

# A Comparative Review of the Neuro-Psychopharmacology of Hallucinogen-Induced Altered States of Consciousness: The Uniqueness of Some Hallucinogens

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## ABSTRACT

Altered states of consciousness induced by hallucinogens (H-ASC) is still a vaguely understood phenomenon. Taken the diverse psychological effects they exert, the main mechanism of action of hallucinogens; LSD, ibogaine, THC, PCP, MDMA, methamphetamine, mescaline, psilocybin and DMT, of which psychological effects are discussed in the article, are not properly understood and explained by the modern methods of neuroscience due to the lack of vigorous research. The involvement of some receptors, such as, 5-HT<sub>2</sub> (and probably other 5-HT receptors), glutamate and dopamine receptors, adrenergic and cannabinoid receptors, is one of the mechanisms, however it is not easy to explain such incongruent psychological effects by only receptor and neurotransmitter systems alone, since H-ASCs have, sometimes, their own unity and gestalt, unfolding the subconscious, in the “voyages” they induce, although the perception may, or may not, be distorted depending on the person, and “set and setting”. They induce visual, tactile and auditory hallucinations; synesthesia; perception of fractals, geometrical and kaleidoscopic images with vivid colors; perception of two dimensional pictures as three dimensional, animated and moving; distortions and alterations in the body perception; alterations in the perceptions of temporal-spatial continuum and time; changes in the perception of the ego and the self; feelings of unification with nature and universe, peak experiences – *mimicking satori or nirvana*-, ecstasy, rapture, extreme euphoria, excitement and happiness, oceanic bliss, self-fulfillment, referred as “good trip”, as well as, dysphoria, anxiety, mania, delirium, psychosis, acute schizophrenia, collapse of the self, known as “bad trip”; depending upon the mood, affection and psychology of the person, and “set and setting”. Mysticomimetic effects of H-ASCs, imitate the consciousness states of ancient mystics, probably, by means of activating prefrontal cortex, limbic system and the right temporal lobe. A hypothetical “holographic brain theory” may give some extra insights about the explanation of some of the effects of H-ASCs. It should be taken into account that H-ASCs, can be accepted as a good tool to investigate the nature of consciousness, brain and the human psyche, as well as some of the H-ASCs are good models of psychosis, too. More detailed scientific research should be performed to understand the basic and *real* mechanisms of H-ASCs, to comprehend and unravel the mystery of human mind and consciousness, since scientific medical research on hallucinogens has been legalized since 1992.

**Key Words:** Altered states of consciousness, Hallucinogen, LSD, ibogaine, PCP, THC, MDMA, Methamphetamine, Mescaline, Psilocybin, DMT

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## Introduction

Hallucinogen induced trance states and altered states of consciousness (H-ASC) have been practiced in different cultures and shamanist groups all over the world for

centuries (Krippner, 2011; Metzner, 1998; Stafford, 1978). Most of the hallucinogenic drugs have been characterized as mimicking psychosis and they have been coined as ‘psychotomimetics’, however there is an increasing number of researchers who are using the term ‘psychedelics’, meaning ‘mind manifesting and/or mind expanding’ (Mithoefer, 2011; Gray, 2010; Hintzen, 2010; Passie, 2008; Metzner, 1971; 1989; 1999; 2002; Grof, 2001; Shulgin, 1991; 1997; Tart, 1990; Stafford, 1978). While the debate about

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the terminology still continues in many scientific circles, it is not quite established whether these natural or synthetic chemicals are really '*manifesting and expanding mind and human psyche*' or not. However, it is obvious that hallucinogens affect conscious states (Hintzen, 2010; Austin, 1999; Siegel, 1992; Shulgin, 1991-1997; Tart, 1990; Stevens, 1988; Lee, 1985; Stafford, 1978); EEG (Brimblecombe, 1973; Fried, 1977; Shagas, 1966; Brazier, 1964), human psychology and behavior (Hintzen, 2010; Passie, 2008; Fantegrossi, 2008; Popik, 1998; Henderson and Glass, 1994; Pletscher, 1993; Tart, 1990; Stafford, 1978), while there has been some attempts to use these psychedelic drugs in psychotherapy (Grof, 2001; Tart, 1990) and in the treatment of heroin addiction (Popik, 1995; 1998).

'*Altered states of consciousness*' is a widely used term to define a deviation from the normal and regular mind state into a *hyper* or *hypo* excitation state. It has been proposed that altered states of consciousness can be attained through various methods, such as Zen meditation (Austin, 1999), expanded sexual response (ESR) (Sayin, 2011; Taylor, 2000; 2002), hypnosis (Ross, 2006; Tart, 1990; Ludwig, 1965 ), metabolic changes (Hobson, 1994; Tart, 1990; ), sensory deprivation (Lilly, 1972; Tart, 1990), hallucinogenic drugs (Brunton, 2010; Hardman, 2001; Shulgin, 1991; 1997; Tart, 1990; Grof, 1985; 2001; Goodman, 1980; Stafford, 1978; Brimblecombe, 1973), central nervous system (CNS) stimulants (Rothman, 2001; Hobson, 1994; Tart, 1990; Nielsen, 1988 ), physiological sleep (Hobson, 1988; Tart, 1990), anesthetic drugs (PCP, Ketamine) (Tart, 1990; Stafford, 1978), etc. Although involvement of many receptor and neurotransmitter systems have been proposed in the mechanism of action of H-ASC inducing drugs, there has been no consensus on the basic mechanisms of some particular effects of some hallucinogenic drugs, such as LSD, ibogaine, THC (tetrahydrocannabinol), PCP (phencyclidine), MDMA, methamphetamine, mescaline, psilocybin, DMT and many others. This article briefly reviews the main psychological effects of H-ASCs and the possible known mechanisms of these mind states, and discusses the uniqueness of some of the hallucinogens. The main hypothesis of this article is that H-ASCs are very drug specific, although they may act on similar

receptor and neurotransmitter systems, and cannot be investigated in a single, general ASC model which can be put into certain standard scales; namely, each hallucinogen's effect on human psychology is *unique* and very specific to that particular individual, an epiphenomenon that seems to violate the deterministic principals of neurochemistry, because of the unpredictable psychological effects of H-ASCs. No psychological outcome of H-ASCs, which exert their effects in a chaotic platform, can be predicted beforehand, and can be investigated in the format of pure deterministic principals.

The *psychedelic* or *psychotomimetic* effects of many hallucinogens change from person to person (Henderson, 1994; Pletscher, 1993; Stevens 1988; Lee and Shlain, 1985; Shulgin, 1991; 1997). Even in the same person, at the same doses, a train of psychological events may be very distinct from each other at every different, successive ingestion (so called-*trips*!) (Hintzen, 2010; Shulgin, 1997; Henderson, 1994; Stevens 1988; Lee and Shlain, 1985). To visualize and compare H-ASCs, the psychological effects of LSD, ibogaine, THC, PCP, MDMA, methamphetamine, mescaline, psilocybin and DMT will be discussed.

One day, H-ASCs may become a powerful tool to investigate the nature of human consciousness in terms of '*quantum mechanics*' of neuropharmacology, if these drugs have *extra* neuro-quantal properties to alter consciousness.

### **Main psychological effects of some hallucinogen induced ASCs**

It should be noted that along with the references cited in each of the following section, author's personal communications with the people who used those hallucinogens during his scientific research and surveys on psychoactive drugs during the last 20 years are also included. The following distinct effects of different hallucinogens are cited as a summary below to compare and elucidate that no hallucinogen has exactly the same effects; every hallucinogen has its own, unique, special consequences of consciousness states. The term *hallucination* is a general term to express the unreal perceptions; however the essence, the unity, the details, the main structure of all of these disorganized hallucinations induced by each hallucinogen



is only drug specific and unique. Even a particular drug induces different kind hallucinations and H-ASCs in different people; moreover, in the same person, the same dose of a particular hallucinogen may exert different effects depending upon the date of use, psychology of the person, *set and setting*, the environment, and many other parameters. So, the main rule of H-ASCs is the “*uncertainty and unpredictability principal*”, by which it is very difficult to perform controlled, statistically significant, and deterministic behavioral experiments.

### Hallucinogenic effects of LSD (Lysergic Acid di-ethyl amide)

(Passie, 2008, 2010; Gray, 2010; Hardman, 2001; Goodman, 1980; Grof, 1985, 2001; Henderson, 1994; Pletscher, 1993; Siegel, 1992; Lee, 1985; Stafford, 1978; Lilly, 1971; Ling, 1966; and personal communications )

**Visual phenomena:** After one hour of the ingestion of 80-150 µg of LSD, the colors may become very vivid and unknown colors may be perceived. This much dose of LSD takes the human brain and mind into an inexplicable “*journey*”, which lasts for 7-8 hours; this duration can be prolonged by adding new doses and/or methamphetamine, which potentiates LSD effects, to the drug regimen; however, tolerance develops very fast. Bright forms of green, red, violet are distinguished. Colors are heard as sound; while sound is identified as colors, as well, known as the phenomenon “*synesthesia*”. The colors dance in the space with the melody of the music. The notes of the music are perceived as colors, while the reverse is possible. The colors and animated images may have profound psychological and philosophical meanings according to the set, setting and the mood of the individual. The brightness of light increases, at night it may be perceived that dawn has come, and sun light is perceived to come from the fringes of the curtain at the window. From human bodies different colors may radiate; these colors mostly change from bright red, violet, a special ‘*psychedelic green*’, to previously unknown forms (wavelengths) of red, violet, orange, blue, yellow which are generally believed to be perceived for the first time in one’s life. When looked at a picture, the two dimensional picture becomes three dimensional, and there is always a movement

and animation in the pictures (depicted in the below animated gif picture, see the animation of the gif picture). When eyes are closed different geometric images, geometrical self-repeating figures of colored fractals, and sometimes, even cartoon characters start to act, dance, move and talk. Their talk is sometimes believed to give some insights of philosophical ideas, as an epiphenomenon of unfolding and revealing of the subconscious. *Kaleidoscopic* images are very commonly perceived during LSD use.

**Acoustic phenomena:** Sounds may seem to be more profound and amplified. Music may become unbelievably deep and philosophical. Music generally becomes into the forms of light and a touchable object. Very light sounds can be heard as amplified. One can hear very light sounds, which he was not used to perceive before, coming from outside, street or at the same apartment house. Acoustic thresholds are lowered.

**Tactile phenomena:** Touching and the feeling of touch may become as an amplified sensation; the tactile sensations may become extremely vivid. The tactile perception may be altered overwhelmingly. Sexual pleasure of fondling and perception of the sexual stimuli are generally enhanced.

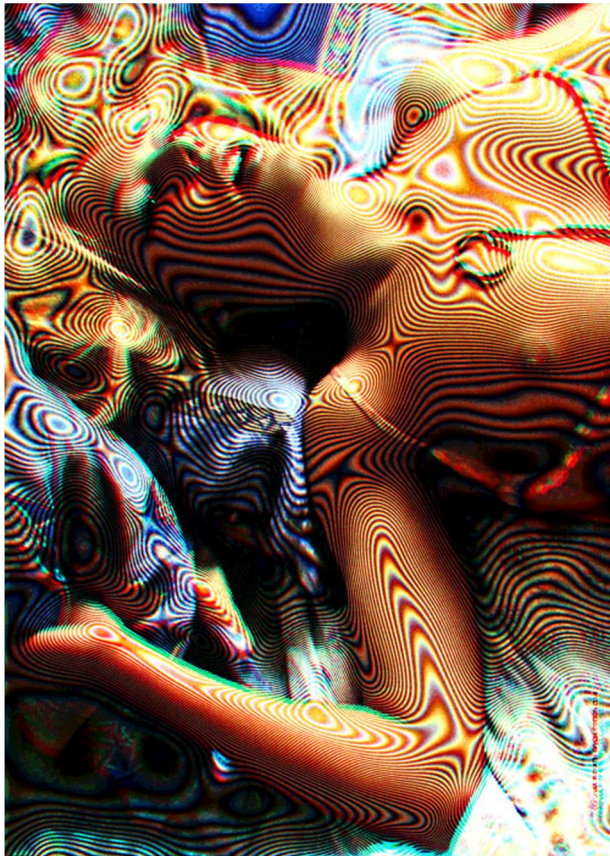
**Changes in body perception:** Body perceptions may generally become distorted (see pictures 2 and 3). Body parts may become distorted and enlarged just as in macropsia and micropsia, which can be seen during the auras of epilepsy. Sometimes there is no distortion or change in the perception of the body of the self or others and the whole “*LSD trip*” may be perceived as philosophical guidance without any distortional perception of the body or the environment. The person, if experienced in LSD use, is generally aware that those distortions are a reflection of how his sub consciousness demands to see the environment.

The meaning of the images may change, becoming more mystical and being converted into more elongated, enlarged forms, according to what the person thinks and imagines at that very moment. One can talk into the pictures or images mimicking a certain form of psychosis, however generally he/she is aware that they are not real and the whole scene and perception is an effect of LSD, which makes LSD perception distinct





from psychosis, while most of the subjects state that they can differentiate whether they are in a kind of delirium state or not. The body may become enlarged as well, and one feels that he is a part of the universe or a form of a state of consciousness, which a number of people have defined as '*cosmic consciousness*', an unrealistic and uncertain form of the perception of the self's identification with the environment and the universe.

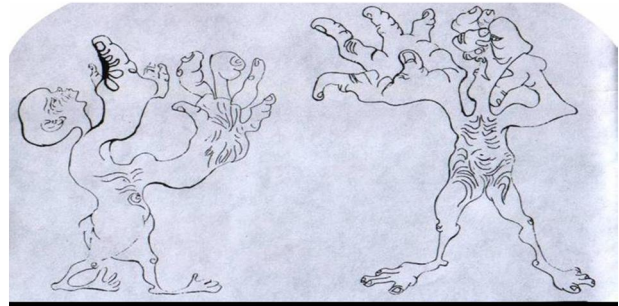


**Picture 1.** The animated surface image under the effect of LSD. Different colors (previously unknown wavelengths of red, violet, green) radiate from the body and there is a continuous movement of the surface, as if the two dimensional surface becomes three dimensional. The brain creates new, previously unknown geometric images, fractals and novel formations of the surface which vibrate continuously. There should be a link to see the animation of this picture as a separately embedded gif image in the journal plus the link should be give on the picture as well.

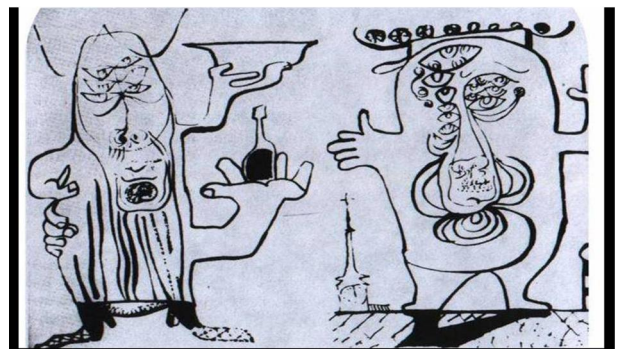
**Sexual pleasure:** Sexual pleasure, arousal and orgasm are generally enhanced. For both male and female, orgasms may be perceived as lasting a couple of minutes to hours. Orgasms may be perceived longer than the usual; some female orgasms during LSD-ASCs are coined as "*cosmic orgasm*" in the psychedelic literature, a term which also appears in the



Tantric literature. Most of the sexual arousal stimuli, such as fondling, touching, kissing, intercourse have a totally different format and effect that the person realizes that he/she has never experienced in his/her life before. For this reason, not only LSD, but also psilocybin, THC, ibogaine, and methamphetamine are powerful aphrodisiacs, some of which are used in tribal sex rituals for centuries, as well. LSD has been used to treat sexual dysfunctions and anorgasmia (Ling, 1966).



**Picture 2.** In Prag, in an experiment done by Dr. J. Roubicek the artist draws the distorted Body images under the effect of LSD. See how the body image is distorted; this effect may not be the same at every LSD session. From: Stanislav Grof, Beyond the Brain, Albany, N.Y.: State University of New York Press, pp: 94, 1985.



**Picture 3.** In an experiment lead by Dr. J. Roubicek in Prag, the artist depicted a nurse at the picture on the left; at the right is a policeman he saw on his way to home from the hospital. From, Stanislav Grof, Beyond the Brain, Albany, N.Y.: State University of New York Press, pp: 95, 1985.

**Synesthesias:** The perceptions of color, sound, taste and touching may turn into each other. The subject may hear colors, see sound, touch the colors, taste the colors or sound, and touch some certain kind's visual or acoustic perceptions. All five senses' stimuli can turn into each other; some of this synesthesia can be developed at will during the "*LSD trip*".

**Hyper suggestibility:** Subjects may become very suggestible to different stimuli and some orders can be followed without any questioning under the effect of LSD. This hyper suggestibility may be observed in some subjects, while not in the others depending upon the set and setting, unpredictability of the “*LSD journey*”.

**Judgment of time, weight, size and spatial relationships:** Judgment of time is generally impaired. The person may not perceive how many minutes or hours have passed since the beginning of the *trip*. Most of the time other comparisons of weight, size and spatial, three dimensional relationships are impaired, too; it is generally difficult to make guesses of weight and size of the objects.

**Changes in spatial and temporal perception:** Flow of time changes generally and the expansion or contraction of time is perceived; five minutes may be perceived as one hour, or the whole ‘*trip*’ may be perceived to be in the span of only a couple of minutes (normally, 80-150 µg of LSD induces an eight hour *trip*). The space may expand and unify with the universe. The same person, at the same dose, may perceive the trip as lasting for a couple of minutes in one trial, and for hours or days, in another, as an evidence of unpredictability of the LSD induced ASCs.

**Thought disorders:** Reasoning may become impaired, but sometimes there is no impairment according to the course, set and setting of the “*LSD trip*”. In some sessions, there may be paranoid thoughts, while in some others, no paranoia occurs. Logical thinking, reasoning may or may not be impaired. Some LSD users stated that they can even solve problems much faster and in a more philosophical and profound way. The associations are generally increased just like in the methamphetamine use.

**Memory:** Childhood experiences, traumas which were forgotten for years, may be remembered all of a sudden. Short term memory may or may not be impaired. Usually, the person remembers many details of what he/she experienced during the *trip*. For this reason LSD has been used for the purposes of psychotherapy (Grof, 2001). Many forms of *hypermnasias* may occur.

**Changes of affectivity:** Affection may change intensely. The affection is one of most influenced psychological change. It is reported

that empathy between people, just like in MDMA, is enhanced. LSD users proclaim that they built deeper relations and understanding with their spouses or friends during a mutual “*LSD trip*”.

**Alterations in ego:** The perception of the ego alters profoundly. The subject may have a feeling of losing the ego, and he/she may have a feeling of unification, which is generally described as feeling the universe within or perceiving the universe within the borders of the self and space-time of the present, a similar consciousness state of ancient mystics, such as Sufis, Zen Buddhists, and shamans.

**Mysticomimetic effects:** In most of the sessions, the meaning of life is questioned depending upon the depth of perceptions, *set* and *setting*. The perception of the events, meaning of life, some philosophical issues are contemplated in a mystical perception of the universe. The subjects may have very subjective and overwhelming mystical experiences of diverse types.

**Perception of dimensions:** Generally the dimensions are distorted, however, some LSD users state that they can perceive other dimensions as well, while the perception of the three dimensional continuum alters profoundly. Some “*LSD trippers*” stated that it was possible to see the real *four dimensional* structure of the space and universe, others mention about higher dimensions, which is difficult to interpret.

**Unfolding of the subconscious and collective subconscious:** In most of the “*philosophical trips*” many elements of the subconscious becomes unconcealed and explicit onto the surface of consciousness and awareness. Many archetypal images, symbols and figures can be seen during course of the *trip*, unfolding the collective subconscious. Many ancient religious symbols, such as mandalas, crosses, churches, demons, angels, stars of David, ying-yang, chakras, etc., and scenery can be perceived (Table-3).

**Controversial effects:** LSD may induce extreme euphoria and happiness, as well as, dysphoria. It may have anxiolytic effects, while it may induce different levels of anxiety. It may induce feelings of laughter, and the user may laugh for hours, with or without any obvious reasons; or he/she may also cry for hours without any obvious reasons. It may induce extreme happiness or grief at the same





time. Many different controversial feelings may precede each other gradually; or only one of them is predominant.

**Flash backs:** Like some of the other hallucinogens, LSD induced mood states may come back without the ingestions of LSD, long after LSD use. This is also related with some predominant stimuli during the *trip*, such as a particular music, certain sounds, visual stimuli, taste or smell, which may trigger a similar state of mind, when exposed to again. A similar and short form of that particular “*LSD mood*” may be perceived long after the *trip*, without the use of LSD. Some people may have such flash backs, after LSD use, some people never experience it!

**Other symptoms:** Dryness of mouth, midriasis, metallic taste, diarrhea, nystagmus, dizziness, symptoms of paralysis, feelings of anxiety, desire not to move much, lethargy, head ache, and other autonomic symptoms. It should not be forgotten that LSD is a very dangerous drug, *which may easily induce mental disorders*, acute psychosis and schizophrenia, and it should never be used for recreational purposes, just like other hallucinogens mentioned in this article.

**Tolerance:** Tolerance easily develops to the effects of LSD after a couple of ingestions; also there is cross tolerance between LSD and mescaline, para-bromo-methamphetamine, tryptamine (Tables 1A, 1B-1C).

### **Hallucinogenic effects of Ibogaine**

(Maciulaitis, 2008; Glick, 1998; Popik, 1995, 1998; Stafford, 1978; and personal communications).

Ibogaine is a very powerful hallucinogen, inducing a long term ASC, lasting for from 24 hours to 48 hours. It has also been tried for the treatment and auto-psychoanalysis of heroin addicts with success. This treatment method was also studied and reported by NIDA and Howard Lotsof, who used to hold the USA patents of ibogaine for the treatments of heroin, alcohol, nicotine, amphetamine and cocaine addictions. Its effects start with LSD-like hallucinations, however not very many *psychotomimetic* actions are observed. It induces a couple of distinct ASC states, transiently. “*Oneirophrenic state*”, a term coined by Naranjo (Stafford, 1978), is a conscious dreamy state, where the individual is very open to psychotherapy and remembers all

his/her conscious dreams (REM-state). Ibogaine induces fantasies and images like a “*slide show*” or “*a movie run at high speed*”. Visual hallucinations happen in the dark, consisting of blue disks dancing up and down the wall. Symptoms like drowsiness, disturbance by the sound, insomnia, dysesthesia, feeling of light-weightedness, hyperacusis may occur along with the continuous hallucinations of different forms and format. Autonomic signs such as dryness of mouth, increased perspiration, midriasis, increased pulse rate, as well as extrapyramidal symptoms (ataxia, tremor, enhanced reflexes, and clonus) may occur. Hypermnasias of different kind usually happen. One of the interesting effects of ibogaine is that auto-psychoanalysis ability increases; and the person may find the thought pathways in his/her brain, and feels an ingenious ability to analyze the events, behaviors, the self, and the people related with his life; and organize his/her thoughts into imaginary folders in his brain. Heroin addicts who were treated with ibogaine, which also stops the withdrawal syndrome, successfully, stated that they were able find the personal reasons, memories or psychological clues of why they used drugs, and analyzed themselves during the “*ibogaine trip*”, and were then able to establish a new identity and personal attitude. Similar auto-psychoanalysis phenomenon, can also be observed, -to some degree-, under the effects LSD, MDMA, psilocybin and DMT (ayahuasca). Ibogaine was also reported to be a very powerful aphrodisiac, while males and females in Gabon, may engage in a ritualistic sexual activity that may last from 6 to 17 hours under the effect of Ibogaine in their subcultures or in the practices of Bwiti cult (Popik, 1995; 1998). Ibogaine has been used in shamanic initiation rituals of the shaman candidates to transcend temporal-spatial dimensions and “*to contact the souls of the ancestors*”, for philosophical and personal development purposes in the subcultures in Gabon for centuries. Most of its hallucinogenic effects have similarities to psilocybin, LSD, and mescaline; however, it induces a whole different H-ASC compared to all, such that *no* other drug has the properties and effects of ibogaine (see Tables 1A, 1B and 1C).



### **Hallucinogenic effects of THC (delta-9-tetrahydro-cannabinol)**

(Pamplona, 2012; Scooter, 2010; Siegel, 1992; Goodman, 1980; Stafford, 1978; Solomon, 1972; and personal communications).

Marijuana is the buds and leaves of the *Cannabis sativa* plant. This plant contains more than 400 chemicals, including delta-9-tetrahydrocannabinol (THC), the plant's main psychoactive chemical. After the ingestion of THC, the acute effects include lowered skin temperature; increased heart rate and blood pressure; analgesia; sedation; drowsiness; slowed speech; slow reaction time and poor coordination; concentration and memory problems; enhanced tendency to remembering events happened in the past; feelings of extreme pleasure; giggling and laughter; hearing, seeing and feeling things, differently (music may seem more distinct and/or subtle, colors may seem to be brighter, emotions can be experienced more intense); a strong desire for food; a feeling that time is passing slowly; a feeling of being separated from reality, and sometimes delusional seeing or hearing things that aren't really there; panic feelings, anxiety, attacks or paranoia (feeling of being scared or suspicious for no reason); depersonalization; dizziness or fainting with large, repetitive doses. At higher doses, visual, vivid hallucinations of colors, images dancing in the air may be commonly perceived. Long term effects include short-term memory impairment; difficulty in learning and problem solving; breathing problems; reproductive system problems, such as low sperm counts, impotence in men, irregular menstrual cycles in women; fearfulness and anxiety which are common after high doses; decreased motivation; low energy and loss of interest in life. The main reason people use cannabis is to get 'high' that is, to experience euphoria, relaxation, and perceptual alterations, and the intensification of ordinary sensory experiences, such as eating, watching films, and listening to music. The 'high states' may be accompanied by excessive laughter and talkativeness. Cognitive effects include impaired short-term memory and a loosening of associations. Motor skills and reaction time are also impaired. Since THC lowers the psychological inhibitions, just like alcohol, it may be perceived that the sexual impulse and libido is increased. The perception of senses (touch, smell, hearing, taste etc.) is sharpened, and

hence the sexual stimulants that lead to sexual arousal can be perceived to be enhanced. It is also used for those aphrodisiac-like effects.

Body perception may become distorted after smoking certain doses of marijuana. Spatial-temporal perception may alter in a dose dependant manner, as the time is perceived to pass slower, or sometimes longer. The tactile perception may become more intense. The sound perception is profoundly affected. There may be visual hallucinations, about which the subject is aware that these are the acute effects of THC, not the reality. Hallucinations of bright, colorful light flashes may be seen (Tables 1A, 1B and 1C).

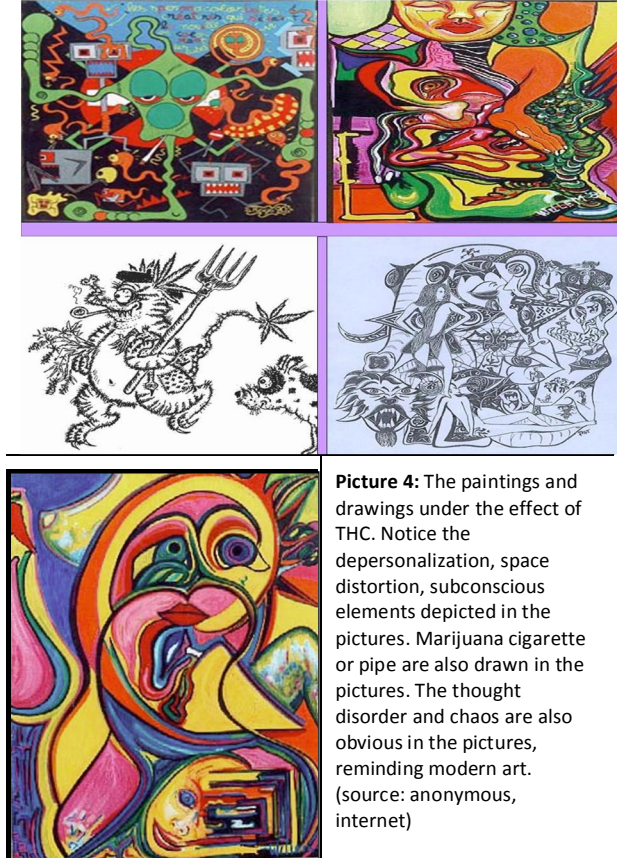
### **Hallucinogenic effects of PCP (phencyclidine)**

(Malizia, 1984; Rawson, 1981; McCarron, 1981; Goodman, 1980; Stafford, 1978; and personal communications).

PCP (phencyclidine), an NMDA receptor antagonist and a dissociative anesthetic, has *psychological* effects of euphoria, calmness, feelings of strength and invulnerability, lethargy, disorientation, loss of coordination, distinct changes in body awareness, distorted sensory perceptions, impaired concentration, disordered thinking, illusions and hallucinations, agitation, combativeness or violence, memory loss, bizarre behavior, sedation and stupor, which are dose dependent. PCP has distinct hallucinogenic effects such as macropsia, micropsia, total alteration of body image, numbness, depersonalization, feelings of "sheer nothingness" and "endless isolation". The most commonly seen effects include a feeling of inebriation and disorientation. Sometimes there is amnesia for the entire experience, although this is generally only at higher doses. Visual, auditory, and tactile illusions and delusions (such as being God, the devil, or an animal) are common; however actual hallucinations are relatively uncommon when compared with those produced by LSD. PCP's *physiological* effects include rise in blood pressure and heart rate, flushing, profuse sweating, ataxia, muscular incoordination generalized numbness of extremities, blurred vision, grimacing facial expression, speech difficulties, marked analgesia, nystagmus, and anesthesia; in the anesthetized state, the patient remains conscious with a gaze and rigid muscles. PCP has been proposed as a



“perfect tool for experimental psychosis” in animal models and human beings; it triggers and aggravates psychosis in the psychotic and schizophrenic patients, similar to methamphetamine and LSD that may last for a couple of weeks (Tables 1A, 1B and 1C).



**Picture 4:** The paintings and drawings under the effect of THC. Notice the depersonalization, space distortion, subconscious elements depicted in the pictures. Marijuana cigarette or pipe are also drawn in the pictures. The thought disorder and chaos are also obvious in the pictures, reminding modern art. (source: anonymous, internet)

### Hallucinogenic effects of MDMA (Ecstasy, N-methy-3,4-methyleine-dioxy-methamphetamine)

(Mithoefer, 2011; Brunton, 2010; Vollenweider, 2001; Holland, 2001; Eisner, 1994; Shulgin, 1991, 1997; Stafford, 1978; and personal communications)

A subjective form of euphoria and feeling of happiness may be maintained as long as 4 hours after the ingestion of 125-250 mg MDMA. There may be some minor hallucinations; some psychedelic visual effects may become predominant after a while. Enhanced empathy is reported to occur; a subjective feeling may be perceived between the self and the environment and the people around. Consciousness seems to be elevated, while there are hallucinations of different colors. At higher doses of 250-500 mg, visual, colorful, hallucinations of images, fractals,

dancing colored geometric shapes may precede; sound and music becomes more intense and meaningful. MDMA is not a very powerful hallucinogen compared to LSD, psilocybin, mescaline or PCP. An interesting study of Vollenweider points out the acute hallucinogenic effects of MDMA compared to psilocybin, as positive experienced derealization, changed sense of time, positive experienced depersonalization, positive basic mood, mania, thought disorder, paranoia, loss of thought control, loss of body control, synesthesias, changed meaning of perceptions, facilitated recollection, facilitated imagination (Vollenweider, 2001). The results of this study are depicted below (Figure 2, Tables 1A, 1B and 1C).

### Hallucinogenic effects of Methamphetamine

(Hardman, 2001; Shulgin, 1991, 1997; Goodman, 1980; Stafford, 1978; Lilly, 1971; and personal communications)

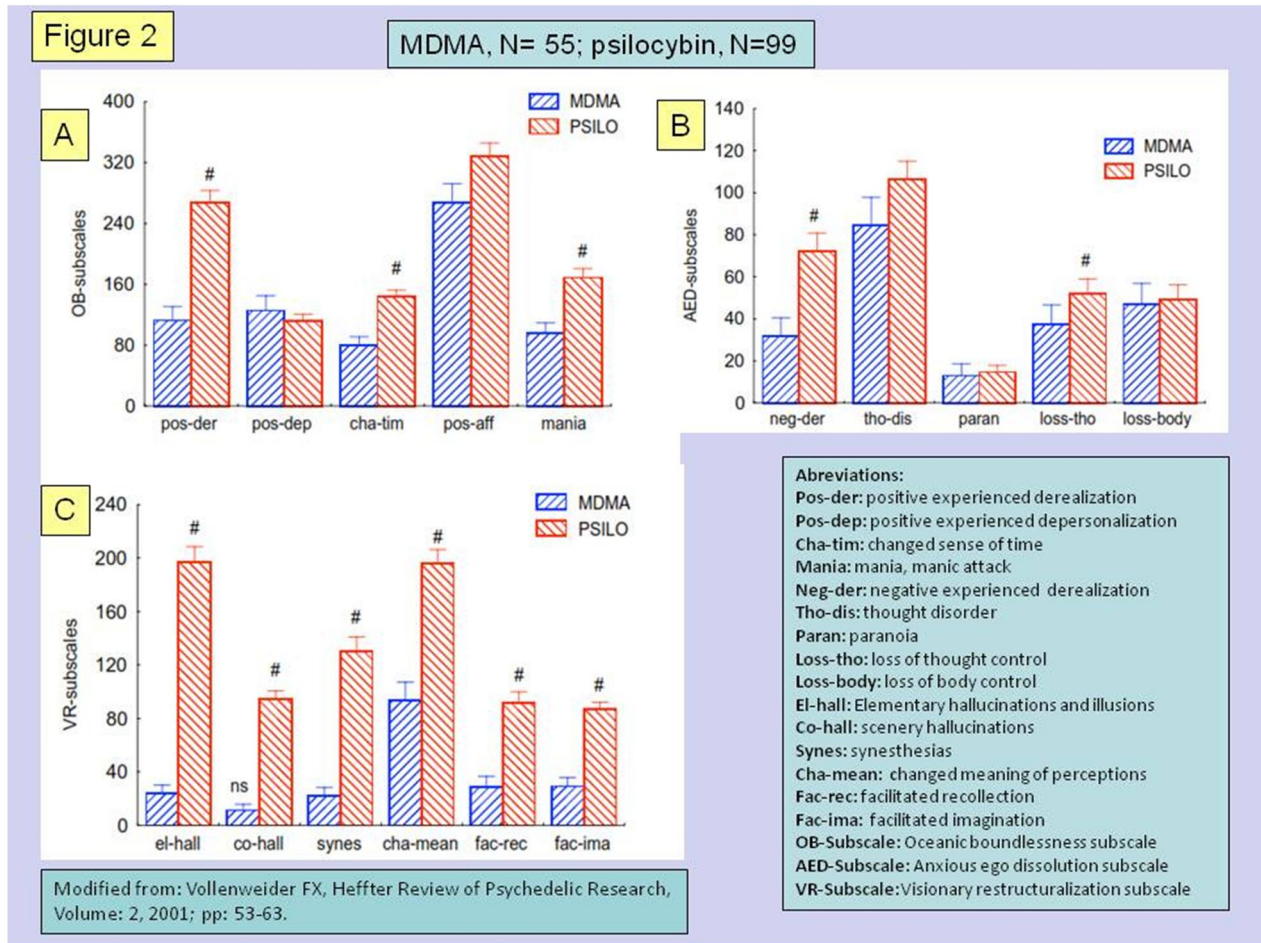
Methamphetamine, which is a central nervous system stimulant, induces brightness and clearness of thought, a sharp wakefulness and clearness of mind at the doses of 15-30 mg, lasting for 24 hours. Associations, imaginations, fantasies are generally increased; at higher doses of 50-60 mg these associations may turn into paranoid reasoning that may result in building up pathological and unrealistic connections between events and people, an obvious acute form paranoid psychosis. At high doses, methamphetamine also induces vivid, colorful, visual hallucinations. Methamphetamine triggers and exacerbates psychosis in the subjects or patients who have tendency to become psychotic. People who used LSD and methamphetamine at the same time confessed that two drugs enhance and amplify the effects of each other, proclaiming that an unreal, imaginary entity of cosmic origin, coined as “cosmic consciousness”, is contacted, as proclaimed in the “LSD with sensory deprivation experiments” of John Lilly (Lilly, 1971). Those users of LSD and methamphetamine together, also confessed that they had a very profound mystical and unification experience with the environment and universe, similar to the “satori” (nirvana) experiences of Zen monks, who practiced Zazen for decades and Sufi’s mystical “En-El-Hak” or “Ana al-Haqq” (I am God) experiences, without the use of any





hallucinogens. During methamphetamine hallucinations, not much of distortion of the space or time perception occurs, unlike LSD, the reality is perceived as it is, some colorful images full of psychedelic colors may be observed. It should not be forgotten that at

the *hallucinogenic doses* of methamphetamine (50-100 mg), it is also a psychosis triggering agent and may induce extreme paranoia; thus making hallucinogenic doses more likely to be *psychotomimetic* (Tables 1A, 1B and 1C).



**Figure 2.** Vollenwieders's study on the psychological effects of NDMA and psilocybin (Vollenwieder, 2001). A) Oceanic boundless subscale findings B) Anxious ego dissolution subscale findings C) Visionary destructuralization subscale findings, during the administration of 1.7 mg/kg MDMA (N=55) and 0.26 mg/kg psilocybin (N=99). Note that visual hallucinations, synesthesia, facilitated recollection and imagination, changed meaning of perceptions is much less in MDMA usage.

### Hallucinogenic effects of Mescaline

(Hardman, 2001; Goodman, 1980; Stafford, 1978; Klüver, 1966; and personal communications).

Peyote cactus extracts, which contain mescaline, have been widely used by many cultures for centuries, such as Indians and Mexicans for spiritual development, shamanic, and philosophical purposes. Many novelists, poets and scientists took mescaline such as, *Louis Lewin, Weir Mitchel, Havelock Ellis, Kurt Beringer, Jack Kerouac, Allen Ginsberg, Herman Hesse, Timoty Leary, Alexander Shulgin and Aldous Huxley (Doors of Perception)* etc. to write some of their work. It is reported that mescaline's *spiritual*

and *philosophical mysticomimetic* effects are much more profound than other hallucinogens. Lewin declared it as, "*modifications of the spiritual life which are peculiar in that they are felt as gladness of soul*". Huxley called it, "*without question the most extraordinary and significant experience, this side of the Beatific Vision*" (Stafford, 1978). Heinrich Klüver described the mescaline images as, "*geometrical images of spirals, funnels, alley, cone, vessel, tunnel and grating, lattice, fretwork, filigree, honeycomb or chessboard mathematical designs happening in the mind automatically just like the ones in the computer programs*" (Klüver, 1966). Most of the trips are



accompanied with auditory hallucinations, such as a voice which is described as a leading Guru or a teacher. In “*mescaline journeys*”, time and space is transcended just like in LSD; time becomes limitless, space becomes infinite. Flying, out of body experience, bodies becoming luminescent or transparent, extra sensory perception (ESP) are some of the common psychological effects of mescaline on the psyche. Like LSD, mescaline also induces *kaleidoscopic images*. Artistic creative potentials are said to be increased in both mescaline and LSD. Some users also claim that their creative potentials in scientific thinking, logical and analytical reasoning, and philosophical, religious and mystical insights are also enhanced as an after-effect of some of the hallucinogens, such as LSD, mescaline, MDMA, psilocybin during or sometime after the “*mescaline-LSD-psilocybin journeys*”. Alex Grey, Salvador Dali, H.R. Giger are reported to be some of the examples of such enhanced artistic capabilities in the literature after using psychedelics. No other hallucinogen is like mescaline either, its effects are very drug specific, although there have been military experiments to compare the potency and hallucination capacity of other hallucinogens to mescaline’s hallucinogenic effects (see the excerpt below) (Tables 1A, 1B and 1C).



**Picture 5.** The paintings and drawings under the effect of mescaline. **A)** Stefan Szuman, Kwartalnik psychologiczny, 1930 (from Klüver, 1966) **B)** Portrait of N. Stachurska, pastel, 1929. A portrait of a real (probably beautiful) face, which is maximally deformed (illusions) painted after alcohol and peyote. Note that both artists focused on spatial distortions and funnel-like images.

As an excerpt from PIHKAL, Alexander Shulgin writes (Shulgin, 1991, truncated):

“... (with 300 mg) I would have liked to, and was expecting to, have an exciting

visual day, but I seemed to be unable to escape self-analysis. At the peak of the experience I was quite intoxicated and hyper with energy, so that it was not hard to move around. I was quite restless... Listening to Mozart's Requiem, there were magnificent heights of beauty and glory. The world was so far away from God, and nothing was more important than getting back in touch with Him. But I saw how we created the nuclear fiasco to threaten the existence of the planet, as if it would be only through the threat of complete annihilation that people might wake up and begin to become concerned about each other. And so also with the famines in Africa. Many similar scenes of joy and despair kept me in balance. I ended up the experience in a very peaceful space, feeling that though I had been through a lot, I had accomplished a great deal. I felt wonderful, free, and clear.

...(with 350 mg) Once I got through the nausea stage, I ventured out-of-doors and I was aware of an intensification of color and a considerable change in the texture of the cloth of my skirt and in the concrete of the sidewalk, and in the flowers and leaves that were handed me by an observer. I experienced the desire to laugh hysterically at what I could only describe as the completely ridiculous state of the entire world. Although I was afraid of motion, I was persuaded to take a ride in a car... I felt that I was at the same time both observing and performing in an outrageous moving picture. I experienced one moment of transcendent happiness when, while passing Epworth Hall, I looked out of the window of the car and up at the building and I was suddenly in Italy looking up at a gay apartment building with its shutters flung open in sunshine, and with its window boxes with flowers. We stopped at a spot overlooking the bay, but I found the view uninteresting and the sun uncomfortable. I sat there on the seat of the car looking down at the ground, and the earth became a mosaic of beautiful stones which had been placed in an intricate design which soon all began to move in a serpentine manner. Then I became aware that I was looking at the skin of a beautiful snake--all the ground around me was this same huge creature and we were all standing on the back of this gigantic and beautiful reptile. The experience was very pleasing and I felt no revulsion. Just then, another automobile stopped to look at the view and I



*experienced my first real feeling of persecution and I wanted very much to leave.*

*... (with 400 mg) During the initial phase of the intoxication (between 2 and 3 hours) everything seemed to have a humorous interpretation. People's faces are in caricature, small cars seem to be chasing big cars, and all cars coming towards me seem to have faces. This one is a duchess moving in regal pomp, that one is a wizened old man running away from someone. A remarkable effect of this drug is the extreme empathy felt for all small things; a stone, a flower, an insect. I believe that it would be impossible to harm anything--to commit an overt harmful or painful act on anyone or anything is beyond one's capabilities. One cannot pluck a flower--and even to walk upon a gravel path requires one to pick his footing carefully, to avoid hurting or disturbing the stones. I found the color perception to be the most striking aspect of the experience. The slightest difference of shade could be amplified to extreme contrast. Many subtle hues became phosphorescent in intensity. Saturated colors were often unchanged, but they were surrounded by cascades of new colors tumbling over the edges.*

*... (with 400 mg) It took a long time to come on and I was afraid that I had done it wrong but my concerns were soon ended. The world soon became transformed where objects glowed as if from an inner illumination and my body sprang to life. The sense of my body, being alive in my muscles and sinews, filled me with enormous joy. I watched Ermina fill to brimming with animal spirit, her features transformed, her body cat-like in her graceful natural movement. I was stopped in my tracks. The world seemed to hold its breath as the cat changed again into the Goddess. As she shed her clothes, she shed her ego and when the dance began, Ermina was no more. There was only the dance without the slightest self-consciousness. How can anything so beautiful be chained and changed by other's expectations? I became aware of myself in her and as we looked deeply into one another my boundaries disappeared and I became her looking at me..."*

**Commentary of the author:** Mescaline is one of the oldest psychedelics known to man. It is the major active component of the small dumpling cactus known as Peyote. It grows wild in the

Southwestern United States and in Northern Mexico, and has been used as an intimate component of a number of religious traditions amongst the native Indians of these areas...

...The dosages associated with the above "qualitative comments" are given as if measured as the sulfate, although the actual form used was usually the hydrochloride salt. The conversion factor is given under "dosage" above...

...Mescaline has always been the central standard against which all other compounds are viewed. Even the United States Chemical Warfare group, in their human studies of a number of substituted phenethylamines, used mescaline as the reference material for both quantitative and qualitative comparisons. The Edgewood Arsenal code number for it was EA-1306. All psychedelics are given properties that are something like "twice the potency of mescaline" or "twice as long-lived as mescaline." This simple drug is truly the central prototype against which everything else is measured. The earliest studies with the "psychotomimetic amphetamines" had quantitative psychological numbers attached that read as "mescaline units." Mescaline was cast in concrete as being active at the 3.75 mg/kg level. That means for an 80 kilogram person (a 170 pound person) a dose of 300 milligrams. If a new compound proved to be active at 30 milligrams, there was a M.U. level of 10 put into the published literature. The behavioral biologists were happy, because now they had numbers to represent psychological properties. But in truth, none of this represented the magic of this material, the nature of the experience itself. That is why, in this Book II, there is only one line given to "dosage," but a full page given to "qualitative comments".

### **Hallucinogenic effects of Psilocybin**

(Griffiths, 2006; Hasler, 2004; Vollenweider, 2001; Hardman, 2001; Tart, 1990; Goodman, 1980; Stafford, 1978; and personal communications).

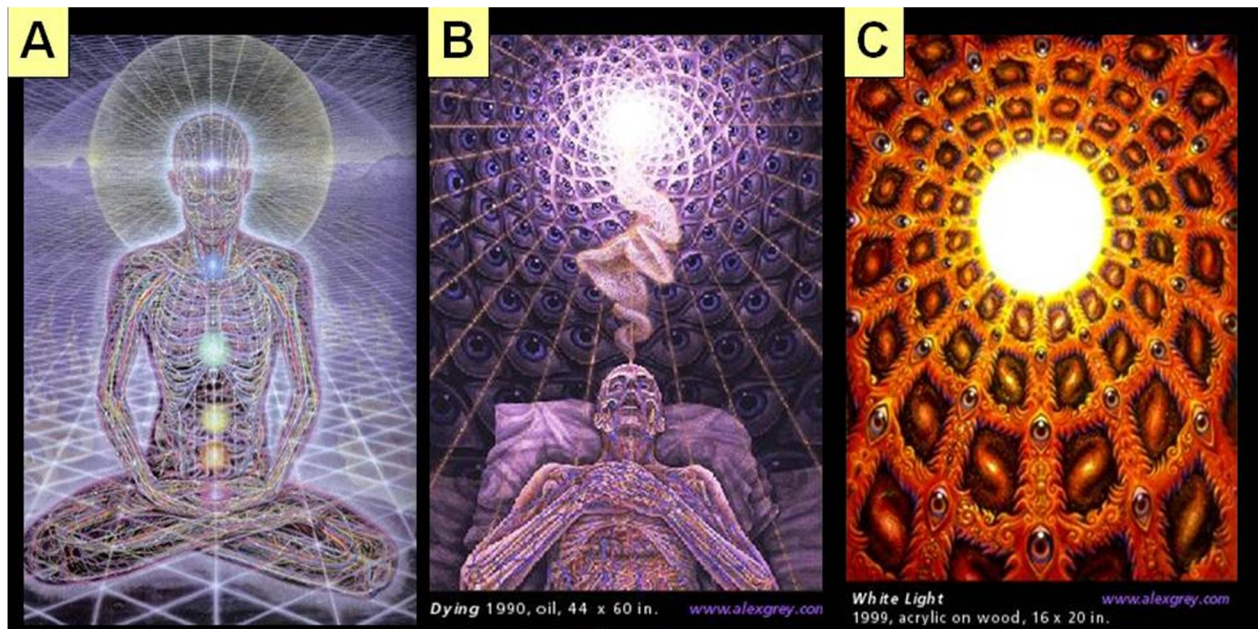
Psilocybin (*magic mushrooms*) has also been used in many shamanic rituals to transcend temporal-spatial dimensions and to contact an imaginary, unreal world of *demons, ghosts, and spirits* for centuries. It induces visual hallucinations of colorful images, dancing psychedelic-green-red-violet geometric shapes very similar to LSD. In some particular ingestions, or *good trips*, users declare that, they have contacted the *Great Spirit*, who gave philosophical insights to the traveler. Like in LSD and other hallucinogens, psilocybin also unfolds the unconsciousness, many archetypal images and thoughts are perceived. *Mysticomimetic* hallucinations are





very common with the use of psilocybin, and it is asserted that “*psilocybin journeys*” induce sharp changes in the philosophical thinking and the ideology of the individual. In Vollenweider’s study (Figure 2) and other studies, some of the effects of psilocybin were summarized as; positive and negative experienced derealization, depersonalization, changed sense of time, change in the temporal and spatial continuum, euphoria, happiness, mania, laughing, both decrease or increase of anxiety, thought disorder, increase in associations, paranoia, loss of thought and body control, synesthesia, changed meaning of perceptions, life and philosophy, depth in philosophical thinking, LSD-like vivid color and visual hallucinations, facilitated recollection and imagination, increase in creative and artistic abilities, unification feeling with the environment, nature and

cosmos. In another study, using different psychometric scales the following classifications of the psychedelic effects of psilocybin were investigated (Hasler, 2004): oceanic boundlessness, anxious ego dissolution, visionary restructuralization, auditory alterations, and reduction of vigilance. Psilocybin made alterations in all scales in a dose dependant manner compared to the controls; inducing, slight drowsiness, increased sensitivity and intensification of preexisting mood states, colorful visual illusions, complex scenic hallucinations and synesthesia, euphoria, dysphoria, fear to lose control, anxiety, a feeling of “*touching and unifying with a higher reality*”, auditory hallucinations, a dreamy state, “*switching between the worlds*”, insightfulness, etc. (Tables 1A, 1B and 1C).



**Picture 6.** Philosophical, psychedelic art work of Alex Grey painted under the effect of LSD (or psilocybin, mescaline) depicting mysticomimetic elements A) Painting depicts meditation and a multi-dimensional perception, the body becoming transparent, translucent, unifying with the nature and cosmos. B) Painting depicts dying or out of body experience, cosmic eyes symbolizing the perception and consciousness of a cosmic being, unification with the cosmos is portrayed. C) Painting depicts a white light which is generally seen after very long meditation (Zazen) practices and the unification with cosmic consciousness, galaxies and cosmos; again the cosmic eyes among galaxies are everywhere in the painting. Source: [www.alexgrey.com](http://www.alexgrey.com)

### Hallucinogenic effects of DMT (Dimethyl-tryptamine)

(Halberstadt, 2012; Mavlyutov 2012; Krippner, 2011; Stassman, 2000; Shulgin, 1997; Goodman, 1980; Stafford, 1978; and personal communications).

DMT is contained in many plants all over the world, such as, Cohoba, Epena Snuffs, and Ayahuasca etc. and is used in many cultures’ tribal rituals for centuries (Krippner, 2011;

Stafford, 1978). DMT containing plants have been used by the medicine men and shamans of primitive cultures, such as the ones in the Amazon. It is also hypothesized that DMT-like endogenous chemicals are secreted from the brain, particularly pineal gland. The duration of the “*DMT trips*” is less than LSD, mescaline, psilocybin etc., and lasting for 1-2 hours. Visual hallucinations are common when the eyes are open or closed. It may start



with colorful, vivid LSD-like visual hallucinations and kaleidoscopic figures which may later build up into scenery hallucinations, where a person can find him "in a Roman or Greek scene, with nymph like figures swimming in the pool". Auditory hallucinations are not uncommon. Mysticomimetic effects of DMT are very powerful. DMT trip may give lots of insights to the person about his/her life, philosophy, space, universe, religious thoughts, celestial entities, aliens, God etc. Subconscious and collective subconscious are generally revealed. Depersonalization, paranoia, both euphoria and dysphoria, anxiety, tremor, ecstatic feelings, extreme happiness, peak experience, oceanic bliss, feelings of self-fulfillment, melting of temporal/spatial continuum, alterations in the time perceptions are a couple of common psychological effects (Tables 1A, 1B and 1C).

Alexander Shulgin writes about DMT trials in TIHKAL (Shulgin, 1997, truncated) as:

... (with 20 mg, intramuscularly) "I began to see patterns on the wall that were continuously moving. They were transparent, and were not colored. After a short period these patterns became the heads of animals, a fox, a snake, a dragon. Then kaleidoscopic images appeared to me in my inner eye, fantastically beautiful and colored."

(with 30 mg, intramuscularly) "There was eye dilation and, subjectively, some perception disturbances."

(with 60 mg, intramuscularly) "I don't like this feeling -- I am not myself. I saw such strange dreams a while ago. Strange creatures, dwarfs or something; they were black and moved about. Now I feel as if I am not alive. My left hand is numb. As if my heart would not beat, as if I had no body, no nothing. All I feel are my left hand and stomach. I don't like to be without thoughts."

(with 75 mg, intramuscularly) "The third or fourth minute after the injection vegetative symptoms appeared, such as tingling sensation, trembling, slight nausea, midriasis, elevation of the blood pressure and increase of the pulse rate. At the same time, eidetic phenomena, optical illusions, pseudo hallucinations, and later real hallucinations, appeared. The hallucinations consisted of moving, brilliantly colored oriental motifs, and later

*I saw wonderful scenes altering very rapidly. The faces of people seemed to be masks. My emotional state was elevated sometimes up to euphoria. At the highest point I had compulsive athetoid movements in my left hand. My consciousness was completely filled by hallucinations, and my attention was firmly bound to them; therefore I could not give an account of the events happening to me. After 3/4 to 1 hour the symptoms disappeared, and I was able to describe what had happened.*

(with 80 mg, intramuscularly) "My perceptual distortions were visual in nature and with my eyes closed I could see colored patterns, primarily geometrical patterns moving very fast, having sometimes very deep emotional content and connotation. My blood pressure went up and my pupils were dilated."

(with 100 mg, smoked) "As I exhaled I became terribly afraid, my heart very rapid and strong, palms sweating. A terrible sense of dread and doom filled me - I knew what was happening, I knew I couldn't stop it, but it was so devastating; I was being destroyed - all that was familiar, all reference points, all identity -- all viciously shattered in a few seconds. I couldn't even mourn the loss -- there was no one left to do the mourning. Up, up, out, out, eyes closed, I am at the speed of light, expanding, expanding, expanding, faster and faster until I have become so large that I no longer exist -- my speed is so great that everything has come to a stop -- here I gaze upon the entire universe."

(with 15 mg, intravenously) "An almost instantaneous rush began in the head and I was quickly scattered. Rapidly moving and intensely colored visuals were there, and I got into some complex scenes. There were few sounds, and those that were there were not of anyone talking. I was able to continue to think clearly."

(with 30 mg, intravenously) "I was hit harder than I had ever been when smoking the stuff. The onset was similar, but the euphoria was less."

### **A comparison of H-ASCs: Is it possible?**

Some of the psychological and physiological effects of the mentioned hallucinogens are summarized in Tables 1-A, 1-B and 1-C. These tables do not reflect an exact, *real analysis* of the comparison of hallucinogens, however, an estimate of a possible evaluation of different individual effects of hallucinogens. The number of the H-ASC induced states and



effects are obviously more than the effects given in the tables. However, to draw a single, established model and explain H-ASCs in a single model to compare them, neuroscience should use psychometric scales for each of the effect cited (and, of course, more of them) and make trials with each hallucinogen in statistically significant research designs. No such study is existent yet. For instance in Vollenweider's study, 16 specific effects of hallucinogens have been compared in psilocybin and MDMA induced ASCs, however these are not the only consciousness and mood states achieved through

hallucinogens (Vollenwieder, 2001)! However, each of the 108 effects cited in Table 1, or even more, should be measured in comparison to try to establish a single, unified model to explain the H-ASCs in one set of consistent and certain mechanisms. Another fact is that not all the effects cited in Tables 1-A, 1-B and 1-C can be observed and experienced in every ingestion of these drugs, because of their unpredictability. Thus it is very early to drive single models, such as high arousal/low arousal model on the hedonic axis, to measure and explain the effects of H-ASCs (Figure 1; Metzner, 1989).

**Table 1-A.** Similarities and dissimilarities of the psychological and physiological effects of H-ASCs. (Source: review of the literature and personal communications. Number of dots is only an estimation, does not depend on real data or a genuine comparative, analytical data of the hallucinogens; the number of dots depicts predominance and intensity of the effect, the probability of the effect to be experienced and the possible frequency) Mamph↓:methamphetamine low dose (15-30 mg); Mamph↑:methamphetamine high dose. ±: both may increase or decrease, may exist or may not exist, may induce or may not induce. ↑: increased ↓: decreased ∅: doesn't have that effect.

| Effect   | LSD       | ibogaine | THC    | PCP   | MDMA  | Mamph↓ | Mamph↑ | Mescaline | Psilo  | DMT    |
|--|-----------|----------|--------|-------|-------|--------|--------|-----------|--------|--------|
| Excitement                                     | •••••     | ••••     | •••    |       | ••••  | ••••   | •••••  | •••••     | ••••   | •••    |
| Euphoria                                       | •••       | ••?      | •••••  | ∅     | ••••  | •••••  | ••     | •••       | •••    | •••    |
| Ecstasy  | •••••     | ••       | •      |       | ••••• | ••     | •      | •••       | •••    | •••    |
| Mania  | •••       | •        | ••     |       | •••   | ••••   | •••••  | •••       | •••    | ••     |
| Paranoia                                       | ••        | •        | •••    | •••   | ••    | ••     | •••••  | ••        | •      | ••     |
| Fearful thoughts ↑                             | •?        | •?       | •••    | ••••• | •     | •      | •••••  | •••       | •      | •      |
| Anxiety  | •••       | ••••     | ••••   | ••    | ••    | ••     | ••••   | •••       | ••     | ••     |
| Depression                                     | ∅ +/-     | ∅        | •• +/- | ••••  | ∅ +/- | ∅      | ∅      | ∅ +/-     | ∅ +/-  | ?      |
| Calmness, serenity                             | ∅ +/-     | •••      | ••     | ∅     | ••••  | ••     | •      | ∅ +/-     | ∅ +/-  | ∅ +/-  |
| Thought disorder                               | •••••     | ••••     | ••••   | ••••• | •     |        | •↑     | •••       | •••    | •••    |
| Depersonalization                              | •••••     | •••••    | •••    | ••••• | •     | •      | ••     | •••       | •••    | ••••   |
| Lethargy                                       | ••        | •••••    | ••••   | ••••• | •     | ∅      | ∅      | ••        | ••     | ••     |
| Dizziness                                      | • +/-     | •••••    | •••    | ••••• | ∅     | ∅      | ∅      | +/-       | +/-?   | ∅      |
| Alteration in affection                        | •••••     | •••••    | •••    |       | •••   | •      | •••    | •••       | •••    | •?     |
| Mood jumps                                     | ••••      | ••••     | ••     |       | ••    | •••    | ••••   | ••••      | •••    | ••?    |
| Ego alteration                                 | •••••     | •••      | ••     |       | ••    | ∅      | ••     | •••••     | •••••  | •••••  |
| Increased empathy                              | •••       | ?        | ••     | •?    | ••••• | ••     | •      | ••        | ••     | ••••   |
| Extreme happiness                              | •••• +/-  | ∅        | ••••   | ∅     | ••••• | ••••   | ••     | •• +/-    | •• +/- | •• +/- |
| Peak experience                                | •••••     | ••••     | •?     |       | •••   | •      | ••     | •••••     | ••••   | •••••  |
| Oceanic bliss                                  | ••        | •••      | •••    | ∅     | •••   | •?     | •?     | •••       | •?     | •?     |
| Loss of thought control                        | ••        | ••       | •      | ••••• | •     | ∅      | •      | •         | ••     | •?     |
| Loss of body control                           | •••       | •••••    | •      | ••••• | •     | ∅      | ∅      | •         | ••     | •?     |
| Controversial feelings                         | ••••• +/- | •?       | ••     |       | •?    | ∅      | ∅      | •?        | •?     | •?     |
| Feelings of being controlled                   | ••• +/-   | • +/-    | •• +/- | ••••  | ∅     | ∅      | •••    | ••• +/-   | ?      | ?      |
| Changed meaning of perceptions                 | ••••      | •••••    | •• +/- | ••••• | • +/- | ∅      | •••••  | ••••      | •••    | •••    |
| Changed meaning of life                        | •••••     | •••••    | •• +/- | ?     | •••   | •      | ?      | •••••     | ••••   | •••••  |
| Dreamy state                                   | •••       | •••••    | •      | ••••  | ••    | ∅      | ∅      | •••       | ••     | •••    |
| Synesthesia                                    | •••••     | ••       | •      |       | •     | ∅      | ∅      | ••••      | •••    | ••     |
| Seeing psychedelic colors                      | •••••     | •••      | •••    | ••    | ••    | ∅      | ••     | •••••     | •••••  | ••••   |
| Seeing fractal geometry                        | •••••     | ?        | ∅      |       | ∅     | ∅      | ∅      | •?        | ••     | ?      |
| Enhancement of light                           | •••••     | ?        | ∅      |       | ∅     | ∅      | ∅      | ••        | ••     | ••     |
| Seeing cartoons                                | •••••     | ∅        | •      |       | ∅     | ∅      | ∅      | ••        | ••     | ?      |
| Wakeful dreaming (REM)                         | ∅         | •••••    | •      |       | ∅     | ∅      | ∅      | ∅         | ∅      | ∅      |
| Seeing archetypal images                       | •••••     | •••      | •      |       | ∅     | ∅      | ∅      | ••        | •••    | ••••   |
| Seeing religious images                        | •••••     | •••      | •      |       | ∅     | ∅      | ∅      | ••••      | •••    | ••••   |
| Seeing colorful flashes-lines-shapes           | •••••     | •••      | ••     |       | •••   | ∅      | •      | ••••      | •••    |        |
| Seeing 2-dimensional pictures as 3-dimensional | •••••     | ?        | ∅      | ∅     | ∅     | ∅      | •      | ••        | ••     | ••     |
| Seeing other dimensions                        | •••••     | ?        | ∅      | ∅     | ∅     | ∅      | ∅      | ••        | ••     | ••     |
| Seeing texture animated                        | •••••     | ?        | ∅      | ∅     | ∅     | ∅      | ∅      | ••••      | ••••   | •••    |
| Vivid visual hallucination                     | •••••     | •••••    | •••    |       | ••    | ∅      | •      | ••••      | ••••   | •••    |
| Scenery hallucinations                         | •••••     | •••••    | •      |       | •     | ∅      | ∅      | ••••      | ••••   | •••    |
| Distortion of self-body                        | ••••• +/- | •••      | ••     |       | ∅     | ∅      | ∅      | •••••     | •••    | •••    |
| Distortion of images                           | ••••• +/- | •••      | •••    |       | ∅     | ∅      | •      | •••••     | •••    | •      |
| Seeing movie/slides                            | •••••     | •••••    | •? +/- | ∅     | ∅     | ∅      | ∅      | ?         | ?      | ?      |
| Kaleidoscopic images                           | •••••     | ∅        | ∅      | ∅     | ∅     | ∅      | ∅      | ••••      | •••    | ?      |
| Spatial borders melt/unify                     | •••••     | •••      | • +/-  | ?     | ∅     | ∅      | ∅      | ••••      | ••     | ••••   |
| Macroscopia/microscopia                        | •••       | ••••     | •      | •••   | ∅     | ∅      | ∅      | •••       | ••     |        |





**Table 1-B.** Similarities and dissimilarities of the psychological and physiological effects of H-ASCs (source: review of the literature and personal communications. Number of dots is only an estimation, does not depend on real data or a genuine comparative, analytical data of the hallucinogens; the number of dots depicts predominance and intensity of the effect, the probability of the effect to be experienced and the possible frequency) Mamph↓:methamphetamine low dose (15-30 mg); Mamph↑:methamphetamine high dose. ±: both may increase or decrease, may exist or may not exist, may induce or may not induce. ↑: increased ↓: decreased ø: doesn't have that effect

| Effect  | LSD      | ibogaine | THC   | PCP    | MDMA  | Mamph↓ | Mamph↑ | Mescaline | Psilo   | DMT     |
|---|----------|----------|-------|--------|-------|--------|--------|-----------|---------|---------|
| Giggling  | ●●●●●    | ?        | ●●●   | ?      | ●     | ●      | ●      | ●?        | ●●●     | ?       |
| Laughing  | ●●●●●    |          | ●●●   |        | ●●    | ●      | ●      | ●●        | ●●      | ●●?     |
| Crying  | ●● +/-   |          | ●     | ●●●●   | ø     | ø      | ø      | ?         | ?       | ?       |
| Auditory hallucinations                               | ●●●      | ●●●●     | ●     |        | ø     | ø      | ø      | ●●●●●     | ●●●     | ●●      |
| Hearing a leading voice (claimed)                     | ●●       | ●●●●     | ø     | ø      | ø     | ø      | ø      | ●●●●●     | ●●      | ●●●     |
| Sound amplified                                       | ●●●●●●   | ●●●●     | ●●    |        | ●     | ø      | ø      | ●●        | ●●      | ●?      |
| Music becomes deep/ philosophical                     | ●●●●●●   | ●●●      | ●●    | ?      | ●     | ø      | ø      | ●●●●      | ●●●●    | ●?      |
| Tactile hallucinations                                | ●●●      | ●●●●●    | ●     | ●●●●●● | ø     | ø      | ●      | ●●●       | ●       | ●?      |
| Excessive talking                                     | ●●●      | ●        | ●●●●  | ø      | ●●●   | ●●●●●  | ●●●●●  | ●●●       | ●●      | ●●      |
| Facilitated imagination                               | ●●●●●●   | ●●●●●●   | ●●●   |        | ●●●●  | ●      | ●●     | ●●●●      | ●●●●    | ●●●     |
| Facilitated recollection                              | ●●●●●●   | ●●●●●●   | ●●●●● |        | ●●●●  | ●      | ●●     | ●●●●      | ●●●●    | ●●●     |
| Hypernesia  | ●●●●●●   | ●●●●●●   | ●●●●  |        | ●     | ●●●    | ●●●●   | ●●        | ●●      | ●●●●    |
| Increased associations                                | ●●●●     | ●●●●●    | ●●●   |        | ●●    | ●●●●●  | ●●●●●  | ●●●●      | ●●●     | ●●      |
| Childhood memories                                    | ●●●●     | ●●●●●●   | ●●●   | ●?     | ●●●●  | ●      | ●●     | ●?        | ●?      | ●?      |
| Flashback phenomenon                                  | ●●●●●●   | ●?       | ●?    |        | ●?    | ø      | ø      | ?         | ●       | ●       |
| Philosophical thinking↑                               | ●●●●●●   | ●●●●●●   | ●●    |        | ●     | ●●●    | ●      | ●●●●●●    | ●●●●    | ●●●●    |
| Changed time sense                                    | ●●●●●↑↓  | ●●●↑↓    | ●●↓   |        | ●↑    | ●●●↑   | ●●●↑   | ●●↑↓      | ●●●↑↓   | ●●●↑↓   |
| Mystical experience                                   | ●●●●●●   | ●●●●     | ●     | ?      | ø     | ø      | ø +/-  | ●●●●●●    | ●●●     | ●●●●●   |
| Unification feeling                                   | ●●●●●●   | ●●●      | ø     | ø      | ø     | ø      | ●      | ●●●●      | ●●●     | ●●●●    |
| Unification with people (claimed)                     | ●●●●●●   | ●●●      | ø     | ø      | ø     | ø      | ●      | ●●●●      | ●●●     | ●●●●    |
| Unification with nature (claimed)                     | ●●●●●●   | ●●●      | ø     | ø      | ø     | ø      | ●      | ●●●       | ●●      | ●●●●    |
| Unification with universe (claimed)                   | ●●●●●●   | ●●●      | ø     | ø      | ø     | ø      | ø      | ●●●       | ●●      | ●●●●    |
| Experience of cosmic consciousness                    | ●●●●●●   | ●●       | ø     | ø      | ø     | ø      | ø      | ●●        | ●●      | ●●●     |
| Revealing-subconscious                                | ●●●●     | ●●●●●●   | ●●●   | ?      | ●●    | ●      | ●●     | ●●●●      | ●●●     | ●●●     |
| Auto-Psychoanalysis                                   | ●●●●●●   | ●●●●●●   | ●●●   |        | ●●●●  |        | ●●●    | ●●●●      | ●●●●    | ●●●●●   |
| Hyper suggestibility                                  | ●●●●     | ●●●●     | ●     | ●?     | ●     | ø      | ø      | ●●        | ●●      | ●●      |
| Feelings of contact with aliens, celestials (claimed) | ●●●●     | ?        | ø     | ø      | ø     | ø      | ø      | ●●●●      | ●●●     | ●●●●●   |
| Contact with ancestors (claimed)                      | ●●●      | ●●●●●●   | ø     | ø      | ø     | ø      | ø      | ●●●       | ●●●●●   | ●●●●●   |
| Contact with spirits (claimed)                        | ●●       | ●●●●●●   | ●●    | ø      | ø     | ø      | ø      | ●●●●●●    | ●●●●●●  | ●●●●●   |
| Nothingness feeling                                   |          |          |       | ●●●●●● |       |        |        |           |         |         |
| Flying  | ●●●● +/- | ●●●      | ●     |        | ø     | ø      | ø      | ●●●?      | ●●● +/- | ●●● +/- |
| Out of body exp.                                      | ●●●●●●   | ●●●●     | ●     |        | ø     | ø      | ø      | ●●●●●●    | ●●      | ●●●     |
| ESP (claimed)   | ●●●      | ?        | ?     | ?      | ø     | ø      | ø      | ?         | ?       | ●●●     |
| Artist/creativity↑                                    | ●●●●●●   | ●●●●     | ●●●   | ?      | ●●    | ●●●    | ●●●●●  | ●●●●●     | ●●●●●   | ●●●●●   |
| Aphrodisiac effect                                    | ●●●●     | ●●●●●●   | ●●●   | ?      | ●●●●  | ●●●●   | ●●●●   | ?         | ●●●     | ?       |
| ↑ Sex.arousal/libido                                  | ●●●      | ●●●●●●   | ●●●●  | ?      | ●●●●  | ●●●●●  | ●●●●●● | ?         | ●●●     | ?       |
| ↑ Sexual pleasure                                     | ●●●●●●   | ●●●      | ●●●●  | ?      | ●●●●● | ●●●●   | ●●●●   | ?         | ●●      | ?       |
| Enhanced orgasm                                       | ●●●●●●   | ●●●      | ●●    | ?      | ●●●●  | +/-    | +/-    | ?         | ●?      | ?       |
| Feeling of prolonged orgasm (ESR)                     | ●●●●●●   | ●●●      | ●●    | ?      | ●●    | +/-    | +/-    | ?         | ●?      | ?       |



**Table 1-C.** Similarities and dissimilarities of the psychological and physiological effects of H-ASCs (source: review of the literature and personal communications. Number of dots is only an estimation, does not depend on real data or a genuine comparative, analytical data of the hallucinogens; the number of dots depicts predominance and intensity of the effect, the probability of the effect to be experienced and the possible frequency) Mamph↓:methamphetamine low dose (15-30 mg); Mamph↑:methamphetamine high dose. ±: both may increase or decrease, may exist or may not exist, may induce or may not induce. ↑: increased ↓: decreased ∅: doesn't have that effect

| Effect                                      | LSD       | ibogaine | THC   | PCP    | MDMA   | Mamph↓ | Mamph↑ | Mescaline | Psilo  | DMT    |
|---|-----------|----------|-------|--------|--------|--------|--------|-----------|--------|--------|
| ↑Sexual fantasies                           | ●●●       | ?        | ●●●●  |        | ●●●+/- | ●●●●   | ●●●●●● | ?         | ●●     | ●+/-   |
| Bizarre sexual behavior                     | ●●        | ?        | ●●    | ●●●    | ?      | ●●●●   | ●●●●●● | ?         | ?      | ?      |
| Bizarre thoughts                            | ●●        | ●●●●     | ●●    | ●●●●●● | ?      | ●●●    | ●●●●●● | ●●●       | ?      | ?      |
| Triggers underlying psychosis/schizophrenia | ●●●       | ●●●??    | ●●●   | ●●●●●● | ●●●●   | ●●●●●● | ●●●●●● | ●●●●      | ●●●●   | ●●●●   |
| Good model for exp. psychosis               | ●●●       | ●●●      | ●●    | ●●●●●● | ●●     | ●●     | ●●●●●● | ●●●●●●    | ●●●    | ●●●    |
| Spatial/temporal continuum altered          | ●●●●●●    | ●●●      | ●     |        | ∅      | ∅      | ∅      | ●●●●      | ●●●    | ●●●●   |
| Has long term effects                       | ●●●●●●    | ●●●●●●   | ●●●●  | ●●●●●● | ●      | ●●     | ●●●●   | ●●●●●●    | ●●●●●● | ●●●●●● |
| Decreased appetite                          | ●●●       | ●●●●●●   | ∅     | ∅      | ●●●●   | ●●●●●● | ●●●●●● | ●●●       | ●●     | ●+/-   |
| Increased appetite                          | ∅         | ∅        | ●●●●  | ∅      | ∅      | ∅      | ∅      | ∅         | ∅      | ∅      |
| Nystagmus                                   | ●●        | ●●●●     | ●●    |        | ∅      | ∅      | ∅      | ●●●       | ●●●    | ●●●    |
| Diarrhea                                    | ●●●●● +/- | ?        | +/-   |        | ●      | ●      | ●      | +/-       | ●●●    | +/-    |
| Nausea                                      | ●●●●      | ●●●●●●   | ●●●●  | ●●●●●● | ●●●●●● | ●●●    | ●●●    | ●●●       | ●●●●●● | ●●●●●● |
| Midriasis                                   | ●●●●●●    | ●●●●●●   | ●●    |        | ●●●●●● | ●●●●   | ●●●●●● | ●●●●      | ●●●    | ●●●    |
| Head ache                                   |           |          |       | ●●●●●● |        |        |        |           | ●      |        |
| Dryness of mouth                            | ●●●●●●    | ●●●●     | ●●    | ●●●●   | ●●●●●● | ●●●    | ●●●    | ●●        | ●●●    | ●?     |
| Metallic taste                              | ●●●●      |          |       |        |        |        |        | ●●?       |        |        |
| Increased pulse rate                        | ●●●●      | ●●●●●●   | ●●●   |        | ●●●●   | ●●●●   | ●●●●●● | ●●●       | ●●     | ●●?+/- |
| Increased blood pres.                       | ●●●       | ●●●●●●   | ● +/- |        | ●●●    | ●●●    | ●●●●●● | ●●●       | ●●●    | ●?     |
| Ataxia                                      | ●         | ●●●●●●   | ●     | ●●●    | ●●?    |        |        | ?         | ●      |        |
| Tremor                                      | ●●        | ●●●●●●   | ●●    | ●●●    | ●●?    | ●●●    | ●●●●●● | ●         | ●      | ●      |
| Enhanced reflexes                           | ●         | ●●●●●●   | ?     |        | ●●     | ●●●    | ●●●●   |           |        |        |
| Tolerance develops                          | ●●●●●●    |          | ●     |        | ●●     | ●●     | ●●●    |           |        | ●      |
| Effect on 5-HT Receptor                     | ●●●●●●    | ●●●      | ●?    | ●?     | ●●●●●● | ●●●●●● | ●●●●●● | ●●●●●●    | ●●●●●● | ●●●●●● |
| Effect on NMDA Receptor                     | ●●●●      | ●●●●●●   | ●?    | ●●●●●● | ●●●●   | ●●●●   | ●●●●   | ●●●?      | ●●●?   | ●●●?   |

## Hyper excitation model of hallucinogen induced ASCs

To explain the consciousness states induced by hallucinogens various models have been proposed (Metzner, 1971; 1989; 1994; 1999; 2001; 2002; Fischer, 1971). According to Metzner, the *content* of a state of consciousness is a function of the *internal set* and *external setting*; regardless of the catalyst or trigger, which might be a drug, or hypnotic induction, or shock, or rhythmic sounds, or music, etc. ASCs, whether induced by drugs or other means, differ energetically on the dimensions of (1) *arousal vs. sedation*, (2) *pleasure vs. pain*, (3) *expansion vs. contraction*. Metzner argues that the classical hallucinogenic or psychedelic drugs are consciousness expanding, and therefore opposite in effect to drugs, such as the opiates, amphetamines, alcohol or barbiturates, that *can lead* to addicted, fixated, contracted states

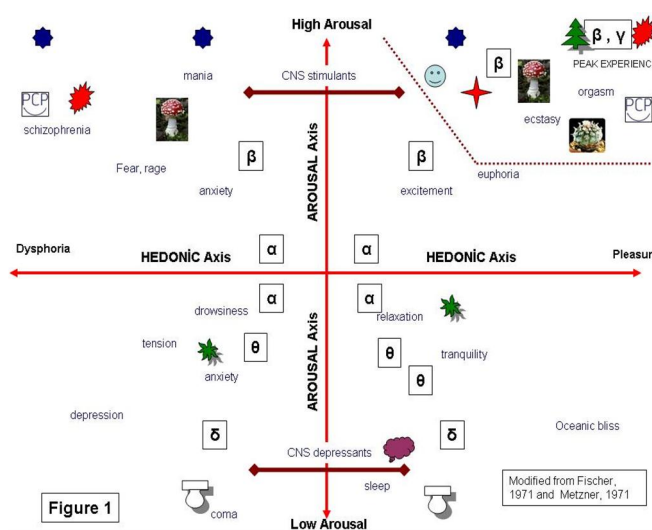
of consciousness and he calls those drugs as *psychoactive* (or “mood regulators”), such as the stimulants and depressants in moderate dosages, that affect primarily the dimensions of arousal and pleasure-pain, without significant expansion of consciousness. Metzner explains the expansion of consciousness in the two dimensional axis, as pleasure-pain and high arousal-low arousal are the main parameters. Similarly, Fischer (Fischer, 1971) arranged various states of consciousness on a continuum of arousal, or what he called *ergotropic* versus *trophotropic* activation, roughly equivalent to sympathetic and parasympathetic nervous system activation (Figure 1).

Metzner also designed a graphic rating scale for measuring the level of ASCs (Metzner, 1989), in which the arousal and hedonic continua were shown on a graph, for self-



rating, each of the two dimensions converted to a 7-point scale. This Altered State Graphic Profile (ASGP) can be, and has been used to compare different states of consciousness within an individual's experience; or different people's experience of a particular kind of state, drug or non-drug. The arousal or wakefulness continuum had a zero or neutral point "awake & calm", and then goes to "alert/attentive" (+1), "stimulated" (+2), and "aroused/excited" (+3); in the opposite direction, it is "alpha/meditative" (-1), "drifting/twilight" (-2), and "deep

trance/sleep" (-1). The hedonic or pleasure-pain continuum had a zero or neutral point, and went to "pleasant" (+1), "elated/euphoric" (+2) and "ecstatic/ heaven" (+3); and in the opposite direction, it is "unpleasant" (-1), "painful/ disturbing" (-2) and "agony/hell" (-3). On the hedonic continuum, the negative part of the scale included such generally unpleasant emotional states as anxiety, depression, anger, sickness and the like. Thus it was possible to rate the effects of any hallucinogenic or stimulant drug (Metzner, 1989).



**Figure 1.** The pain-pleasure / low arousal-high arousal depiction of the action of some hallucinogenic drugs. Some hallucinogenic drugs may induce opposite effects at the same dose, while a CNS stimulant methamphetamine induced a dose dependent alteration in the psychological responses of the consciousness, from happiness and ecstasy to acute psychosis and dysphoria.

A criticism can be made against Metzner's model proposing that such effects of some CNS stimulants which become hallucinogenic at very high doses are dose-dependent, while the psychological effects of hallucinogenic drugs at specific doses are unexpected, chaotic and unpredictable. As seen in Fig 1, the effects of methamphetamine, a CNS stimulant, could be acting at both sides, toward pain and dysphoria or pleasure, dependent on the dose used (Metzner, 1971; 1989; Fischer, 1971; Goodman, 1980) 20 to 40 mg of methamphetamine can induce euphoria, happiness, a clear mind and mindfulness, while 50-100 mg of methamphetamine could induce paranoia and acute psychosis (personal communications), while at similar doses or higher, methamphetamine becomes also a hallucinogenic drug as well (Goodman, 1980;

and personal communications). The difference in those effects is probably due to the main mechanism of action of methamphetamines, namely increased release and blockade of reuptake of some neurotransmitters such as norepinephrine, dopamine and serotonin. However, this was not the case in many H-ASCs; for instance 150 µg of LSD can induce both -so called- ecstatic state of consciousness (referred as 'good trip') or paranoia, acute psychosis and extreme anxiety or dysphoria (referred as 'bad trip') (Gray, 2010; Lee, 1985; Goodman, 1980); similar effects were also seen with PCP (street name as, 'angel dust') (Goodman, 1980). PCP, which is a general anesthetic, has amphetamine-like, LSD-like and barbiturate-like psychological effects, making the drug very distinct from many other hallucinogens (Balster, 1987). PCP is also used





for experiments to mimic psychosis in animal models (Balster, 1987), and it is proposed that PCP induced states of consciousness is a good model for schizophrenia (Balster, 1987).

So Metzner's efforts to ascertain the basic effects of hallucinogens can be criticized as being very difficult to put into a single scale in the case of many hallucinogenic drugs; only some of the general effects can be put into scales and psychometric tests. For instance, in an "*LSD trip*" one can make a classification of visual hallucinations for a "*visual hallucination scale*" such as: a) perception of known colors b) perception of unknown colors c) perception of two dimensional objects as three dimensional d) animation of two dimensional figures e) increased light f) synesthesia (seeing taste, sound, music, smells) g) colorful images dancing in the sky etc. (this list may go for tens), however review of the literature and talking to LSD users revealed that, in some "*LSD trips*" the same person, with the LSD dose of X, may experience all the visual hallucination classification parameters (namely, from a, b, c, d, e, f, g to .... az); in the next "*LSD trip*", with the dose X, he may experience nearly one third of all the classified alterations, or vice versa. Thus it is possible to hypothesize that the main resultant effect of hallucinogens was not solely dependent of the content of the neurotransmitters they induced to increase or decrease or alterations in the receptor response (5-HT<sub>2</sub>, or others), but it was very unpredictable, chaotic and dependent on the '*set and setting*', psychological background of the person, the consciousness state during the ingestion of the hallucinogen, even particular trivial events happened during that day, etc (Gray, 2010; Grof, 1985; 2001; Leary, 1989). The biochemical mechanisms and the neuropharmacology of this '*unpredictability*' of hallucinogenic drug induced ASCs have not been thoroughly investigated, explained and understood in the literature, proclaiming an analogy to the Heisenberg's "*principle of uncertainty*" in quantum physics. Whether those effects may have some quantal basis, which can be explained by quantum mechanics of neuropharmacology of consciousness is of importance and further investigation is needed to be pursued.

LSD induces dramatic alterations in visual perception, auditory perception, tactile perception, body perception, spatial and

temporal perception, synesthesias, thought disorders, hypermnesias, affection, alterations of consciousness and ego functions, and has mysticomimetic effects (Hintzen, 2010). The neuro-psychopharmacological mechanisms of such psychological states have not been explained yet.

LSD and ibogaine have some unique effects which are not reported by other hallucinogenic drugs on the human consciousness, as well (Popik, 1995; 1998). For instance, terminal cancer patients who were given LSD and compared its pain-reducing effect to that of morphine, said that with the psychedelic they still felt the pain but it wasn't as painful anymore; and there were many other more differentiated experiences that occupied their attention (Metzner, 1989). Ibogaine induces a state of '*awake dreaming*' and '*oneipherenia*' which are very distinct from the psychological effects of LSD, PCP, THC or psilocybin (Popik, 1995). Taken the distinct psychological effects of different hallucinogenic drugs, it is very difficult to design a single model of action contrary to what Metzner argued (Metzner, 1971; 1989; 1994).

### Proposed neuropharmacological mechanisms of hallucinogen induced ASCs

Depending upon the neurophysiology and neuro-psychopharmacology experiments, some neurotransmitter and receptor systems have been proposed to take part in the induction of ASCs and hallucinations induced by the above hallucinogens. Glutamatergic, serotonergic, GABAergic, dopaminergic, cholinergic, noradrenergic, and opioid and other receptor systems have been proposed to be influenced in different ways by different hallucinogens in the literature. A summary of the possible connection of hallucinogens and ASCs are summarized in Table-1. The hallucinogens may have similar psychological effects; however most of the ASCs induced by that particular hallucinogen are totally drug specific and dose dependent, thus making it very difficult to compare so called "*voyages*" of different hallucinogens with each other. As seen in Table-2, most of the crucial receptor systems are affected by hallucinogens. For instance, LSD is reported to have both agonistic and antagonistic effects on 5-HT receptors (5-HT<sub>2A</sub> antagonist), proposing 5-



HT<sub>2</sub> receptors correlating with the hallucinogenic potency (Aghajanian, 1999). LSD acts as an agonist on 5-HT<sub>1A</sub> receptors in locus coeruleus, raphe nuclei and the cortex, inhibiting firing and serotonin release of these cells; it is a partial agonist on the postsynaptic 5-HT<sub>1A</sub> site, while having high affinity to others, like 5-HT<sub>1B</sub>, 5-HT<sub>1D</sub>, 5-HT<sub>1E</sub>, 5-HT<sub>2C</sub>, 5-HT<sub>5A</sub>, 5-HT<sub>6</sub>, 5HT<sub>7</sub> receptors (Hintzen, 2010; Passie, 2008; Aghajanian, 1999). If 5-HT agonism is an important factor for explaining the basic mechanism of actions of ASCs induced by LSD, it would be expected that some other drugs, such as serotonin re-uptake inhibitors (SSRIs), that induce an increase of 5-HT in the synaptic cleft of many parts of the brain, would induce similar hallucinations, as LSD does; however, this is not the case, there are some reports mentioning about some

visual hallucinations during SSRI use, however they are very scarcely found in the literature, only a couple of case studies to report such an effect exists (Capaldi, 2010; Marcon, 2004). Another interesting point is that, chlorpromazine which is a dopamine receptor antagonist and which has minimal or no effects on 5-HT receptors, and a benzodiazepine derivative alprazolam (xanax, personal communications), which enhances inward GABAergic chloride currents; sharply block the “LSD trips”. Using current data on the mechanism of actions of hallucinogens it is very difficult to determine how such profound psychological changes and ASCs, that may have even long term influences in human life can occur, so easily after the ingestion of only 50 µg of a chemical substance (such as LSD), which is only 1 / (2 x 10<sup>6</sup>) of the body weight.

**Table 2.** The proposed mechanism of action of hallucinogens to induce ASCs through the agonism or antagonism of various neurotransmitter and receptor systems or interactions with them cited in the medical literature (source: [www.erowid.org](http://www.erowid.org), the reference section and web of science, <http://apps.webofknowledge.com> )

|            | Glutamatergic system<br>NMDA, Met. R. | Serotonergic system<br>5-HT R.<br>(5-HT <sub>2</sub> others) | Dopaminergic system<br>DA-Receptors | Noradrenergic System<br>α1, α2 R. | Cholinergic Receptors | GABAergic system<br>GABA <sub>A</sub> , GABA <sub>B</sub> R. | CB-1-2<br>Cannabinoid Receptors |
|------------|---------------------------------------|--|-------------------------------------|-----------------------------------|-----------------------|--|---------------------------------|
| LSD        | •                                     | •  | •                                   | •                                 |                       | ?  |                                 |
| Ibogaine   | •                                     | •  | •                                   | •                                 | •                     | •  |                                 |
| THC        | •                                     |  | •                                   | •?                                |                       | •  | •                               |
| PCP        | •                                     | ?  | •                                   | ?                                 |                       | •  |                                 |
| MDMA       | •                                     | •  | •                                   | •                                 |                       | •?   |                                 |
| Methamph   | •                                     | •  | •                                   | •                                 |                       | •?   |                                 |
| Mescaline  | •                                     | •  | •                                   | ?                                 |                       |  |                                 |
| Psilocybin | •                                     | •  | •                                   | •                                 |                       |  |                                 |
| DMT        | •                                     | •  | •?                                  | ?                                 |                       |  |                                 |

The main mechanism of action of LSD and psilocybin have been reported to be through 5-HT<sub>2</sub> receptors (Hintzen, 2010; Aghajanian, 1999), however, our personal communications with psychedelic drug users and review of the literature reveals that no “*psilocybin voyage*” is described as similar to an “*LSD trip*”, although having some similar forms of hallucinations, each drug creates its own format of ASCs, making each *trip*, very distinct and drug specific. Near to such controversies, LSD, PCP, psilocybin, methamphetamine can have striking effects at both sides of the hedonic axis (Figure-1, dysphoria vs. pleasure), namely the same person, using the same dose of the drug, may have a very “*good trip*” or a very “*bad trip*” depending upon yet unexplained reasons, which is an evidence of the unpredictability of these hallucinogens. In the psychedelic subcultures, there are “*psychonaut’s guides*”, which describe how to attain a “*good trip*” (Gray, 2010). Another unexplained phenomenon is reported by Ram

Das, who gave elephant doses of 900 and 1500 µg of LSD to an Indian guru twice, but could not record any expected hallucinatory effects of LSD on the guru, being surprised to hear that the guru was already there (Austin, 1999; pp.419)!

### Is psychedelic experience psychosis?

Although medical literature accepts LSD and other psychedelics as psychotomimetic drugs, and recognizes the experience as a model of psychosis, the answer to this question should be both *yes* and *no*! Because, first of all the person is generally aware of all the hallucinations being the effects of LSD, and he/she observes what is happening in his/her brain, just like watching a movie, or dreaming. There is generally no loss of control, even the *mind* itself, if experienced, can direct the whole “*LSD trip*” to wherever it wants to take! There can be depersonalization, thought disorders, loss of ego, visual and auditory hallucination phenomena, however most of



the time the reasoning, analytical thinking, insight, abstract thinking, philosophical thinking, the capability of observing the whole experience and scene, and short or long term memories are not impaired, unlike in the case of psychosis. There are many elements mimicking psychosis, but also there are other factors which avert us from presuming that whole experience is always *simply* a form of *psychosis*! This question is still debated in many academic and scientific circles all over the world.

### **Today can we explain the drug specific effects of H-ASCs by the present models and the current knowledge of psychopharmacology?**

The answer to this question is: *No*. Because, the behavioral and psychological effects of these hallucinogens are so diverse and the findings in the hallucinogen research is so contradictory and paradoxical that it is too difficult to reach to any conclusions on the mechanism of action of hallucinogens after 70 years of research since LSD, unpredictably and accidentally, bumped into Albert Hoffman's Swiss lab! The hallucinogens nearly influence most of the receptor systems and many neurotransmitters (Table-2). For instance, let's take some effects of LSD: *a*-inducing fractal like geometrical visual hallucinations, very much similar to the computer programs' fractals *b*-synesthesia *c*-inducing cartoon movie-like images *d*-seeing two dimensional figures as three dimensional (some people even describe seeing things in four dimensions!) *e*-surreal images some of which can also be seen in dreams *f*-seeing very vivid known or unknown colors, kaleidoscopic images, imaginary insightful shapes and figures *g*-mysticomimetic effects, unification feelings with the universe similar to the experiences of the ancient mystics. None of the drugs that affect above neurotransmitter and receptor systems (namely, serotonergic system, glutamate and NMDA receptors, dopaminergic system etc.) have similar, specific combined effects and no other hallucinogen is like LSD. As an analogy, the trials to understand these effects are like observing a four dimensional hypercube, passing through a three dimensional world, where the three dimensional observers are. More basic scientific knowledge should be attained about the mechanisms of ASCs and the brain to elucidate the real mechanisms of

action of hallucinogens, which is probably one of the best spheres to investigate the real essence and structure of consciousness.

### **Question 1: How can we explain tens of different perception alterations and ASCs under the effect of hallucinogens using current neuroscience knowledge?**

Today, neuroscience is only at the stage of observing and classifying the possible H-ASCs and the effects of hallucinogens, not at the level of understanding and explaining the main mechanisms of how 5-HT receptor activation (or in accordance with the antagonism of some 5-HT receptors) can induce the music to be seen, colors to be heard, both music and colors to be touched or tasted or the inauguration of "*fractal geometric designs being perceived without the aid of computers, just in our brains, when the eyes are closed*"! An analogy is that spiders (*Zilla-x-notata Cl.*) given LSD and mescaline could weave perfect geometrical shaped nets compared to the ones administered with caffeine or THC (Stafford, 1978; pp.138-139) or to the normal ones, without any drug; what can be the mechanism of this phenomenon? If, one thinks that it is only a chaotic impairment of the *software* of the brain by LSD, then how is the philosophical and scientific insight and sometimes creativeness is enhanced just like in the case of geneticist *Kary Mullis*, who has attributed his Nobel Prize winning discovery of the PCR chain-reaction to his molecular concepts with the aid of LSD ([http://www.miqel.com/entheogens/kary\\_mullis\\_lsd\\_dna.html](http://www.miqel.com/entheogens/kary_mullis_lsd_dna.html)) or in the case of Nobel prize winner geneticist *Francis Crick* who was said to be high on LSD, while discovering double helix ([http://www.miqel.com/entheogens/francis\\_crick\\_dna\\_lsd.html](http://www.miqel.com/entheogens/francis_crick_dna_lsd.html))? Did Kary Mullis and Francis Crick make those discoveries when they were psychotic and schizophrenic?

It is obvious that, LSD, and probably other psychedelics as well, induce extreme chaos in the consciousness compared to daily life's consciousness, however it should kept in the mind that it is also a kind of hurricane or a cyclone in the subconscious level, which probably connects different pathways of the brain and unfolds many novel consciousness levels, also, which are yet unfamiliar to us. The motto of a psychedelic experience should probably be "*different experience for every*





*different person and different experience, each time, for the same person!"*. Such drugs, of course, are very dangerous and not for everyone; and should not be used for the recreational purposes for anyone, since they can trigger an underlying psychosis or other psychiatric disorders very easily; however, that should not prevent science to investigate them to unravel many facts about consciousness and beyond-consciousness levels. Today's neuroscience is not at a level to comprehend how such complex "*door of perceptions*" are opened and how such a complicated universe is revealed to us through the attainment of H-ASCs.

**Question 2: Can it be possible that some hallucinogens make certain unknown functions of the brain manifest?**

To answer to this question is very difficult, since all the hallucinogens are controlled drugs, and it is challenging and difficult to investigate these drugs; and data coming from animal research on H-ASCs are very insufficient and inadequate to derive insights for explaining human behavior. Although there are some scientific studies on hallucinogens, they are not as much as the researches done on other areas of neuroscience and neuro-psychopharmacology.

Lately, DMT and DMT-like "*natural hallucinogen*" endogenous chemicals have been hypothesized to be secreted from certain areas of the brain, particularly from the pineal gland (Strassman, 2000); actually, DMT containing plant *ayahuasca* has been used in the shamanic rituals to induce trance states and mystical experiences in the Amazon for centuries (Krippner, 2011). This phenomenon is an important finding that the brain synthesizes its own hallucinogens and needs them (Halberstadt, 2012).

Brain also has its own cannabinoid receptor system (CB-1, CB2), to which THC binds, and there are endogenous cannabinoid ligands of these receptors, *anandamide* (arachidonoyl ethanolamide) and *2-arachidonoylglycerol*, which exert hallucinogenic effects and were hypothesized to take part in the mechanism of psychosis (Koethe, 2009). Cannabinoid receptors are mentioned to be taking part in the memory processes, and particularly "*forgetting*". However, no solid evidence has been presented that anandamide or endogenous

cannabinoids are totally responsible of endogenous psychosis, yet.

Not only cannabinoid system, but also other H-ASCs were also hypothesized to have a common pathway and similar neuropharmacological action that is effective in the development of endogenous psychosis (Ciprian-Ollivier, 1997). Similarly, endogenous DMT have been detected to be slightly increased in the urinary excretions of psychotic patients, however, the results were not statistically different than the controls (Checkley, 1980). Corbet et al. investigated the cerebrospinal fluids of 50 schizophrenic patients and 41 non-psychiatric patients for the presence of DMT and 5-MeO-DMT; although these methylated indolealkylamines (MIAs) were slightly elevated in psychotic patients, the results were not significantly different than the controls (Corbet, 1978). Other studies also failed to prove that endogenous DMT was *primarily* responsible of the development of endogenous psychosis (Murray, 1979; Ciprian-Olivier, 1997). Some of the new generation antipsychotics, such as clozapine, olanzapine and risperidone which have actions on 5-HT receptors, too, have also been hypothesized to be an evidence for MIA-mechanism of psychosis (Jackson, 1993); however, this area is still under investigation. The data from the related research is still controversial.

If the brain has its own endogenous hallucinogens for some biological reasons during the normal course of evolution, then there should be a reason why our brains need hallucinations, probably, just as in the case of dreaming and hypnosis! Also, it is very difficult to establish a single model of endogenous psychosis which is dependent on H-ASCs of endogenous origin. Science generally tries to explain all the phenomena utilizing only the available knowledge and scientific techniques. 100 years ago when some botanists classified and used those natural hallucinogens, they had no idea about neurotransmitters, 5-HT receptors, NMDA receptors etc. Novel discoveries in neuroscience may reveal many other mechanisms of actions of H-ASCs and the mechanisms of how endogenous psychosis develops in near future. Here human imagination and insight can be an effective determinant.



What if, the brain's learning and retrieving system has an "electromagnetic holographic structure" (Di Biase, 2009; Astakhov, 2008; Grass, 2004; Belyi, 1979 ) and what if, LSD is "neuroquantally" interfering with this holographic structure by means of some other yet unknown mechanisms, along with 5-HT<sub>2</sub> system? A hologram can easily create fractal, kaleidoscopic images which are perceived during an "LSD trip". The answer to this question could be discussed and speculated within or beyond the limits of today's neuroscience knowledge span, although this theory seems to be "science fiction", today!

There are three hypotheses:

- 1) H-ASCs are a form of psychosis, and there are common pathways of H-ASCs and endogenous psychosis.
- 2) H-ASCs can be regarded as psychosis in some ways, but there may be other aspects of H-ASCs, such as revealing some unknown functions of the brain.
- 3) H-ASCs are not exactly psychosis and are distinct from endogenous psychosis, although they may mimic some kinds of symptoms of psychosis. Neuroscience should investigate these hypotheses to find the truth, and animal models (mouse, rat, cat or none-human primate models) are not very appropriate to perform such research; because, first of all you cannot apply DSM-IV (or DSM-V, in 2013) criteria to a rat, a cat or a none-human primate to call the behavior as psychosis, which is a general term for human beings! Second, what researchers call psychosis in these models are some crude behavior patterns of animals induced by methamphetamine, PCP or LSD, such as altered stereotypic behavior, locomotor activity, social interaction, drug discrimination etc. Third, one cannot ask the tens of H-ASC effects listed in Tables 1-A, 1-B and 1-C to a rat, cat or a chimp to make any comparisons. How can a scientist determine and define a chimp's mystical experience, and unification feeling with all other primates and nature? Most of the H-ASC effects that are recorded until now, have unique correlations with the higher cortical activity of the *Homo sapiens* and human neocortex, and it is nearly impossible to test these effects in animal models. Fourth, no one knows what the animal is *really* feeling and seeing under the influence

of these hallucinogens, because of the lack of communication!

### **Question 3: If yes, one day will it be possible to attain some consciousness states without the ingestion of hallucinogens?**

Using hallucinogens is not the only way to induce ASCs in the human psyche. Prolonged meditation, sensory deprivation, hypnosis can induce similar consciousness states without the intake of any chemicals (Austin, 1999; Tart, 1990; Lilly, 1972). In some women, expanded sexual response (ESR) and expanded orgasms (EO) may mimic the acute effects of some hallucinogens for a very short period of time (Sayin, 2011; Taylor, 2000; 2002). For centuries, mystical experiences through yoga, Zen meditation, prayers have been cited to induce a kind of ASC (Muramoto, 2004; Wain 2007; Austin, 1999; Tart, 1990). Right temporal lobe and prefrontal cortex have been reported to be the important loci of mystical tendencies and abilities ((Muramoto, 2004; Wain, 2007; Saver, 1997). Naturally, the brain has its own capacity and tendency to perceive the environment, and universe in a mystical and philosophical perspective. Subjective "unification perception" between the self and the nature or universe; and transcending "the ego" can be, activated by some of these chemicals by means of an unknown mechanism, perhaps at the quantum level, as has been done in many religious and mystical groups or cults, such as Sufis, Zen Buddhists, Yogis, Taoists, for centuries (Table 3).

It is reported that the tendency of the human psyche increases for religious and mystical experience in schizophrenia, mania, temporal lobe epilepsy and brain tumors (Saver, 1997). It is also reported that the excessive activation of medial prefrontal cortex may induce mystical experience (Muramoto, 2004; Wain, 2007); also, fMRI studies of nun's mystical experience revealed that during such a trance right medial orbito-frontal cortex, right temporal cortex, right caudate nucleus were activated (Beauragerd, 2006); and cerebral blood flow was increased in prefrontal cortex and right temporal lobe during religious experience in the nuns (Newberg, 2003). Temporal lobe disturbances are mentioned to induce the individual's tendency for believing in and searching



paranormal phenomena (Pizagalli, 2000; Lavalley, 1992; Persinger, 1985). In the epileptic patients, who suffer from particularly temporal lobe epilepsy, many mystical delusions, hallucinations and mystical experiences have been reported, during ictal and interictal episodes, hinting that disturbances in the temporal lobe may impair normal consciousness and may induce a delusional or a none-delusional state of mystical encounter (Devinsky, 2008;

Devinsky, 2003; Ogata, 1998). Most probably, either during these neurological or psychiatric disorders, or during H-ASCs, the unknown tendency and capability of the human mind for mystical experiences are activated through uncertain and yet unknown mechanisms, which may be unraveled in a couple of decades in the near future.

**Table 3.** Religious imagery during an LSD trip among 206 subjects. Source: Peter Stafford, *Psychedelics Encyclopedia*, CA: Ronin Press, 1978; pp.89. Experiment made by Masters and Houston.

|  |      |  |      |
|--|------|--|------|
| Religious imagery of some kind                     | 96 % | Miraculous and numinous visions  | 60 % |
| Religious architecture, temples, churches          | 91 % | Galaxies, heavenly bodies, creation of universe, of earth and solar system | 14 % |
| Religious sculpture, painting, stained windows     | 43 % | Scenes from contemporary Christian, Jewish, or Muslim Rites                | 10 % |
| Religious symbols (cross, yin yang, Star of David) | 58 % | Ancient Greek, Roman, Egyptian, Mesopotamian, and similar rites            | 67 % |
| Devils, demons                                     | 49 % | Primitive rites  | 31 % |
| Angels   | 7 %  |  |      |

## Conclusion

As a summary, we have to determine the main characteristics of H-ASC as:

- 1-They induce extraordinary and inexplicable forms of consciousness levels in different human beings.
- 2-They may induce tens, or maybe hundreds, of unusual and baffling effects on the human psyche.
- 3-They are very unpredictable. Their effect differs from person to person; also the same dose of a particular drug may have different effects on the same particular person depending upon many factors.
- 4-They may mimic some effects of psychosis, however, this does not mean that all H-ASCs are simply another form of psychosis or schizophrenia.
- 5-Most of the hallucinogens tested are not like each other, and they have their own specific format of ASCs on human beings. Some of them are unique.
- 6-Current knowledge of neuro-psycho-pharmacology and neuroscience, *e.g.*, through known receptor and neurotransmitter systems, is not able to explain many of the mechanisms of the effects of H-ASCs.
- 7-Since H-ASCs have many astonishing and peculiar effects on the human psychology and consciousness, more detailed and extensive research on H-ASCs should be performed to unravel the mysteries of human mind and consciousness.

The reason that the full spectrum of effects hallucinogens that apply on the human

psyche and consciousness have not been studied much in the published medical literature is because of the illegal status they have had since the 1970s worldwide. In 1992, it became possible to study effects of hallucinogens in a context other than a drug of abuse to a limited extent; however, until recently, it was not possible to perform clinical human trials with those hallucinogens. Despite being able to do the research, the ethical concerns and “*bad reputation*” surrounding the study of these “*dangerous drugs*” prevented the implementation of the studies. Even as newer research is completed in the last decade, it was difficult to publish this work in peer-reviewed scientific journals, because not enough was known about the subject, and peers had no basis on which to review journal submissions. More research needs to be done carefully with scientifically rigorous methodology to support this developing field that is coming out in 21st Century.

We hope that such a conclusion, summary and comparison of H-ASCs in this article will have some impacts on the scientists and the law enforcement agencies to look into the field of H-ASCs with different perspectives and through different dimensions. Many mysteries of the brain and mind are hidden in the structure of *consciousness*; if the consciousness is solved, the brain and human psyche will be solved, too, including many mental and psychiatric disorders.





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