

EFFECT OF LYSERGIC ACID DIETHYLAMIDE (LSD-25) ON PERCEPTION OF PART-WHOLE RELATIONSHIPS*

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A. INTRODUCTION

In studying the behavioral effects of lysergic acid diethylamide (LSD-25) from the developmental point of view, our research program has called for the sampling of behavior at various levels of functioning, e.g., physiological level, sensory level, perceptual and conceptual levels. This paper is restricted to a study of the effects of *LSD* on one aspect of perceptual functioning, namely, the perception of part-whole relationships.

Our hypotheses follow from certain implications of a general principle characterizing development, viz., with developmental progression there is an increase in differentiation and hierarchic integration (6). This general principle, together with our assumption that *LSD* operates as a primitivizing agent (regression hypothesis), leads to the general expectation that a normal adult will operate at a less mature level under the drug than without the drug.

With respect to the problem of perception of part-whole relationships, it is expected on the basis of the general developmental principle that presented figures become increasingly differentiated into parts and that each of these parts becomes increasingly subordinated to the whole. These expectations have already received some confirmation in ontogenetic studies employing the Rorschach (2); in other perceptual tasks (5); and they have also been supported in studies employing criteria of developmental level other than chronological age (3,4). Some of these studies (5) provide empirical ontogenetic standards for certain tests; criteria against which we may evaluate the regressive effects of *LSD*. Three of these tests are employed in the present study, each test being pertinent for a different aspect of part-whole relationships.

One of the specific situations is that concerning the Müller-Lyer Illusion, an illusion based on the assimilation of parts to the whole. A second situation is the Titchener Circles Illusion, an illusion based on the contrast

* Received in the Editorial Office on April 8, 1959, and published immediately at Provincetown, Massachusetts. Copyright by The Journal Press.

¹ This investigation was supported by a grant, MY 2262, from National Institute of Mental Health, U. S. Public Health Service.

relationship between parts constituting the whole. The last situation employed is the Heiss-Sander situation which is based upon the ability to abstract an element or part from the whole, or, put in another way, a situation wherein the degree of embeddedness of a part within the whole can be evaluated.

In keeping with the analysis that the Müller-Lyer Illusion is essentially based on the assimilation of parts to the whole (lesser differentiation of parts) this illusion was shown to have greater effect on children 6 years old and gradually decrease in effect to age 15 when susceptibility again increases somewhat (5). The Titchener Circles Illusion, on the other hand, based on a contrast relation between parts depends upon greater articulation of parts, and the effect of the illusion, therefore, would be expected to increase with age. This expectation was verified in an ontogenetic study (5). The Heiss-Sander's task is based upon the ability to extract a part from the whole, and this ability would be expected to increase with development. Ontogenetic data (1) confirm the expectation.

Our specific hypotheses, therefore, are that under *LSD* the normal adult will be more susceptible to the Müller-Lyer Illusion, less susceptible to the Titchener Circles Illusion, and will be less able to extract the part from the whole in the Heiss-Sander situation.

B. EXPERIMENT 1. EFFECT OF *LSD* ON PART-WHOLE RELATIONS: MÜLLER-LYER ILLUSION

1. Procedure

The Müller-Lyer pattern was presented as pictured in Figure 1. *S*'s task was to tell *E* how to adjust the right part to apparent equality with the left part. The left part of the pattern (angles inward), 75 mm. long, was used as the standard; the right part could be adjusted by *E*. *S*, sitting 3 ft. from



FIGURE 1
MÜLLER-LYER ILLUSION TEST PATTERN

the pattern, told *E* how to adjust the variable. Two trials were employed; on one of the trials the initial setting of the variable was small (25 mm.); on the remaining trial it was large (125 mm.). The sequence of trials defined in terms of initial setting was the same for all *Ss*, namely, small, large.

Each *S* carried out this task under two conditions: Condition *A*—two to three hours following oral administration of 75 gamma of LSD-25; and Condition *B*—under control (no drug) conditions. Sequence was controlled by reversing the order of drug-no-drug conditions for half of the group of 20 *Ss*. An average of one week was interpolated between conditions.

2. Subjects

Ss were normal volunteers whose ages ranged from 19-54, mean = 29.5 years.

TABLE 1
EFFECTS OF LSD-25 ON PART-WHOLE RELATIONS:
MÜLLER-LYER ILLUSION

Source	df	MS	F	P
<i>F tests</i>				
Between individuals (I)	19	0.23398	—	—
Sequence	1	0.01050	< 1.00	> .05
Sex	1	0.07650	< 1.00	> .05
Is within sequence	17	0.25639	—	—
Order	1	0.00500	< 1.00	> .05
Conditions	1	0.06000	1.546	> .05
Error residual	18	0.03882	—	—
Total	39	0.13357	—	—
<i>Means (cms)*</i>				
LSD-25		13.2		
No Drug		13.3		

* A score of 15.0 cm indicates objective equality.

3. Measures Employed

The mean of the two trials served as the measure used in the analysis.

4. Results

The results are summarized in Table 1. As can be seen, the hypothesis that LSD would increase susceptibility to the Müller-Lyer Illusion was not confirmed.

C. EXPERIMENT 2. EFFECT OF LSD ON PART-WHOLE RELATIONS: TITCHENER CIRCLES ILLUSION

1. Procedure

The Titchener Circles Illusion, shown in Figure 2, consists of an inner circle surrounded by a concentric ring of circles. The standard, always on the left, was composed of an inner circle 16.5 mm. diameter and five surrounding circles each with a diameter of 25 mm. The inner circle of the variable varied from 9.00 to 21.00 mm. in steps of .75 mm. These variable

circles were surrounded by seven circles each with a diameter of 9 mm. *S* was presented with a chart on which were drawn 17 pairs consisting of the standard configuration on the left and the variable configuration on the right. At the top of the chart the inner circle of the variable configuration was smallest and it increased toward the bottom so that the lowest pair had the biggest inner circle, 21.00 mm. diameter.

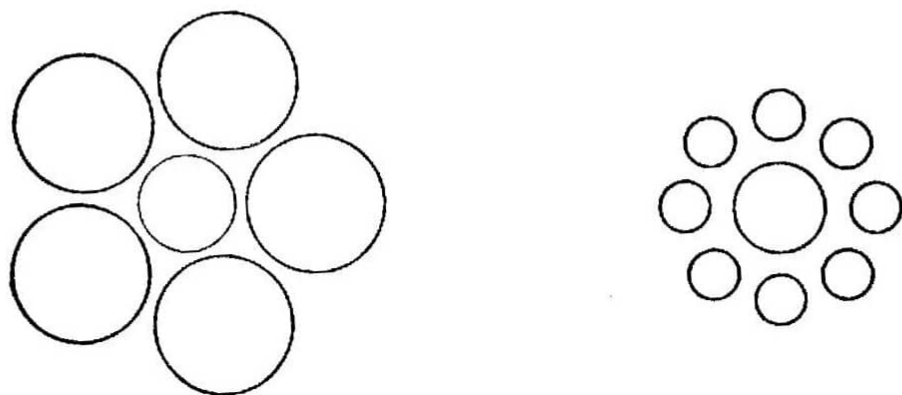


FIGURE 2
TITCHENER CIRCLES ILLUSION SAMPLE TEST FIGURE

The task for *S* was to judge for each of the 17 pairs whether the center circle on the right (variable) was larger, equal, or smaller than the center circle in the standard on the left. Two trials were given for each *S*, i.e., in one trial *S* started from the top going down (from the variable with the 9.00 mm. diameter inner circle); in the other trial *S* started with the bottom pair (inner circle of variable 21.00 mm. diameter) going upward.

Each *S* carried out this task under two conditions: Condition *A*—two to three hours following oral administration of 75 gamma of LSD-25; and Condition *B*—under control (no drug) conditions. Sequence was controlled by reversing the order of drug-no-drug conditions for half of the group of 20 *Ss*. An average of one week was interpolated between conditions.

2. Subjects

Ss were the same sample described in Experiment 1.

3. Measures Employed

Utilizing an ascending and descending series, the point of subjective equality (expressed in mms.) was calculated and served as a basic measure in the analysis.

4. Results

The results are summarized in Table 2. There is no evidence in keeping with the hypothesis that *LSD* decreases susceptibility to the Titchener Circles Illusion.

TABLE 2
EFFECTS OF *LSD*-25 ON PART-WHOLE RELATIONS:
TITCHENER CIRCLES ILLUSION

Source	df	MS	F	P
<i>F tests</i>				
Between individuals (I)	19	0.3986	—	—
Sequence	1	0.2002	< 1.00	> .05
Sex	1	0.0004	< 1.00	> .05
I's within sequence	17	0.4337	—	—
Order	1	0.0366	< 1.00	> .05
Conditions	1	0.0002	< 1.00	> .05
Error residual	18	0.2585	—	—
Total	39	0.3144	—	—
<i>Means (mm)</i>				
<i>LSD</i> -25		14.3		
No Drug		14.3		

D. EXPERIMENT 3. EFFECT OF *LSD* ON PART-WHOLE RELATIONS:
HEISS-SANDER FIGURES²

1. Procedure

S was seated four feet from a screen upon which were simultaneously projected two figures at *S*'s eye level. These figures, a sample of which is shown in Figure 3, were projected through a 2 × 2 slide projector and were separated by about two feet on the screen.

A pair of figures always consisted of an inspection figure on the right (in which was designated by a dot the part for which *S* was to search), and a test figure on the left (in which *S* was required to locate the designated part).

There were six displays of each of two types of test figures, one with randomly grouped parts and the other consisting of parts grouped in a configuration. The figure on *S*'s right, the inspection figure, in all cases, consisted of a configuration made up of parts.

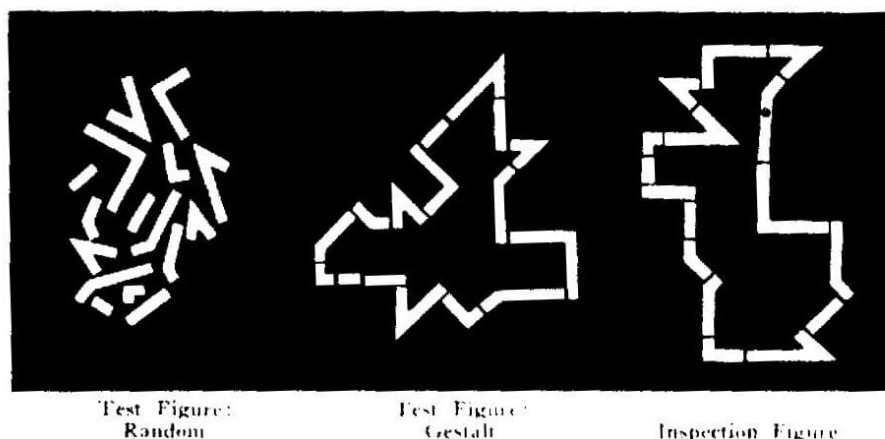
A trial consisted of the simultaneous presentation of one inspection and one test figure. Thus there were 12 trials.

On each of these trials, *S*'s task was to look at the inspection figure, ascer-

² The stimulus figures and technique of presentation employed in this study were developed by Dr. J. E. Podell.

tain the part he was to search for, and then find that part as rapidly as possible in the test figure on his left. The part for which *S* was to search was designated by a dot appearing on it as shown in Figure 3. *S* was told it could be rotated in the test but would never be turned over, i.e., a mirror image was never a correct answer.

FIGURE 3
SAMPLES OF HEISS-SANDER TEST FIGURES



E knew *S* had identified the correct part when *S* touched it with a three foot wooden pointer furnished him. If *S* touched an incorrect part *E* said "no" and *S* continued his search. Both figures were projected on the screen until *S* identified the correct part, at which time both projectors were shut off.

A single switch controlled operation of both projectors and a timer so that stopping both projectors at a correct response automatically stopped the timer and furnished *S*'s score for that trial.

The time taken by *S* for those test figures which were configurations and for those which were random displays were the two scores analyzed and reported in Table 3.

Each *S* carried out this task under two conditions: Condition *A*—two to three hours following oral administration of 75 gamma of LSD-25; and Condition *B*—under control (no drug) conditions. Sequence was controlled by reversing the order of drug-no-drug conditions for half of the group of 20 *S*s. An average of one week was interpolated between conditions.

2. Subjects

Same sample as employed in Experiments 1 and 2.

3. Results

Results are summarized in Table 3. Under the drug, the total time, independent of whether the test figure is random or gestalt, to select the correct part is significantly greater (mean = 5.94 secs) than without the drug (mean = 4.62 secs).

TABLE 3
EFFECTS OF LSD-25 ON PART-WHOLE RELATIONS:
HEISS-SANDER SITUATION

Source	df	MS	F	P
<i>F tests</i>				
Between individuals (I)	19	8.65	—	—
Sex (S)	1	20.29	2.53	> .05
Pooled I's $\times$ S	18	8.00	—	—
Within I's	60	3.19	—	—
Drug (D)	1	34.84 ^a	5.40	< .05
Configuration (C)	1	5.83 ^b	14.36	< .01
D $\times$ C	1	0.37 ^c	1.00	> .05
D $\times$ S	1	9.13 ^a	1.42	> .05
C $\times$ S	1	2.10 ^b	5.17	< .05
C $\times$ D $\times$ S	1	0.01	< 1.00	> .05
Pooled I's $\times$ CD Comb.	54	2.58	—	—
Pooled I's $\times$ D	18	6.45	—	—
Pooled I's $\times$ C	18	0.41	—	—
Pooled I's $\times$ CD	18	0.87	—	—
Total	79	4.50	—	—
<i>Means (secs)</i>				
Configuration				
	Gestalt	Random	Total	
LSD-25	6.28	5.60	5.94	
No Drug	4.82	4.42	4.62	
Total	5.55	5.01		

^a Tested against Pooled I's $\times$ D.

^b Tested against Pooled I's $\times$ C.

^c Tested against Pooled I's $\times$ CD.

Inasmuch as young children take a differentially longer time for the configured test condition than for the random display condition, a similar result was expected under LSD. Though the results are in the expected direction (difference between configuration and random with LSD = .68 secs, without LSD = .40 secs) they are not statistically significant. Thus, both sets of results are in the expected direction, i.e., the time required to identify a part in a configuration is greater under LSD; the score reflecting the overall effect attaining significance and the interaction, reflecting the differentially greater time for gestalt than random configurations under drug compared to no-drug, falling short of significance.

E. SUMMARY AND CONCLUSIONS

The hypothesis that under *LSD*, the individual would operate at a less mature level in the perception of part-whole relationships was substantiated in the Heiss-Sander situation but not in the case of the Müller-Lyer and Titchener Circles Illusions. Thus, the regression hypothesis is substantiated for the situation which involves the task of extraction of a part from the whole.

That one obtains developmentally significant effects of *LSD* in the Heiss-Sander situation but not in the Müller-Lyer and Titchener Circles Illusions may perhaps be explained as follows.

The empirically determined relation between the developmental principle of increased differentiation and the ontogenetic results of the Heiss-Sander situation is more simple and clear-cut than the relations between this principle and the ontogenetic results of the Müller-Lyer Illusion. With respect to the principle and the Heiss-Sander situation, ontogenetic changes occur monotonically, i.e., the least degree of differentiation and hierarchic integration (as indicated by the restricted ability to perform the required task) is found in young children with a progressive increase in degree of differentiation and hierarchic integration with increase in age (as indicated by progressively greater capacity to extract an element).

In contrast, in the Müller-Lyer Illusion, changes with age bear a curvilinear relationship to the developmental principle: ontogenetic studies have shown greatest susceptibility at early age levels, decreasing susceptibility to approximately age 15, and then greater susceptibility to the illusion at later ages. Until the basis of this curvilinear relationship between increasing age and susceptibility to illusion is discovered, it may be impossible to determine any developmentally regressive effects of *LSD* in that situation.

With respect to the comparison of the Heiss-Sander Situation and the Titchener Circles Illusion, the following may be said. That there are significant effects of *LSD* with the former but not with the latter may be related to the differences in magnitude of ontogenetic changes that occur with each of the situations. An examination of the curves (1, 5) plotting performances in these situations as a function of chronological age, shows that these two curves are monotonic but that the general slope appears to be steeper for the Heiss-Sander than for the Titchener Circles. This means that the Heiss-Sander is more sensitive to changes in ontogenesis insofar as there are greater differences between successive age levels in Heiss Sander than in the Titchener Circles. Admittedly, there are different units involved in the two sets of curves. However, if this difference in slopes proves a valid one, it would

suggest that in searching for regressive effects of *LSD*, it would be most fruitful to look to those situations for which highly potent ontogenetic changes occur.

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