Brit. J. Psychiat. (1972), 121, 299–310

Conditioning in Relation to Conceptual Thinking

By R. F. BARR and N. McCONAGHY

The aim of this study was to determine the relationship between loose or 'allusive' thinking and conditioning performance. The theoretical proposition examined was that looseness of thinking is associated with weak internal inhibition of autonomic responses in classical conditioning.

Allusive thinking and Lovibond's object sorting test

Bleuler (1911) considered that a basic symptom of schizophrenia was a form of thought disorder which manifested itself primarily as a loosening of the associative process. Bleuler believed that in normal thinking thought associations were goal-directed, and that those aspects of a concept selected were usually relevant to the context. By contrast, in schizophrenia associations lacked direction towards a goal and associations irrelevant to the context were often selected. Bleuler considered that a failure to inhibit irrelevant associations characterized the thinking of the schizophrenic.

Rapaport (1945) noted that schizophrenics showed 'loosening of the concept span' in an object sorting task, in that they included objects in groups to which they did not strictly belong. Rapaport reported that such loosening of thinking was shown not only by schizophrenic patients but also by schizoid members of a non-mentally ill control group.

Lovibond (1954, 1966) modified the form of the object sorting test described by Rapaport, and developed a method of scoring designed to measure the degree of looseness of thinking. He reported that the test differentiated schizophrenics from normals, and that the scores correlated significantly with a psychiatrist's clinical assessment of the degree of looseness of thinking present in the schizophrenic patients.

In a series of studies using Lovibond's test, McConaghy (1959, 1960, 1961, 1965) reported that looseness of thinking was often shown by non-schizophrenic subjects. He recommended the term 'allusive thinking' in order to avoid any implication of pathology. McConaghy (1959) administered the object sorting test to the parents of ten schizophrenic patients. The patients all showed looseness of thinking clinically. All the parents were normal in the sense that they were engaged in an occupation in the community and were not apparently suffering from any form of psychiatric illness; but when compared with a control group, significantly more parents of schizophrenics had high scores on the object sorting test. This finding was replicated by Rosman *et al.* (1964). These authors, unlike McConaghy, regarded the looseness of thinking measured by the object sorting test as related to the irrationality they had noted in the parents of schizophrenics, which they considered to be associated with frankly psychotic behaviour in these parents. In a further series of studies using university students as subjects, McConaghy (1965) found that a considerable percentage of such subjects showed a significant degree of looseness of thinking clinically and obtained scores in the object sorting test in the same range as those obtained by schizophrenic patients. He concluded that such looseness of thinking was a normal code of conceptual thinking. Since it was known that loose or allusive thinking was familially distributed in schizophrenia, McConaghy considered that the same was likely to be true for allusive thinking in non-schizophrenics. McConaghy and Clancy (1968) assessed one hundred and one university students using the object sorting test; an attempt to obtain evidence of the presence of schizophrenia was made by using two measures, academic performance and the F scale of the M.M.P.I. (confusion, irrationality, lack of comprehension). The scholastic performance of schizophrenic students had been shown to be signi-

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ficantly below that of non-psychotic matched controls (Kiersch and Nikelly, 1966). Winter and Stortroen (1963) investigated the validity of scales and indices derived from the M.M.P.I. as measures of schizophrenic pathology. They found that the F scale best differentiated schizophrenics from normals; seventy-two per cent of the schizophrenic patients obtained K-corrected T scores in the F scale of over 60, as compared with 8 per cent of controls. McConaghy and Clancy found that students with high object sorting test scores showed a significantly greater tendency to have a parent with a high object sorting test score that did students with low scores. No tendency was present for high object sorting test scorers (allusive thinkers) to have poor academic performance compared with low scorers; neither was any tendency found for high scorers on the object sorting test to have high M.M.P.I. F scale scores compared with low scorers. The authors concluded that allusive thinking was inherited. This conclusion may be criticized on the grounds that the familial distribution of allusive thinking described could be explained by environmental influences. McConaghy and Clancy also concluded that allusive thinking was not commonly associated with schizophrenia; however it may be argued that poor academic performance and high M.M.P.I. F scores are unsatisfactory indices of the presence of schizophrenia.

The theoretical relationship between allusive thinking and internal inhibition

Lovibond (1954) has postulated that allusive thinking results from weakness of internal inhibition, which allows irrelevant thought associations to achieve dominance.

Pavlov (1927) considered the following phenomena to be forms of internal inhibition:

(1) Differential inhibition, which is inhibition of responses to unreinforced stimuli in discrimination learning. In discrimination learning two different stimuli are presented separately; reinforcement (e.g. an electric shock) regularly follows one stimulus but not the other. The subject learns to respond to the reinforced stimulus and to inhibit responses to the unreinforced stimulus.

(2) Inhibition of delay, which is inhibition of conditioned responses until the appropriate time. In delayed conditioning there is a relatively long interval (e.g. ten seconds) between the onset of the conditioned stimulus and the onset of the unconditioned stimulus. The subject learns to delay the conditioned response until near the time of expected onset of the unconditioned stimulus.

(3) Inhibition with reinforcement, which refers to the diminution of a conditioned response which may occur within reinforced trials if such trials are repeated at short intervals. That such diminution is secondary to internal inhibition is shown by the fact that a slight change in the conditioned stimulus or experimental situation is followed by the reappearance or increase in the conditioned response.

(4) Habituation, which is the tendency for responses to discrete identical stimuli to decrease with repetition.

If allusive thinking is secondary to weak internal inhibition, allusive thinkers would therefore be expected to show (1) poor discrimination; (2) little tendency for conditioned response amplitude to decrease in late trials (secondary to weak inhibition of delay and weak inhibition with reinforcement); (3) a relatively slow rate of habituation to unconditioned stimuli.

One further prediction can be made concerning the rate of conditioning in allusive thinkers. Pavlov considered that in health an equilibrium exists between the strength of cortical excitatory and inhibitory processes. He regarded the linking of stimuli in conditioning as being dependent on cortical excitatory processes. Therefore, if allusive thinkers have weak internal inhibition they would also have weak cortical excitation resulting in a slow rate of conditioning.

Lovibond (1963) reported a study of galvanic skin response conditioning, in which allusive thinkers differed significantly from non-allusive thinkers in that they showed a slower rate of conditioning and poorer discrimination.

The present study

The aim of the present study was to examine the relationship between allusive thinking and internal inhibition. Two classical conditioning procedures were designed in such a way as to

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maximize internal inhibition. In both procedures delayed conditioning was used, and in addition one procedure was a discrimination learning experiment.

The galvanic skin response is part of the orienting response and tends to increase following any change in the environment (Sokolov, 1960). It is therefore not ideal for the purpose of studying conditioning, since after habituating to several conditioned stimulus only presentations (adaptation trials) it tends to increase in response to the conditioned stimulus following the introduction of the unconditioned stimulus. This increase in galvanic skin response amplitude to the conditioned stimulus is partly due to the changed stimulus input caused by the introduction of the unconditioned stimulus, as well as to 'true conditioning' secondary to conditioned stimulus—unconditioned stimulus pairing (Zimny *et al.*, 1966).

For these reasons the penile volume response, which is not part of the orienting response, was measured in addition to the galvanic skin response.

Sixty-two male first year university student volunteers were examined (mean age 19·4 years, standard deviation 2·4). Each student was given the Lovibond object sorting test, Eysenck personality inventory, and Taylor manifest anxiety scale, and underwent two conditioning procedures.

Method

The method used for measuring penile volume change was described by McConaghy (1967). The two conditioning procedures and the method of scoring penile volume responses used have been described in detail by Barr and McConaghy (1971). Briefly, in the appetitive procedure the unconditioned stimuli were ten nude female film sequences and ten nude male sequences. The nude sequences were of ten seconds duration and each was preceded by a conditioned stimulus also of ten seconds duration. A circle preceded female sequences and a triangle preceded male sequences. In the aversive experiment the unconditioned stimuli were ten unpleasant electric shocks. Each shock was preceded by a tone of 10 seconds duration, 65 decibels intensity and 500 c.p.s. The reinforced tones were alternated with an unreinforced tone of the same duration and intensity but of 1,500 c.p.s. The experimental procedures are represented by diagrams in Fig. 1.

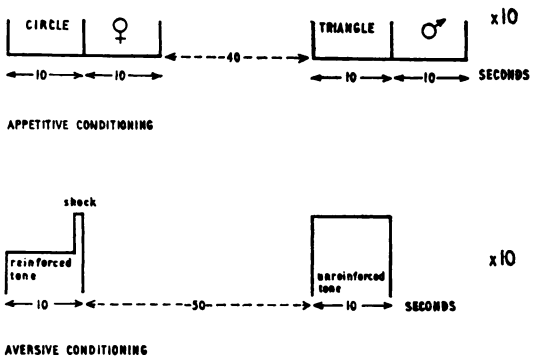


FIG. 1.—Diagrams illustrating experimental procedures in the two conditioning experiments.

As an adaptation procedure, in the appetitive experiment the circle and triangle were presented twice in alternation prior to being reinforced. A similar procedure was followed for the 500 and 1,500 c.p.s. tones in the aversive experiment. In both procedures conditioned stimuli were presented at intervals of one minute.

Each subject underwent the appetitive and aversive conditioning procedures on the same day, with a rest period of 20 minutes between the two procedures. Half the subjects received the appetitive procedure first and half the aversive procedure.

Galvanic skin responses were measured with a model 5 P1 preamplifier in a standard Grass model 5 D polygraph. Silver electrodes coated with silver chloride were placed on the palm of the left hand at the base of the index and fifth fingers and as far apart as possible. In order to keep the area of moist skin constant Beckman electrodes were used. Galvanic skin responses were measured in units of change in the square root of conductance in micromhos.

Method of scoring galvanic skin responses

The response in adaptation trials was scored by calculating the difference in conductance from the time of conditioned stimulus onset to the point of maximum conductance change occurring within the 10 seconds of stimulus presentation. Conditioned galvanic skin responses were scored by calculating conductance change from the time of conditioned stimulus onset to the time of unconditioned stimulus onset. The unconditioned response was scored by noting the difference in conductance from the time of conditioned stimulus onset to the maximum conductance change occurring within 10 seconds of unconditioned stimulus offset in the aversive procedure and within 10 seconds of unconditioned stimulus onset in the appetitive procedure. This method of

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scoring the unconditioned response was used because skin conductance tended to rise through the period of conditioned stimulus exposure and then continue to rise following the onset of the unconditioned stimulus. Thus the record was of one complex response and not two distinct responses. In the aversive procedure, the galvanic skin response to the unreinforced tone was scored by noting the conductance change from the time of tone onset to the point of maximum conductance change occurring within the next 10 seconds. Figs. 2 and 3 show photographs of the penile volume and galvanic skin response recordings in the appetitive and aversive experiments.

Results

Two records of penile volume changes showed no responses. This was almost certainly due to the presence of a small air leak in the replaceable rubber diaphragm. The two records were therefore discarded. The galvanic skin response records in the aversive procedure were satisfactory for all 62 students.

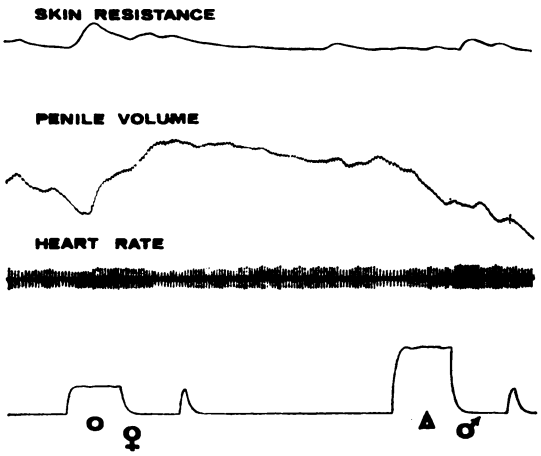


Fig. 2.—Photograph of polygraph record in the appetitive experiment.

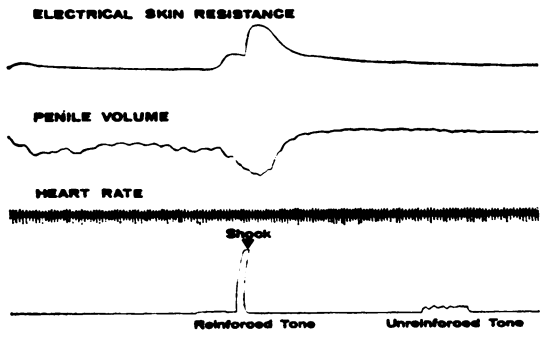


Fig. 3.—Photograph of polygraph record in the aversive experiment.

The main purpose of this paper is to describe differences in conditioning performance between high and low scorers in the object sorting test. It is first necessary to give a brief account of conditioning for the whole group of subjects in order to show that conditioning did occur and to describe the significant relationships between unconditioned and conditioned response amplitude.

(a) *Penile responses*

The unconditioned and conditioned penile volume responses have been described in detail in an earlier paper (Barr and McConaghy, 1971).

In summary, penile volume increases occurred in response to female sequences, and penile volume decreases occurred in response to male sequences. In the aversive procedure, penile volume decreases occurred in response to electric shocks. Similar penile volume changes occurred in response to the associated conditioned stimuli.

The correlations between mean conditioned (trials 2–10) and mean unconditioned (trials 1–10) penile volume response amplitude were as follows:

Mean penile conditioned response amplitude	Mean penile unconditioned response amplitude	r	d.f.	SIG.
to circles	to females	+0·574	58	0·001
to triangles	to males	+0·563	58	0·001
to reinforced tone	to electric shocks	+0·409	58	0·001

It was concluded that the amplitude of conditioned penile responses was significantly related to the amplitude of the unconditioned responses on which they were based.

In 54 of the 60 students the penile volume responses to females were significantly more positive than responses to males (Mann-Whitney test, $P < 0{\cdot}05$). Only these 54 subjects will be further considered in relation to penile

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volume conditioning in the appetitive experiment.

(b) *Galvanic skin responses*

1. *Galvanic skin responses to female and male film sequences*

Of the 54 students whose penile responses to females were significantly more positive than their responses to males, 51 showed a higher mean galvanic skin response to females than to males. For these 54 students, the mean total response to females was 1·634 $\sqrt{\text{micromhos}}$ (standard deviation 1·036). The mean total response to males was 0·936 $\sqrt{\text{micromhos}}$ (standard deviation 0·800). This difference was significant (t test, paired observations, t = 7·670, d.f. 53, $P < 0·001$).

2. *Galvanic skin responses to electric shocks*

The mean total galvanic skin response to electric shocks was 5·050 $\sqrt{\text{micromhos}}$ (standard deviation 2·400). These responses were thus over three times as large as those to female sequences.

3. *Conditioned galvanic skin responses*

In the appetitive procedure, the mean galvanic skin response to the first two unreinforced circles (adaptation trials) was 0·071 $\sqrt{\text{micromhos}}$ (standard deviation 0·094). The mean conditioned galvanic skin response to circle (trials 2–10) was 0·106 $\sqrt{\text{micromhos}}$ (standard deviation 0·073). This difference was statistically significant (t test, paired observations, t = 3·555, d.f. 59, $P < 0·01$).

The mean conditioned galvanic skin response to triangle (trials 2–10) was also significantly greater than the mean response to the first two unreinforced triangles (t test, paired observations, t = 2·743, d.f. 59, $P < 0·01$).

For the 54 students showing significantly more positive penile responses to females than to males, the mean galvanic skin response to circles was significantly greater than the mean galvanic skin response to triangles (t test, paired observations, t = 2·743, d.f. 53, $P < 0·01$).

The correlation between conditioned response amplitude to circles and unconditioned response amplititude to females was +0·686 (d.f. 58, $P < 0·001$). The correlation between conditioned response amplitude to triangles and unconditioned response amplitude to males was +0·651 (d.f. 58, $P < 0·001$).

It was concluded that conditioned galvanic skin responses occurred, and that the amplitude of conditioned responses was significantly related to the amplitude of the unconditioned responses upon which these were based.

In the aversive experiment the mean conditioned galvanic skin response to reinforced tone was 0·241 $\sqrt{\text{micromhos}}$ (standard deviation 0·134). The mean response to the initial two unreinforced tones was 0·086 $\sqrt{\text{micromhos}}$ (standard deviation 0·094). This difference was significant (t test, paired observations, t = 8·965, d.f. 61, $P < 0·001$). The mean galvanic skin response to the unreinforced tones was 0·129 $\sqrt{\text{micromhos}}$ (standard deviation 0·083). This was significantly smaller than the mean response to the reinforced tone (t test, paired observations, t = 9·757, $P < 0·001$). The mean galvanic skin responses of the 62 students in the aversive experiment are shown in Fig. 4.

The correlation between conditioned response amplitude to tones and unconditioned response amplitude to electric shocks was +0·746 (d.f. 60, $P < 0·001$). It was concluded that conditioning of the galvanic skin response occurred and that the amplitude of the conditioned responses was significantly related to the amplitude of the unconditioned responses upon which they were based.

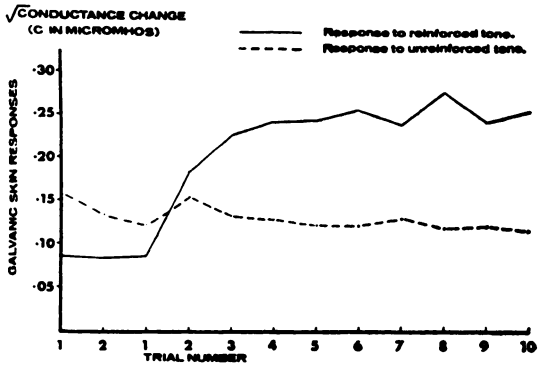


FIG. 4.—Mean G.S.R. responses of 62 students to reinforced and unreinforced tones.

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Personality variables

The mean scores on the personality variables of the 62 students were as follows:

Object sorting test score mean	13·4 (standard deviation 7·0)
Eysenck neuroticism score mean	10·1 (standard deviation 4·8)
Eysenck extraversion score mean	12·4 (standard deviation 4·0)
Manifest anxiety scale score mean	16·2 (standard deviation 7·0)

The correlations between these personality variables were as follows:

		1	2	3	4
Object sorting test score	1	1·000			
Eysenck neuroticism score	2	0·026	1·000		
Eysenck extraversion score	3	−0·054	−0·032	1·000	
Taylor manifest anxiety scale score	4	0·062	0·802*	−0·210	1·000

n = 62.

* Correlations greater than 0·250 significant at 0·05 level.

The correlations between object sorting test score and questionnaire measures of neuroticism and extraversion were near zero, however a negative correlation (−0·210) was found between extraversion scores and Taylor manifest anxiety scores. In order to compare conditioning performance of high and low scoring groups on three personality variables (allusive thinking, anxiety and extraversion) it was thought desirable to divide subjects into high and low scoring groups on scores which were related to a single personality characteristic and unrelated to the other personality characteristics. For this reason scores on the object sorting test, Eysenck neuroticism scale, Eysenck extraversion scale and manifest anxiety scale were analysed by the method of principal components and a varimax rotation was performed on the first three factors. These factors are orthogonal, that is, the aspects of personality which they represent are not related. The rotated factor matrix was as follows:

Variable	Factor I Anxiety	Factor II Object sorting test	Factor III Extra-version
Object sorting test score	0·024	0·999	−0·026
Eysenck neuroticism score	0·956	−0·002	0·050
Eysenck extraversion score	−0·066	0·026	0·995
Manifest anxiety scale score	0·939	−0·038	−0·167

Thus three orthogonal factors were extracted relating to questionnaire anxiety, allusive thinking and extraversion. The students were then divided at the median into high and low scorers on Factor II (allusive thinking).

Allusive thinking in relation to habituation of unconditioned responses to females and electric shocks

High scorers on the allusive thinking factor showed significantly larger galvanic skin responses to electric shocks than low scorers (two way analysis of variance with repeated measures one way, $F = 4·79$, d.f. 1/61, $P < 0·05$). These are shown in Fig. 5. The amplitude of the initial response to shock was about the same for high and low scorers. The low scorers however,

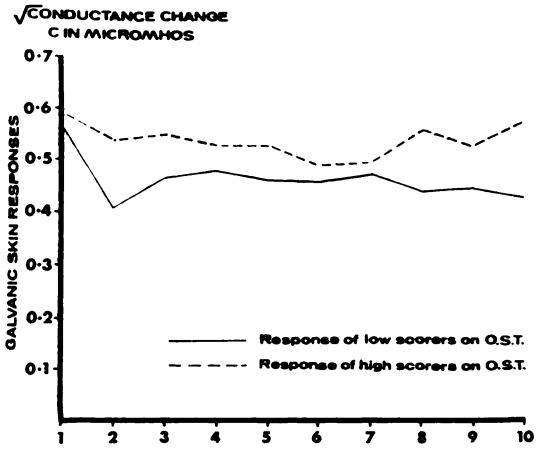


FIG. 5.—Mean unconditioned galvanic skin responses of 31 high and 31 low scores in the O.S.T. to electric shocks.

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unlike the high scorers, showed a tendency to habituate. Since habituation is a manifestation of internal inhibition, this finding is in accordance with prediction.

High and low scorers on the allusive thinking factor also differed significantly in rate of habituation of penile volume responses to electric shocks (two way analysis of variance with repeated measures one way, $F = 1 \cdot 92$, d.f. 9/522, $P < 0 \cdot 05$). The low scorers showed a significantly greater tendency for penile volume decreases to shocks to habituate than did high scorers (Fig. 6).

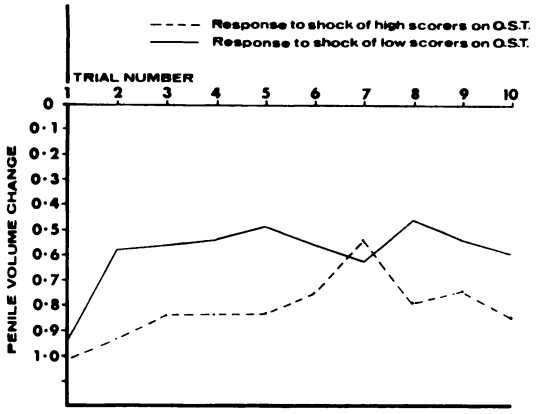


FIG. 6.—Mean unconditioned penile volume responses of 30 high and 30 low scorers in the O.S.T. to electric shocks.

High and low scorers did not differ significantly in their mean responses or pattern of change over trials in response to the female nude sequences. This was the case for both penile volume and galvanic skin responses.

Allusive thinking in relation to conditioning

The conditioned penile volume increases to the circles preceding female sequences of high and low scoring groups on the allusive thinking factor differed significantly in pattern of change over trials (two way analysis of variance with repeated measures one way, $F = 2 \cdot 46$, d.f. 9/468, $P < 0 \cdot 01$). As shown in Fig. 7, the high scorers (allusive thinkers) showed a slower rate of conditioning in early trials and less tendency for conditioned responses to diminish in late trials than did low scorers (non-allusive thinkers).

The significant difference between groups was in pattern of change over trials and not in mean conditioned response amplitude.

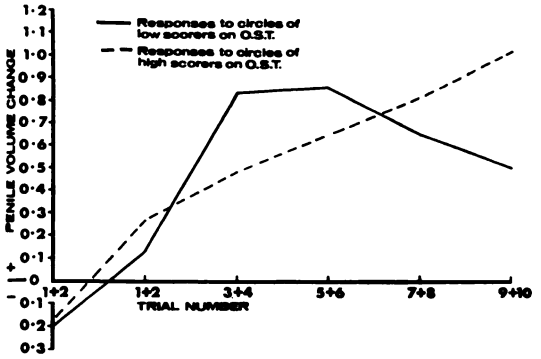


FIG. 7.—Mean penile volume change to circles of 27 high and 27 low scorers on O.S.T.

In order to elucidate this difference between groups in pattern of forming conditioned responses, penile volume increases to females and preceding circles were measured at two-second intervals for an early trial (4) and a late trial (10), these are shown in Fig. 8. In trial 4 the low scorers (non-allusive thinkers) showed larger conditioned penile volume increases to circles than high scorers (allusive thinkers). By contrast, in trial 10 the high scorers (allusive thinkers) showed larger conditioned penile volume increases to circles than low scorers (non-allusive thinkers); the penile volume increase of the latter was largely delayed until the onset of the female sequence.

As described earlier, the amplitude of conditioned responses was significantly related to the amplitude of the unconditioned responses upon which they were based. The difference in pattern of conditioning found between allusive and non-allusive thinkers might therefore be secondary to a difference in unconditioned penile volume increases to females between allusive and non-allusive thinkers. In order to study the relationship between allusive thinking and pattern of change in conditioned responses over ten trials with the influence of response amplitude partialled out, the conditioned penile volume increases to circles were analysed by a further method. A factor analysis of the covariance matrix of the ten conditioned penile responses to circles was carried out for the 54 students (only subjects whose penile volume responses to females were significantly more

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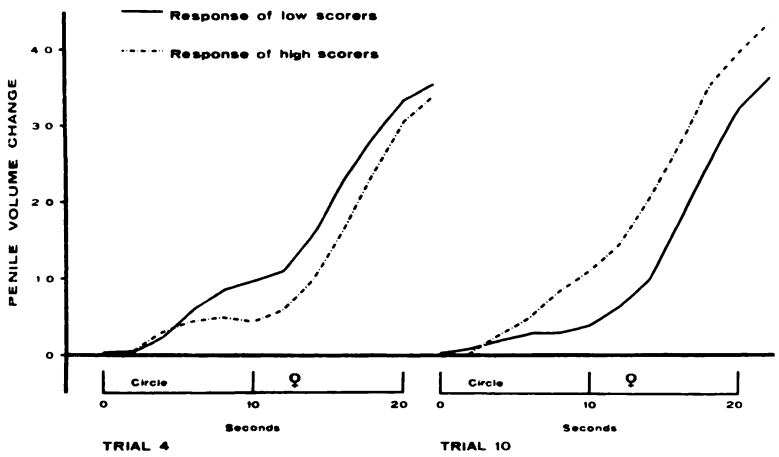


FIG. 8.—Mean penile volume changes measured at two second intervals of 27 high and 27 low scorers on O.S.T.

positive than their responses to males were included in the analysis). The analysis produced Factor I which accounted for 52·1 per cent of the variance and described the amplitude of the conditioned penile responses to circle. Factor II accounted for 16·3 per cent of the variance and referred to the shape of the learning curve with the influence of amplitude partialled out. Low scorers on Factor II (reflected) tended to form conditioned responses rapidly and then to show diminished conditioned response amplitude in late trials. By contrast high scorers on Factor II (reflected) showed a relatively straight learning curve; conditioned responses were formed slowly and in 10 trials there was no tendency for conditioned response amplitude to diminish.

The correlation between the object sorting test factor and the early-late learning factor (reflected) was +0·341 (d.f. 52, $P < 0·05$). This method of analysis shows therefore that high and low scorers on the allusive thinking factor show a significantly different pattern of learning when the influence of response amplitude is partialled out.

Inhibition of irrelevant responses

A further significant difference between high and low scorers on the allusive thinking factor was in the galvanic skin responses to the unreinforced tone in the aversive experiment. The low scorers differed from the high scorers in that they showed more ability to discriminate between reinforced and unreinforced tones and to inhibit galvanic skin responses to the latter. This difference between groups was significant (two way analysis of variance with repeated measures one way, $F = 2·19$, d.f. 9/540, $P < 0·05$). The galvanic skin responses to unreinforced tones of high and low scorers are shown in Fig. 9.

Other conditioning measures

The conditioned penile volume decreases to triangles preceding male sequences of allusive and non-allusive thinkers also differed in pattern of change over trials. Allusive thinkers showed a

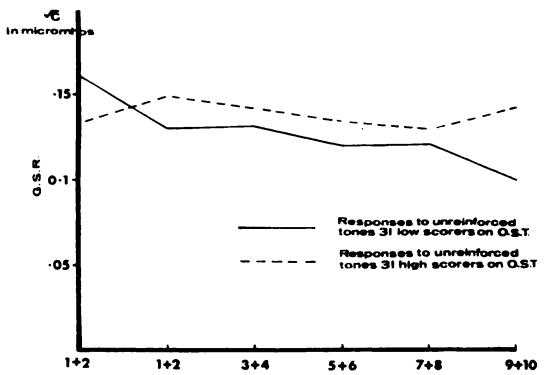


FIG. 9.—Mean G.S.R. to unreinforced tones of 31 high and 31 low scorers on O.S.T.

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slower rate of conditioning in early trials and less tendency for conditioned responses to diminish in late trials than did non-allusive thinkers. The same trend for allusive thinkers to differ from non-allusive thinkers in the predicted way was present in the conditioned penile volume changes to reinforced tones (preceding electric shocks), and in conditioned galvanic skin responses to the circle (preceding females). In the case of conditioned galvanic skin responses to the reinforced tone (preceding electric shocks), allusive thinkers showed less tendency than non-allusive thinkers for conditioned responses to diminish in late trials, however there was no tendency for groups to differ in rate of conditioning in early trials. With this exception, all conditioning measures differed between groups in that allusive thinkers showed a slow rate of conditioning in early trials and little tendency to show conditioned response decrement in late trials compared with non-allusive thinkers. The difference in pattern of conditioning between groups reached statistical significance only in the case of conditioned penile volume increases to circles preceding females.

Conditioning in relation to neuroticism and extraversion

Subjects were divided at the median into high and low scorers on the questionnaire anxiety and extraversion factors. The unconditioned and conditioned responses of these groups were compared, using a two way analysis of variance with repeated measures one way. In no case was a significant difference found between high and low scoring groups.

The correlations between mean conditioned response amplitude and anxiety and extraversion factor scores were as follows:

The first year examination results in relation to allusive thinking and conditioning

Of the 62 students tested only 52 were present at the end of first year examination in psychology. Eight of those absent were low scorers on the object sorting test and two were high scorers in this test.

The final examination mark was derived from an essay paper and a multiple choice examination. The mean examination mark for low O.S.T. scorers was 61·7 (standard deviation 12·1), and for high scorers it was 61·8 (standard deviation 7·6). It was concluded that allusive thinkers did not have an inferior academic performance compared with non-allusive thinkers.

The correlation between examination results and the early-late learning factor was +0·029 (d.f. 50, N.S.). It was concluded that there was no relationship between conditioning efficiency as measured by the early-late factor and academic performance.

Discussion

The penile volume responses have been discussed in an earlier paper (Barr and McConaghy, 1971) and will not be dealt with further except in relation to allusive thinking.

In the present study the amplitude of conditioned responses was found to correlate strongly and positively with the amplitude of the associated unconditioned responses. Working with classical conditioning of the galvanic skin response, Cadoret (1963) reported a similar positive correlation between conditioned and unconditioned response amplitude. Similar findings have been reported in relation to penile volume conditioning by McConaghy (1970). Conditioned response amplitude appears to depend to a considerable extent on the reflex

	Penile to circle	Penile to triangle	G.S.R. to circle	G.S.R. to triangle	Penile to reinforced tone	G.S.R to reinforced tone
Personality factor score:						
Anxiety	−0·173	−0·210	+0·114	−0·024	−0·103	+0·048
Extraversion	+0·147	+0·013	−0·071	+0·061	+0·061	+0·152

n = 54.

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sensitivity of the response system under study, as well as the amount of learning which the subject shows. The difference in pattern of conditioning of penile volume increases to circles, found between allusive and non-allusive thinkers, might depend primarily on a difference between groups in their unconditioned penile volume increases to female sequences. The findings of the present study do not support such a view, since unconditioned penile volume increases to female sequences did not differ significantly between allusive and non-allusive thinkers. It is therefore concluded that allusive thinking is primarily associated with the pattern of conditioning described rather than with a characteristic pattern of unconditioned penile responses to females.

This conclusion is supported by the finding that the early-late factor (derived from the factor analysis of the covariance matrix of conditioned penile increases to circles) correlated significantly with the allusive thinking factor. The early-late learning factor described the pattern of conditioning with the influence of amplititude (i.e. penile reactivity) partialled out. The significant correlation between the early-late learning factor and allusive thinking factor lends further support to the conclusion that allusive thinkers form conditioned responses more slowly and have less tendency to show conditioned response decrement in late trials than non-allusive thinkers.

In terms of Pavlov's theory, inhibition with reinforcement, inhibition of delay, differential inhibition and habituation, are all manifestations of internal inhibition.

There is a suggestion of inhibition of delay of penile volume increases to circles in the present study, since a significantly greater penile volume increase during the first two seconds of female sequence occurred in late trials than in early trials. The shape of the penile volume response to circle and female in trial 10 (Fig. 8), of low scorers on the allusive thinking factor suggests that they have more ability to delay penile volume increase until the onset of the female sequence than do high scorers. Since the conditioned stimuli were not presented alone after learning trials, the role of inhibition of delay in producing conditioned response decrement in late trials cannot be exactly defined from the results of the present study.

The finding that high scorers on the allusive thinking factor showed significantly less ability than low scorers to suppress irrelevant galvanic skin responses to unreinforced tones in the aversive procedure is in accordance with prediction.

Since habituation, that is the ability to inhibit responses to repeated identical stimuli, is a manifestation of internal inhibition, allusive thinkers would be expected to show less habituation than non-allusive thinkers. The finding that allusive thinkers showed significantly less habituation of both penile and galvanic skin responses to electric shocks than non-allusive thinkers lends further support to the conclusion that allusive thinking is associated with weak internal inhibition.

McConaghy and Clancy (1968) found that high and low scorers on the object sorting test did not differ in their university examination results. The findings of the present study also suggest that allusive thinking is not associated with inferior academic performance.

Conclusions

The basic theoretical proposition underlying the present study is that allusive thinking results from a weakness of internal inhibition which allows irrelevant aspects of concepts to be activated. Lovibond has predicted that this weakness of internal inhibition should also be observable in conditioning performance. He assumed that the strength of internal inhibition was positively related to the strength of cortical excitation. He therefore predicted that allusive thinkers would show a slow rate of conditioning (reflecting a low level of cortical excitability) and slow habituation, the slow development of inhibition with reinforcement (or delay), and a relative inability to suppress irrelevant responses to an unreinforced stimulus (reflecting weakness of internal inhibition). The findings of the present study confirm all four of these predictions, and lend support to Lovibond's hypothesis concerning the mechanisms of allusive thinking.

Since schizophrenics, and to a lesser extent their parents, show allusive thinking, it seems likely that they also differ from non-allusive

https://doi.org/10.1192/bjp.121.3.299 Published online by Cambridge University Press

thinkers in their pattern of forming conditioned responses. Further research using schizophrenic patients or their relatives may throw light on the possible existence of a basic inherited neurophysiological characteristic, which is present in schizophrenic patients but which is also found in a sizeable minority of those whose psychiatric health is normal. Huxley *et al.* (1964) have suggested that a genetically predisposing factor to schizophrenia may carry an advantage for its possessors. They argued that since such a genetic predisposition has obvious disadvantages in schizophrenia (such as reduction in fertility) it must also have advantages in non-schizophrenic relatives in order to account for the survival of the genes concerned.

It may be that allusive thinking and the associated physiological correlates described in this paper are sometimes biologically useful and yet are also manifestations of a genetic predisposition to schizophrenia. Weak internal inhibition and the associated tendency to show relatively loose thought associations may, for example, be useful in creative work such as painting or writing.

Summary

Sixty-two male student volunteers were assessed for loose or 'allusive' thinking using the object sorting test. Their conditioning performance was evaluated, using an appetitive and an aversive conditioning procedure. It was found that allusive thinkers differed significantly from non-allusive thinkers in that they showed a slower rate of conditioning, less inhibition of delay and less ability to suppress irrelevant responses. It is concluded that allusive thinking is associated with weakness of internal inhibition in classical conditioning.

Acknowledgements

The assistance of Professor S. H. Lovibond, School of Psychology, University of New South Wales, and Professor L. G. Kiloh, School of Psychiatry, University of New South Wales, in the preparation of this paper is gratefully acknowledged.

The statistical advice of Kevin Bird and Daphne Mitchell, School of Psychology, University of New South Wales, is also gratefully acknowledged. This research was made possible by the appointment of the principal worker as a Research Fellow of the New South Wales Institute of Psychiatry.

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A synopsis of this paper was published in the February 1972 *Journal*.

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(*Received 2 August 1971*)

https://doi.org/10.1192/bjp.121.3.299 Published online by Cambridge University Press