

EFFECTS OF ALCOHOL ON VERBAL
PERFORMANCE

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EFFECTS
OF
ALCOHOL ON VERBAL PERFORMANCE

By
PETER HARTOCOLLIS

A THESIS

Submitted to the School of Graduate Studies
of Michigan State College of Agriculture and Applied Science
in partial fulfillment of the requirements
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Department of Psychology

1954

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AN ABSTRACT

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Donald W. Johnson

One difficulty in studying the effects of alcohol on intellectual processes is the difficulty of identifying intellectual processes and separating one from another. One psychological function may be facilitated by alcohol while another is inhibited, but if both are confounded on the same test, the results will not be clearcut. From the results of several recent factor analyses one can select a variety of fluency tests that are similar in requiring the production of words but different in degree of restriction on production. The experiment reported here began with the hypothesis that fluency tests which differ in degree of restriction will be differentially affected by alcohol.

Four tests were prepared in several forms, all of which required the production of words. The principal variation in the tests was the degree of restriction on the words to be produced.

Thirty experimental subjects took a pre-drink series of tests, then a drink calculated to induce a moderate alcohol effect, then a post-drink series of tests. Thirty matched control subjects followed the same procedure except that the drink was non-alcoholic.

In general alcohol reduced fluency of production of words. An exception occurred on tests of a moderate degree of restriction, such as naming trees. The experimental subjects relaxed their standards of conformity and, since all plausible responses were counted, actually made slightly higher scores than the control subjects. This is probably what happens in social situations where alcohol is said to increase fluency.

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I. BACKGROUND OF THE PROBLEM

A. Introduction

Although unaware of the existence of ethyl alcohol as such, men have long been using it and have been subject to its effects. It is found among beverages of all known cultures. Having at first served as a means of allaying problems, alcohol soon became a problem itself; its use acquired moral and religious implications. In our world, the problem that the use of alcohol presents can hardly be overestimated.

But alcohol is more than a social problem: it has become a controversial issue among those who believe that its effects, when not used in excess, can be beneficial to its users, and those who claim that alcohol's desirable effects are only illusory, the result of exaggeration and misinterpretation.

During the last fifty years there have been a series of attempts to attack the ancient issue experimentally. The effects of alcohol on psychological functions and performance, starting from the simple reflexes and going up to performance presumably involving higher levels of neural integration, have been studied. Various conclusions as well as theories concerning alcohol's action have been advanced. According to the most prevalent theory, the so-called "reaction-level" theory, alcohol is a general depressant but acts by affecting the central nervous system progressively from the higher centers downward; in doing so, it depresses the inhibitory control of the higher centers

upon the reflex mechanism to such a degree as to overshadow the direct depressing effect upon the reflex mechanism itself. Hence the popular impression that alcohol stimulates the organism and facilitates performance.

Yet it is not only performance on the level of the simple reflexes, according to the popular contention, that is facilitated. The claim refers to the so-called "higher" mental processes and thinking as well. Some literary people have expressed their conviction in practice and theory that alcohol is an agent that helps to bring about inspiration while, on the other hand, the layman has resorted since ancient times to alcoholic beverages in order to secure more fluent verbal expression. The well-known saying "bending the elbow loosens the tongue" is an expression of popular opinion regarding alcohol and its effects on verbal performance.

By an extension of the reaction-level theory, psychologists have tried to account for the alleged facilitation of fluency. They postulate a decrease in inhibition for which frontal-lobe centers and, in general, the phylogenetically newest part of the nervous system are held responsible (19). Yet the fact is that the effect of alcohol has never been tested in relation to the degree of fluency. The furthest that anyone has ever gone in this direction is Hollingworth (13) with his attempt to study the effects of alcohol on the "higher complex motor mechanism of speech." He reported rather unreliable results. A propos, it seems traditional with experiments that deal with the effects of alcohol on psychological processes that the results are more or less doubtful.

The present study was undertaken with the conviction that adherence to a sound methodology along with the use of a reasonable system of constructs could produce results that are clear-cut and useful in an area of theoretical as well as social importance, such as the study of the effects of alcohol on verbal performance.

B. Review of the Literature

1. Effects of Alcohol on Functions Analogous to "Lower" Types of Neural Integration

a. Sensory-motor capacity. The early experimental work with alcohol in psychology, following the trend of the times, concerned itself with the motor and sensory capacities. Among the first in this country, Dodge and Benedict (7) studied alcohol's effects on such a simple motor ability as the rapid to-and-fro movement of a finger. Using a group of five young men as subjects they found that a dose of 30 c.c. of alcohol produced an average decrement of three to four per cent. Miles (22, 23), who repeated the experiment, reported substantially the same results. Dodge and Benedict tested also for speed and accuracy of eye movements and they reported that their five subjects were found to be 2.5 per cent slower following a dose of 30 c.c., and even more affected after 45 c.c. Again Miles confirmed their results. The latter also studied performance on the pursuit meter and the pursuit pendulum (a device consisting of a pendulum out of which came a stream of water that the subject had to catch up in a cup). The pursuit pendulum was employed to test muscular co-ordination for short periods. Miles (23) reported that performance of eight subjects on both the pursuit meter and the pursuit pendulum deteriorated markedly about 85 minutes after the ingestion of

almost 30 c.c. of alcohol. In another experiment the same worker measured the swaying movements of a person standing upright with his feet together for two minutes. After about 30 c.c. of alcohol, an average increase in wavering of about 20 per cent was found.

A detrimental effect on efficiency that involved a series of such motor capacities as rate of tapping, steadiness of hand, and eye-hand co-ordination was reported by Hollingworth (13) who tested for all of these using six subjects and standard doses of about 40 and 80 c.c. of alcohol.

More recently, Lahy (18) gave a series of psychomotor tests to seven subjects. Five of them were tested following the administration of enough alcohol to produce a concentration in the blood of 0.5 per cent; the other two received enough alcohol to bring about twice as high a concentration in their blood. Both doses were calculated in terms of the subjects' body weights. All tests were repeated three times at thirty-minute intervals for a total of six hours following ingestion. According to the reported results, simple auditory reaction time became slower and less accurate, recovery reaction time slowed down, and individual control of the two hands deteriorated also. But neither deterioration nor improvement could be proved for strength of grip tested by means of a dynamometer as the results were too variable.

The effect upon muscular work has been investigated chiefly by means of the ergograph. More than once, alcohol was reported to have facilitated performance on the ergograph, or not affected it at all. Thus among the earlier workers in the field, Kraepelin (see 19) reported improvement, while Rivers (30), first in the records to try to control

for suggestion by disguising the alcohol with a flavoring mixture, found that doses up to 20 c.c. had no appreciable effect on the ergographic records of his two subjects. When 40 c.c. were given, one showed a slight increase and the other a slight decrease in the work performed. Somewhat later, Vernon (39) claimed that the ergographic performance was not appreciably affected even with 60 c.c. of alcohol.

The effects of alcohol on typewriting have been investigated by several workers. Miles (23) used five professional typists in a series of 44 experiments (half with and half without alcohol) and found that following a dose of 21 to 42 grams in 22 per cent solution, speed of writing decreased only by three per cent. Rivers (30), using a range of alcohol doses from 5 to 40 c.c., could find no appreciable effect on typing ability.

Performance on a typewriter along with two more psychomotor tests was used by Eggleton (8) in a recent attempt to study the effects of a mild dose of alcohol on central nervous activity. He reported disturbance of central nervous system function was influenced not only by the absolute concentration of alcohol, but also by the rate and direction of change. The typewriting test was performed by one subject, while for the other two tests (a dotting machine test and a "distraction machine" test) three subjects were used.

Regarding alcohol's effects on sensory capacity, Dodge and Benedict (7) reported that sensitivity of the skin to electrical stimuli was reduced, while the threshold increased following the standard dose of 30 c.c. of alcohol. Miles (22), however, when he repeated the experiment, found the opposite results.

Mullin and Luckhardt (25) tested for cutaneous sensitivity to touch and pain. Using the von Frey technique, they performed twenty-five experiments on ten subjects. Regions of the skin tested before the ingestion of 60 and 75 c.c. of alcohol were tested again every half hour for two and a half to three and a half hours following the ingestion. The results showed that sensitivity to pain was diminished, and more markedly so under the larger dose. A short period of increased sensitivity to pain was usually recorded immediately following the depression caused by alcohol. But there was practically no effect on sensitivity to touch.

Miles (23) reported that visual acuity was impaired when a small dose of alcohol was used.

b. Reflexes. The effect of alcohol on reflexes has also been subject to early wide research that has served as a springboard for the comparative study of more complex psychological processes.

One of the first reflexes to be studied under the influence of alcohol is the knee jerk. Dodge and Benedict (7), confirmed by Miles (22), reported that the patellar reflex latent time increased while its amplitude decreased following the ingestion of 30 to 45 c.c. of alcohol. In particular, 30 c.c. of alcohol on six subjects increased latency of the reflex 9.6 per cent, and diminished amplitude by 48.9 per cent; 45 c.c. on the same subjects impaired reaction still more. Travis and Dorsey (37), on the other hand, using five subjects and doses of 40 and 60 c.c. of alcohol, found that the latent time of the patellar reflex decreased rather than increased. Finally, Tuttle (38), using a dose equivalent to 50 c.c. of whisky, reported differential results with

subjects classified according to their previous experience with alcohol. Thus, the patellar amplitude was increased with occasional drinkers as subjects, but it was reported as inhibited with habitual drinkers.

Among the other reflexes that have been studied, the eyelid reflex to noise was investigated by Dodge and Benedict (7), who photographed the shadow of the eyelashes on a moving strip of paper. Amplitude of the reflex decreased while its latent time was augmented following a standard dose of 30 c.c. alcohol. In a later series of experiments, Miles (22) confirmed these results.

Scheffield (31) studied the effects of increasing doses of alcohol (15, 30 and 45 c.c.) on the "ocular adjustment to an environmental situation of moving objects," the so-called optic nystagmus. Five subjects, serving as both experimental and control group, were used in the main experiment. A tendency for alcohol to disturb the ocular adjustment was reported, with the experimenter himself concluding: "... to suggest that the results of this investigation indicate anything more than interesting trends would be unwarranted."

The influence of alcohol on conditioned reflexes has been studied with animal and human subjects. In a well controlled experiment, Gantt (9) studied alcohol's effects on the conditioned salivary response of dogs. On the assumption that conditioned responses represent a cortical level of the nervous system while unconditioned responses represent a subcortical level, he conditioned the salivary reflex to sound. Using doses ranging from 0.5 to 4 c.c., he found that the conditioned response showed a more marked tendency to decrease as the dose was increased, more so than the unconditioned response. The magnitude of the change in both

cases was a function of the size of the dose. These results were interpreted to mean that "functions mediated by the cerebral cortex are generally more disrupted by alcohol than those at lower levels."

Working with human subjects, Mead (19) showed that a simple conditioned reflex like finger conditioning was likely to be affected by alcohol later (at a later time) than performance in tasks that presumably represented a higher type of neural integration of mental activity. Mead contends that his results support the view that "the release of lower centers from cortical inhibitions may permit the simultaneous appearance of intellectual impairment without corresponding reflex detriment."

2. Effects of Alcohol on Functions Analogous to "Higher" Types of Neural Integration

Most of the performances or functions mentioned so far have been studied in conjunction with other performances that are supposed to represent more complex or higher levels of neural integration.

Testing for what they considered to be simple intellectual abilities, Dodge and Benedict (7), in their pioneer study already referred to several times in this review, found that the free-association verbal responses to the Kent-Rosanoff list (for six male subjects under the influence of the standard dose of 30 c.c. alcohol) was not changed in either latency, associative category, or frequency. They also found no effect on the ability to learn words when presented one letter at a time backwards.

Hollingsworth (13) conducted an extensive study of the influence of alcohol on psychological processes. He employed six subjects on full-day

programs of tests, and administered on alternate days two kinds of commercial beer: one that contained alcohol (a standard dose of 39.4 c.c. in three bottles) and one from which the alcohol had been extracted. Besides testing for the motor processes mentioned earlier, Hollingworth attempted to study the effect of alcohol on the "higher complex motor mechanism of speech," by using a color naming test; this last consisted of naming orally a hundred small squares of color, twenty each of red, blue, green, yellow and black, printed in random order on a card. After using two doses of about 40 and 80 c.c. alcohol each, he reported some loss of the function corresponding to the increase of size of the dose. However, the change in performance from control to experimental was not large enough to be considered reliable, especially in the case of the smaller dose where any change appeared only in three out of the six subjects used in the experiment.

Hollingworth's battery of tests included abilities involved in the naming of opposites, adding, and substitution. He also tested for immediate memory by the method of paired associates. A dose of 39 c.c. alcohol resulted in an average net loss of memory of 13 per cent. Yet Miles (24) has reported that a dose of 30 c.c. of alcohol improved memory.

Another experimenter who tested for memory was Cattell (5). He employed fifty subjects, twenty-five men and twenty-five women -- one of the largest groups ever to be used in an experiment dealing with alcohol's effects on humans. About two thirds of the group were students, nineteen to twenty-five years of age. The rest were widely chosen and included eight middle-aged persons.

The subjects were divided into five groups, each containing five men and five women. Each subject took doses of 12.5 and 25 c.c. mixed with a standard lemonade solution. Memory ability was tested by a method of writing answers to sets of general information questions. For the fifty subjects the average memory score after 12.5 c.c. was a little lower than normal, while 25 c.c. produced about twice as large a decrement. But the difference between experimental and control (days without alcohol) results are hardly any larger than their probable errors and, moreover, the score decrement is to be attributed mostly to the effect of the alcohol on the women.

Cattell tested also for intelligence, using five equivalent I.Q. tests composed of items or questions that were selected from older tests. Included were such items as analogies, synonyms, inferences, etc.; each test required a little more than an hour to finish.

Cattell claims that "a dose of 20 grms. of alcohol lowers the intelligence quotient and diminishes the power of recalling past experience." But in reality his results are in the direction of improvement rather than loss of both intelligence and recall following the nominal dose of 12.5 c.c., while the loss was only one per cent after 25 c.c. As Miles (24) points out, Cattell did not base his conclusions on the general results, but rather on the finding that "there was similarity within each of four families represented by two or more persons, and there was also striking contrast between the separate families."

Seward and Seward's (32) often cited experiment showed that what these workers defined as the "process of judgment" was not affected by a moderate dose of alcohol. Probably the first to administer it in

terms of the subjects' individual body weight, Seward and Seward used a dose of alcohol amounting to approximately 65 c.c. for an average 150-pound person. The experimenters' main goal was to determine the relationship between alcohol effect and complexity of mental task. Complexity was defined in terms of three variables: length of problem, task and practice. They actually tested for (a) syllogistic judgments of several degrees of complexity; (b) immediate reproduction of syllogistic material of varying length; and (c) speed of reading comprehension of syllogistic material. Summarized, their results read as follows: (a) no general effect on judgment could be established; (b) some impairment in reproducing syllogistic material became evident; (c) reading time was increased in proportion to the complexity of the printed material. In trying to account for the disappointing inconclusiveness of their results, the authors suggested an interpretation in terms of the "obscuring influence" of extraneous variables and the "availability of compensating neural mechanisms."

Seward and Seward make specific mention of an increase of variability under alcohol that they encountered in their results. In summing up the situation, they point out that a similar increase of variability "was reported by Kraepelin for addition and syllable reading," and "was also suggested by Kurka as an interpretation of the interference of alcohol with learning nonsense syllables. Miles found that alcohol increased variability in speed of typing."

Indeed, increase in variability of performance following the drinking of small or moderate doses of alcohol seems to be a common occurrence in the reports of all generations of experimental psychologists. Rivers

and Miles agreed that variability increased greatly for most of the tests that they studied, including typewriting. Hollingworth, Cattell and others have pointed to such an increase of variability under alcohol in discussing the non-significance of a large part of their results.

In one of his earlier works, Miles (22) studied the effects of 30 c.c. of alcohol on a code transliteration test, known as the Johnson Substitution Code Test. When the test was applied to a single trained subject "under varying conditions," a decline of seven per cent in efficiency was found; when used on eight untrained subjects the average decline of efficiency was found to be four to five per cent.

Much later, Mead (19), in the study mentioned earlier in this review, attempted to examine the effects of a moderate dose of alcohol on two types of performance which, presumably, involved different levels of neural integration. He compared the effects of a standard dose of 30 c.c. of alcohol (disguised in a mixture of grape juice and water with oil of peppermint) upon simple conditioning and upon a symbolic mental process consisting of the learning of an artificial language. Like Miles, he used only a few subjects ($N=6$), a practice that he himself deplors. His results showed no effect on conditioning, while the learning of the artificial language proved to be more susceptible to deterioration from alcohol. Mead himself concludes: " ... after assuming that the symbolic ideational type of performance involved in the artificial language test is of a more intellectual nature than that involved in the finger conditioning, and granting that these activities are roughly equivalent to 'higher' and 'lower' types of neural integration, then we have here another instance of alcohol affecting

intellectual types of ability before reflex or motor performance." He considered his results to be opposed to the view that the less intellectual activities of the organism are affected first by moderate doses of alcohol, and to be supported by Mead's view as to the interplay between thalamus and central cortex in that alcohol tends to make a subject a "thalamic" rather than a "cortical" organism.

C. Criticism Related to Scientific Theory and
Past Experimental Work With Alcohol

Poffenberger (28), after a brief review of the experimental literature of alcohol's effects on psychological processes, seems to be convinced that the drug is a depressant. Yet in a concluding statement, he goes on to say that "every function that has been measured in the laboratory, from the simple reflexes to the process of judgment, shows this depression, if there is any reliable trend at all."

In other words, he admits that all there is is a trend (toward showing alcohol to be a depressant) and not a very reliable one.

Indeed, one might have more to say about the methodology of these studies of alcohol than about the results.

The scientific contribution of these studies may be evaluated in relation to four standard criteria listed by Preston (29): "(a) the definition of its concepts; (b) the logic with which such concepts are used; (c) the suitability of the test of the theory to the requirements of the theory; and (d) the conduct of the test of the theory."

But experiments that deal with the effects of alcohol on psychological processes seem to defeat themselves in more than one of the above points. Thus, in failing to secure adequate controls, they violate the

1. The first step in the process of creating a new product is to identify a market need.

2. The next step is to develop a concept that addresses the market need.

3. The third step is to create a prototype of the product.

4. The fourth step is to test the prototype with potential customers.

5. The fifth step is to refine the product based on customer feedback.

6. The sixth step is to create a business plan for the product.

7. The seventh step is to secure funding for the product.

8. The eighth step is to manufacture the product.

9. The ninth step is to distribute the product to customers.

10. The tenth step is to monitor the product's performance in the market.

11. The eleventh step is to make adjustments to the product as needed.

12. The twelfth step is to continue to market the product.

13. The thirteenth step is to evaluate the product's success.

14. The fourteenth step is to plan for the future of the product.

15. The fifteenth step is to repeat the process for future products.

16. The sixteenth step is to continue to improve the product.

17. The seventeenth step is to continue to market the product.

18. The eighteenth step is to evaluate the product's success.

19. The nineteenth step is to plan for the future of the product.

20. The twentieth step is to repeat the process for future products.

21. The twenty-first step is to continue to improve the product.

22. The twenty-second step is to continue to market the product.

23. The twenty-third step is to evaluate the product's success.

24. The twenty-fourth step is to plan for the future of the product.

25. The twenty-fifth step is to repeat the process for future products.

last point about proper conduct of the test or experiment. Jellinek (15), in preparing an inclusive review of the literature, has reported that among "nearly two hundred psychological investigations that have been carried out on the effects of alcohol on psychological functions," one-fourth employed just one subject, and this subject was frequently the investigator himself. In most of the experiments that he came across only two or three subjects were used. And "only sixteen per cent of all the investigations had twenty subjects or more."

On the other hand, in the experiments where the subjects outnumbered the experimenters, the handling of the subjects and of the alcohol were such as to make for "a very crude experimental method." (15) Jellinek again makes the point that in a majority of the experiments that he reviewed, the dose of the alcohol was an absolute amount rather than a proportion of the subject's weight, body surface, or other such function known to be related to alcohol concentration in the blood and degree of intoxication. This, according to the same critics, would be enough to explain why individual differences in the effects of alcohol appear to be so great and results so inconclusive.

Besides inadequacy of controls, the suitability of the test of the theory to the requirements of the theory has been doubtful if not altogether erroneous in the majority of the experiments that dealt with alcohol. Workers in the field have talked about mental processes which they had tried to track down by means of miscellaneous tests (naming opposites and adding figures) or traditional faculties such as memory and judgment, the latter defined in terms of symbols substituted according to a code.

But the mere accumulation of facts is not enough to establish a relationship between them (e.g., their lawfulness) even though it may be true that those facts belong to the same area of interest, or that they pertain to the same problem. For the relationship among facts is determined by the definition of the problem itself to which these facts should be shown to be relevant, and not just related.

To define mental processes in terms of more or less arbitrary tests is not only meaningless but also dangerous, often leading to false generalizations. Yet if the right to generalize on the basis of experimental results is denied to the scientist, there can be no lawfulness or any possibility of building up a model system.

Careful planning -- with a clear definition of the concepts themselves, a consideration of their appropriateness to the problem under investigation, and the suitability of the tests used to measure these concepts -- is necessary, before any serious attempt to test a theory can be made. The conduct of the test of the theory is, of course, hardly of less importance.

It seems that the problem of the effects of alcohol on mental or other psychological processes has been looked upon mainly from the angle of the independent variable, the alcohol. Its composition has been thoroughly discussed, and lengthy accounts of the physiological and psychological implications likely to be encountered in its study have been made, regardless of whether any of these variables have been considered or not in the actual experiment. But with respect to mental processes, most experimenters seem to take for granted that they compose a unity which is understood and homogeneous. Yet it is obvious

that the differentiation between "mental" and "non-mental" or "higher" and "lower" processes has been made on the basis of the anatomical parts of the central nervous system which they involve, a differentiation that may have a doubtful origin in the question of consciousness when "the dualism of mind and body was accepted as basic truth." (3, p. 38)

But it is conceivable that mental processes may differ from each other in several important respects. Thus they may involve different physiological substrata, or they may be genetically of a lower or higher order; furthermore, they may manifest themselves in a complementary, supplementary, or contrasting manner.

Another way of differentiating among them might be in terms of specific manifestations that would be defined by way of some operation. This seems to have been the main basis of differentiation among mental processes that most of the older experimenters have been concerned with.

A memory test, an arithmetic test, or a vocabulary test could serve, perhaps, as an acceptable basis of differentiation in a study where the objective is a mere analysis into elements; it would be of no help, however, if one were to attempt a synthesis into a functional, systemic totality.

It seems that studies that make their differentiations in terms of the traditional faculties, considering also the question of hierarchy (a crude and empirical one) among mental processes, have come closer to a synthetic approach. Yet, as long as the concepts remain as arbitrary as the obsolete faculties or the tests that represent them (define them), the logic of such studies is destined to fail when it comes to the point where these concepts have to be related, generalizations to be

made and a theoretical model built up. The appropriate method of induction is inadequate when the concepts at hand are not well defined, while the deductive method would be not only inadequate but entirely impossible, as long as the theoretical a priori formulation is missing.

In short, any theory or even hypothesis about the effects of alcohol upon mental processes should consider both aspects of the problem, namely: the alcohol as well as the mental processes, both in a unified theoretical scheme to which the investigated variables are inherently related, clearly defined, and well controlled.

II. THE PROBLEM

A. Introduction

Several classifications of the thought process have been undertaken so far. As Johnson (16) points out, nearly all of them, "whatever the method of classification, have included, in some way or another, the production of varied responses." Such an agreement comments indirectly on the importance or centrality of the process of production within the psychology of the higher mental processes. Moreover, in association with the subject of alcohol, the concept assumes the special importance of a social issue. Finally, production can be defined objectively, and thus treated experimentally. For these reasons the production process was selected to be the basal concept of the present investigation, which was meant to contribute to the study of the effects of alcohol on the thought process.

Continuous association of responses produced copiously, with the set remaining constant, could serve as the operation that would define the basal mental process of productivity or "production process." It has been suggested (16) that "emission or production of responses" may be a more preferable term than "continuous association." Responses may be simple or complex, good or bad, verbal, manual or locomotive. The production of verbal responses has been termed "fluency" by the British.

Continuous production of words may be restricted in a variety of ways. The subject may be asked to name birds, countries, or uses of

some object. By thus specifying the kind of words to be produced, various degrees of restriction may be introduced.

It is expected that with a minimum amount of restriction the flow of words will be plentiful, yielding a number of responses directly related to the extent of the subject's vocabulary. But with restriction of words becoming gradually more severe, the production process would tend to differ more and more from the original basal process. Such a change has been demonstrated in factor analytical studies, where change in the direction of increased restriction has resulted in a transition from one factor to another. Several abilities, all verbal but having different factorial loadings, have been identified by a number of investigators.

Thurstone (34) describes his word fluency factor (W) as "the ability to produce words in accordance with some restriction, as distinguished from the ability to understand words when they are given in a test." He has demonstrated, in analyzing a battery which included several kinds of verbal tests, that "word fluency" could be separated more or less from "verbal comprehension" as measured by vocabulary tests.

Thurstone's factor W (Word Fluency) was split by Taylor (33) into two factors: word fluency (W) and "ideational fluency" (F). Word fluency, as defined by the same author, is the "facility in producing single, isolated words that contain one or more formal restrictions, without reference to the meaning of the words." Ideational fluency, on the other hand, is described as "a facility in expressing ideas by the use of words and their meanings." According to Taylor, factor F is "similar in some respects to, but also is rather different from,"

Carroll's factor E, described by its author as "an associational facility with verbal material where the only restriction is that the responses must be syntactically coherent." Carroll (4) had earlier subdivided Thurstone's Word Fluency (W) factor into A and E factors, the latter factor corresponding to fluency under a high degree of restriction.

Finally, Johnson and Reynolds (17), who approached the problem from a different theoretical angle, succeeded in isolating a factor of fluency of words under minimal conditions of restriction, which they called "flow of responses" (F), and another that corresponded to a process of selection of words, a factor to which they gave the descriptive title "selection of responses" (S). *

Conditions affecting the output of words have been studied. As for alcohol, it is supposed to operate indirectly, increasing fluency by decreasing inhibition. But there seems to be no direct evidence for such a hypothesis, that is to say, evidence relevant to the validity of the interpretation that the hypothesis attempts, or to the truth of the statement about alcohol's effect on fluency.

B. Hypothesis

The problem of the present study refers, essentially, to the influence of alcohol on verbal performance. The specific question was

* Inasmuch as the hypothesis that led to the differentiation of the two latter factors aimed at describing dynamically the process of problem solving, any study that deals with the mutual variation of the two factors, fluency and selection of responses, may contribute to the topic of problem solving itself. But a discussion of the implications of such a relationship can wait until the test of the basal, fundamental processes as proposed has been carried out.

asked: does alcohol facilitate or, on the contrary, inhibit verbal performance and the processes that underly such performance?

On the basis of relevant studies, it was accepted (1) that fluency, or the production of verbal responses, is the ability corresponding to a process central among those that underly verbal performance; and (2) that fluency can be made to stand for a series of more or less distinct processes, depending on the degree of restriction that would be placed upon the production process. These are processes that factor analysis has identified and, allegedly, isolated.

The problem may thus be rephrased as a test of the effects of alcohol on fluency under several degrees of restriction.

Assuming that alcohol reduces inhibition, the following hypothesis was advanced:

Alcohol inhibits production of words (fluency) in direct relation to the degree of restriction placed upon the production process.

Obviously a test of this hypothesis must be arranged in such a way that the effects of irrelevant variables, such as practice and suggestion, can be controlled.

III. METHOD

A. General Plan

In order to eliminate extraneous factors that might invalidate the apparent effects of the alcohol, a number of precautions were taken. These included the following points: selection of tests representative of specific identifiable mental processes; adequate control records of these performances; elimination of suggestion; selection of the most appropriate dosage; and allowance for the proper interval between alcohol administration and test performance.

Furthermore, incidental problems -- the duration of the effects of the alcohol, individual differences in susceptibility to it, habituation or the development of a tolerance to the drug -- were considered and every effort was made to keep these variables constant.

B. Subjects

A total of sixty subjects, equally divided into an experimental and a control group, was used in the experiment. This population was selected according to a plan that aimed at the control of variables related primarily to the use of alcohol. For the purpose of securing better controls, the subjects were matched on the basis of some of the variables that were considered most closely related to the use of alcohol.

1. Selection of the Subjects

Primary factors in the selection of any population in the test of a psychological hypothesis usually are age, intelligence, health, and often, sex. In the present case the population was selected on the basis of the following variables:

a. Age. Certain age limits were set up in advance, namely, a range from 21 to 36 years of age, inclusive. The decision on the particular range was dictated by the desire to deal only with individuals who would be likely to have reached maturation, both mental and physical, and who had not passed the prime of life.

b. Health. The health of the subjects was a major concern in the selection of the experimental population. For, even when there is no great risk to the subject's welfare, the course of the experiment itself might be upset by factors related to the state of health, the bad or peculiar functioning of some organs or system. Therefore the conditions were made that (1) subjects with known heart, liver, or metabolic disorders, (2) subjects with digestive disorders, and (3) subjects about whom there might be a question of mental disturbance, present or past, were to be excluded from the experiment. To safeguard the experimenter and the institutions under the auspices of which the study was conducted, all subjects were requested to make a specific declaration as to the state of their health, and to sign a release (see appendix) to the effect that they would not raise any claims regarding complications of any sort that might result from participation in the experiment. No such complications arose.

c. Intelligence. Although not crucial in the case (since every subject's alcohol performance was to be judged on the basis of his own pre-test performance), the variable of intelligence was controlled by the fact that all subjects were or had been students, the majority of graduate status.

d. Sex. It will be recalled that Cattell (5) found that alcohol produced a larger decrement on the recall test-scores of his women subjects than of the men. To avoid any complication or implication that the sex variable might introduce into the study, an exclusively male population was employed in the experiment.

e. Tolerance. Habituation to the use of alcohol does not seem to have any effect on the rate of absorption, but may be important in developing a tolerance to the drug that is likely to influence the behavior of the individual (27).

The points at which the various brain centers succumb seem to be constant and variable for all individuals in the final phase of intoxication. However, in the initial stages, human subjects show a wide variation in behavior. This has always been a puzzling aspect of alcohol's effects on the organism, and scientists have repeatedly tried to explain it by advancing elaborate theories and hypotheses such as an acquired tissue tolerance (27), or a specification of the liver function which in the tolerant subject gives priority to the oxidation of the alcohol while carrying on its other tasks secondarily (6). Others prefer a psychological explanation, according to which the experienced drinker knows what to expect and therefore, by anticipating the effects of alcohol, he is able to compensate for them; but the

inexperienced drinker with the same concentration of alcohol in his blood becomes overwhelmed (1).

In an attempt to meet the problem of tolerance, all prospective subjects were asked to define their experience with alcohol by checking one of the four categories used by Dodge and Benedict (7) in their pioneer study. They were asked to check whether they considered themselves "abstainers," "casual," "moderate," or "heavy" drinkers. Furthermore they were asked to define these categories quantitatively in terms of drinking occasions in a month's period and kind of preferred drink. (See appendix.) Then, "abstainers" and "heavy" drinkers were excluded from the experiment, while the remaining "casual" and "moderate" drinkers were matched accordingly.

2. Grouping of the Subjects

It has already been mentioned that the subjects finally selected for the experiment were equally divided into an experimental and a control group. The use of a control group was made in order to meet, primarily, the variable of learning or practice effect. Assuming that chances for practice were the same for both groups, experimental and control, the effect that might result from it would tend to cancel out mutually.

A second reason for using a control group was the necessity to hold constant the variable of suggestion, namely, the possibility that a change in performance after the ingestion of alcohol might be due to the idea rather than the substance of the drink.

The details concerning the variables of learning and suggestion and their controls are presented later in this chapter under the appropriate headings.

3. Matching of the Subjects

To secure better controls, especially in the case of variables commonly believed to be crucial in the study of the effects of alcohol on psychological processes, the subjects were matched one by one. The variables that presented themselves for consideration were:

(a) hour of the day that a subject ingested the drink, (b) tolerance, (c) age, and (d) body weight. Of these, hour of the day, tolerance and age were considered more thoroughly, while body weight was taken to be of less importance in the matching effort, since it had been already taken care of in the determination of the dose of the drink (made in terms of individual body weight).

The matching procedure can be described briefly as follows: As soon as a subject became available for the experiment, he was classified on the basis of his past experience with alcohol. Within each of the newly formed classes of casual and moderate drinkers, the subjects were then matched in terms of age, with some regard to body weight. The two groups that emerged from such a subject-by-subject matching were assigned to experimental sessions with alcohol, and control sessions without alcohol. These sessions were arranged into three periods of the day -- morning, afternoon and evening -- and followed a light meal by at least two hours. The same number of experimental and control subjects were scheduled at equivalent hours of successive days.

All subjects had been informed that they were to be given alcohol, but they did not know how much or under what conditions.

For a list of the variables and their respective weights in the experimental and control populations, the reader is referred to Table I.

C. Selection of Tests

According to the theory underlying the problem, the tests should conform to two main conditions: (a) they should represent one basic kind of mental process, namely, the production process; (b) they should vary from each other according to only one dimension, that of restriction. In other words, they should reflect or measure things that lie on the same continuum.

Factor analytic studies have made use of a wide variety of fluency tests, and have analyzed their relationships in some detail. From the results of these studies it is possible to select or construct fluency tests to meet the requirements of the present study. Four degrees of restriction were considered: (a) fluency with minimal restriction (virtually unrestricted); (b) fluency with some restriction; (c) fluency with moderate restriction; and (d) fluency with severe restriction.

1. Test I

To measure fluency with minimal restriction Test I was selected. It is an item from the ten-year level of the Stanford-Binet Scale that asks "to name words, any words at all" for three minutes. The test has been found to be factorially loaded with "fluency-unrestricted" (Johnson and Reynolds' "flow of responses" factor). Responses to be made can be, theoretically, as many as the extent of the subject's vocabulary would permit.

TABLE I
COMPOSITION OF EXPERIMENTAL AND CONTROL GROUPS

	Experim.	Control
N	30	30
Tested in Morning	10	10
Tested in Afternoon	10	10
Tested in Evening	10	10
Casual Drinkers	19	17
Moderate Drinkers	11	13
Mean Age	28	27
Mean Weight (lbs.)	164	168
Time of Ingestion (min.)	8.2	3.8
Faculty Members	3	4
Graduate Students	26	25
Undergr. Coll. Students	1	1

2. Test II

Test II was expected to introduce some restriction in the study of fluency, as it limits the number of available responses to words beginning with a particular letter. Such a restriction might be expected to cut down the number of potential responses by at least ten-fold. (Actually, the number of responses, compared to the number given in Test I, was cut down only by half.)

Test II has been used by Thurstone in studies aimed to discover the Primary Abilities (36). The four letters (S, P, M, and T) suggested by Thurstone as equivalent were adopted to serve as the stimulus letters in the four alternative forms of the test called for by the design to be discussed further on in this chapter.

Before the adoption of the four Thurstone letters, a count of the words beginning with various letters in ten different dictionaries of the English language was made. Two of the four letters, S and P, gave the largest word counts in all letters in the English alphabet. The other two, M and T, were not far behind.

After being adopted, the four letters were combined into pairs that promised to yield approximately equal word counts. Thus S combined with M occupies an average number of approximately 31 pages in the ten dictionaries surveyed; P in combination with T amounts to an average of approximately 26 pages. (The idea of combining the four letters into equivalent pairs will be made clearer when the experimental design is presented.)

The time limit for each form of both tests discussed so far was finally set at three minutes. This was thought to be long enough to

make the tests reliable. Also, a period of three minutes was short enough so as (a) to avoid possible distraction of attention to be expected especially in subjects under the influence of alcohol, and (b) to prevent the element of frustration from entering the experiment. For, in a preliminary experiment conducted without the use of alcohol it was found that, by the time the three minutes expired, most of the subjects had arrived at a substantially lower rate of production.

3. Test III

For the third category, fluency under "moderate restriction," Test III, similar to the "ideational fluency" tests used by Taylor (33) was adopted. To meet the need for four equivalent forms the following pre-test was conducted.

Six terms representing common classes of objects were administered to a group of 54 college students who were asked to name as many members of these classes as they could in two minutes. When the results were assessed, the four categories of Birds, Trees, Vegetables, and Articles of Furniture were found to yield approximately equal numbers of responses and almost identical standard deviations. These categories were adopted for Test III. Quadruped Animals and U.S. Cities, the other two categories in the preliminary test, although found to command the largest word counts, were rejected for two reasons: (a) they yielded so many more responses than the two next categories; and (b) they seemed to introduce hardly any more restriction than Test II, "fluency under some restriction." In fact,

the pilot study mentioned earlier showed that in some cases the two rejected categories elicited even more responses than the "some restriction" of Test II !

The four categories selected were again combined into pairs according to the same principle applied in the combination of the four stimulus letters of Test II.

The four categories were defined by the given term in each case, and no further restriction was imposed. Each individual subject thus set up his own standards.

4. Test IV

Finally, for the restricted-fluency category, the completion tests of the 1940 and 1943 editions of the American Council on Education were used (35). Composed of thirty items each, both tests ask for a word to fit a given definition. But in order to be acceptable the word should begin with one of five letters attached to the respective definition.

Sample:

A place or building for athletic exercises.

C D G H T

The versions of the years 1940 and 1943 were preferred over the more difficult alternatives of older dates which not only restricted the meaning and the first letter of the required word, but also the number of its composite letters.

Johnson and Reynolds (17), who studied a similar "restricted completion" test (the Completion test of the 1931 A.C.E. examination),

found it to be loaded with the "selection of responses" factor, indicating a high degree of restriction.

5. Instructions

As soon as a subject entered the experimental room, he was asked to seat himself comfortably on a couch next to the experimenter's chair. After a few social minutes the subject was then addressed with the following instructions:

This is an experiment that involves alcohol. We are interested in studying the effects of alcohol on verbal abilities, so the whole thing will be oral. Now, if some of the tests don't appear to be very meaningful, don't you worry. First I want you to name as many words as you can until I call time. Any words will do. Let's have a trial of half a minute and see if you have any questions. Ready, go ahead.

(After thirty seconds:) Stop. That's the idea. Now let's do it for the real thing. You may repeat any of the words that you used in the practice -- any words at all, until I call time -- go ahead.

If the subject asked whether he could use sentences, he was discouraged from doing so with the explanation that, although naming sentences was within the rules, such a procedure would not be to the subject's advantage since a sentence counted as a single response. But unless he particularly inquired, the subject was not confronted with any more restrictions than those involved in the main body of the instructions. This was true for every test. In the rare case in which, after he had begun, the subject attempted counting or naming words in a series, he was promptly interrupted after the third consecutive response with the remark that "counting or series doesn't count."

The instructions for Test II were as follows: "Now I want you to name words beginning with S (or M, P or T, as the case happened to be) until I call time."

In Test III the subject was asked to name birds (or vegetables, or trees, or articles of furniture).

Finally in Test IV the subject was asked to read each problem of the thirty-item test aloud and give the answer orally -- thus providing the experimenter with evidence that the subject was, at least outwardly, occupied with the relevant item. (Each item was typed on a separate card to avoid confusion, and all cards were bound together in the form of a notebook, after the example of the Picture Completion Subtest of the Wechsler-Bellevue Scale of Intelligence.) Opportunity for practice was offered beforehand in two examples as given in the instructions of the respective ACE tests.

The policy of keeping all performance on an oral level was observed throughout the experiment (pre- as well as post-test series*) in an effort to avoid any spurious or secondary restrictions that might result from the effect of alcohol on non-mental processes such as hand-coordination in writing, and presumably higher mental processes such as correct spelling of the produced words.

6. Scoring

The score customarily used in studies of continuous production of words (tests of fluency) is simply the number of words produced in a standard period of time.

* The expression "pre-" and "post-test series" refers, of course, to pre- and post-alcohol tests. In the case of the control group, while there was actually no alcohol, the same expression was used. This was done in order to simplify the presentation of the experimental design and of the comparative results.

Names, expressions or sentences composed of more than one word counted only as one response -- as a single word. Such instances (picked from those that occurred during the experiment) are "red shoes," "anticipatory goal response," and "I am tired." That the subjects themselves considered such complex responses as individual responses was apparent when several of the subjects immediately after giving a complex response broke it down to its composite words. Composite words were counted when such a separate breakdown was made.

In all but Test IV, the important thing was the quantity of the responses, not the quality. Even in Test III, where the subjects were required to name words belonging to a certain category, all but plainly extraneous responses were accepted as valid. It was reasoned that if a subject was too liberal with one category, he would be likely to show the same tendency in the rest, thus serving as a control of his own performance.

The question whether to score repetitions or not seemed to refer to the nature of the fluency ability itself, to which the case of alcohol was expected to add one more intricate aspect. By definition the problem under study pertains to the production process rather than to any reproduction process. Provided that the subject understood and accepted the rules, it should be quantitatively immaterial whether his responses were new (in the sense of being produced for the first time in the particular test) or repeated ones, as long as the subject did not repeat deliberately. But where the repetition of a response was deliberate and only then, the underlying process should be considered one of reproduction rather than production. As for a differentiation

between production and reproduction this could be made on the basis of the intervening mental effort, namely, whether the subject was spontaneous or not in making a response. For, as long as he responded to the agreed rule, any attention to the partial condition of the prohibition of repetitions, whether resulting in avoidance or in employment of the repetition, would be undesirable as irrelevant to the issue. Such reasoning dictated that, while to repeat intentionally the same response could not be acceptable, the unintentional reproduction of a response (a response that the subject came upon spontaneously) should be considered legitimate and be accepted as if it were an original production.

It would not, perhaps, be so simple a matter to determine whether a reproduction was spontaneous or not. Hence, and in order to avoid any further complications of the problem, the rule was made to accept repetitions as original productions as long as they were given after an interval of at least five consecutive responses following the response in question, and to reject responses within the same interval. Such a rule would also tend to make the records of the performance more reliable.

7. Practice Effect

Exactly three decades ago Meyer (21), reviewing the contemporaneous literature, expressed the opinion that the "higher intellectual processes" had actually never been studied, all attempts to do so having been nullified by the inability to get rid of the learning curve. Although there has been some improvement since that time, the problem remains with most studies as long as they use an insufficient number of subjects and as long as they fail to employ reliable measures

of performance that are unaffected by practice so that pre-alcohol and post-alcohol scores can be compared.

In the attempt to secure good reliability of the measurement employed in the experiment, four alternative forms for each of the three tests of "fluency under restriction," discussed earlier in this chapter, were adopted. In this way the possible effect of practice resulting from the repetition of the same tests four times was expected to be eliminated.

It seems that there is no way, however, of devising alternative forms for Test I, of the unrestricted (minimal restriction) fluency. To smooth out performance in Test I, a short (thirty seconds) practice trial was introduced just preceding the test, and it was left to the design itself, calling for a control group, to take into account the practice effect, if any.

D. The Drink

1. Dosage

The nature of the test performances selected for the study seemed to contraindicate the use of a large dose of alcohol. The reason is that the study of verbal abilities involves more than the process of production -- with which the present investigation was primarily concerned. Among extraneous processes and abilities involved, hand coordination in writing and correct spelling have already been mentioned. These were eliminated by the fact that all performance was kept at an oral level. However, what Hollingworth has called the "higher complex motor mechanism of speech" remained as a factor, and the only way to control it seemed to be through the use of a dose of alcohol that

would not affect speech appreciably. Also, large doses would probably depress all functions, masking the differential effect under investigation.

The history of past experimentation with alcohol could serve as a guide in selecting the dosage appropriate to the problem. A review of the literature showed that the dose used in a good number of previous experiments fluctuated between 30 and 60 c.c. for an adult subject of average weight.

On the other hand, more practical considerations suggested that the dosage be such as to produce a degree of intoxication comparable to that commonly observed in everyday life, and described by the traffic laws with the label "under the influence." Such a dose could render the results more meaningful for the argument presented in the introduction, the one involving popular and scientific belief as to the effects of alcohol on human performance.

Based on such considerations as the above, a plan was finally drawn up, calling for a moderate dosage of alcohol to be administered orally. As for the exact amount, this was to be based on theoretical premises regarding degree of intoxication, the latter defined operationally in terms of standards set up by relevant authorities such as the American Medical Association, the National Safety Council, and generally accepted traffic legislation. Thus, on the basis of chemical tests, three ranges of alcohol concentration in the blood, corresponding to degree of intoxication, were established. These are as follows: (a) a range of from 0 to 0.05 per cent alcohol in the blood, corresponding to sobriety or no intoxication; (b) a range of from 0.05 to 0.15 per cent alcohol

in the blood, which would establish a person legally as being "under the influence"; and (c) the range from 0.15 per cent and up, for which intoxication is a reality beyond any statistical doubt. It takes a concentration in the blood of as high as 0.3 to 0.4 per cent to produce severe intoxication (10).

Berry (2) is of the opinion that 0.10 per cent of alcohol in the blood is enough to include most drinkers in the category of "under the influence." Hence, the mid-point of the middle range in the official classification of alcohol concentration in the blood was set up as the goal for each experimental subject of the present study.

The dosage of alcohol that would raise the concentration in the blood up to the decided point of 0.10 per cent was then calculated in terms of the body weight of each subject. For, body weight is known to have a definite relation to the amount of the body fluid that in turn determines the extent to which alcohol is eventually diluted after absorption. On these general premises, and in line with a more specific discussion found in Haggard and Jellinek (12), a formula for the determination of the experimental dose was worked out as follows:

About 72 per cent of the body fluid, in which the alcohol is gradually distributed evenly, is made up of water; blood, by being more fluid than other tissues, contains about 90 per cent. Therefore, when all of the alcohol is distributed, the blood should contain about 1.25 times as much per unit as the rest of the body. In order to attain an alcohol concentration of 0.10 per cent in the blood, one should divide the latter figure by 1.25. By multiplying the resulting figure by the

body weight of each subject one could derive the required dose of alcohol in pounds and then convert it into cubic centimeters.

With body weight of either experimental or control group covering a range of from approximately 110 to 210 pounds, the size of the alcohol dose employed in the experiment ranged from approximately 40 to 80 c.c. To prevent possible irritation of the membranes of the throat and stomach, a 20 per cent solution was prepared according to a formula to be presented later in this chapter. The resulting drink varied in total quantity from approximately 200 to 400 c.c.

For the sake of convenience, a table of alcohol doses was made up in advance showing, in ounces and cubic centimeters (c.c.), the dosage required to raise alcohol concentration in the blood up to 0.10 per cent for body weights ranging from 110 to 200 pounds. This table is included in the appendix.

2. Control of Suggestion

Control of suggestion may be achieved in two ways. First, by concealing the existence of alcohol in the experimental drink, that is, ruling out the knowledge of the alcohol. Second, by preparing a control drink that would have the sensory characteristics of the experimental drink, i.e., by holding "knowledge" of the alcohol constant. In other words, while in the first case the suggestion of alcohol would not even enter the situation, in the second, suggestion, by being equally present in both experimental and control situations, could be ignored in the final results.

The first solution, that of keeping the subject unaware of the alcohol's existence, presented the most attractive alternative. Yet,

except for one instance of intravenous ingestion (26), there is no example in the literature of a drink or preparation which, while containing alcohol, could be administered without arousing the subjects' suspicion as to its true nature. Even in the hypothetical case in which the subject could be convinced that the experimental drug contained no alcohol but rather something else, this "something else," named or not, might exercise a non-physiological influence as difficult to control as the suggestion of alcohol. Therefore, the second alternative followed by the majority of previous investigators, that of preparing a control drink readily accepted by the subjects as alcohol, and one without lasting physiological effects due to alcohol or any other of its ingredients, was adopted in the present study.

Mixed proportionally, for a total determined (as already described) in terms of each subject's body weight, the experimental drink was made out of the following ingredients: one-fifth absolute (100 per cent) ethyl alcohol, one-fifth water, three-fifths grapefruit juice, and one or two drops of oil of peppermint.

In the control drink the alcohol was replaced by water for a total of two-fifths of water and three-fifths of grapefruit juice, in which one or two drops of oil of peppermint were also added to give it a burning taste somewhat similar to that of alcohol. The drink was served ice-cold.

This preparation follows closely another formula reported by Mead (19), and was successful in fooling all but one or two of the thirty control subjects into believing that they were given alcohol.

E. Procedure

1. The Period Before and Just After the Drug Administration

The interval between drug administration and test performance is crucial inasmuch as it is related to the state of the organism during the post-test performance following the administration of alcohol. The determination of the appropriate interval depends on several factors in the mechanism of intoxication and needs to be controlled. A discussion of these factors, arranged in accordance with the sequence of the events that leads to intoxication, follows.

a. Food Intake. Thirty to forty per cent of the ingested alcohol is absorbed directly and rapidly through the walls of the stomach; the rest is taken care of by the intestines. Absorption of alcohol by the intestines occurs as rapidly as it passes from the stomach. The presence of food in the stomach at the time the alcohol is drunk not only slows down absorption from the stomach but also delays passage into the intestines. Therefore, all subjects (and regardless of their experimental or control status) were asked to observe the condition of eating nothing for a period of at least two hours before they appeared for the experiment. The addition of an interval of thirty minutes, called for by the experimental design (namely, the interval occupied by the pre-test series of tasks preceding the administration of the drug) would make for a minimum of two and a half hours, a total that should be considered adequate for absorption by the stomach.

b. Psychological Conditions. With all drugs it is found that human susceptibility to intoxication is variable between large limits.

6

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Even the same individual may react differently at different times. Changes in alcohol tolerance under influence of a certain mood or attitude have been discussed by Meerloo (20) with the help of actual case histories. Very little is known of the physiological background and mechanism of this varying behavior under different emotional states, except perhaps for the case of excitement.

Disturbance of the autonomic balance of the organism due to excitement may change the concentration of the alcohol in the brain (by changing the concentration of alcohol in the rest of the body). In particular, release of adrenalin as a result of stimulation or excitation produces vasoconstriction in striated muscles while it does not affect the capillaries of the brain; this brings about a higher concentration of blood and, consequently, alcohol in the brain.

However, such an effect is rather temporary since adrenalin is rapidly destroyed by the body; as a consequence the constrictor action of the vessels soon disappears, and blood concentration in the brain returns to normal. On the other hand, it has been shown that the dose of adrenalin necessary to produce any significant effect is by far greater than the amount released in the body under stimulation or excitement (14). All this would tend to minimize the importance of the emotional factor in the case, except for the fact that the emotions of the subject may have a grave impact on his motivational state; and the latter can never be overestimated in a case where psychological variables are involved.

Therefore, every precaution was taken to keep the subjects relaxed and well motivated throughout the experiment. They rested on a couch,

were provided with an interesting occupation whenever they were not busy with the tests, and an attempt was made to avoid emotional situations such as frustration and excitement as far as possible. The experiment was conducted in a small room with only the experimenter present.

c. Environmental Conditions. Where there is not enough oxygen in the air, alcohol is poorly tolerated, because the latter forms a compound with hemoglobin in the blood that needs an optimal oxygen pressure in order to break down (20). Temporary changes in tolerance to alcohol may also be affected by temperature and other environmental conditions. Therefore, care was taken to keep the environment constant, with good air circulation, comfortable temperature, and elimination of outside noise. Furthermore, opportunities for visual stimulation were kept down to a minimum and in all cases fairly constant.

d. Administration of the Drink (Rate of Ingestion). Upon being given the drink, the subjects were requested to drink it "as rapidly as is convenient."

The amount and the taste of the drink made the drinking difficult for some subjects, especially for members of the experimental group who, on the average, took more than twice as much time as the control group (see Table I).

e. Waiting Period. Three picture books were used during the experiment to keep the subjects occupied during the thirty-minute interval between pre- and post-test periods. The selection of the particular

1. The first step in the process is to identify the problem or issue that needs to be addressed.

2. The second step is to gather information and data related to the problem.

3. The third step is to analyze the information and data to identify the root cause of the problem.

4. The fourth step is to develop a plan of action to address the problem.

5. The fifth step is to implement the plan of action and monitor the results.

6. The sixth step is to evaluate the results and make adjustments as needed.

7. The seventh step is to document the process and results for future reference.

8. The eighth step is to communicate the results to the relevant stakeholders.

9. The ninth step is to review the process and make improvements as needed.

10. The tenth step is to ensure that the problem is resolved and the system is functioning properly.

11. The eleventh step is to provide ongoing support and maintenance to the system.

12. The twelfth step is to conduct regular audits and reviews to ensure compliance with standards.

13. The thirteenth step is to maintain accurate records of all activities and results.

14. The fourteenth step is to ensure that all personnel are trained and qualified to perform their duties.

15. The fifteenth step is to establish a clear chain of command and reporting structure.

16. The sixteenth step is to ensure that all activities are conducted in a timely and efficient manner.

17. The seventeenth step is to ensure that all resources are properly managed and utilized.

18. The eighteenth step is to ensure that all activities are conducted in a safe and secure manner.

19. The nineteenth step is to ensure that all activities are conducted in a transparent and accountable manner.

20. The twentieth step is to ensure that all activities are conducted in a professional and ethical manner.

21. The twenty-first step is to ensure that all activities are conducted in a consistent and standardized manner.

22. The twenty-second step is to ensure that all activities are conducted in a flexible and adaptable manner.

23. The twenty-third step is to ensure that all activities are conducted in a proactive and preventive manner.

24. The twenty-fourth step is to ensure that all activities are conducted in a continuous and iterative manner.

books (*) was made on the principle that such books should require as little mental effort as possible on the part of the subjects and should keep them amused or interested, thus easing the problem of boredom and sleepiness during the rather long period of the wait for the alcohol concentration in the blood to rise.

2. Duration of the Effects of Alcohol and Spacing of the Tests

Twenty-five or thirty minutes after the termination of the drinking, the post-test series of tasks was begun. Theoretically, a delay of twenty to thirty minutes after the drug is ingested, provided that the stomach is fairly empty, is enough to produce nearly the highest concentration of alcohol in the blood -- a point, by the way, that is attained rather abruptly. During the next half hour, absorption from the stomach and the intestines slows down, and the rise in alcohol concentration in the blood, although still going on, is very small. This period corresponds to a virtual plateau (the so-called "Grehant plateau") in the typical curve of alcohol concentration in the blood. See Figure 1, adapted from Haggard (11).

The course of intoxication follows the curve of concentration rather closely. This is due to the fact that only a small portion of the dose (2 to 10 per cent) is excreted through the lungs and the

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- *1. Anonymous. International Poster Annual (1948-49). Pitman Pub. Corp., New York, 1949.
 2. Abner Dean. What Am I Doing Here? Simon and Schuster, New York, 1947.
 3. F. R. Emmett. High Tea, Infused by Emmett. Faber and Faber, Ltd., London, 1950.

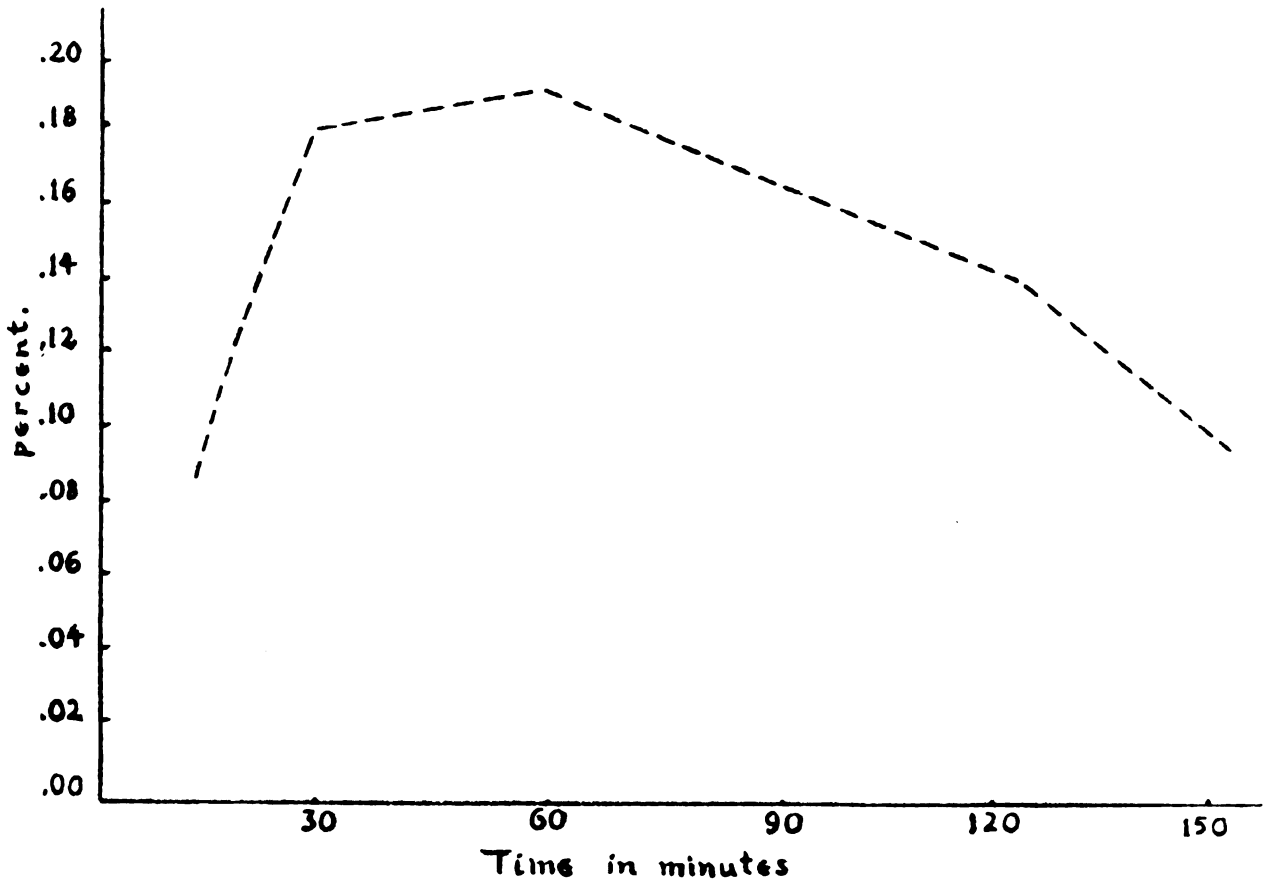


Fig. 1. Typical curve of the concentration of alcohol in the blood over a period of 150 minutes. Adopted from Haggard (11).

kidneys. Practically all the rest must be oxidized through the blood, and this takes place at a relatively constant rate (approximately 10 c.c. per hour).

The experimental tasks were spaced in the same way in both pre- and post-test periods. The diagram in Figure 2, adapted from Seward and Seward (32), may help to make clearer the schedule of a sitting (that is, the sequence of the particular events and their exact timing).

The whole experiment ran for a total of about seventy-five minutes, consisting of two test series of twenty-one minutes each, and an intervening period of thirty minutes, the last occupied by the drinking interval and the wait for the alcohol to take maximum effect. Each test-series, pre-test and post-test, was made up of the same four tests. All but one were administered in four equivalent forms, two in each test-series, once preceding and once following all other tests. Test IV, by being placed in the midst of the others, satisfied both conditions of placement, as half of it followed and half of it preceded all others.

The tests of the post-test series required no more than twenty or twenty-five minutes (the same as the pre-test series), and thus they took full advantage of the thirty-minute period of high alcohol concentration in the blood following the first twenty to thirty minutes after the end of the drinking.

At least in theory, the alcohol concentration in the blood remains practically stationary for the second half hour. But, although blood concentration may serve as a rather safe indicator of the concentration of alcohol in the brain and, therefore, of the degree of intoxication, it might not be considered safe to assume that an equally stable

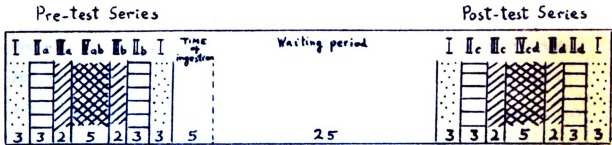


Fig. 2. Diagram showing schedule of an experimental sitting. The Roman numerals represent the tests; the letters at their base signify a different form of the same test. The Arabic numbers at the base of the blocks represent the time in minutes each test ran. The shading of the blocks, going from lighter to darker and then to lighter again, stands for the different degrees of restriction placed upon the production process that the tests are designed to measure.

psychological state runs parallel to the plateau that corresponds to the blood concentration.

It is an old observation that in many subjects alcohol causes a short-lived excitation before it becomes a depressant (7). Any organism should be expected to react to new conditions about or within him, and try some way of adjustment, for better or worse, which may reflect on the test performance. Therefore, and in order to cancel out any differential effects that might result from a possible variation in the degree of intoxication during the post-alcohol period, the special arrangement of the tests described above and illustrated in Figure 2, was carried out. Such an arrangement would also help to control for any positional effects that might have resulted from a less impartial placement of the tests.

3. Recording of the Performance

The responses that the subjects made within the time interval that each test covered were immediately recorded by the experimenter. Whenever the rate of the actual production permitted, responses were written out as they were given; otherwise they were simply checked by a notch. This was generally the case with Test I.

Repetitions, when within an interval of five consecutive responses, were identified immediately by a cross. As for responses seemingly inappropriate, those were recorded faithfully, but with a question mark attached to them.

Finally, the rate of production was followed by the procedure of recording the time at the end of one-minute intervals. Such a particular recording had been used in a preliminary study for the purpose of

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determining the appropriate duration for each test; although no hypothesis demanded it, the same procedure was followed when recording the responses in the final study.

IV. RESULTS

A. General

Two main approaches were followed in the analysis of the available data. First, the analysis was done in terms of the average performance under alcohol and control conditions as reflected in the scores of the two groups, experimental and control. Second, the data were analyzed in respect to the number of subjects showing the changes.

The first approach stands on the following premises. Both groups went through the same procedure of taking the tests twice, once before the ingestion of the drink (which only in the case of the experimental group contained alcohol) and once following the drinking. The performance of the control group was taken to be the typical performance against which the performance of the experimental group was to be compared. Any variation (change) in the pre- and post-test performance of the control group would be expected to occur under normal or, rather, control conditions and it should be interpreted as due to factors other than the experimental variable of alcohol.

The results showed that, in general, the post-test performance of the control group changed for the better (in terms of number of responses given during a standard time) over the pre-test performance of the same group. The performance of the experimental group followed a parallel, but less accentuated, course of improvement. By eliminating all the change (improvement or deterioration) expected on the basis of the

control group performance, the effect due to alcohol alone could be isolated.

Statistically this was carried out by means of a t ratio, which tested for the significance of the differences between average performance under experimental and control conditions for each of the four tests employed in the study. Specifically, such an operation compared the mean differences obtained between pre-test and post-test performance in each test under both experimental and control conditions.

In following the second approach, the chi-square technique was used. By means of such a test it became possible to establish whether the number of individual subjects that showed a change in performance after the administration of alcohol was significantly larger than would be expected by chance.

The t test, by being based on the average group performance, gives more weight to the size of the change. On the other hand, the chi-test, based on the intragroup variability, emphasizes the uniformity of the change.

B. Fluency and Restriction

1. Test I

The level of performance under alcohol was found to be inferior to that under control conditions. A t ratio equal to 2.151, testing for the significance of the difference between mean difference in pre- and post-test performance for the two groups, was found to be significant at the 0.05 level of confidence. These results appear in Table III.

TABLE II
MEAN PRE- AND POST-TEST SCORES
AND MEAN DIFFERENCES UNDER EXPERIMENTAL AND CONTROL
CONDITIONS ON ALL FOUR TESTS

Test	Experimental				Control			
	Pre	Post	Diff.	Level of Conf.	Pre	Post	Diff.	Level of Conf.
I	201.93	211.56	9.63	0.05	211.33	233.93	22.60	0.01
II	91.93	91.93	0.00	n.s.*	86.23	98.76	12.53	0.01
III	48.06	50.33	2.27	n.s.	46.40	46.87	0.47	n.s.
IV	21.80	20.96	-0.83	n.s.	22.80	23.80	1.00	n.s.

(*) not significant

TABLE III
DIFFERENCE BETWEEN
IMPROVEMENT UNDER EXPERIMENTAL
AND CONTROL CONDITIONS ON ALL FOUR TESTS

Tests	Exper.	Control	Diff.	Level of Conf.
I	9.63	22.60	-12.97	0.05
II	0.00	12.53	-12.53	0.01
III	2.27	0.47	1.80	n.s.*
IV	-0.83	1.00	- 1.83	0.05

(*) not significant

(Table II shows the partial differences, i.e., the mean difference in pre- and post-test performance for each of the two groups, experimental and control respectively. Although both differences were significant, the difference for the control group was highly more so. The fact that this difference in significance was statistically significant has already been presented in the previous paragraph.)

The change reflected in the above results was found to be true in most individual cases, as well as for the average. A chi-square of 3.888 was computed, which indicates that, regardless of size of the change, the number of individuals affected by the experimental variable in their performance on Test I is significantly larger than would be expected by chance. (See Table IV.)

2. Test II

A t ratio of 3.918, testing for significance of the difference between the mean differences in pre- and post-test performance in the two groups, was found to be significant at the 0.01 level of confidence. This shows that the level of performance in Test II was decisively lowered by the use of alcohol (in the dose called for by the experiment) as compared to performance under control conditions. (See Tables II and III.)

Testing for the significance of the change in terms of individuals rather than of size of the change, a chi-square of 4.022, was found to be significant at the .05 level of confidence. (See Table IV.)

TABLE IV

COMPARISON OF EXPERIMENTAL AND
CONTROL CONDITIONS IN TERMS OF NUMBER OF INDIVIDUALS AFFECTED

	Test I		Test II		Test III		Test IV	
	Exper.	Cont.	Exper.	Cont.	Exper.	Cont.	Exper.	Cont.
Number who improved	17	25	18	25	19	14	17	20
Number who deteriorated	13	5	12	5	11	16	13	10
Level of confidence	0.05			0.05	not sign.		not sign.	

3. Test III

By means of a t ratio worked out as above, it was found that performance in Test III remained about the same under experimental or control conditions. (See Tables II and III.) It should be noted, however, that the direction of the change, even though not significant, was this time in favor of the experimental group.

Testing for significance of the direction in the apparent change within the two groups, a chi-square of 1.077 was computed, which was not significantly different from what would be expected by chance. (See Table IV.)

4. Test IV

A t ratio of 2.293, worked out as in the previous three tests, was found to be significant at the 0.05 level of confidence. (See Tables II and III.) This result was taken to mean that the level of performance under experimental conditions was noticeably lower than performance under control conditions.

Testing for significance of the detected change in terms of individuals and regardless of size in the change, a chi-square of 0.282 showed such a change to be not significantly different from zero. (See Table IV.)

For a comparison of all four tests in respect to pre- and post-test scores and to the superiority of the control over the experimental group the reader is referred to Figures 3 and 4.

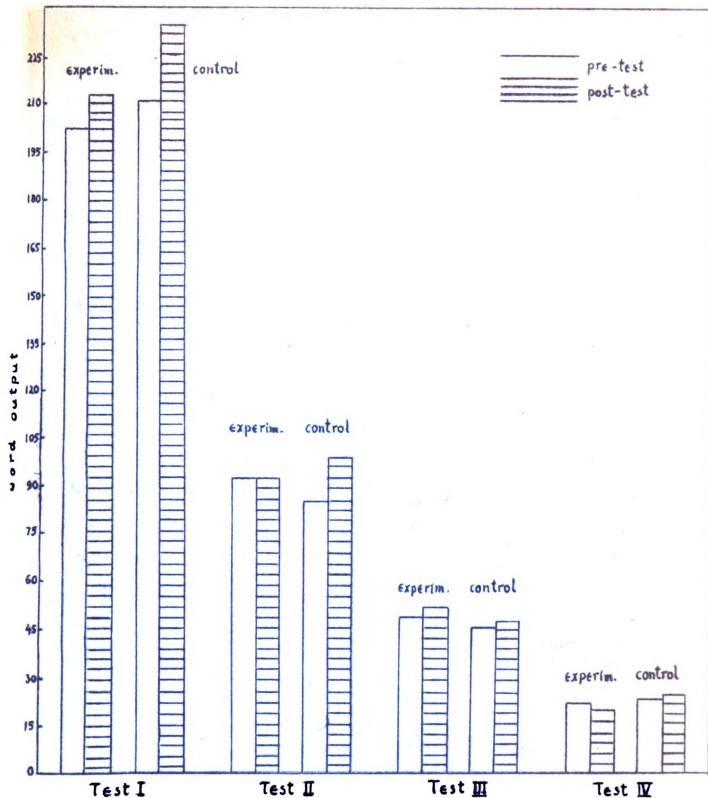


Fig. 3. Comparison of pre- and post-test performance under experimental and control conditions in terms of total (mean) scores.

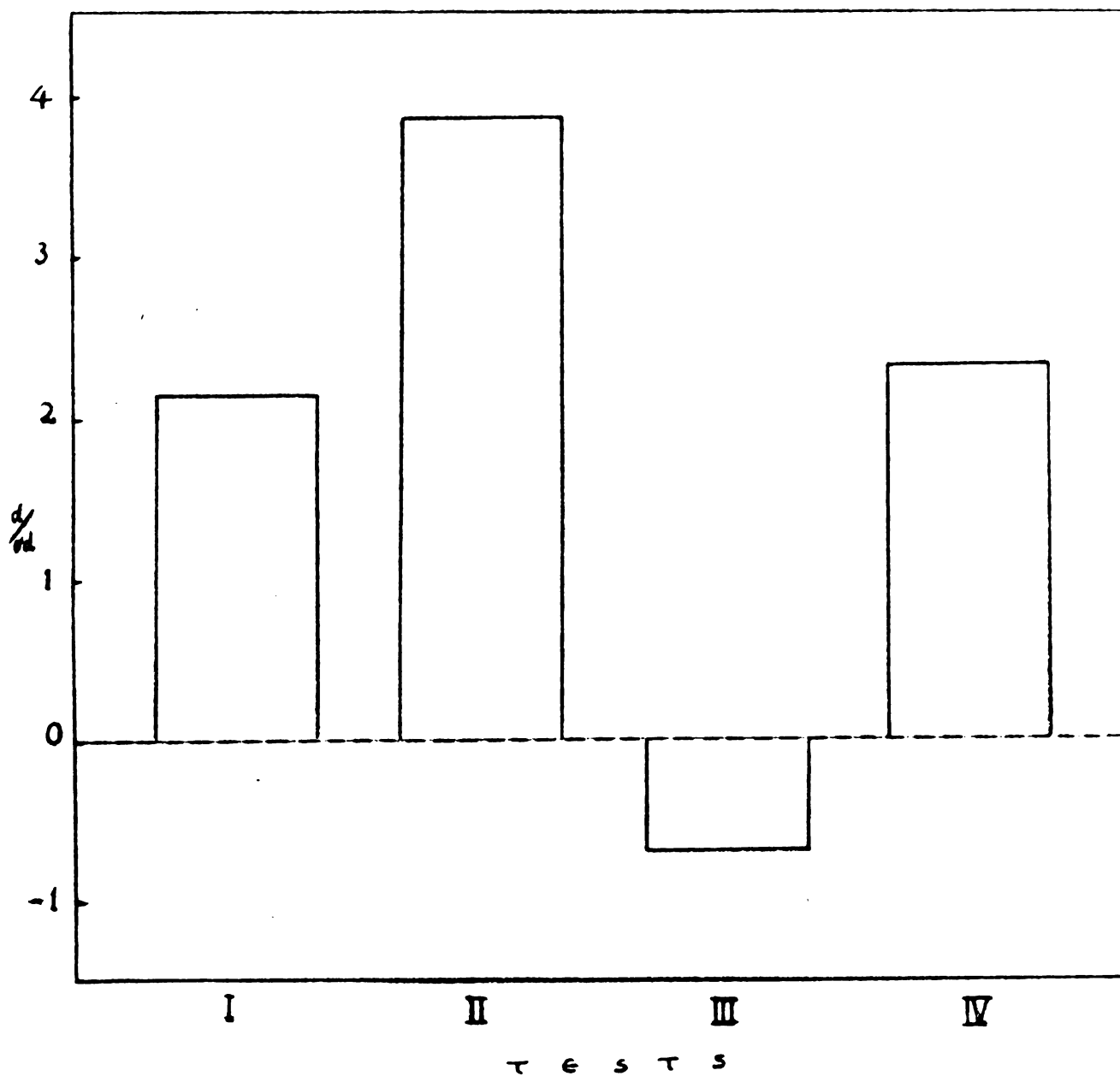


Fig. 4. Comparison of four tests in respect to superiority of control over the experimental group plotted in terms of standard errors of differences.

5. Comparison of Variabilities

The variability of performance under the experimental condition of alcohol does not seem to differ considerably from that of the control group in any of the tests studied; and in most cases, variability under experimental conditions was nominally, if not significantly, lower than under control conditions. The standard deviation of each distribution of differences between pre- and post-test performance for all four tests appears in Table V.

C. Analysis of Rate of Production

A minute-by-minute analysis was carried out next. The responses produced within each of the one-minute periods were counted separately, and these part scores were treated in their own right, independently of the performance as a whole. Such partial treatment yielded results that were more or less consistent in all three tests considered in the manner just described. (Test IV, for reasons to be explained later, was not amenable to such treatment.)

Thus, for both Tests I and II it was found that, at the end of the first minute interval, the score representing performance under alcohol was significantly lower than under control conditions. In particular, regarding Test I, a t ratio of 2.617, testing for significance of the difference between the mean differences in pre- and post-test first one-minute performance, was found to be significant at the 0.02 level of confidence. (See Tables VI and VII.) Regarding Test II, a t ratio equal to 3.925 was significant at the 0.01 level of confidence. (See Tables VIII and IX.)

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TABLE V

STANDARD DEVIATION OF EACH DISTRIBUTION
OF DIFFERENCES BETWEEN PRE- AND POST-TEST PERFORMANCE
FOR ALL FOUR TESTS. (MEAN DIFFERENCES ARE
SHOWN IN TABLE III)

Tests	Exper.	Control
I	25.04	26.22
II	10.87	13.37
III	10.63	9.93
IV	3.17	3.50

TABLE VI

TEST I. COMPARISON OF THE PRE- AND POST-TEST
PERFORMANCE UNDER EXPERIMENTAL AND CONTROL CONDITIONS
IN TERMS OF WORDS PRODUCED IN EACH MINUTE

Experimental				Control		
Minute	Pre	Post	Diff.	Pre	Post	Diff.
1st	80.43	78.90	-1.53	84.50	90.40	5.90
2nd	63.93	67.70	3.77	65.10	73.40	8.30
3rd	57.57	64.97	7.40	61.73	70.13	8.40

TABLE VII

TEST I. COMPARISON OF MEAN DIFFERENCES
BETWEEN PRE- AND POST-TEST PERFORMANCE UNDER EXPERIMENTAL
AND CONTROL CONDITIONS IN TERMS OF WORDS PRODUCED IN EACH MINUTE

Minute	Exper.	Control	Diff.	Level of Conf.
1st	-1.53	5.90	-7.43	0.02
2nd	3.77	8.30	-4.53	n.s.
3rd	7.40	8.40	-1.00	n.s.
Total (3')	9.64	22.60	-12.96	0.05

TABLE VIII

TEST II. COMPARISON OF THE PRE- AND POST-TEST
PERFORMANCE UNDER EXPERIMENTAL AND CONTROL CONDITIONS
IN TERMS OF WORDS PRODUCED IN EACH MINUTE

Experimental				Control		
Minute	Pre	Post	Diff.	Pre	Post	Diff.
1st	41.90	39.86	-2.04	41.37	47.47	6.10
2nd	27.33	28.30	0.97	25.07	27.83	2.77
3rd	22.70	23.77	1.07	19.80	23.47	3.67

TABLE IX

TEST II. COMPARISON OF MEAN DIFFERENCES
BETWEEN PRE- AND POST-TEST PERFORMANCE UNDER EXPERIMENTAL
AND CONTROL CONDITIONS IN TERMS OF WORDS PRODUCED IN EACH MINUTE

Minute	Exper.	Control	Diff.	Level of Conf.
1st	-2.04	6.10	-8.14	0.01
2nd	0.97	2.77	-1.80	n.s.
3rd	1.07	3.67	-2.60	n.s.
Total (3')	0.00	12.54	-12.54	0.01

But at the end of the second minute interval the picture for both Tests I and II was changed radically. The t ratios, testing for significance of the difference between the mean differences in pre- and post-test performance during the second minute interval were, for either Test I or II, found to be not significant. This was taken to mean that by the end of the second minute the difference in performance between experimental and control groups had shrunk to a point that was no longer to be considered significantly different from zero.

The same procedure, followed for the first and second minute performance, showed that at the end of the third minute the difference between experimental and control performance for both Tests I and II remained not significant. (See Tables VI through IX.)

The relationship of the experimental and control performance in Tests I and II throughout its entire course of three one-minute intervals appears in Figures 5 and 6.

Regarding Test III, however, a minute-by-minute analysis of the data showed that, in each minute interval of the two-minute test, the difference in the scores standing for performance under experimental and control conditions is not significantly greater than zero. (See Table X.)

It should be noted, though, that while in the first-minute post-test performance both groups, experimental and control alike, fell below their respective pre-test level, in the second minute the scores representing performance rose considerably for both groups. The relationship appears in Figure 7.

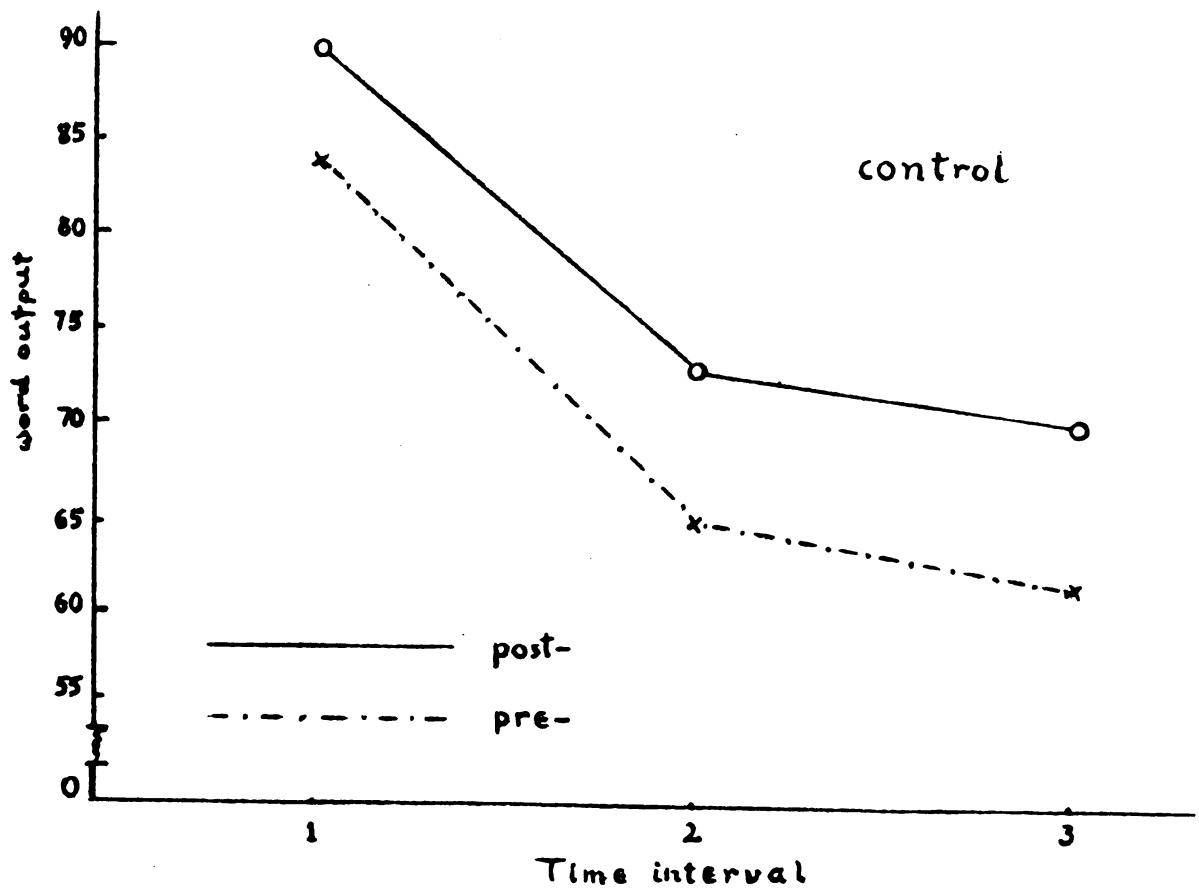
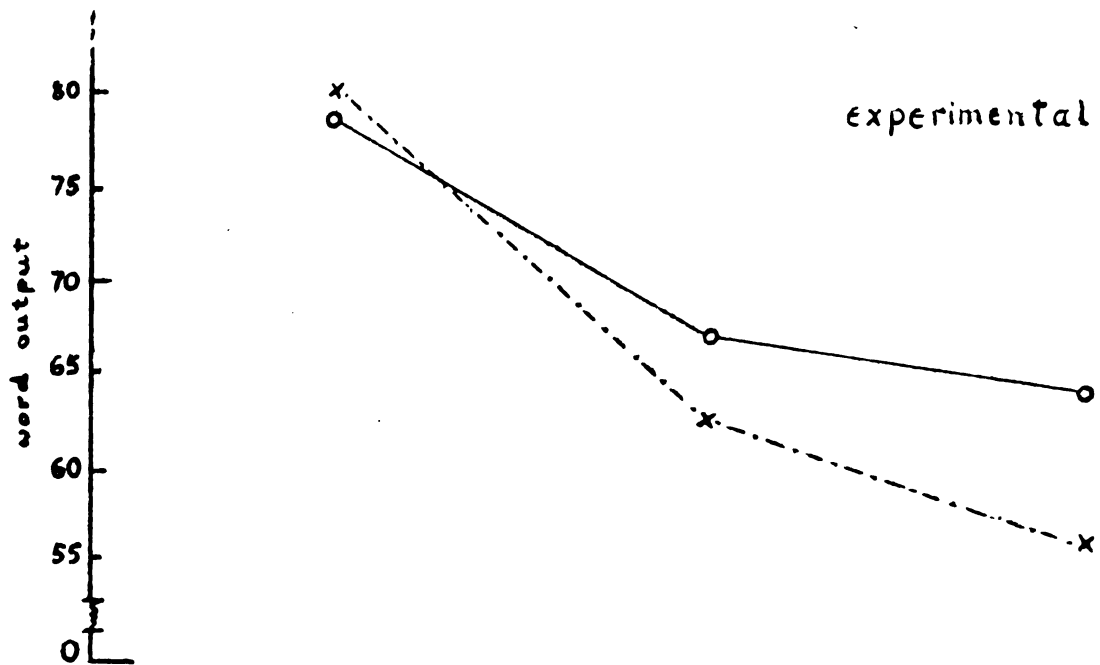


Fig. 5. Test I. Comparison of pre- and post-test performance in each one-minute interval.

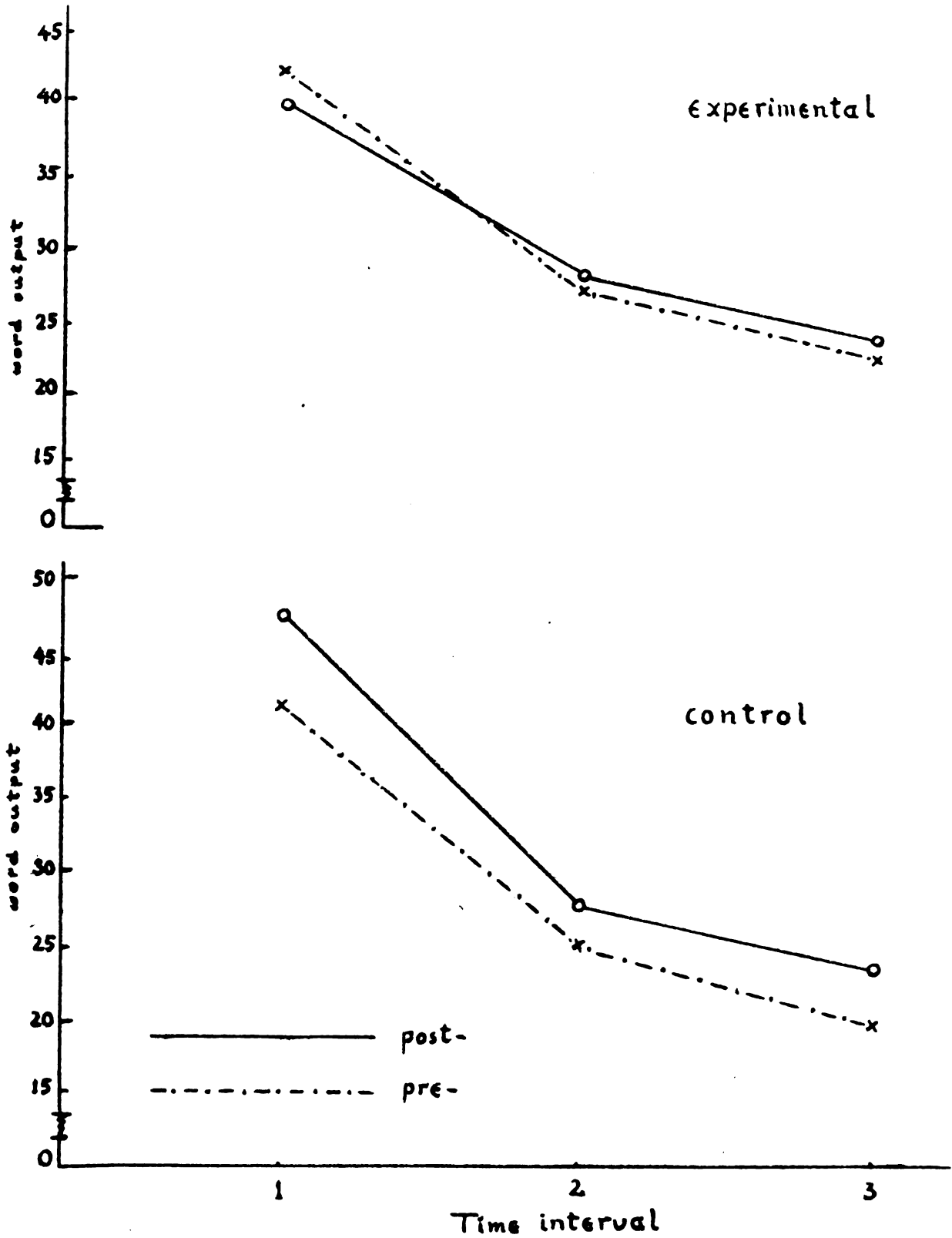


Fig. 6. Test II. Comparison of pre- and post-test performance in each one-minute interval.

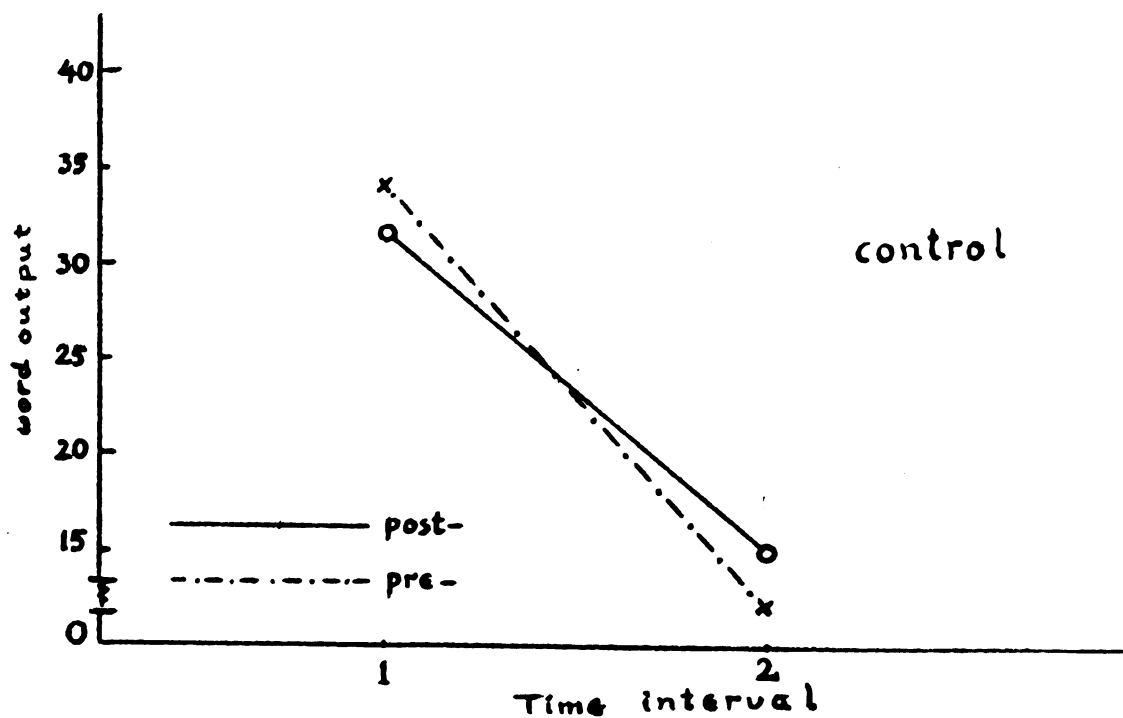
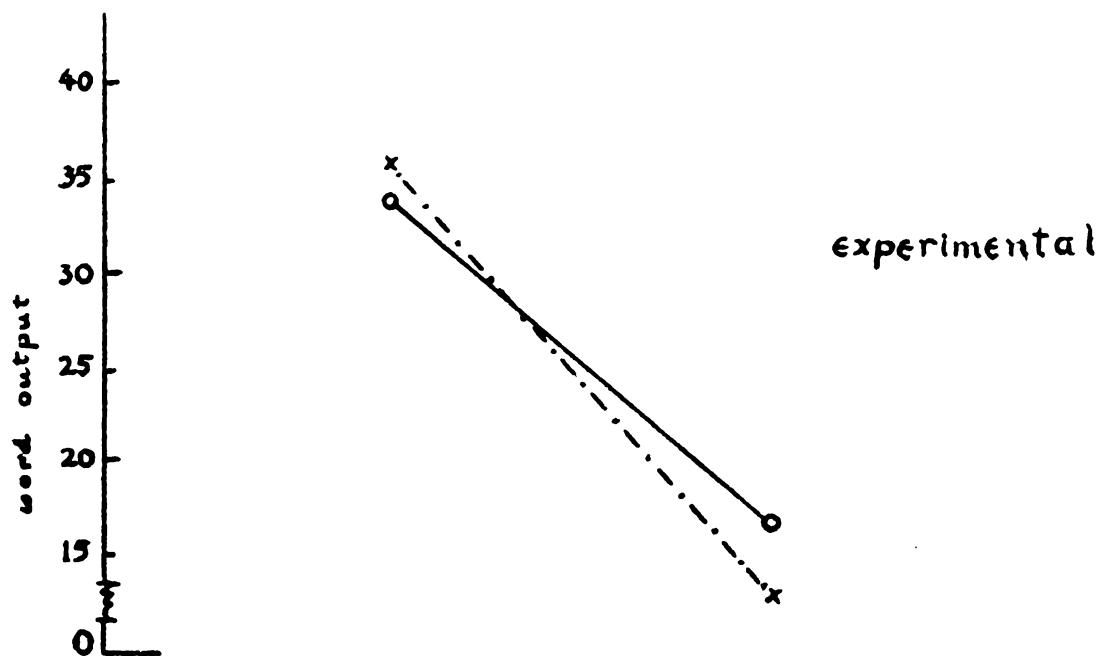


Fig. 7. Test III. Comparison of pre- and post-test performance in each one-minute interval.

TABLE X

TEST III. COMPARISON OF THE PRE- AND POST-TEST
PERFORMANCE UNDER EXPERIMENTAL AND CONTROL CONDITIONS
IN TERMS OF WORDS PRODUCED IN EACH MINUTE

Experimental				Control		
Minute	Pre	Post	Diff.	Pre	Post	Diff.
1st	35.30	33.70	-1.53	34.33	31.80	-2.53
2nd	12.77	16.57	3.80	12.07	15.07	3.00

TABLE XI

AVERAGE NUMBER OF REPETITIONS
IN PRE- AND POST-TEST PERFORMANCE UNDER
EXPERIMENTAL AND CONTROL CONDITIONS IN THE
FIRST THREE TESTS COMBINED

	Pre	Post	Difference
Experimental	0.566	1.700	1.133
Control	0.600	0.866	0.266
Difference			0.867 *

* Significant at the 0.05 level of confidence.

Although it was a five-minute test, a minute-by-minute analysis of the data was not attempted in Test IV, since its items were arranged in terms of an order of ascending difficulty and equal minute intervals no longer constituted comparable units.

D. Repetitions

According to the rules for scoring stated in Chapter III, repetitions were considered to be valid responses as long as they were given after an interval of more than five words, regardless of whether the subject was aware or not of his repeating the word. But repetitions that came within the interval of five consecutive words were checked and eliminated in the process of scoring.

The number of words repeated within the interval of five consecutive words was counted for each subject in each group and for both pre- and post-test performance for the first three tests. For both control and experimental groups, repetitions were more frequent during the post-test period. But when the difference between post- and pre-test repetitions for the control group was compared with the same difference for the experimental group, the two were shown to differ significantly from one another. Specifically, the difference in repetitions that occurred in the experimental group was larger than the difference for the control, with a t ratio of 2.178 being significant at the 0.05 level of confidence. (See Table XI.)

It should be pointed out that the number of the repeated words represents the sum of repetitions in all three tests (there could be no repetitions in Test IV) of each experimental series, pre- and

post-test. The number of repetitions for each individual test, thrown out from the final score, was actually so small as to have no influence on the main results, regardless of whether it was considered or eliminated in the final scoring.

E. Practice Versus Test Performance

A different set of data, not related to the experimental condition of alcohol, was finally analyzed, with curious results.

It will be remembered that every subject was given the opportunity of a half minute practice before he started responding for the first test. When the score of this thirty-second trial was compared with that of the first thirty-second period of Test I, it was found that the latter score was significantly lower than the trial score, the difference (with a t ratio of 2.584) being significantly greater than zero, almost at the 0.01 level of confidence.

V. DISCUSSION

A. Restatement of the Problem

The overall picture of the results immediately suggests one thing: performance under the influence of a moderate dose of alcohol (so calculated as to bring a theoretical concentration of about 0.10 per cent in the blood) in three of the four tests included in the present design, is noticeably different from performance under control conditions. Furthermore, it appears that alcohol affected performance differentially in these tasks.

To examine the results from the standpoint of the main problem, the relation between alcohol effect and fluency (the latter varied according to several degrees of restriction), it will be necessary to restate some of the basic premises underlying the study.

Broadly speaking, the purpose of this study was to investigate the effects of alcohol on mental processes. Among the latter, the production process (defined by its manifestation of "production of responses") was selected for its reliable and interesting background to serve as the building stone in a theoretical system concerning mental processes.

Fluency or "production of words", one of the main aspects of the production of responses, happens to be an important psychological concept as well as a lively reality in the world outside the experimental room. On the other hand, factorial studies have identified tests that could serve as reliable measurements of fluency. Among these, a series of

tests differing from each other only in one essential respect, namely, the degree of restriction imposed on the production process, were finally adopted for the present study.

The question then was asked: What is the effect of alcohol on the ability of fluency? And, furthermore: Is this alcohol effect a function of the degree of restriction placed on the production process?

A general hypothesis to the effect that alcohol would inhibit production of words in direct relation to the degree of restriction placed upon the production process was advanced, and subsequently tested with the results discussed below.

B. Alcohol and Fluency

1. Fluency and the Variable of Practice or Learning

The level of performance under alcohol appeared, for the most part, to stay the same, or to go even higher than under non-alcohol conditions. However, the showing of the control group makes evident the fact that performance under alcohol was not up to what should be expected from a repeat performance without alcohol. When the appropriate subtractions are made, as in Table III, the true nature of the alcohol effect may be seen.

Yet, to say that alcohol has affected -- either inhibited or helped -- the performance in tests that stand for the production process, may not be the same as to say that it has affected the production process itself.

In designing the experiment a number of possible variables other than alcohol were considered, and care was taken either to eliminate them, or to hold them constant. Among these variables, practice effect, natural in any kind of performance that is to be repeated, and suggestion, special

to the use of agents such as alcohol, were specifically dealt with. But unless the effort to eliminate a variable is successful, the mere fact of controlling it, no matter how successful the control is, does not preclude it from the results. In this particular case it seems certain that practice played an important role in the determination of at least a part of the post-test performance for both experimental and control groups. In such a case one might conclude that the experimental performance was below the control because alcohol suppressed only the practice effect, and not necessarily that which might be considered to be fluency. Or, it may be that both the practice effect and fluency were affected by the alcohol.

The results in Test I speak particularly for the case of practice. There, post-alcohol performance was significantly better than the pre-alcohol, even though, on the basis of the pre--post-test performance difference of the control group, this improvement should have been, also significantly, greater. On the contrary, there is no evidence of practice effect in Test IV, where the post-test level of performance was lower than the pre-test. And the results in Test II and III indicate no change at all, or a non-significant improvement in post-alcohol performance.

2. Alcohol and the Variable of Restriction

According to the hypothesis, the size of the inhibitory effect expected from the alcohol should be directly related to the degree of restriction placed upon the production process. However, the results do not seem to verify such a hypothesis. For, what was true for Test I (fluency without restriction) was also true for Test II and IV

(fluency under light and heavy restriction, respectively). In all three of these tests, performance after alcohol was far below that of the control group.

But if alcohol resulted in the suppression of the level of performance in Tests I, II and IV, no such change was apparent in Test III. Assuming that Test III is as representative of the production process as Tests I, II and IV, and that the only difference among them lies in the degree of restriction involved in each, then any explanation as to the difference encountered in the results of these tests should be sought in the variable of restriction.

It will be remembered that Test III (naming words within categories) was selected to represent conditions of higher restriction than Test II (naming words beginning with a certain letter), and even more than Test I (naming any words). That the restriction imposed by Test III is heavier than that in Test I or II is indicated by the fact that the output of words, for both control and experimental groups, in Test III was consistently smaller than the final word output in Tests I and II. But restriction in Test III is not only heavy; it also happens to be quite elastic, in the sense that it permits a double standard of performance.

To give an example, where the test calls for naming trees, a subject under the influence of alcohol could, and in all cases did, relax his standards so as to name, in addition to trees such as "elm," "oak," etc., such "other" trees as "big tree," "family tree," "Christmas tree" and the like. The restriction seems to have been even more elastic in the instance where the test calls for naming articles of furniture. People

under the alcohol effect generally had few scruples about naming such different articles of furniture as "dining table," "kitchen table," "study table" and so on, while those who hit on the sub-category of utensils secured, literally, their future insofar as the score in Test III was concerned. For, all such responses were considered legitimate, as they were produced in accordance with the scoring rules specified in the instructions.

That a person under alcohol develops a tendency to evade the rules by lowering his standards is indicated by the results referring to the scored repetitions (repetitions given within an interval of five consecutive responses). The experimental group gave significantly more such repetitions than the control group.

The interpretation as regards the tendency of the alcohol people to lower their standards when under adverse conditions may be applied consistently to the results in Test I and II as well as in Test IV. In Tests I and II, likewise in Test IV, the alcohol people did significantly worse than the control population. Reserving a question mark for the possible role of learning in the case of Test I, this deterioration of performance may be due to the fact that Tests I and II offer very little restriction that is susceptible to modification by the subjects. On the other hand, Test IV imposes so much and so rigid restriction (there could be only one correct response in Test IV) that again there is very little possibility of varying the conditions to the advantage of the subject, while the alcohol effect is working against him.

It may sound paradoxical, but the conclusion seems to be that restriction is a factor favoring performance under the influence of

alcohol in tests of fluency. The possibility of evading restriction creates a situation that can be exploited so as to increase the final score in the tests. And there is evidence in the results (scored repetitions) suggesting that it is just the person under the influence of alcohol who tends to exploit such a situation.

The possibility of insufficient awareness of the rules should be considered in this connection. Rules become, probably, less clear-cut, less imposing — the idea of following strictly the rules may appear less meaningful to a person who is under the influence of alcohol. He can now be satisfied with an easier, less exact response. In other words, the act of relaxing his standards may not be intentional at all, but is rather, the consequence of an inability on the part of the subject to live up to what he expects himself to do, to conform with the agreed rules.

Along the same line of reasoning, a habitually undisciplined person would be expected to change less under alcohol, just because in his case there is little to be abandoned, there is less self-demand for perfection or conformity with inner and outer rules. Such an interpretation seems to approach the view that psychologists have usually taken regarding the problem of the effects of alcohol on fluency, namely that alcohol facilitates fluency by suppressing inhibition. With the difference that, in the light of the evidence discussed so far, alcohol does not facilitate fluency; on the contrary, it seems more probable that it suppresses it. And, when it does appear to facilitate it, this does not really mean what the popular notion about alcohol, referred to earlier in this paper, would call for: a better verbal performance.

For, being more fluent at the expense of one's standards cannot be called improvement by any means. A good conversationalist would not become better if he started talking more if that "more" were incoherent or did violence to his usual conversational standards -- unless the judge is in a similar state of intoxication, as is usually the case in social situations.

C. Variability of the Effect of Alcohol

One finding that seems to contradict results of older studies is the fact that within the alcohol population in the present study variability was no higher than it was in the control group. Since the times of Kraepelin, high variability in the performance under alcohol has been a constant complaint among all experimenters. But perhaps the incidence of high variability in most of those studies may have been only an artifact due to weaknesses inherent in the design and make-up of the control and experimental populations.

D. The Alcohol Effect in the Course of the Performance

The plan of following the course of performance in its minute-by-minute progress by checking the time at the end of one-minute intervals rendered available additional data that may reflect a more dynamic aspect of the subject's performance under the influence of alcohol.

Thus, a minute-by-minute analysis of the results in Test I and II showed both experimental and control groups doing better in the second and third minute of their post-test performance, but only the control group improving in the first minute. The experimental group's post-test

performance during the first minute was below its own pre-test as well as the control's first-minute pre-test level of performance.

What happens during the first minute of performance may very well be the key to the question of the alcohol effect on fluency and the intricate role of learning in this case. As with the post-alcohol performance in Test IV (considered in its entirety) the deterioration of the first minute in Tests I and II seems to signify something more than the mere absence of a practice effect. It almost certainly means that the ability of fluency, as represented by Tests I, II and IV, has been affected by alcohol and, in particular, inhibited.

In other words, it appears that a person is less fluent than normal when he begins to perform while under the influence of alcohol. Yet the interval of a single minute is enough to make him recover. This recovery is apparent in both his fluency and in his ability to profit from practice. His recovery appears to be, for all practical purposes, complete. The inference seems to be that it is the first minute that causes the performance of a person under the influence of alcohol to lag behind that of a sober individual. This was translated (in the discussion of the overall results in Test I) as a relative deterioration of performance under alcohol.

The above inferences may come as a surprise to the student who is aware of the common observation that alcohol tends to exert an excitatory influence for a short while before becoming a depressant. Yet on the basis of the present results people under the influence of alcohol seem to be slow starters, or, to recall a term familiar in the psychology

of human performance, they require a longer warm-up period than sober people in their performing.

Is this phenomenon peculiar to verbal performance or does it, perhaps, concern every kind of human performance? The question would seem to involve the great subject of motivation, strangely foreign as yet to the history of the experimentation with alcohol. For motivation may be a variable far more important than any other in the human performance under alcohol, at least in a social setting. Social beings have a tendency to respond more generously, to make a special effort, whenever ego-involved. And what incites ego-involvement best is the danger of failure -- a danger that seems to be particularly existent when a person is in a state of mild intoxication.

This danger of failure when performing under the influence of alcohol is not simply the threat that the mere suggestion of alcohol might constitute. Except when unaffected by the drug, a person feels the difference in his blood, in his brain, in his senses and motions. Operating under novel conditions (as is usually the case with a casual or even a moderate drinker) is by itself a challenge to most subjects, who try to show that they can perform as efficiently under alcohol as under everyday conditions. Overcompensation may be the result, and this will reflect, in some way or another, in the final score.

Thus, concerning a test of fluency, the number of responses may go up -- only, perhaps, at the expense of the quality of the performance. This was the interpretation advanced earlier in order to explain the absence of significant difference in the results of the control and

experimental groups in Test III. The same may now be said about the second and third-minute performances in Tests I and II.

In fact, what happens in the two minutes of Test III resembles very much the three minutes of Tests I and II. For, while during the first minute of Test III the post-test fluency score of the experimental (and, for that matter, of the control) group is lower than the pre-test score, the relationship gets reversed during the second minute, in which the post-test score (for both groups) is considerably higher than the pre-test. Such a retarded improvement of performance in Tests I and II may very well have been due to the evident tendency of the members of the alcohol group to lower their standards when faced with frustrating conditions of restriction, a tendency which seems to be more profitable, in terms of score improvement, in a test like Test III. The latter test seems to impose an optimal degree of restriction upon the production process so as to permit the adjustment of performance described earlier in this chapter.

Speaking of overcompensation in the performance under alcohol, available observational data show that the post-alcohol behavior of many experimental subjects resembled very much the kind of behavior that was exhibited by a few overanxious subjects among the control group. Only that the latter behaved more or less alike in both their pre- and post-test periods.

E. The Production Process and Its Dynamics

The following matter, being pertinent to fluency and its tests, may be also related to alcohol and its effects on the production process.

The question is, why do people do progressively worse in tests of fluency, regardless of externally imposed conditions such as alcohol or restriction.

According to the commonly held view, people name fewer words in later periods of performance because their pertinent vocabulary becomes gradually exhausted. But a set of incidental data in the present study, besides observational data held aside by the experimenter, suggest that the answer to the problem is not as simple as the one commonly given. The data refer to the words produced in the thirty-seconds practice period that was given to all subjects before Test I. A comparison between the scores achieved in the thirty-seconds trial and the scores of the first thirty-seconds period of Test I, showed that the words produced during the latter period were significantly fewer than in the equally long trial period. (And this, despite the fact that the subjects were specifically told in the instructions that they were free to repeat any of the words that they had used in the trial period.) The difference may be meaningful in that it cannot be explained on the basis of a thinned-out vocabulary.

The evidence is certainly not conclusive as regards Test I as a whole; yet it seems unlikely that the subjects slow down in their production of words because they have used most of the available responses. It might be pointed out that it is not simply the use of most of the available words, but also of the most available ones -- in other words, of the most frequently used words -- that counts in the case. But, of course, this could not be the case in the results concerning the thirty-seconds trial -- Test I difference just discussed. And the experimenter

often had the opportunity to observe that many of the easiest words -- those most likely to have priority in use -- were mentioned very late in the tests of the experiment or never at all. The idea then may be advanced of a reservoir of used words rather than left-over words, the incidental build-up of a memory that stands as a barrier in the further production of responses, causing the subject's mind to block in front of the ever-increasing restricting condition imposed by the already produced words not to be produced again.

In conclusion, it may not be too farfetched to suggest that there may exist a connection between the alcohol influence and the tension created by such an intervening variable, like the one proposed, of incidental memory. Alcohol may have a depressant effect on such a variable which by becoming less potent would tend to cause less interference in the production process, and hence, improvement as it was reported to occur during the later period of the performance under alcohol in Tests I and II. The occurrence of significantly more repetitions within the experimental group would seem to bear on the hypothesis just advanced.

VI. SUMMARY AND CONCLUSION

In discussing the historical background of the problem, the critical view was expressed that most of the experimental studies dealing with alcohol's effects on psychological processes have not succeeded in producing clear-cut results, because they more or less failed to comply with the requirements of scientific theory. Hence the need to develop a reasonable theory and to rely on secure methodology was, in the present study, held to be of equal importance to the problem itself.

As a first step in an attempt to study the effects of ethyl alcohol on the thought process, production of words was selected to serve as a basal process. Tests of fluency, identified by previous factorial studies, were used to measure it. By specifying the kinds of words to be produced, several degrees of restriction were introduced. A hierarchical system of mental processes, as reflected in the selected tests of verbal ability, thus became available for investigation.

Then the hypothesis was advanced that alcohol inhibits production of words in direct relation to the degree of restriction placed upon the production process.

The experiment to test the hypothesis used sixty subjects -- thirty experimental and thirty control -- and lasted approximately 75 minutes for each subject. The obtained results, following the oral administration of a moderate dose of alcohol, are presented in outline along with the proposed interpretation, as follows:

(1) Performance in the tests of fluency used in this study was found to be affected differentially, but in a manner not corresponding exactly to that predicted by the main hypothesis. In particular,

(a) it has not been proven that alcohol facilitates fluency-unrestricted. The contrary might have been shown to be true if it were not for the uncertainty that the presence of a noticeable practice effect introduced into the results;

(b) the condition of restriction does not predetermine the effect of alcohol on fluency. In other words, fluency-restricted is not necessarily inhibited by alcohol as the hypothesis would have it;

(c) whether fluency-restricted is inhibited or not by alcohol seems to be determined by the possibility that restriction can be relaxed, and not by the absolute degree of restriction placed upon the production process. It may happen thus: as if to counteract alcohol's effects, subjects tend to relax their standards of performance. When the conditions of restriction are optimal, such a tendency is more likely, and a relative quantitative improvement in performance may occur.

(2) Variability in performance under alcohol in the amount tested did not differ significantly from that of performance under control conditions. The view was expressed that the alleged variability of the effect of alcohol may be just an artifact due to shortcomings in the experimental method.

(3) In each three-minute period of the fluency tests involving minimal or little restriction, performance under alcohol became better with the course of time, until in the final two minutes it reached the level of normal (control) performance. This was attributed to a

longer warm-up period that the experimental group required as well as to the tendency of people under the influence of alcohol to lower their standards of performance -- as described above in (1).

(4) One more set of data that seemed to reflect on the dynamics of the production process was discussed. A significant difference between the score gained at a practice period and that of the test immediately following, in favor of the former, was found. The hypothesis was advanced that it may be the blocking influence of a continuously growing incidental memory of the produced words rather than an exhausted supply of available responses which causes the slackening of the normal performance in tests of fluency.

. . .

The present study seems to have proven certain definite things about the effect of a moderate dose of alcohol on the production process as represented by the production of words or fluency, and to have raised important questions that involve the psychology of a person under the influence of alcohol. Furthermore, it seems to have strengthened the belief that the alcohol effect is not such an evasive variable to study, after all, and that the selection of the appropriate tools and control of the extraneous variables may help to procure useful results.

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• *Staphylococcus aureus* (Staph aureus) is a common cause of skin infections, such as abscesses and impetigo.

• *Streptococcus pyogenes* (Strep pyogenes) is another common cause of skin infections, including cellulitis and erysipelas.

• *Pseudomonas aeruginosa* (Pseudomonas) is a gram-negative bacterium that can cause skin infections, particularly in burn victims.

• *Clostridium perfringens* (Clostridium) is a gram-positive bacterium that can cause skin infections, such as gas gangrene.

• *Neisseria meningitidis* (Neisseria) is a gram-negative diplococcus that can cause skin infections, including meningitis and sepsis.

• *Haemophilus influenzae* (Haemophilus) is a gram-negative bacterium that can cause skin infections, such as cellulitis and abscesses.

• *Legionella pneumophila* (Legionella) is a gram-negative bacterium that can cause skin infections, including pneumonia and sepsis.

• *Campylobacter jejuni* (Campylobacter) is a gram-negative bacterium that can cause skin infections, such as cellulitis and abscesses.

• *Yersinia enterocolitica* (Yersinia) is a gram-negative bacterium that can cause skin infections, including cellulitis and abscesses.

• *Brucella abortus* (Brucella) is a gram-negative bacterium that can cause skin infections, such as cellulitis and abscesses.

• *Mycobacterium tuberculosis* (Mycobacterium) is a gram-positive bacterium that can cause skin infections, including tuberculosis and abscesses.

• *Coccidioides immitis* (Coccidioides) is a fungus that can cause skin infections, such as cellulitis and abscesses.

• *Histoplasma capsulatum* (Histoplasma) is a fungus that can cause skin infections, including cellulitis and abscesses.

• *Cryptosporidium parvum* (Cryptosporidium) is a parasite that can cause skin infections, such as cellulitis and abscesses.

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APPENDIX

TABLE XII

QUANTITY OF EXPERIMENTAL DRINK AND ALCOHOL DOSE
REQUIRED TO PRODUCE A 0.10 PER CENT CONCENTRATION IN THE BLOOD
CALCULATED IN TERMS OF BODY WEIGHT

Body Weight	Alcohol		Total Mixture
(lbs.)	(ounces)	(c.c.)	(c.c.)
110	1.408	41.63	208.15
115	1.472	43.53	217.65
120	1.563	45.42	227.10
125	1.600	47.31	236.55
130	1.664	49.20	246.00
135	1.728	51.10	255.50
140	1.792	52.99	264.95
145	1.856	54.88	274.40
150	1.920	56.77	283.85
155	1.983	58.67	293.35
160	2.048	60.56	302.80
165	2.112	62.45	312.25
170	2.176	64.34	321.70
175	2.240	66.24	331.20
180	2.304	68.13	340.65
185	2.368	70.02	350.10
190	2.432	71.91	359.55
195	2.496	73.81	369.05
200	2.560	75.70	378.50

Age: _____

Weight: _____

Abstainer: Yes _____ No _____

If non-abstainer, do you consider yourself a casual, a moderate, a heavy drinker?
(Underline one best answer)

How often do you drink in a month? _____

What kind? _____; What amount (in one sitting)? _____

Ever intoxicated? Yes _____ No _____ How often? _____

How much without noticeable effect? _____ Kind? _____

First noticeable effects:

Excitement or the contrary -- Neither (normal)

Talkative or the contrary -- normal

Happy or the contrary -- normal

Peculiar sensations _____

Effect on affection _____; on temper _____

Effect on digestion _____; on urine _____

Any heart, kidney, or metabolic (diabetes) disorder? _____

RELEASE

For science, and in consideration of other good and valuable reasons, the undersigned hereby volunteers his services as a participant in an experiment conducted by Peter Harocollis of the Michigan State College Department of Psychology, dealing with the effect of alcohol upon the higher mental processes. The undersigned specifically represents the following:

- (a) That he is over 21 years of age;
- (b) That he is not addicted to the use of alcohol;
- (c) That he is free from any known physical or mental defect or impairment which might be harmed or aggravated by the use of alcohol.

In consideration of the foregoing and the furnishing to him, without cost, of a supply of alcoholic beverages consistent with accepted health standards, he agrees to release and hold harmless Michigan State College and its employees, and all others participating in the said experiment, from any personal injury and/or property damages arising from the use of said alcoholic beverages or experiments connected therewith.

(L.S.) _____

Date _____

Witness _____

Witness _____

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