinations (9.2%), time sped up (7.2%), %), decreased sexual arousal (5.2%), more anxious (3.6%) and more depressed (3.5%).

Intoxication level. Only one study examined the level of intoxication at which effects were experienced [38]. Intoxication was measured as: 'just', 'fairly', 'strongly', 'very strongly' and 'maximum'. Not all participants gave ratings for the effects, so for this review effects were categorized into three groups: effect experienced predominantly at 'just-fairly' range, effect experienced predominantly at the 'strongly-maximum' range or effect experienced equally across intoxication levels (does not vary more than 10% across the levels). The lower level of intoxication was associated with: easy to get to sleep, more sociable, increased appetite, talk less. Effects experienced equally at both levels were: relaxed, memory improved and increased sex drive. Effects experienced at higher levels of intoxication were: floating feeling, drowsy, time alteration, less sociable, talk more,

Table 1. *Ten most frequently reported effects elicited via open-ended questions*

Berke (1974)	%	Goode (1970)	%	Atha (1998)	%
Enhanced relaxation	25.7	More relaxed	46.1	Relaxation	25.9
Happiness	16.1	Senses more perceptive	36.1	Insight/personal growth	8.7
Appreciation of music	15.5	Think deeper	31.4	Pain relief	6.1
Visual illusions/hallucinations	13.4	Laugh much more	28.8	Anti depressant/happy	4.9
Laughter	12.5	Exaggeration of mood	25.1	Cognitive benefits	2.9
Enhanced insight into others	11.9	Time slowed down	23.0	Respiratory benefit	2.4
Hunger/appetite enhanced	11.9	Become more withdrawn	22.0	Creativity	2.3
Heightened sense perception	11.7	Feels nice, pleasant	20.9	Socializing	2.0
Elation	11.5	Mind wanders	20.9	Sensory perception	1.6
Colours brighter	11.1	Feel dizzy, giddy	20.4	Improved sleep	1.6
Total sample size	522		191		2794

Table 2. *Cannabis effects endorsed in studies using close-ended questions*

	Increased/present			Decreased/opposite present		
Effect	%	*n*	*k*	%	*n*	*k*
Time slows (vs. goes faster)	96.3	327	3	42.0	250	2
Appetite	90.9	372	4	–		
Relaxation	90.7	3197	7	–		
Concentration	85.9	177	2	55.5	2863	3
Thinking better (vs. confusion)	84.2	177	2	39.8	2955	5
Goes to sleep easily	83.3	150	1	39.1	345	3
Talkativeness	82.7	295	3	72.4	250	2
Laughter and giggling	82.0	372	4	–		
Dry mouth and throat	79.8	272	3	–		
Sexual pleasure	73.5	377	3	–		
Floating sensation	69.2	295	3	–		
Sociability	68.4	3010	4	62.6	227	2
Drowsy	62.9	2913	4	–		
Creativity	54.3	2760	3	–		
Memory	51.9	295	3	49.7	445	4
Paranoia	51.4	2708	3	–		
Sexual arousal	51.3	2808	4	26.4	250	2
Anxiety	40.4	2737	5	70.3	37	1
Depressed	27.4	3084	6			
Dizziness	24.6	2658	3			
Hallucinations/visions	19.8	3082	6	–		
Irritability	7.7	2855	4	–		

n: total sample size and *k* the number of studies pooled to obtain *n*.

memory worse, cannot think as clearly, paranoid, sexual pleasure increased, difficult to get to sleep, hallucinations and decreased sexual drive.

Stability of reported effects. Stability of subjective effects (range of 0.38 – 0.50) has been reported 2 years after baseline interview [16] and 5 – 6 years after a baseline interview [44]. In the latter study, positively evaluated effects generally decreased from being 'usually' to 'occasionally' experienced, although feeling high and relaxation remained 'usually' experienced. The pattern of changes in adverse effects was mixed, with some effects increasing (e.g. headaches, red eyes and coughing), and other effects decreasing (e.g. dry mouth, rapid heartbeat and lightheaded). The most frequently experienced adverse effects were increased hunger, increased thirst and dry mouth or throat.

Laboratory studies

Participants in laboratory studies who were asked to rate subjective effects on bipolar or visual analogue scales (VAS) have endorsed both sedative and stimulant effects from smoked cannabis [19,45 – 47] and oral THC [46,48]. Frequent cannabis users reported less sedation than infrequent (past) users [48] and tolerance to stimulant effects have been reported over a 16-day period [49]. Studies that have utilized scales from the Addiction Research Centre Inventory (ARCI) have reported statistically significant increased sedation and decreased stimulation [45,50], decreased stimulation only [51] and neither effect [52].

Research utilizing the ARCI scales have been mixed in relation to smoked cannabis producing euphoria. While a significant increase on the ARCI euphoria scale has been reported [51], other studies have not reported significant increases [45,50,53]. When the results from a laboratory study was compared with previous research, 'the relatively minor role played by euphoria and elation' was noted [53]. A more recent electroencephalographic (EEG) study [54] has reported that euphoria (defined as 'intense good feelings') occurred in multiple short episodes following the first 15 minutes after smoking cannabis, while a moderate dose of alcohol was reported to produce a longer period of euphoria [55].

Increased heart rate is consistently reported in laboratory studies and has been described as the most reliable physiological sign of acute cannabis intoxication [56]. Research into changes in mood and anxiety have been more variable. Some studies [50,51] have reported significant increases on the dysphoria/somatic

ARCI scale while another study did not [45]. While a linear relationship between euphoria events and intoxication has been reported [54], other studies have not found a statistically significant relationship between self-reported mood and intoxication [56–58]. Additionally, an absence of meaningful effects of either smoked cannabis or oral THC on Profile of Mood States (POMS) scales has been reported [51]. An earlier study reported increases on the POMS anxiety and confusion scales [50]. However, these increases were described as 'relatively small'. Small increases in anxiety ratings on VAS have also been reported following oral THC [48,59]. The effect of cannabis on anxiety has been reported as being subject to considerable individual variation [60], while negative mood ratings have been reported following cessation of smoked cannabis [47].

Contextual factors have also been reported as influencing cannabis effects. Study participants who smoked cannabis in a small group of four rated the effects differently to when they smoked alone [20]. Participants who smoked alone reported a 'relaxed, slightly drowsy, undramatic' state, whereas in the group situation, reported 'elation, euphoria, uncontrolled laughter, and a marked *lack* of sedation'.

Discussion

A finding common to the naturalistic and laboratory studies was the variation in effects that were experienced. Variation in effects have been reported in terms of opposite effects being experienced by different individuals [18] as well as variation within a single occasion [19,58] and between occasions of use [60]. This variation may be accounted for by certain effects not being experienced due to tolerance [48], effects occurring during different phases of intoxication [59] or effects being multi-dimensional [19]. This latter explanation has been proposed to account for the stimulation and sedation reported by cannabis users. Cannabis effects were hypothesized in terms of two dimensions: sedation–alertness and anxiety–calmness [19]. In relation to laboratory studies, alternative explanations for this variation may be due to differences in the validity of the scales used (single-item VAS versus multi-item ARCI scales) and findings occurring by chance in studies with small samples and multiple tests.

The mixed findings regarding euphoria in the laboratory studies were of interest, given that euphoria has been identified in several reviews [6,7,61] as a primary factor associated with cannabis use. Certain positive mood enhancement items were not included in Table 2 because of wording diversity. Avoiding depression, feeling good, happy, content, well-being and euphoric were not considered necessarily to be equivalent effects. The ambiguity concerning whether euphoria is an elevated mood or a feeling of well-being is highlighted in a study of words describing emotions. In this study 58 coders did not agree whether euphoria was an active or a passive experience [62]. The literature on what constitutes euphoria is sparse, and the few authors [63,64] who discuss euphoria in detail describe the ambiguity associated with use of the term.

Irrespective of method, relaxation was the effect most frequently reported by cannabis users in the naturalistic studies. Sensory alteration as well as changes in appetite, cognition and mood were also reported frequently although the rank order of effects was not necessarily similar between the open-ended and closed question studies, nor among the open-ended question studies. The variation among the open-ended studies was due most probably to differences in question wording and the coding system used. In relation to question wording, Atha *et al*. [34] asked about health benefits and problems, whereas the other two studies asked more generally about what happens when cannabis was used.

Support for the importance of relaxation is provided by a study that examined the expectancies of adolescent substance users [16]. Cannabis users expected more relaxation and tension reduction, less cognitive and behavioural impairment and fewer global negative effects from cannabis than did primary stimulant or alcohol users. They also expected more social and sexual facilitation from cannabis compared to stimulant users. Relaxation or feeling calm is also frequently reported by 'medical' users of cannabis [28,30], although pain reduction is also reported commonly among medicinal users [30]. Relaxation is also reported commonly as a reason for cannabis use among long-term cannabis users [23].

Numerous perceptual effects were also not included in Table 2 because of diverse item wording. Perceptual changes wording ranged from combined taste, smell or sound items to multiple specific effects for a single sense. Perceptual changes are of interest because although mentioned commonly in the open-ended question studies, they were reported significantly less frequently in a study that examined the stability of cannabis effects between baseline measurement and at a subsequent follow-up 5–6 years later [44]. The frequency with which these effects were reported may have been influenced by differential tolerance to the effects of cannabis [49,65], changes in expectancies or smoking environment [44]. The relationship between tolerance to negative effects and continued use has, however, received limited attention in the literature.

In the current review the similar percentages of cannabis users in Table 2 reporting increased and decreased talkativeness, sociability and memory effects

was unexpected. In part this may be accounted for by level of intoxication [38]. Available data [38,66] suggest that higher levels of intoxication result in less sociability but increased talkativeness, and conversely lower levels of intoxication result in increased sociability but less talkativeness. Alternatively, it has been suggested that although speech decreases, there is a perceived social closeness [67] or increased indirect social interaction [68]. The self-reported improvement in thinking and creativity is also of interest, given research linking cannabis to subtle cognitive impairments [7]. It is possible, however, that some of these very impairments are considered as positive by cannabis users (e.g. less focused attention and attending to stimuli normally considered irrelevant).

This review has several limitations. First, only a relatively small number of studies were identified that met the inclusion criteria. These studies were predominantly from the United States and United Kingdom, so the effects reported cannot be generalized to non-industrialized countries, where enhancement of work is frequently reported as an expected effect of cannabis use [22,26]. Further, the studies were usually 'snow-ball' samples, as is often the case in studies of illegal substances. In one case the sample was restricted to males [27]. Data were also generally not available on the relationship between self-reported effects and key variables such as age, experience with cannabis, level or frequency of consumption. This is an important issue, given the differential significance of frequency of use versus duration of use on cognitive functioning and psychopathology that has been described [7].

Further, the studies reviewed were published over a 30-year period, which also raises issues regarding the impact of popular culture and public health warnings on expected cannabis effects. It could be argued that the older studies were also undertaken at a time before the more potent forms of cannabis were readily available, and that the self-reported effects may now be different. While the available longitudinal data suggest only a modest 2–3% increase in THC content between the 1970s to the late 1990s [69], fluctuations in the availability of high-potency cannabis and changes in preferred smoking methods may well have altered effective THC consumption over the period. An additional issue with the available evidence is the difference in methodologies between these studies. This was addressed in the current paper by including only effects from closed-question studies if all three authors agreed that effects had similar wording. However, differences in samples, context and other methodology may well have altered responses in them. Because different effect items could potentially include different combinations of studies, there was a potential for the methodological differences to have a differential impact across effects listed in Table 2. There is a need for a more rigorous approach to collecting data on self-reported cannabis effects, especially in terms of examining factors that may affect expectancies, such as context, participants, the phrasing of questions and the quantity, duration and frequency of use.

In summary, the commonly reported subjective effects of cannabis show significant similarity and variation across individuals. Drug tolerance, setting and cognitive set are factors that may explain this variation. A more finely grained focus is required to examine individual experiences, particularly with regard to relaxation, given that it is the most frequently reported effect and reason for using cannabis. Similarly, although euphoria is often considered central to drug experience it is a poorly defined construct. Additionally, research needs to advance beyond simply describing the effects of cannabis to examining the differing individual salience of cannabis effects and how personal characteristics (e.g. psychological and biological), social factors and dose might be related to different profiles of effects.

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