

INDIVIDUAL DIFFERENCES IN THE EFFECTS OF MESCAL

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Although a number of reports concerning the psychological effects of mescal (*Anhalonium Lewinii*) have appeared within the last forty years, in no case, as far as the present writer has been able to learn, have a number of subjects been given the drug at the same time and a comparative study made of their reactions to it. It is true that Prentiss and Morgan (5) as early as 1895 studied the physiological action of the drug and reported observations based on five subjects, one of whom was administered the drug twice. All of the five subjects experienced the unusual type of imagery characteristic of mescal but great individual differences were noted in the vividness, intensity, saturation, complexity, and duration of the visual phenomena.

The material about to be reported represents the by-product of another experiment, and, as such, is lacking the completeness which might be expected of data resulting from an experiment designed primarily to reveal individual differences in the effects of mescal. However, because of our relatively scant knowledge concerning the workings of this drug, it seems worth while to publish all available observations concerning it.

In conjunction with an experimental attempt to produce artificial chromaesthesia by the technique of the conditioned response,¹ five persons, including the writer, took doses of mescal in the hope that it might facilitate any latent tendency toward chromaesthesia which might have been established during the course of the experiment. Since each subject took the same dose and at the same time, and each kept a record of his experiences, it is of interest to note the individual differences appearing in their reactions to the drug.

Inasmuch as Klüver (4) has already published an excellent account of mescal and its characteristics, it is not necessary to include here a complete description of the drug or to review in detail its many interesting properties. However, in order that the reader may be in a better position to evaluate the material which follows, it seems desirable to state briefly some of the more important facts concerning this so-called "Divine Plant."²

"Mescal Buttons" or mescal beans are the dried tops cut from several species of the cactus *Lophorus* (*Anhalonium*). The drug has been variously named by different groups of Indians who use it in connection with certain of their religious ceremonies. It has been called mescal in practically all of the English scientific writings concerning it. Commercially it is known as "peyote" a derivative of the Aztec word "peyotl" which is an Indian word for "cocoon." The chemical constituents of the drug

¹The manuscript of this article is now in press.

²This characterization seems to have been used first by Havelock Ellis (1).

are somewhat uncertain, although its active principle is conceded to be an alkaloid.

When ingested in sufficient quantities an unusual train of phenomena results. The chief physiological effects are a lowering of the pulse rate and a state of indigestion often accompanied by headaches. The psychological effects are much more interesting, and, happily, more pleasant. The most predominant of these is the production of colored imagery, kaleidoscopic in nature, and varied beyond description. All colors, forms, shapes, and movements imaginable appear as hallucinations upon closing the eyes or upon entering a dark room. Another marked psychological effect is hyperaesthesia of certain senses, especially vision. Small bits of faded color are seen as brilliant splashes; faint sounds are unusually noticeable; and normally unobserved kinaesthetic sensations are so marked as to be annoying. A very marked hyperaesthesia is noted for the specific odor of mescal which, when one is not under the influence of the drug, has only a faintly perceptible scent.

Still another psychological effect of the drug, especially when ingested in large amounts, is a temporal and spatial disorientation (2). Because one experiences thousands of sensations which are normally below the limen of consciousness, time seems greatly extended. In some cases the perception of space is also distorted as it is by *hasheesh*, and objects often appear much larger or smaller than they really are.

These, then, are some of the experiences to which the five above-mentioned subjects might look forward. They will be referred to as Subjects A, B, C, D, and E (the writer). All were students of psychology and all were between the ages of twenty and twenty-five. Subjects A and B were female and the other three were male.

Although standard doses of the drug have not been determined, the reports of previous observers indicated that six buttons, or approximately 15 grams, would probably be sufficient to produce the imagery, and yet not enough to be at all dangerous to life or health. The buttons were mashed with mortar and pestle in order to make ingestion reasonably easy and were then swallowed with the aid of water.³ Three doses of 5 grams each were taken, each with about 8 ounces of water.

The first dose was administered⁴ at 2:10 P.M., at which time each subject

³After the first dose there is a hyperaesthesia for the specific and distinctly unpleasant odor of the drug, which often makes ingestion very difficult. The writer suggests that future experimenters take their doses in capsule form rather than as here described. It is possible that this method would serve to ameliorate the unpleasant physiological reaction of the drug without affecting the desired psychological reaction.

⁴I am indebted to Professor W. R. Miles of Stanford University for providing the mescal buttons and to Dr. Victor Hall, also of Stanford, for medical supervision of the experiment.

was provided with a notebook and instructed to keep a record of his experiences. At 3:05 all subjects entered a dark room and the C-major diatonic scale was played on a small piano-keyboard accordion. The second dose was administered at 3:10 P.M., followed by a second presentation of the tonal stimuli at 3:45 and a demonstration of the phi-phenomenon by means of flashlight bulbs. The third dose was given at 4:10. Subjects D and E also took a fourth dose of 5 grams at 5:10 and at 6:30 respectively.

All but one of the subjects were rewarded for their pains by gorgeous arrays of colored visions which vied with those described by previous investigators. For all but one, however, the shows were expensive, since all but the writer suffered from severe attacks of nausea. Unfortunately, Subject D, who did not observe visions of any kind, seemed to suffer more than any of the others. One is here reminded of the *Katzenjammers* suffered by William James (3), when he sought to make a personal study of the drug.

Let us now look at the records made by the five subjects while experiencing the effects of mescal. It is to be regretted that it is not possible to reproduce them in full, since in many cases attempts were made to draw the imagery experienced. However, the following excerpts from the records, arranged in a temporal sequence, present a fair picture of the reactions experienced by the various subjects and at the same time serve to emphasize the likenesses and differences in them. In all of the notebooks, including that of Subject D, who did not experience any unusual imagery, there is evidence of a marked lowering of motor coordination as indicated by a constantly decreasing clarity of handwriting, so great in some cases as to make it practically illegible. In reading the following excerpts it should be remembered that they were written by persons in a distinctly abnormal state of mind; otherwise, some of the remarks might seem very peculiar. They have been copied, practically as written, without any attempt to give them coherence or to correct grammatical errors.

Two additional points should be emphasized: First, that none of the subjects were trained in the technique of introspection. They merely tried to make some record of what they were experiencing. Secondly, and this is of even greater importance, it would be impossible for anyone, no matter how well trained, to describe, even orally, all of his experiences because of their profusion, their strangeness, and the rapidity with which they change. This inability to report and describe more than a fraction of what is experienced has been mentioned by every previous observer. Even Fernberger (2), who dictated his observations to a stenographer, found it impossible to describe all of his experiences. In the case of the present records, which were of necessity written by the subjects as they came in and out of the dark room, it is obvious that the accounts are woefully incomplete. Indeed, in many instances it will be seen that the entries represent merely

an attempt to summarize the experiences occurring in the preceding period of time.

With these reservations in mind, let us now proceed to an examination of the records. For the reasons already mentioned, the accounts of the individual subjects are presented not as units but have been dissected and rearranged in a temporal sequence. The figure on the extreme left shows the time of the notation (each subject had his own watch), while the letters A, B, C, D, and E indicate the subject making the observation.

2 to 3 o'clock

- A 2:10 Mescal has a slightly bitter alkaline taste (somewhat like acetanilid). The taste persists for a short while after taking the drug—around ten minutes.
- B 2-3 Writing a term paper.
- C 2-3 Taking an examination in neurology.
- D No comment.
- E 2:10 Rather bitter nauseous taste—perhaps a little like the taste of hay or ragweed.
- A 3:00 I feel a slight "weaving back and forth sensation."
- B 2:40 First begin to feel a strange calmness.
- D 2:50 Slight ache or pressure in or above eyes.
- E 2:50 A vague—almost imperceptible pressure sensation in temporal lobes.

3 to 4 o'clock

- A 3:05 As the scale was played I saw a pale light which wove back and forth seemingly with the vibrations of the notes. The light was of no special color—just ordinary daylight slightly cream-colored.
- B 3:00 Before scales—a blue triangle, with faint yellow background changing to red. Now mostly red sometimes shading into orange-yellow or into violet.
- C 3:05 Walking downstairs, felt like my calves were weak. Head feels dull and stomach not any too good. Feel as if I had been in a swing. A violet caudate nucleus to the wall and corner of ceiling. Hazy as notes are played.
- D 3:05 No colors seen in dark-room. Note E guessed same as one heard 1000 times yesterday—actually note A.
- E 3:05 Upon entering dark room—a very slight purplish tint in extreme right periphery of visual field.
- A 3:10 Have a slight headache in upper occipital region. Rather a dull lopsided sort of pressure. A cigarette is normal in taste.
- B 3:20 Started writing letters. Feel slightly excited and slight waves of numbness if I stop to think about it.
- C 3:10 Two more buttons. My stomach—Oh! How can I take two more buttons.

- D 3:10 In dark-room. Feel restless, especially in legs.
Positive after-images yellow just like light bulbs.
Same thing yesterday with blue lamps.
- E 3:25 The dull pressure in the temporal lobes has become more general
and a slight headache is noticeable.
- A 3:40 Went into dark-room. Feel slightly "stewed" also a slight
nausea. Everyone but me seems rather silly.
B giggles all of the time.
- B 3:35 Woozy to walk. People seem to talk slowly.
A little round cell, blue with pink center and green border—
now all a pinkish purple.
Blue field with 3 pink flowers with yellow centers, changing
to pinkish-blue or blue with pink center.
- C 3:35 Concentric circles of blue and purple.
Regular Fourth of July fireworks, white lights began falling
then violet, blue and green. Moved down to the floor and under
the chair. As I looked up—two equilateral triangles, one with
blue balls at each corner, the other with green ones at the same
place.
- A 3:50 Oh—I'm sleepy. Writing is rather difficult.
- B 3:50 Very apathetic—others are too.
Phi-phenomenon as usual. Afterwards, a blue triangle, then a
violet and a green one. Bubbling paint pot splashing out con-
centric rings of violet and green of 2 shades.
Feel cold.
- C 3:45 Two violet blue eyes, one in each corner of the room.
Change—pronto—green egg in the middle, hazy at first and then
it came toward me.
Everything but my stomach seems funny.
Phi-phenomenon was terribly irritating.
On looking out of window, note that dark lines are violet and
spaces are blue. Note too that I am having an awful time with
spelling.
Fish with lurid sparkling eyes—violet and green scales.
Even as I write, I can see violet behind my eye lids.
God help my stomach—it is near the third button.
- D 3:50 No spontaneous images. No unsteadiness in writing noticeable.
- E 3:45 After-images of light bulb usually brilliant.

4 to 5 o'clock

- A 4:10 Third dose was horribly nauseating. The mescal has a decided
odor now where it didn't have before. Motor co-ordination is
not so good.
- B 4:10 Finished taking about 1 button when lost most of all taken be-
fore—a light purple and yellow windmill. Then the whole field
filled with scribbles. Amphitheatre of four tiers, each going
in different directions—light blue. Then suspension bridges—
ad infinitum.
Strings of all colors. Beads—yellow-green. A giant spider web.
Huge flower made of blue china plates. Colored plumes. Rain-
bow spirals.

- C 4:10 Taking that third dose was harder for me than anything I ever have done. If I can only keep it down.
My eyes at present feel as if they were turning up and in. Paper is turning greenish, now back to colorless again.
Have a terrible headache. Have body sway when I try to walk. Have green outlining my fingers. Everything on outside of my vision is green.
- E 4:00 Odor of mescal very noticeable and nauseous for first time.
- A 4:40 I feel nauseated. Geometric design of light color—a slight tinge of green is noticeable through—later same design with dots of blue. Now a curtain—descends and rises gradually. I I feel awfully nauseated.
- C 4:22 Eating green mint. It tastes like spinach with a ticklish flavor. Gee—the time is going slowly. I feel nervous instead of calm, feel like doing something, dancing or anything. Face feels terribly hot.
- 4:30 On looking out of window—most beautiful violet clouds. Feeling like sitting here forever—much calmer now. Paper a beautiful violet. Oh—feel so tired. Ain't we kids? Concentric circles—awful dirty red.
- D 4:50 After ten minutes in the dark—first feeling of nausea. About 30 seconds later, a very slight rhythmical lighting of black field in periphery.⁸
- E 4:45 Motor co-ordination badly upset—very difficult to write.
- 4:48 Green fir tree—like an after-image. Spiderweb spinning in a clockwise direction.

5 to 6 o'clock

- A 5:00 Bird's nest with 4 eggs in it and after a little they hatched into blue forget-me-nots. Worm with green and blue on edges. Jagged flowers on end of the worm. Gold bands like canals. Moist hands—saliva normal. Saw a katy-did. Long line of nude ladies with long eye lashes. Butterfly with eyes and changing colors. Cats coming down. Background hard to define, but figures perfectly distinct.
- B 5:05 Feel rather numb. Awfully hard to think of words for things. Hard to comprehend what people mean. Flowered caterpillars, green and purple like printed calico. First they were like cactus, then started to wiggle and move. Yellow corpuscles with red dots streaming in certain streams. Rainbow snakes, fishes and monsters seem to come out of nothing. Colored wires wriggling. Merry-go-round on top of water turns into figures which sway back and forth. Monkey faces with rainbow halos—rainbow trout and other fishes in hordes. Balloons, embroideries, dancing daisies, 2 hippotomi kissing. Halo flashing different faces each time.

⁸This was the sole experience on the part of Subject D of anything that might be called unusual visual imagery.

- C 5:00 Snake of violet and scarlet red with eyes closed. Stomach is very unsettled—feel as if I had a lump in my stomach. Skin feels (gosh—but that word is getting me) dull. Huge red lips with white teeth shining through. My face is burning up.
- D 5:10 Seventh and eighth buttons. Strong impulse to vomit, which disappeared as such after two or three minutes. No colors in dark.
- 5:15 A new wave of nausea.
- E 5:15 Green chipmunk. Large yellow tulip—shot like a cannon releasing a gorgeous fountain of colors.
- A 5:30 (Could no longer write. Following written by fellow student who was observing the experiment.) Musical scales produced imagery of cones, concentric circles receding to vanishing point, revolving clockwise, faster with higher notes. Pine trees. Corpuscles of color, frogs, snakes. Restless—secretions increase. Colors appear bright. Feel like running after all colors. First saw red stripe in a suit. See distant objects clearly. Inhibitions loosened. Red line around letters at first glance. To read is nauseating. Swallowing loud and disturbing. Main desire—to get it over. Feel far from floor. Glance at colored cards—colors are alive—when eyes are closed colors seem to pulsate. Notice red quickly. Upon closing eyes one enters another world; one forgets what he has just spoken; coherence suffers; speech is an effort.
- C 5:30 Hanging out of window—so sick. And keep seeing a parrot that's red with green beak. Sombrero with blue beads for trimmings grew into wigwam with blue beads around flap door.
- D 5:45 Another very extreme wave of nausea.

6 to 7 o'clock

- C 6:00 Everything is in shades of purple and they are running around. The clouds out of the window seem to be made up of islands of purple. A cathedral window which I saw previously had beautiful individual designs—blue squares inside of circles of orange. White triangles inside of black polygons and they were all so clear and distinct and fitted together to form an immense window.
- D 6:15 Vomited. Looked deathly pale according to others. Then lay on a couch for about an hour and felt better but quite weak. Never any images or colors. Cold sweat.
- E 6:30 Fourth dose—5 grams. Very nauseous to smell and could hardly swallow it.

7 to 10 o'clock

- A 7:00 Badly uninhibited at dinner. Cup of chocolate seen as pond and spoon as green frog jumping in pond. Extremely humorous. Great difficulty in walking.
- B 8:00 Home. Tastes are insignificant. Sugar and salt have no taste at first—then slowly appearing. This perhaps due to dryness of mouth. Cracked wheat bread has lost most of its flavor. Cookies taste faintly sweet.

- Pimento cheese, very mild. Fish salad—repulsive. Ate two pieces of bread and cheese, toasted, a piece of bread and a cookie. Aside from lack of taste—not repulsive. Things are hard to do, e.g., cut bread and put away things.
- C 8:00 Still very nauseated but feel sane. Purple still covers everything.
- 8:20 No more purple—see colors naturally now.
- E 7:00 To dinner in a cafe with Subject A and an observer. Quite uninhibited—acted as if drunk. Ordered a small steak, french fried potatoes, lettuce salad and coffee. Foods tasted only as they first touched the mouth, then became flat tasteless masses—must chew for a long time and even then swallow only with effort. No taste of salt. The steak looks simply magnificent—extremely large and so prettily set off by bright green lettuce leaves. Not hungry—eating seemed unessential as compared with visual experiences. Tail lights on cars and neon signs simply fascinating. All colors, especially red seemed to have an hypnotic effect. Eyes constantly searching for colors. Tiny colored threads in clothing stand out so sharply that cloth appears striped. All noises greatly amplified. Small noises (rattle of car) sound like breaking glass. No nausea—extremely happy. Continual kaleidoscopic visions—especially with eyes closed. Predominated—a whirl of incandescent globules or jewels of every color and description—sometime moving in one direction and sometimes in the other. Jewels hanging on ceiling extending indefinitely into space. Time greatly exaggerated. Cried and laughed on slightest provocation.
- B 8:30 Drove back to laboratory. Driving is exhilarating. I have good control. Colored things stand out somewhat more than usual.
- 9:15 Into dark-room. Visions persist. Playing scales or notes does not change them. After-images are beaded. E swings a cigarette and we see a ball of fire following it. This convulses us, especially E. Later—drove home and tried smoking a cigarette—very mild. Inhaled and felt woozy. Tried to read but it is very slow. Things seem funny.
- E 8-10 Smoke curtain of scarlets, reds and violets. The drinking fountain appears as a flowing rainbow. Sense or illusion of general hyperaesthesia. Chromatic aberrations of white light greatly over-emphasized. Many images of the general nature of coiled tubes with small particles of all colors moving in all directions. Violet predominating color, but all colors are seen.

Remainder of the Night

- A 11:00 To bed, but could not sleep all night because of vivid visual imagery and the loudness of ordinarily unnoticed sounds. Bad stomach pains which seemed beautifully colored and which became brighted in color as the pain increased. A very restless night.
- B 11:30 To bed. Stayed awake until twelve-thirty seeing gorgeous colors, floral designs, beaded dresses, embroidered runners, colored balloons, fires, dancing flowers, etc.

- C 12:30 Had to get out of bed to get my note book for no sooner did I get in bed than I started seeing colored things all over again. Saw the most striking Japanese paper-prints, the colors changed, first a bird of paradise—the tail feathers changed to green then red. Then Fujiama only the snow part was in baby blue. I certainly never heard the clock strike so loudly. Noises just as I imagined always that ghosts would make when I was a child. Lights off.
- 1:15 I am now sure that the noises were in me and not in the room or outside. Rasping clicks—now the sound of rushing water. Lights off again.
- 1:45 Had to turn off lights again. My stomach has seemed like a bubbling cauldron—it feels as if it were radiating heat. I never felt anything so peculiar. Lights off.
- D 11:45 To bed and to sleep about twelve-thirty. No images at any time. Slept soundly until 7:30. No dreams remembered.
- E 11:00 To bed. Could not sleep until three A.M. because of imagery on closing eyes and hearing of many ordinarily unnoticed sounds. Definite synaesthetic tendencies. Imagined could see all parts of body by moving them. Extremely conscious of kinaesthetic sensation on moving joints. Also seemed to hear noises in my body.

Next Morning

- A Next day—tired and still seeing imagery whenever eyes were closed. Slept next night as usual, but still occasional imagery on the second day after taking mescal.
- B 6:00 Awake, felt pretty well.
- 7:30 Up, very tired. Breakfast tasted fairly normal tho' a little pale. Don't get visions any more. Not shutting eyes from light any more.
- C 7:00 Woke up this morning feeling fairly good—not particularly tired but a little wobbly on my feet.
- 10:00 Got whirls of dirty red in dark-room. Nauseous at times second and third days.
- E 6:00 Awake—no nausea, headache or images. Eye balls slightly tender. Occasional dull pain in head throughout the day. Taste normal. Smell unusually acute, especially odor of mescal in the room in which the experiment was conducted.

In spite of the relative crudity of the above records, it is evident that significant individual differences appeared in the subjects' reactions to the drug. Perhaps the most striking was the failure of Subject D to experience any unusual imagery of any sort although he did experience the usual physiological reactions. Next should be mentioned the almost complete absence of a physiological disturbance (headache, nausea, etc.) on the part of Subject E although he took an extra five-gram dose of the drug. Nevertheless, he experienced psychological effects as markedly as any other member of the group. The third important individual difference which appeared was the radically different duration of the

effect ranging from the relatively sudden disappearance of the visual effect in Subject C to the recurrently appearing images on the second day in the case of Subject A. It should be mentioned here that Subject A shows a decided tendency toward eidetic imagery and also that she was in a rather fatigued physical condition at the time of the experiment.

The wide variation in the actual imagery reported by the subjects was of course to be expected. Perhaps the most significant observation here is the similarity of certain aspects of the imagery. All of the subjects reported blue or purple as the most predominant and most often re-occurring color and all (although some did not record it in writing) remarked about the prevalence of concentric circles (spider-web formations) in their visual forms. Also of interest is the fact that all of the four subjects reported seeing small colored animals of the "Mickey Mouse" variety, and it was suggested that this might be the result of each member of the group having seen a film of this type on the previous night. This explanation, in terms of recent experience, is hardly satisfactory since there was a marked absence of squares in the subjects' imagery, yet all had seen thousands of colored squares in the course of the conditioning experiment. The writer is more inclined to attribute such similarity of imagery to suggestion, since the subjects were together and were constantly discussing their imagery with one another.

Still another interesting effect of the drug should be mentioned: the markedly increased duration of the positive after-images previously noted by Prentiss and Morgan (5) and also by Fernberger (2). Although no attempt was made to study the phenomenon scientifically,⁶ the notation made by Subject B at 9:15 in regard to the cigarette calls it forcefully to our attention. There was, however, no noticeable effect on the perception of the phi-phenomenon.

As stated at the beginning of the paper, the material here reported was only the by-product of another experiment. The varied observations secured from this group of five subjects may serve to emphasize the possible usefulness of mescal as an agent of research in the field of visual phenomena. The unpleasant physiological effects of the drug as well as the possible physical harm which may accompany its repeated ingestion by the same subjects tend to make its use somewhat precarious, but it does seem to offer unique possibilities along certain lines of investigation.

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⁶The writer was under the influence of the drug and consequently was in no condition to devise suitable elaborations of the experiment.

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THE INFLUENCE OF SOME ANTIPYRETIC DRUGS ON LEARNING*

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The problem concerning the influence of antipyretic drugs is one on which little previous investigation has taken place. Since these, and other similar drugs, are used by many persons at different times without regard to their effect other than relief, an investigation of the possible effect of these antipyretics upon the rate of learning is justified.

The effects of antipyretics were first studied by Münsterberg (9), and later by Macht, Isaacs, and Greenburg (7). Both studies were concerned with psychological reaction-times. Münsterberg found that antipyrin and quinine lengthened the time. The doses which he used, however, were exceedingly large. Macht, Isaacs, and Greenburg found that all the antipyretics with the exception of quinine retarded reaction-times. Therapeutic doses were given.

Lashley (5, 6), using strychnine and caffeine, reports that the former in small doses has little or no effect upon habit formation in rats. Large doses, however, give incoordination of movement but, at the same time, accelerate learning. Caffeine, on the other hand, in doses of 0.5 mgm. or more, retards the learning in direct proportion to the size of the dose.

The aim of this study is to investigate the effects of aspirin and quinine upon the rate of learning nonsense syllables.

There are two groups or types of antipyretics. The first of these is made up of aspirin, antipyrin, acetanilid, acetphenetidin, pyramidon, and salol. These are known as antipyrins. This type of drug causes vasodilation and directly increases the heat loss. The second group is made up of quinine and its compounds. These are distinguished from the antipyrins by lessening heat production by direct action on various metabolic processes in the tissues.

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