

AN INVENTORY OF COGNITIVE ENHANCEMENT EFFECTS OF CANNABIS

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ABSTRACT

Social policy debate on cannabis has focused on its medicinal value and "recreational" use. Little attention has been given other reported commonly reported positive effects of cannabis, such as improved cognition or as a means of eliciting transcendent states of consciousness. This paper attempts to lay groundwork for future studies of positive cognitive effects of cannabis by constructing a comprehensive list of specific reported positive effects on thought processes, creativity and self-insight.

Relevant items from survey studies conducted from 1970 to 2019 on experiences, expectancies and motivations of cannabis users are presented and summarized. Additional items are also proposed based on published user reports and other anecdotal evidence. 134 positive effects of cannabis on cognition and creativity are identified from previous studies and 73 new possible effects are suggested.

Further research is needed to verify and better characterize these effects, understand their biological mechanisms, and determine correlates, such as dosage, cannabis strains, means of ingestion, etc. It is important in any case to recognize that use of cannabis for its potential positive effects on cognition, creativity and insight constitutes a category distinct from medicinal or recreational use. Common reports of improved mental clarity as a cannabis effect suggests cannabinoids might be used to produce new medications to treat symptoms of anxiety disorders, PTSD, and ADHD.

Greater awareness of the cognitive enhancement potential of cannabis may help to change user expectations and motivations and promote responsible use.

KEY TERMS: Cannabis; cognition; positive effects; mental lucidity; creativity; insight, psychometrics; survey research.

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1. INTRODUCTION

A fair and scientifically-informed social policy on cannabis must take into account not only risks but potential benefits of its use. Most agree that cannabis has potential for misuse. That cannabis has legitimate medical applications is also widely accepted. However there is also significant evidence of non-medicinal positive effects of cannabis.

Besides euphoria and relaxation, many positive cognitive effects have been reported, including improved thought processes, enhanced creativity and mental insight. While rigorous studies of these putative effects are lacking, it seems unlikely that the consistent subjective reports of so many users are baseless or can be dismissed as placebo effects.

One factor that has limited the availability of scientific evidence on positive cognitive effects of cannabis is legal in nature: for many decades, not only has cannabis use been illegal, but experimental research on its effects has been restricted. Moreover, since the mid-1970's, research on cannabis' cognitive effects has been mainly concerned with the express purpose of establishing its harms.

Another factor limiting research on positive cognitive effects of cannabis is lack of adequate instrumentation. By comparison, significant recent progress in understanding the potential of psilocybin and other psychedelic drugs to help elicit religious states of consciousness (e.g., Griffiths, 2006, 2011; James, 2020) has occurred. This research has been facilitated by the availability of psychometric instruments like the *Mystical Experiences Questionnaire* (Richards, 1977; Barrett, 2015; Maclean, 2012).

Development of a psychometric instrument to assess positive cognitive effects of cannabis may be similarly helpful. To produce such an instrument is a relatively straightforward process characterized by the following steps: (1) a set of candidate items is developed, say by means of literature review or focus groups; (2) pilot studies are used to reduce the items to a smaller, more manageable set; (3) selected items are presented to a large number of subjects in a standardized format; (4) factor analysis and other data reduction techniques are used to divide the items into meaningful, content-specific subscales, and (5) a final set of items is selected, and the reliability and of the resulting subscales are determined.

Our concern here is with the first step: generating a pool of candidate items. First, a short review of relevant literature is presented. Second, relevant items used in previous studies are listed. Next, new candidate items based on additional review of anecdotal evidence are proposed. Finally, discussion and conclusions are presented. This paper will be circulated to other researchers in the hope of identifying additional candidate effects.

2. METHODS

Study selection criteria

Study selection began with well known original reports and review articles (e.g., Green et al., 2003) on the subjective effects of cannabis. Research papers that cited or were cited by these sources were then examined. The process of checking cited and citing articles continued iteratively until it appeared that most relevant, high-quality sources were identified.

Independent of this, research papers involving the development and use of several standardized questionnaires on cannabis effects, expectancies and motivations for use were reviewed. These questionnaires included the *Marijuana Effects Questionnaire* (MQ), the *Marijuana Effect Expectancy Questionnaire* (MEEQ), the *Cannabis Expectancy Questionnaire* (CEQ), the *Marijuana Motives Questionnaire* (MMQ), and the *Comprehensive Marijuana Motives Questionnaire* (CMMQ). See Table 1.

Table 1. Cannabis Effects/Expectancies Questionnaires Included

Acronym	Instrument	References
MQ	<i>Marijuana Effects Questionnaire</i>	Tart (1971), Adamec (1976), Pihl (1979)
MEEQ	<i>Marijuana Effect Expectancy Questionnaire</i>	Schafer (1991), Galen (1999), Aarons (2001), Buckner (2013)
CEQ	<i>Cannabis Expectancy Questionnaire</i>	Young (1997), Connor (2011)
MMQ	<i>Marijuana Motives Questionnaire</i>	Simons (1998)
CMMQ	<i>Comprehensive Marijuana Motives Questionnaire</i>	Lee (2009), Lee (2007), Blevins (2016), Bonar (2017), Haug (2017), Bohnert (2018)

Studies with small sample sizes ($n < 100$) were generally given little consideration. Papers mainly concerned with identifying negative effects of cannabis use — i.e., with a clear bias towards categorizing it unconditionally as 'drug abuse' — were generally excluded; several questionnaires were excluded for the same reason (Table 2).

Table 2. Cannabis Effects/Expectancies Questionnaires Not Included

Acronym	Instrument	References
ACEQ	<i>Adolescent Cannabis Expectancies Questionnaire</i>	Willner (2001)
CEQ	<i>Cannabis Experiences Questionnaire</i>	Stirling (2008)
MCEQ	<i>Medical Cannabis Expectancy Questionnaire</i>	Morean (2019)
MMBMEQ	<i>Memory Model-Based Marijuana Expectancy Questionnaire</i>	Linkovich-Kyle (2001)
MEICA	<i>Marijuana Expectancy Inventory for Children and Adolescents</i>	Alfonso (2007)

Item inclusion criteria

The selected studies were examined for reports of cognitive enhancement effects of cannabis. For the present study enhanced cognitive activity was defined as improved: (1) thought processes, (2) visual/auditory perception, (3) insight and self-understanding, (4) creativity, (5) memory, (6) mind-body coordination or (7) communication.

Effects related to transcendent, 'peak,' spiritual or religious experiences were not considered. (These will be discussed in a separate paper.)

Studies reviewed are summarized in Table 3. Cognitive enhancement effects reported in these studies are shown in APPENDIX A1.

In addition to the list of effects identified by a review of previous studies, a list of additional cognitive enhancement items was constructed based on unpublished and anecdotal reports, such as those found on Lester Grinspoon's website, marijuana-uses.com. These are shown in APPENDIX A2.

3. REVIEW OF LITERATURE

Goode (1970)

Goode (1970) interviewed 204 marijuana users, most 18 to 29 years old. Interviews included the question, "In as much detail as you can, describe to me everything that happens to you when you get high — the high and everything else." Goode tabulated results based on 191 individuals who reported they had been high and offered to describe their experience. Roughly 50 distinct effects were reported by at least ten subjects; of these, 16 meet our selection criteria. These fall into categories of Thought (7 items), Perception (4 items), Creativity (3 items) and Communication (2 items).

Halikas (1971)

In a study of 100 regular marijuana users, Halikas et al. (1971) found that 30% reported usually experiencing better concentration and improved mental powers during cannabis intoxication (Earlywine, 2003; p. 110).

Table 3. Studies Included

Study	Followup/related studies	N	Instru- ment	Relevant Scale(s) / Factor	Positive cognitive effects
Goode (1970)		191			16
Halikas (1971)		100			2
Tart (1971)	Adamec (1976), Pihl (1979)	150	MQ	Creative Lucidity	39
Hochman (1972)	Brill (1974)	~1400			11
Berke (1974)		522			37
Schafer (1991)	Galen (1999), Aarons (2001), Schmits (2016)	704	MEEQ	Perceptual and Cognitive Enhancement	4
Atha (1997)		1333			5
Young (1997)	Connor (2011)	~1000	CEQ	Positive Expectancy	4
Simons (1998)		161		Expansion	5
Green (2003)		various			4
Hathaway (2003)		104			4
Lee (2009)	Lee (2007), Blevins (2016), Bohnert (2018)	346	CMMQ	Altered Perceptions	6
Kristjansson (2012)		425		Global Positive Changes, Cognitive/Motor Enhancement	5
Sexton (2019)	Cuttler (2016)	2905			8
<i>Total</i>					134

Tart (1971)

The most comprehensive inventory of marijuana effects was developed by the pioneer in the study of altered states of consciousness, Charles Tart (Tart, 1971). Drawing on many sources, he constructed a questionnaire that included 220 effects, positive and negative, of acute cannabis intoxication. This is known as the *Marijuana Effects Questionnaire* (MQ).

Of approximately 750 questionnaires mailed out, 150 were returned with sufficiently complete answers to permit statistical analyses. In the analyzed sample, most respondents were from California (67 percent). 86% were age 17 to 30 years, inclusive; 67% were students. Over half reported using marijuana at least once a week, and daily use was common. 95% reported having used marijuana for more than 6 months, and 74% for 2 years or more.

Tart grouped items of his questionnaire into the categories of: Vision sense (23 items), Hearing sense (7 items), Touch sense (16 items), Smell sense (4 items), Time and space (13 items), Extrasensory perception (5 items), Perception of the body (26 items), Movement (10 items), Relations with other people (17 items), Sexual activity (7 items), Thought processes (21 items),

Memory functioning (10 items), Emotions (10 items), Self-control (15 items), Identity (7 items), Spiritual experiences (4 items), Sleep (7 items), Special techniques (4 items) and Miscellaneous (14 items).

He performed factor analysis — a data reduction and exploratory technique — on the 150 questionnaires. However, due to limitations of computer hardware and software at the time, Tart included only every other item in the factor analysis. Varimax factor rotation was applied. A large first factor dominated the results, which Tart named "Being high." Items loading strongly on this factor included: Insights into others; Better long-term memory; Mind feels more efficient in problem solving; Work more accurately on problems; Skip intermediate steps in problem solving; and Ideas more original.

Adamec (1976) subsequently performed a factor analysis using 150 items from Tart's original inventory on a new sample of $N = 236$ cannabis users in Montreal, Canada. Ages ranged from 18 to 31 years (58% between 21 and 23). In the varimax-rotated factor solution, a dominant first factor again emerged, which was termed Creative Lucidity. Items loading strongly on this factor included: Ideas more original; Mind feels more efficient; Skip intermediate steps in problem solving; Spontaneous insights into self; Work with more efficiency, absorption, energy; Insight into psychological processes; and Deliberate insights into self.

Pihl (1979; Glantz, 1984, p. 115f) performed another factor analysis of the MEQ on a small sample ($N = 91$) of experienced marijuana smokers, again in Montreal. Ages ranged from 18 to 35 years old (56% between 18 and 21). Approximately 65 percent reported using cannabis at least twice a week. A factor analysis produced results similar to those of Tart (1971) and Adamec (1976).

Of the 220 items in Tart's original questionnaire, 39 meet our criteria of enhanced cognition or creativity.

Hochman (1972)

Hochman (1972) and Brill (1974) reported a study of marijuana use and attitudes in a sample of approximately 1,400 UCLA undergraduates. A detailed questionnaire included questions about marijuana effects and motivations for use. Reported cognitive enhancement effects (Hochman, Table 6) included Increased abstract thinking, Increased self-awareness, and Clarified thinking. Motivations (Hochman, Table 11) included For creative inspiration, To be able to concentrate, To gain understanding of a problem, and To help solve a specific problem.

Berke (1974)

Berke (1974) isn't as well known as other early studies but is very interesting nevertheless. The two authors were a psychiatrist and a professor of literature, both students of the British psychiatrist R. D. Laing. Their goal was to conduct a study that was both scientifically sound and phenomenologically meaningful. They also wished to go beyond the raw data to the level of interpretation: to understand the marijuana user's experience of intoxication from the broader standpoint of personality theory.

In their study, $N = 522$ cannabis users were asked: *What did you experience [using marijuana]? In your body? Your mind? Your self? Your relations with other people? The world about you?* The open-ended responses were subjected to a multi-step content analysis. First, responses were reviewed to identify 'atomistic' individual *effects*. 21,690 such effects (*effect units*) were found. These were typed on cards, which were sorted into piles with similar themes, producing 167 groupings, termed *effect categories*. Effect categories were then organized by the authors into a theory-based taxonomy with individual domains of: Mind, Body, Senses (including artistic creativity), Mood, Interpersonal, Self, Outer world, and Transcendental.

Unlike most other authors, Berke and Henton attempted to relate specific effects to different stages or levels of cannabis intoxication, which they assigned the colloquial terms of (in order of increasing intensity) 'buzz,' 'high,' and 'stoned.'

Our list includes 37 of their effect categories taken from the Mind, Sense and Self domains.

Schafer (1991)

Schafer and Brown (1991) developed the *Marijuana Effect Expectancy Questionnaire* (MEEQ). From interviews with community volunteers, a 70-item instrument (the current version has 48 items) was developed. Subsequent exploratory and confirmatory factor analyses of items were performed using a sample of $N = 704$ college students. Six marijuana expectancy factors, both positive and negative, were identified. One of the three positive effects factors was Perceptual and cognitive enhancement,

The factor structure of the MEEQ was confirmed in subsequent studies by Galen (1999), Aarons (2001) and Schmits (2016). Our list includes four items from the Perceptual and Cognitive Enhancement factor.

Atha (1997)

Atha (1997) distributed anonymous cannabis questionnaires to attendees of British pop music festivals. The questionnaires covered many topics, including demographic information, cannabis purchase and cultivation, and use of other drugs. An open-ended question asked respondents their reasons for using cannabis. $N = 1333$ cannabis users mailed in responses. Ages ranged from 15 to 68 (78% between 17 and 29), with a mean age of 25 years. The majority were daily cannabis users. Five reasons for use shown in their study report are included in the present list.

Young (1997)

Young (1997) developed the *Cannabis Expectancy Questionnaire* (CEQ), a 60-item questionnaire assessing positive and negative cannabis use outcome expectancies. An initial pool of 92 items were generated from interviews with 27 cannabis users. Subjects were asked: (a) How does cannabis affect you?, (b) How do you behave when smoking and (c) How does cannabis change your emotions? The final scale was constructed following further analyses based on responses of subjects in a separate sample.

Connor (2011) subjected the CEQ to exploratory and confirmatory factor analyses in two additional samples ($n = 501$ and $n = 505$, respectively) of young adult (mean age = 27 years old) cannabis users. Four items from the CEQ are included in our list.

Simons (1998)

Simons (1998) developed the *Marijuana Motives Questionnaire* (MMQ). This was based on the *Drinking Motives Measure* (Cooper, 1994), a 20-item questionnaire assessing four motive dimensions for drinking. Simon (1998) added 5 items specifically related to marijuana, which they collectively called the Expansion subscale; three items were adapted from Newcomb (1988).

The authors performed a factor analysis based on responses on the MMQ by 299 introductory psychology students; 161 participants reported previous use of marijuana, with an average of 2–3 times a month in the last 6 mos. All 5 items of the Expansion subscale are included in our list.

Green (2003)

Green (2003) reviewed self-reported effects of cannabis in 12 previous studies. Three of the studies used open-ended questions and nine used closed-ended questions. Those in the former group (Goode, 1970; Berke, 1974; Atha, 1998) and two in the latter (Halikas, 1971; Tart, 1971) are discussed above. The eight remaining studies supply four cognitive enhancement items.

Hathaway (2003)

Hathaway (2003) interviewed $N = 104$ cannabis users between 18 and 55 years of age (mean = 34 yrs.). Over three-quarters (77%) used cannabis at least weekly in the month prior to the interview. Subjects were first shown a list of 20 possible reasons for using cannabis and asked which were important to them. 60% reported as one of their reasons, To get inspiration.

They were also asked about 53 possible effects of cannabis. Over 50% reported having experienced Clear thinking (60%) and Thinking faster (52%). The author observed that the latter effect could be considered positive or negative, depending partly on the user's intentions.

Another commonly reported effect — here and in in other studies — Forgetting worries (65%), while not constituting enhanced cognition or creativity per se, may play a facilitating role.

Lee (2007, 2009)

Lee (2007) had $N = 634$ incoming college students (mean age 18 years) who used marijuana at least once complete a questionnaire. Participants were asked to “think about what motivates you to use marijuana and briefly list the top five reasons in rank order.” A total of 2258 open-ended reasons for using marijuana were reviewed by the researchers, who assigned them into 19 content domains. The six items from each domain considered the most representative were retained. This produced a pool of $6 \times 19 = 114$ items for further consideration.

Lee (2009) then gave these 114 items to a subset ($n = 346$) of the original sample, who were asked to rate their personal relevance. A factor analysis of responses yielded a 12-factor solution. The three highest loading items on each factor comprise the final, 36-item *Comprehensive Marijuana Motives Questionnaire* (CMMQ).

Followup studies confirmed the factor structure of the CMMQ in "heavy" cannabis-using high school students (Blevins, 2016) and in medical cannabis patients (Bohnert 2018).

Our list includes three items from the Altered Perceptions subscale of the CMMQ (Because you want to alter your perspective; To allow you to think differently; So you can look at the world differently) and three additional motivations from the original 114-item pool (To enhance experiences; Music sounds better; Every day activities more interesting).

An issue to note with the CMMQ is that items originated in open-ended responses of college-bound 18-year olds, who (arguably more so than in 2009 than 1969) may have lacked sufficient life experience or acquired social values that highly prize such things as philosophical self-insight and artistic creativity.

Kristjansson (2012)

In a longitudinal study, Kristjansson (2012) gave a questionnaire on marijuana expectancies to 225 high-risk and 205 matched control adolescents. High risk was defined as having a parent with a history of alcohol abuse disorder. The questionnaire was a simple adaptation of an abbreviated 34-item version of the *Alcohol Expectancies Questionnaire* (Christiansen, 1982), produced by replacing "drinking alcohol" with "smoking marijuana."

A factor-analysis of the responses produced four marijuana expectancy factors: Global Positive Changes, Relaxation–Tension Reduction, Cognitive/Motor Enhancement and Cognitive/Behavioral Impairment. Five items are included in our list.

Sexton (2019)

Sexton (2019; cf. Cuttler, 2016) studied demographic characteristics, use patterns, and self-reported effects in a self-selected convenience sample of $N = 2905$ adult recreational and medical cannabis users. Ages of participants ranged from 18–80 years, with a mean (SD) of 35 (13.7) years; over half reported daily use.

Respondents were given a list of 45 possible acute cannabis effects and asked to indicate which ones they experienced. 72.4% reported More creative as an effect, 50.1% reported More 'inward' focus, 44.0% reported Sense of clarity/perspective, 41.9% reported Musical and 40.1% reported Improved concentration. These and three other effects (Memory improvement, 13.6%; Altered sense of time, 37.6%; and More articulate/communicative, 41.3%) are included in our list. Altered time perception includes subjective time dilation; insofar as that may enable a person to perform more tasks in a given amount time, it could be considered cognitive enhancement.

Mayor's Committee (1944) & Weil (1968)

Although they supply no items for our present list, two other studies are noteworthy from a methodological standpoint.

A study commissioned the New York City's mayor's office (Mayor's Committee, 1944) was exemplary in its use of an extensive battery of psychological tests. Tests of intellectual function included the Bellevue Adult Intelligence Test, the Army Alpha test, the digit symbol, cancellation, form board, and Koh's block design tests, and memory tests. Projective and personality tests included the Rorschach inkblot test, Goodenough's Draw-a-Person test, and the Thematic Apperception Test. Unfortunately its conclusions were limited by irregularities in the dose and administration of cannabis and by use of a prison population.

Weil (1968) conducted a scientifically rigorous double blind, two arm (placebo vs. cannabis), two group (cannabis naive vs. experienced users) study, with strict control over cannabis administration. Unfortunately the sample size was very small ($n = 9$ in the naive group; $n = 8$ in the experienced users group). Importantly the study reported finding an interaction between the treatment group and performance on both a digit symbol test and pursuit rotor performance test. For both tests, experienced users were found to (1) have higher baseline scores than cannabis naive subjects; and (2) to improve after using cannabis in the experimental setting (whereas scores of cannabis naive subjects decreased). Although these effects were statistically significant, the authors correctly considered them as merely trends because of possible pre-existing differences between the two treatment groups.

4. DISCUSSION AND CONCLUSIONS

The present paper is intended as a first step only. Next steps may include distributing the preliminary item list to other researchers to solicit suggestions, and organizing a final pool of items into substantively related categories. A final list can be used to systematically collect self-report data, which may then be subjected to data reduction strategies like factor analysis. Nevertheless some preliminary and tentative conclusions may be offered here.

1. Evidence of positive effects

There does seem to be sufficient evidence to strongly suggest that — at least for some users and under some conditions — cannabis may produce enhancements of cognition, perception and creativity.

2. A distinct category of use

It also appears there is a category of cannabis use that is conceptually distinct from *medical* and what is commonly called *recreational* use. The adjective 'recreational' is sufficiently broad as to allow things like using cannabis merely to relax, to escape from reality, to have fun or even to 'veg out.' Such motivations and experiences would typically be considered ethically and morally neutral. However some of the effects we have noted here potentially serve to enhance a person's

ability to perform socially useful work and for intellectual, philosophical and aesthetic self-improvement. These are positive moral goods, and this distinction is potentially very important from a social policy standpoint.

It seems clear that cannabis misuse may be associated with certain harms. On that basis, society has a priori grounds for prohibiting cannabis use. That cannabis can be used for recreation may not suffice to outweigh the risks of misuse. An argument to legalize non-medical cannabis use would be qualitatively stronger if it can be established that it may have definite positive effects on cognition and creativity. Hence we may wish to recognize a third category of cannabis use, which might be called *enhancement* or *self-improvement*.

3. Direct (excitatory) and indirect (inhibitory) effects

We might make a useful distinction between direct and indirect enhancement effects. By direct effect we mean an excitatory effect on some brain mechanism that produces a particular form of enhanced cognition or perception. An indirect effect would be action of cannabis to reduce some brain activity (e.g., worry, anxious rumination, random mental chatter), enabling other cognitive processes (imagination, perception, insight) to occur with less interference.

4. Potential medications

If cannabis does improve mental clarity for some users under some conditions, it raises the possibility that cannabinoids might be made into standard medicines to treat thought disorder in psychiatric conditions such as OCD and other anxiety disorders, Bipolar disorder, ADHD and PTSD.

5. Correlated negative effects

Even if cannabis may produce bona fide cognitive enhancements, there may also be associated negative effects. For example suppressing worry for an hour may enhance one's creativity; but if the effect lingers it may cause one to not attend fully to important responsibilities. By objectively studying both positive and negative effects on cognition, we can possibly understand how to gain the former without the latter.

6. Strain-specificity

Today there are scores of commercially available cannabis strains, each with a unique cannabinoid profile. Many users report that *Cannabis sativa* strains have more of an uplifting effect, whereas *Cannabis indica* strains tend more towards producing states of relaxation or even somnolence. Some also claim that hybrid sativa/indica strains are especially effective in enhancing cognition, creativity and focused mental activity due to a combination of excitatory and inhibitory effects. One motivation for having a standard inventory or checklist of cognitive enhancement effects is to provide a basis for comparing different strains, with the possible ultimate aim of breeding strains to optimize positive effects with minimal side effects.

7. Expectations and cultural framing of cannabis use

If people are more aware of its potential to enhance cognition and creativity, they may be more motivated to use cannabis for these purposes, more responsible in its use, and less likely to use it in a frivolous or harmful way.

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APPENDIX A1. Items From Previous Studies

Note. Italicized words are scales, factors or thematic groupings of items defined by studies' authors.

Goode (1970)
<i>Thought:</i>
Think deeper, have more profound thoughts
Time seems slowed down, stretched out, think more time has passed
Concentrate better, become more involved in anything
Selective concentration: concentrate on one thing, shut out all else
Become pensive, introspective, meditative
Subconscious comes out; the real you emerges, one's truer self
Mind works more quickly, mind races
<i>Perception:</i>
Hear music better, musical ear sharper, more sensitive, accurate
Enjoy music more, greater pleasure from listening to music
Colors appear to be brighter, more vivid
My vision is clearer, sight improved, see more, see more detail
<i>Creativity:</i>
Mind wanders, free-associates, stream of consciousness
Aesthetic impulse greater, enjoy art works more
Enjoy dancing more
<i>Communication:</i>
Can communicate with others better
Able to understand others better, their meaning and being
Halikas (1971)
Better concentration
Improved mental powers
Tart (1971), Marijuana Effects Questionnaire (MQ)
<i>Vision sense:</i>
1. I can see new colors or more subtle shades of color than when I'm straight.
4. When I look at pictures they may acquire an element of visual depth, a third dimensional aspect that they don't have when straight.
8. If I try to visualize something, form a visual image, I see it in my mind's eye more intensely, more sharply than when straight.

10. Things seen are seen more sharply in that their edges, contours stand out more sharply against the background.
13. I can see patterns, forms, figures, meaningful designs in visual material that does not have any particular form when I'm straight, that is just a meaningless series of lines or shapes when I'm straight.
19. It is easier to read than usual while stoned.
20. If I read while stoned, I remember more of what I've read hours later than if I had been straight.
22. I have more imagery than usual while reading; images of the scenes I'm reading about just pop up vividly.
<i>Hearing sense:</i>
24. I can hear more subtle changes in sounds; e.g.. the notes of music are purer and more distinct, the rhythm stands out more.
25. I can understand the words of songs which are not clear when straight.
27. If I try to have an auditory image, hear something in my mind, remember a sound, it is more vivid than when straight.
29. When listening to stereo music or live music, the spatial separation between the various instruments sounds greater, as if they were physically further apart.
30. With my eyes closed and just listening to sounds, the space around me becomes an auditory space, a place where things are arranged according to their sound characteristics instead of visual geometrical characteristics.
<i>Time and Space:</i>
55. I get so lost in fantasy or similar trips in my head that I completely forget where I am, and it takes a while to reorient after I come back and open my eyes.
58. Time passes very slowly; things go on for the longest (e.g., one side of a record seems to play for hours).
<i>Extrasensory perception:</i>
65. I feel so aware of what people are thinking that it must be telepathy, mind reading, rather than just being more sensitive to the subtle cues in their behavior.
66. I can foretell the future by some kind of precognition, more than just predicting logically from present events.
<i>Perception of the body:</i>
93. I have lost all consciousness of my body and the external world, and just found myself floating in limitless space (not necessarily physical space).
<i>Relations with other people:</i>
111. I feel the things I say in conversation when stoned are more profound, more appropriate to the conversation, more interesting.
113. I have feelings of deep insights into other people, how they tick, what their games are, when stoned (regardless of whether they check out later).
114. I empathize tremendously with others; I feel what they feel; I have a tremendous intuitive

understanding of what they're feeling.
<i>Thought processes:</i>
129. I can get so wound up in thoughts or fantasies that I won't notice what's going on around me or won't hear someone talking to me unless they attract my attention forcibly.
133. In thinking about a problem of the sort that normally requires a series of steps to solve, I can get the answer without going through some of the usual intermediate steps; i.e., I start to think about the problem and then just arrive at what is clearly the answer, without being aware of the steps in the thought process I would normally be aware of.
137. I am more willing to accept contradictions between two ideas or two views of the situation than when straight. I don't get up tight because the two things don't make immediate sense.
138. I learn a great deal about psychological processes, what makes people tick, i.e., general knowledge about how the mind works (as opposed to specific insights about yourself).
139. <i>Spontaneously</i> , insights about myself, my personality, the games I play come to mind when stoned, and seem very meaningful.
140. If I <i>deliberately</i> work on it I can have important insights about myself, my personality, the games I play.
141. If I try to solve a problem, it feels as if my mind is working much more efficiently than usual (regardless of how you evaluate your solution later).
143. If I work on some problem while stoned, I work more accurately than straight, as judged by <i>later</i> real-world evaluation.
145. The ideas that come to my mind when stoned are much more original than usual.
148. When thinking about things while stoned, there are visual images that just automatically go along with the thinking; i.e., I think much more in images instead of just abstract thoughts.
149. I think about things in ways that seem intuitively correct, but which do not follow the rules of logic.
<i>Memory functioning:</i>
151. My memory for otherwise forgotten events is much better than straight when I consciously try to remember.
<i>Self-control:</i>
178. I have excellent control over my fantasies; I can make them go in whatever direction I want.
179. I can work at a necessary task with extra energy, absorption, and efficiency.
<i>Spiritual experiences</i>
193. I am able to meditate more effectively than when straight.
<i>Miscellaneous:</i>
217. I get much more involved in ordinary tasks than when I'm straight: they're completely absorbing.
218. With my eyes closed, my inner visions and fantasies become extremely real, as real as nighttime dreams.
220. I move up to higher levels of consciousness in jumps, sudden increases, rather than smoothly.

Hochman (1972)
Clarified thinking
To be able to concentrate
To gain understanding of a problem
To help solve a specific problem
Increased self-awareness
Slowing of time sense
To change your perspectives
Increased creativity
For creative inspiration
Increased ability to communicate
Increased understanding of others
Berke (1974)
<i>Mind:</i>
Opened, expanded, freed
More aware
More alert
More active
Thought promoted
Think more deeply
Think more clearly
Think on multiple levels
Think newly, originally, differently
Think logically, analytically, critically
Think philosophically
Easier access to the sub/unconscious
Increased imagination
Fantasy
Acceleration of thought
Generation of ideas and images
Ease of association
Heightened concentration
Absorption in internal mental processes
<i>Sense:</i>
Heightened vision
Heightened hearing
Brighter light
Brighter colour
Heightened appreciation and enjoyment of colour
Heightened awareness of sound

Heightened awareness of music
Heightened understanding of the structure of sound and music
Absorption in the music
Time slows down
Present time enhanced
Shapes, patterns, forms enhanced
Heightened creativity (in general)
Heightened artistic perception/appreciation (incl. performing arts, literature)
Active creativity: making music, painting and drawing, writing
<i>Self:</i>
Increased introspection
Heightened awareness of/insight into oneself
Decreased ego-games
Schafer (1991), Marijuana Effect Expectancy Questionnaire (MEEQ)
<i>Perceptual and Cognitive Enhancement:</i>
1. Marijuana makes small things seem intensely interesting.
9. I feel like I can focus on one thing better when I smoke marijuana.
16. I become more creative or imaginative on marijuana.
22. Music sounds different when I smoke marijuana.
Atha (1997)
Inspiration
Perception
Meditation
Look at reality
Know self
Young (1997), Cannabis Expectancy Questionnaire (CEQ)
1. I get better ideas when smoking cannabis .
14. I am more aware of what I say and do when I am smoking cannabis
34. Smoking cannabis helps me to feel “normal” again
37. Smoking cannabis helps me concentrate
Simons (1998), Marijuana Motives Questionnaire (MMQ)
<i>Expansion:</i>
21. To know myself better
22. To because it helps me be more creative and original
23. To understand things differently
24. To expand my awareness
25. To be more open to experiences

Green (2003)
Concentration
Thinking better (vs. confusion)
Creativity
Increased memory
Hathaway (2003)
Inspiration
Clear thinking
Forgetting worries
Thinking faster
Lee (2007), Comprehensive Marijuana Motives Questionnaire (CMMQ)
Because you want to alter your perspective
To allow you to think differently
So you can look at the world differently
To enhance experiences
Music sounds better
Every day activities more interesting
Kristjansson (2012)
<i>Global Positive Changes:</i>
6. makes me more creative and imaginative
<i>Cognitive–Motor Enhancement:</i>
13. makes me feel in control of the situation
22. makes me feel more alert
24. I can do things better after smoking marijuana
26. helps me understand things better
Sexton (2019)
<i>Cognitive:</i>
Sense of clarity/perspective
More articulate/communicative
Improved concentration
Memory improvement
<i>Psychological:</i>
Altered sense of time

<i>Artistic/social:</i>
More creative
More “inward” focus
Musical

APPENDIX A2. New Items

<i>Improved thinking:</i>
Absorption
Better decision making
Better discernment
Clear brain fog
Clearer judgment
Concentration
Conscious/unconscious integrated
Easily resist obsessions, compulsions
Elimination of distracting thoughts
Fewer intrusive thoughts
Gathering of scattered thoughts, self-recollection
Harmonizes brain hemispheres
Helps control thinking
Logical reasoning
Thinking less often goes off on tangents
<i>Specific cognitive skills:</i>
Ability to interpret facial expressions
Astronomy
Better reading comprehension
Chess skill
Consciousness expansion
Detached observation
Double-consciousness,
Enhanced capacity of mind
Fine motor skill
Foreign language skill
Foresight
Geometry
Hand-eye coordination
Heightened reality
Improved studying
Improved verbal fluency
Mathematical ability
Patience
Problem-solving
See things from more than one point of view
Spatial reasoning
Spontaneous scientific insight/discovery
<i>Introspection/Insight:</i>
Can ignore inner critic more

Contemplation
Experience transcendental ego
Insight into self-deceptions
Mindfulness
Moral elevation
Noesis
Opening third eye
Opening third eye
Reflection
Self-control
Wisdom
<i>Perception:</i>
Better depth perception
Improved night vision
Improved pattern recognition
Notice more visual details
Outside time and/or space
Perception of light and shadow
Peripheral vision
<i>Work:</i>
Absorption in physical work
Attention to detail
Easier to work on computer
Effortlessly neat and orderly
See new ways to make tasks easier
Work is fun
Work more efficiently, methodically
<i>Creativity:</i>
Ability to understand or write poetry
Dance skill
Drawing
Dreamy visions
Eloquence
Inspired writing
Literary composition
Painting
Penetrate conceptual boundaries
Promote fluidity of associations