EXTRAVERSION-INTROVERSION AND RETENTION OF KINESTHETIC AFTER-EFFECTS

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Gerda T. G. Liem

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ABSTRACT

Two experiments bearing on the problem of retention of kinesthetic after-effects were carried out. A kinesthetic after-effect is defined as the change in the point of subjective equality (PSE) of the width of wooden bars (standard) after kinesthetic exposure (inspection) of both hands, one to a bar wider than the standard and one to a bar narrower than the standard. In the first study it was found that over a period of three days, with kinesthetic inspection on each day there is a growth in size of the after-effect, due to the fact that on each day but on the first the pre-inspection PSE is higher than on the previous day, indicating a residual after-effect or retention of the after-effect. It was also found that there was still significant retention of after-effect two weeks after the last inspection period.

The second experiment also involved retention of after-effect. Two weeks after a 10 minute kinesthetic inspection period, there was still significant retention of the after-effect. A control group, having no kinesthetic inspection showed no systematic change in PSE over a two week period.

The design of the second experiment allowed for a test of Eysenck's hypothesis that there should be a relationship between size of after-effect, retention of after-effect, and extraversion-introversion. Six groups were tested. There was an extravert, ambivert, and introvert control group and experimental group. None of the analyses showed any significant main effect or interaction involving the extraversion variable. Results do not support the Eysenck hypothesis.

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By

Gerda T. G. Liem

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INTRODUCTION

An after-effect is the distortion or displacement of a perception after exposure to an inspection stimulus. After-effects have been found in a number of modalities. The present studies are concerned with kinesthetic after-effects, specifically with the retention of these effects and the relation between the personality variable extraversion-introversion and after-effects.

The classical study of kinesthetic after-effects was done by Koehler and Dinnerstein (1947), though Gibson and Radner (1937) had reported this earlier. Koehler and Dinnerstein had blindfolded subjects judge the width of a standard width block held in one hand by using the other hand to find a point of subjective equality on a variable width block. Ss then "inspected" a third block, either wider or narrower than the standard. Inspection consisted of rubbing the inspection-block between the thumb and one finger of the hand that held the standard block before inspection. After inspection there was a tendency for Ss who had rubbed the narrow inspection block to have wider PSE than they had before inspection. The reverse was true for Ss who had rubbed the wider inspection block. This distortion is the kinesthetic after-effect. It was measured by taking the difference between the average of a number of pre-inspection and post-inspection judgments.

Persistence of after-effects

An interesting result of a number of studies of after-effects has been the persistence of the after-effects over time. Gibson (1933) reported some of his visual after-effects persisting over hours even days. Koehler and Wallach (1944) and Koehler and Fisback (1950) have reported persistence of visual after-effects over months.

Koehler and Dinnerstein (1947) found that when testing daily over a period of weeks there was a growth of the after-effects, indicating day to day retention and new growth added to the residual effect of the previous day. Some of their Ss showed residual after-effects as long as 5 months after the last inspection period. Wertheimer and Leventhal (1958) reported significant residual after-effects 8 months after the inspection period. Other studies reporting retention of kinesthetic after-effects are those of Gardner (1961), Heinemann (1961) and Bakan and Thompson (1962).

The studies most relevant to the present investigation are those of Wertheimer and Leventhal (1958) and Bakan and Thompson (1962). Wertheimer and Leventhal conducted their experiment with three groups of subjects who came at the same time of day for five successive days. The first group was the control group and was not given inspection at any time, but spent 1 minute between the pre-test and the post-test standing at rest between the inspection blocks without touching them. The second group was given 1 minute of inspection between the pre- and post-inspection measures of PSE.

The third group was given 1 minute of inspection between the pre-and post-test and 4 minutes of further inspection following the post-test. Their results reveal that the after-effects increase with an increase in the amount of inspection induced. There was an increase in pre-inspection judgment as a function of day, with Group 3, the five minute group, showing the greatest increase and Group 1, the control group, the smallest increase.

While Wertheimer and Leventhal investigated retention of kinesthetic after-effects on a short-term basis, Bakan and Thompson have found retention of kinesthetic after-effects on a long-term basis. On their first day of study 31 subjects were given 45 seconds of inspection; these Ss returned one week after Day 1 and were given 10 minutes of inspection, consisting of ten 60 seconds inspection periods with a five second rest period between them. Twenty seven Ss returned approximately 1 month after Day 2 and were tested on the retention of after-effects. These authors have found significant differences (P=.005) between the pre- and post-inspection measures of PSE on Day 1. The pre-inspection measures on Day 2 also differed significantly from the pre-inspection measures on Day 1 (P=.001). Although the PSE of the post-inspection measures on Day 2 was significantly reduced after 1 month, there was a residual after-effect significant at the .005 level measured against the pre-inspection trials on Day 1.

Learning and after-effects

Several investigators have suggested an analogy between after-effects and learning. A general definition of learning considers that it is a relatively permanent change in behavior as a result of practice. An after-effect can be considered as such a change if inspection is considered as a form of practice. Amount of inspection would be analogous to number of trials or amount of practice. It has been shown that amount of inspection is positively related to size of after-effect (Bakan, Myers, and Schoonard, 1962, and Wertheimer and Leventhal, 1958). Bakan (1962) has suggested that after-effects may actually be a primitive kind of learning. Koehler and Fishback (1950) have suggested that neural satiation, the tissue change postulated by Koehler and Wallach (1944) as the neural substrate of the after-effect, may be a change similar to that of the memory trace, the neural substrate of learning. In their article they say: "it seems possible that memory traces are weak patterns of satiation; but at the present time no convincing proof of this thesis can be given. (Koehler and Fishback, 1950 p. 409)

There is still another view of the relation between learning and after-effects. This is that satiation is a process akin to reactive inhibition (I_R) of Hullian theory. This view has been proposed by Duncan (1956) and Eysenck (1955b). This view is expressed by Eysenck:

> "Phenomena of reminiscence, of massed and spaced learning, of vigilance, of blocking and many others, have been interpreted in terms of inhibition. While it remains

> possible, of course, that in each separate case we must have recourse to a different type of inhibition, this does not seem a likely contingency, and the hypothesis certainly seems worth testing that it is the same type of cortical inhibition which causes all these phenomena as well as the perceptual ones" (Eysenck, 1955, p. 105).

Extraversion-introversion and after-effects

In several of his works (1947, 1953, 1955, 1960), Eysenck classified the dysthymic personality as the prototype of introversion and the hysteric personality as the prototype of extraversion. He took the Hullian law of inhibition as his point of departure and proposed a postulate of individual differences:

> "Human beings differ with respect to the speed with which reactive inhibition is produced, the strength of the reactive inhibition produced, and the speed with which reactive inhibition is dissipated. These differences themselves are properties of the physical structures involved in the evocation of responses." (Eysenck, 1955, pp. 34-35)

In order to make his theory complete he added one further postulate which may be stated as follows:

> "Individuals in whom reactive inhibition is generated quickly, in whom strong reactive inhibitions are generated, and in whom reactive inhibition is dissipated slowly are thereby predisposed to develop extraverted patterns of behavior and to develop hysterico-psychopathic disorders in cases of neurotic breakdown; conversely, individuals in whom reactive inhibition has developed slowly, in whom weak reactive inhibitions are generated, and in whom reactive inhibition is dissipated quickly, are thereby predisposed to develop introverted patterns of behavior and to develop dysthymic disorders in cases of neurotic breakdown." (Ibid.)

Assuming a correspondence between satiation and reactive inhibition, Eysenck (1955b) deduced that hysterics, or extraverts, will differ from the dysthymics, or introverts, on a

number of satiation phenomena, with respect to the speed of induction, strength, and persistence of figural after-effects. It is his opinion that: (1) hysterics develop satiation and figural after-effects more quickly than do dysthymics; (2) that hysterics develop stronger satiation and figural after-effects than do dysthymics; and (3) that hysterics develop more persistent satiation and figural after-effects than do dysthymics. Thus, it can be predicted that extraverts will have greater retention of kinesthetic after-effects than introverts.

The present investigations

This thesis consisted of two experiments. Experiment I is a replication and extension of the Wertheimer and Leventhal study (1958). Instead of testing the subjects for five successive days, E tested the growth of kinesthetic after-effects over a period of three successive days. An experimental group, for which kinesthetic after-effects were induced by kinesthetic inspection of wooden blocks, was compared with a control group whose Ss received the same treatment except for kinesthetic inspection. Another modification of the Wertheimer and Leventhal study was that the Ss of the experimental and the control group returned two weeks after the third experimental day and were tested for residual kinesthetic after-effects. If the learning analogy applies here, it can be predicted that the experimental group should show greater immediate and residual after-effects than the control

group, since the size of kinesthetic after-effects is related to the amount of inspection.

Experiment II was modelled after the Bakan and Thompson study (1962). Several alterations were made in the procedure of their experiment. First, Bakan and Thompson failed to include a no-inspection control group in their study, therefore the main contribution of this thesis was the introduction of a control group. Second, while the Ss in Bakan and Thompson's experiment inspected with only with one hand, the Ss in the present investigation inspected with both hands with stimuli respectively narrower and wider than the standard in each hand. Third, instead of subjecting the Ss in the experimental group to a 45 second and a 10 minute inspection period, these Ss were given only 10 minutes of inspection between the pre- and post-inspection measures of PSE on Day 1. Fourth, in contrast to Bakan and Thompson, E tested the Ss on the retention of kinesthetic after-effects over two weeks rather than over one month. Fifth, one additional factor was introduced in the present study, namely, the personality variable introversion-extraversion. It was predicted that the experimental group should differ from the control group with respect to the size of immediate and residual after-effects. Moreover, in agreement with Eysenck, it was expected that extraverts should show greater satiation effects and retention than introverts.

METHOD

As was mentioned in the introduction of this thesis, this study consisted of two experiments which differed with respect to samples and procedure. The experiments will be considered separately.

Experiment I

Subjects and design

This sample consisted of 33 volunteers of both sexes from introductory psychology courses at Michigan State University. Each S came at the same time of day for three successive days and on a fourth day, two weeks after the third day. Ss were randomly assigned to an experimental group for which kinesthetic after-effects were induced by kinesthetic "inspection" of wooden inspection blocks, and a control group which received the same treatment except for the kinesthetic inspection. The design of the experiment is outlined in Table 1.

Apparatus

A schematic diagram of the apparatus is presented in Figure 1. The apparatus consisted of 4 wooden blocks. In the front were 2 test blocks: on S's right was a variable width stimulus which was 1 in. wide at the near end and increased in width at the rate of 1/32 in. per inch to 2 7/8 in. at the far end; on the left was a standard stimulus of 1⅝ in. In the

Table 1

Design of Experiment I

Day	Group	
	Experimental	Control
1	4 practice trials Pre-inspection 1 min. inspection Post-inspection 4 min. inspection	4 practice trials Pre-rest 1 min. rest Post-rest
2	Pre-inspection 1 min. inspection Post-inspection 4 min. inspection	Pre-rest 1 min. rest Post-rest
3	Pre-inspection 1 min. inspection Post-inspection 4 min. inspection	Pre-rest 1 min. rest Post-rest
4 2 wks after Day 3	Pre-inspection 1 min. inspection Post-inspection	Pre-rest 1 min. rest Post-rest

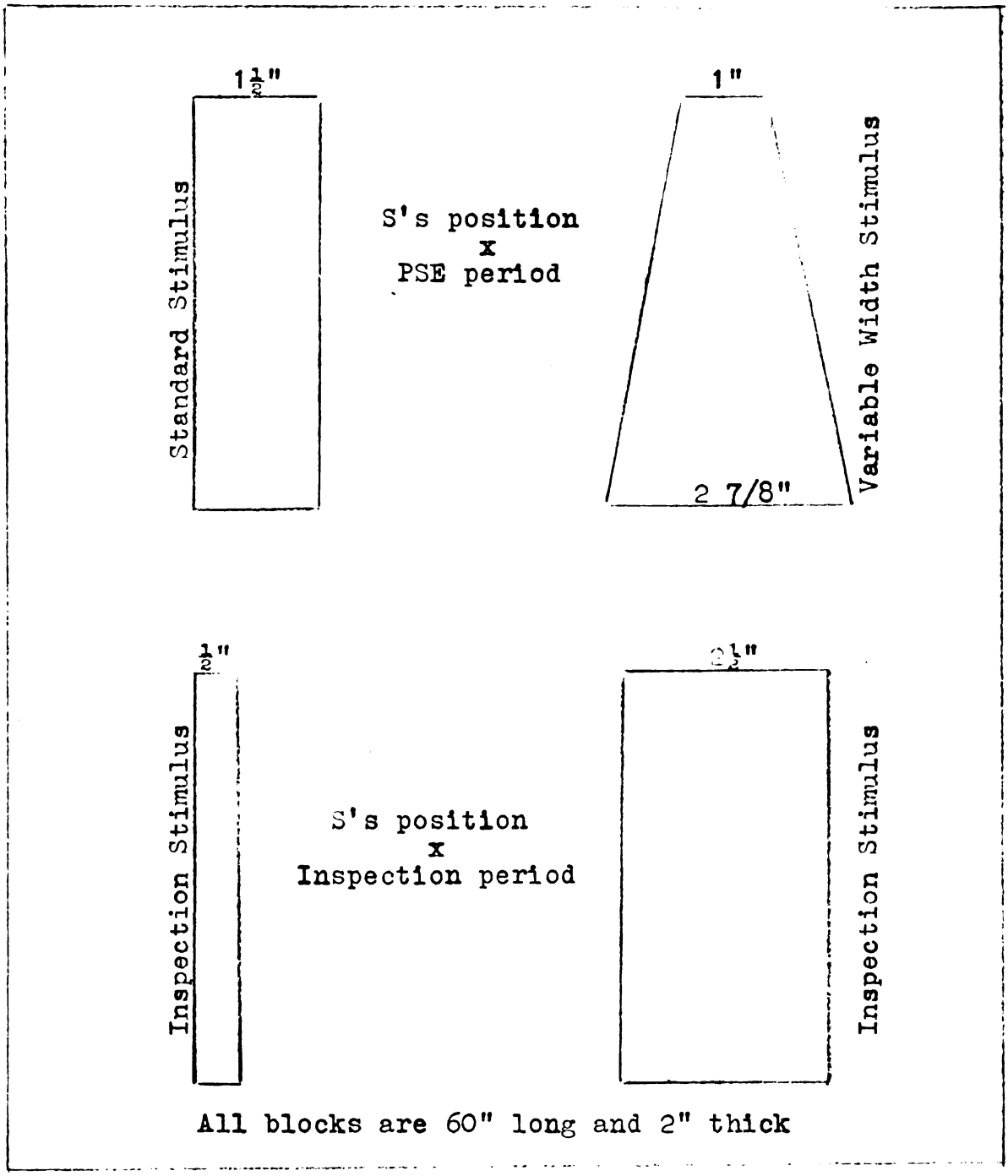

Figure 1. Schematic diagram of apparatus

back were 2 "inspection" blocks: the left block was ½ in. wide and the right block was 2½ in. wide. All blocks were 60 in. long and 2 in. thick, they were mounted on tables which were 36 in. high, and parallel to each other. A movable H-shped rider was affixed to the variable width stimulus in such a way that the position of the thumb and the forefinger was kept constant as S moved these fingers up and down along the sides of the block.

Procedure

All Ss were blindfoded during the experiment. The procedure for the experimental group consisted of taking a measure of point of subjective equality (PSE) of the standard stimulus before and after a 1 minute inspection period. Following the post-inspection measure on each of the first three days there was a 4 minute inspection period. For the control group 2 measures of the PSE separated by 1 minute were taken each day. Each PSE is the mean of 4 settings made by S on the variable width stimulus. E reset the starting point on the variable width stimulus at the beginning of each trial to produce an ADDA order of starting points, A meaning a setting below the point of objective equality (ascending) and D meaning a setting above the point of objective equality (descending).

The inspection period came between the pre- and post-inspection measures of PSE. The subjects in the experimental group would step back and rub back and forth on the two

inspection stimuli simultaneously, for 1 minute, with one in each hand at the rate of about 1 movement per second of about 18 in. along the inspection stimuli. Subjects in the control group were not given inspection at any time but spent 1 min. between the pre- and post-test trials standing at rest between the "inspection" stimuli without touching them.

The following instructions were given to Ss in the experimental group: "In this experiment we want to see how accurately you can match the width of a wooden bar held in your right hand with a wooden bar held in your left hand. You are now standing between 2 wooden bars. The one on your left is the same width throughout, the one on your right is tapered from thin at the front to thick in the back. (Let S feel the bars) Your task will be to find a point on the tapered bar in your right hand which feels equal in width to the bar in your left hand. I will show you where to place your hand at the start of each trial, it will be at a different place from trial to trial. We will now have a few practice trials. Remember, you are to move your hand back and forth along the tapered bar until you find a point which feels equal in width to the bar in your left hand. Do you have any questions?... Please step back. You are now again standing between 2 bars. You will hold a bar between the thumb and forefinger of each hand and rub back and forth along both bars with both hands at the same time. (Demonstrate 1/sec. over 18 in.)... Now will you please step forward. Hold the bars as before and find a place on the bar in your right hand which feels equal

in width to the bar in your left hand now.... Please step back again . Hold the bars between the thumb and forefinger of each hand and rub back and forth along both bars with both hands at the same time, till I ask you to stop". The control group received the same instructions except for rubbing the "inspection" bars.

Measures of immediate and residual after-effects were taken. Immediate after-effects is the difference between the mean width of PSE chosen during the pre-inspection trials and the mean width chosen during the post-inspection trials. Residual after-effect is the difference between the width chosen during the pre-inspection trials on the first day of study and the mean width chosen during the pre-inspection trials of the next day of study.

Results

The results of the experiment are summarized graphically in Figure 2. The analysis of the data appears in Table 2.

It can be observed from Figure 2 that the experimental group showed an increase in pre-inspection PSE from the first to the third day of the study. Although the PSE of the post-inspection trials on Day 3 was reduced considerably after 2 weeks, the mean width of the pre-inspection trials on Day 4 is still greater than that of Day 1, indicating a residual after-effect. The immediate after-effect is also directly observable, the PSE of the post-inspection trials were greater than the PSE of the pre-inspection trials on each experimen-

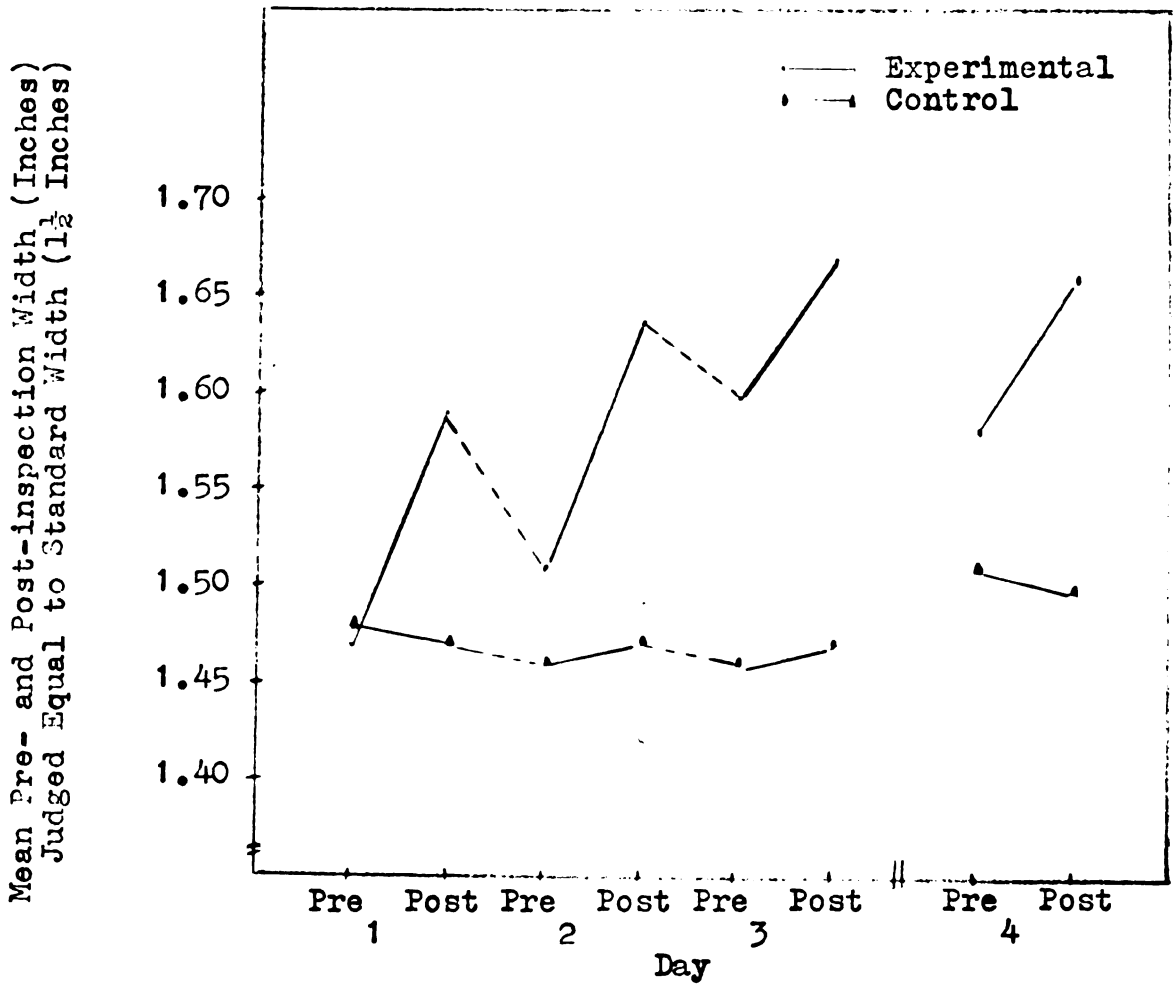

Figure 2. Immediate and residual kinesthetic after-effects as a function of the amount of inspection, data pertaining to Experiment I

tal day. The control group, on the other hand, did not show a trend of increase in pre-inspection PSE nor in post-inspection PSE, but their mean widths remained relatively stable. The learning analogy applies here: the experimental group which was subjected to kinesthetic inspection showed an increase in kinesthetic after-effects with practice, and showed retention after 2 weeks; the size of immediate and residual after-effects was a function of the kinesthetic inspection.

It should be mentioned that the two groups had an unequal number of subjects, the experimental group had an N of 17, while the control group had an N of only 16. In order to facilitate computations the mean of the control group was assigned to a fictitious S number 17.

The procedure for analyzing the data was derived from Lindquist (1956) and Edwards (1960). "Inspection" refers to the experimental and control groups, i. e., the presence of kinesthetic inspection; "Periods" applies to pre- and post-inspection periods; and "Days" has reference to Day 1, Day 2, Day 3, and Day 4.

The F value for the Inspection is significant at the 1% level. From this fact it can be concluded that the means of the experimental and the control groups differ significantly from each other. The experimental group showed evidence of immediate and residual after-effects, while the control group showed no increase in pre-inspection PSE from day to day, nor between pre- and post-inspection PSE within days.

Table 2

Summary of the Analysis of Variance of Experiment I

Source of Variation	Sum of Squares	d.f.	Mean Square	F	P
Between Subjects:					
Inspection (C)	.85	1	.85	12.14	.01
Error (b)	2.31	32	.07		
Within subjects:					
Days	.15	3	.05	12.50	.01
Periods	.15	1	.15	37.50	.01
Days x Periods	.02	3	.006	1.50	.5
Days x Inspection	.12	3	.04	10.00	.01
Periods x Inspection	.18	1	.18	45.00	.01
Days x Periods x Inspection	.01	3	.003	.75	.5
Error (within)	1.10	224	.004		
Within Sum of Squares (total)	1.73	238	.007		
Total	4.89	271			

The main effects of Days represent a comparison between the means of Day 1, Day 2, Day 3, and Day 4, for both the experimental and the control groups taken as a whole. The explanation for a significant ($P<.01$) mean square for Days is that the means of Day 1, Day 2, Day 3, and Day 4 differ significantly from each other; this is attributed to the fact that the residual after-effect for the experimental group increased from day to day. The variation due to days must be considered in terms of the significant Days x Inspection interaction.

Similarly, the main effect of Periods indicate a comparison between the means of the pre-inspection and the post-inspection periods over the four days for both groups. A significant mean square for Periods ($P<.01$) is due to the fact that the means of all pre-inspection periods differ significantly from the means of all post-inspection periods; this main effect must be considered in terms of the significant Period x Inspection interaction.

The Days x Periods interaction mean square is not significant ($P>.5$). This means that the difference between the means of Periods is not dependent on Days.

The Days x Inspection interaction mean square is significant ($P<.01$). This means that the change over Days is a function of inspection. The magnitude of the difference between the means of Day 1, Day 2, Day 3, and Day 4 is not the same for the experimental and the control groups. This is obvious from the results which show that the experimental

group showed increasing after-effects during the course of the study, while the control group did not show any after-effects.

The same explanation holds for the significant Periods x Inspection interaction mean square ($P<.01$). This means that kinesthetic after-effects are produced by inspection. The difference between the means of the pre- and post-inspection periods of the experimental group is considerable while the difference for the control group is minimal. The F value for Days x Periods x Inspection interaction is not significant.

The significance of the difference between the residual after-effects after two weeks for the experimental and the control group was tested by means of a t test and was found to be significant ($P<.01$). This means that the experimental group differed significantly from the control group with respect to the residual after-effects, which is an indication that the retention of kinesthetic after-effects is a function of the kinesthetic inspection induced.

Experiment II

Subjects and design

The Maudsley Personality Inventory was given to 144 male and female students of introductory psychology courses at Michigan State University. The MPI was developed by H. J. Eysenck and it is intended to measure on the verbal level two dimensions of peronality: Introversion-Extraversion and

Neuroticism. The E (extraversion) and N (neuroticism) scale of the MPI were derived from rather elaborate procedures involving item analysis and factor analysis of other personality inventories, principally the Guilford inventory of factors STDCR and the Maudsley Medical Questionnaire. The items making up the scale are highly correlated with factors they are said to measure and they have significant correlations with other factors. The complete MPI is given in Appendix I. It consists of 24 E-scale items, 24 N-items, 20 Lie-scale items, and 12 "buffer" items which help in concealing the nature of the questionnaire from the subject. The Lie-scale was intended to detect subjects who tend to present themselves in a favorable light to such an extent as to make the validity of their scores questionable. Two points are given to the designated scale for the keyed responses, and one point to the designated scale for the questionable responses. Thus the possible range of scores on the E and N scale is from 0 to 48.

Sixty-six male subjects were selected to serve as a sample for this experiment. Twenty-two of these students who scored lowest on the MPI represented the introverted group; 22 of the subjects who obtained a middle range score were selected for the ambivert group; and 22 of the subjects who scored highest were considered the extraverts. The Ss in each of these groups were randomly assigned to an experimental group for which kinesthetic after-effects were induced by kinesthetic "inspection" of wooden inspection blocks, and a

control group which received the same treatment except for the kinesthetic inspection. All the subjects returned two weeks after their first experiment to be tested for the retention of kinesthetic after-effects. The design of the experiment is shown in summary in Table 3.

Apparatus

The apparatus used in Experiment II is the same as the one used in Experiment I.

Instructions

These subjects were given similar instructions as those of Experiment I, with the exception that the experimental groups were not instructed to rub the inspection blocks following the post-inspection trials.

Procedure

Some modifications were made in the procedure of Experiment II. All Ss were blindfolded during the experiment. The procedure for the experimental group consisted of taking a measure of PSE of the standard stimulus before and after a 10 minute inspection period. For the control group 2 measures of the PSE separated by 10 minutes were taken on the first day. Each PSE is again the mean of 4 settings made by S on the variable width stimulus. E reset the starting point on the variable width stimulus at the beginning of each trial to produce an ADDA order of starting points, A meaning a

Table 3

Design of Experiment II

Day	Group					
	Introvert		Ambivert		Extravert	
	Expmntl	Control	Expmntl	Control	Expmntl	Control
1	4 pract. 4 pre- 10' insp. 4 post-	4 pract. 4 pre- 10' rest 4 post-	4 pract. 4 pre- 10' insp. 4 post-	4 pract. 4 pre- 10' rest 4 post-	4 pract. 4 pre- 10' insp. 4 post-	4 pract. 4 pre- 10' rest 4 post-
2 2 wks after Day 1	4 pre- 1' insp. 4 post-	4 pre- 1' rest 4 post-	4 pre- 1' insp. 4 post-	4 pre- 1' rest 4 post-	4 pre- 1' insp. 4 post-	4 pre- 1' rest 4 post-
	(N=11)	(N=11)	(N=11)	(N=11)	(N=11)	(N=11)

setting below the point of objective equality (ascending) and D meaning a setting above the point of objective equality (descending).

The inspection period came between the pre- and post-inspection measures of PSE. The Ss of the experimental group would step back and rub back and forth on the 2 inspection stimuli simultaneously for 10 minutes, consisting of ten 60 seconds inspection periods with a 5 second rest period between them. They would hold one block in each hand and rub back and forth at the rate of about 1 movement per second of about 18 in. along the inspection stimuli. Ss in the control group were not given inspection at any time but spent 10 min. between the pre- and post-test trials at rest between the inspection stimuli without touching them.

All subjects returned 2 weeks after the first day. On the second day the experimental group was given only 1 min. of inspection between the pre- and the post-inspection measures of PSE, and the control group rested for one minute.

Results

A graphic presentation of the results of Experiment II appears in Figure 3. It is evident from this graph that the experimental groups showed a great increase in the post-inspection measures of PSE which was due to the long inspection period. Although the post-inspection PSE of Day 1 was significantly reduced after two weeks, the Ss in the experimental groups nevertheless showed residual after-effects.

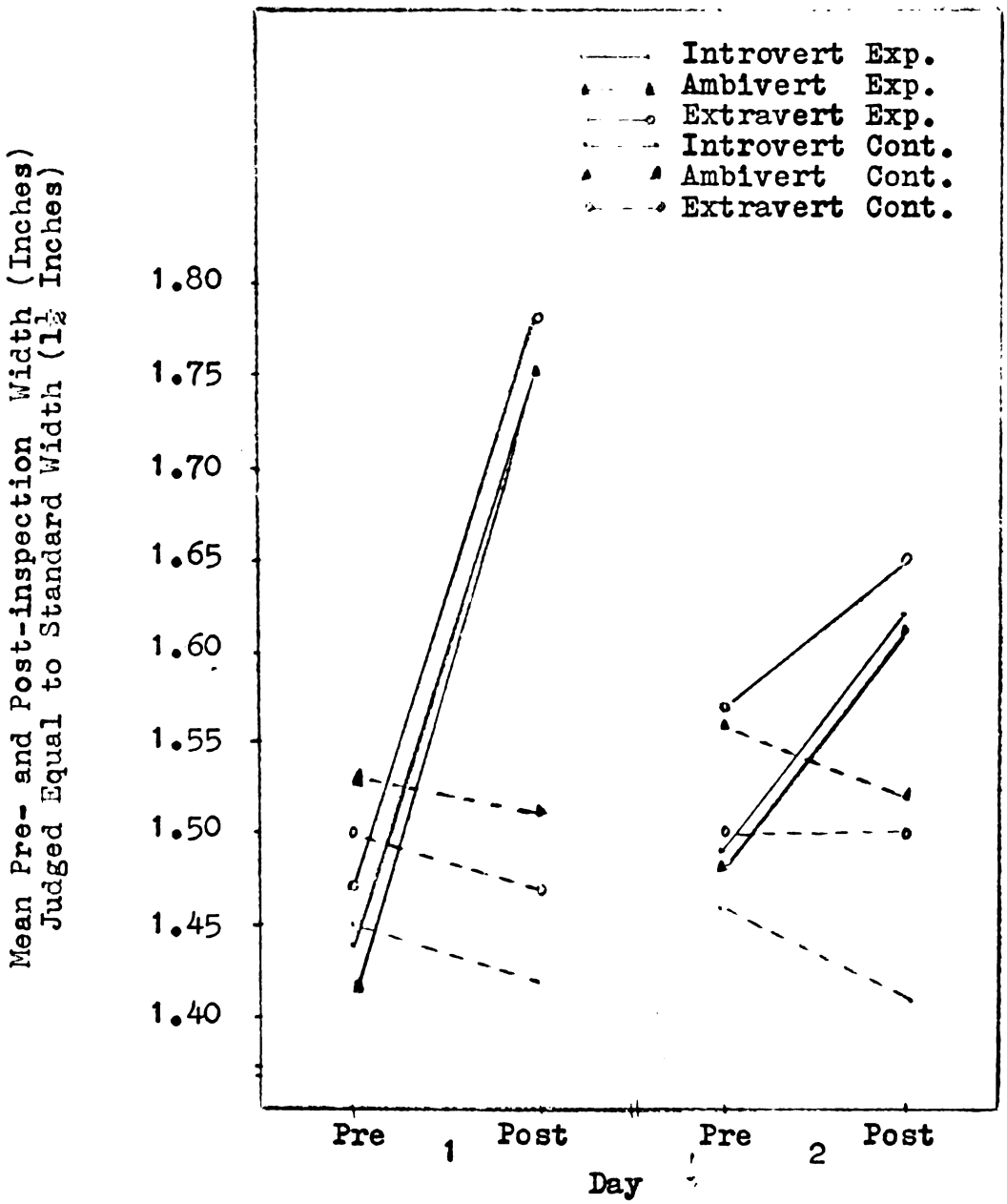

Figure 3. Immediate and residual kinesthetic after-effects as a function of the amount of inspection for Introverts, Ambiverts, and Extraverts

Their means of the pre-inspection measures on Day 2 were greater than the means of the PSE of the pre-inspection measures on Day 1. It is observable that the extraverts showed the greatest residual after-effects, their mean of PSE of the pre-inspection trials on Day 2 was not as greatly reduced as compared with the ambiverts and introverts. The increase in the post-inspection PSE on Day 2 is again an indication of the effect of inspection. It is obvious that the control groups did not show immediate after-effects; although they showed an increase in PSE of the pre-inspection measures on Day 2, this increase was not significant.

The results of Experiment II were statistically analyzed by means of three analyses of variance, the first one to determine the significance of the immediate after-effects on Day 1, the second one to measure retention or residual after-effects, and the third one to indicate the immediate after-effects on Day 2. These analyses of variance are summarized in Tables 4, 5, and 6.

With respect to the immediate after-effects on Day 1, it can be concluded from Table 4 that the introverts, ambiverts, and extraverts, taken as a whole, do not differ significantly from each other ($P > .5$). However, if the experimental groups are compared with the control groups, the results indicate that these groups differ considerably with respect to the immediate after-effects on Day 1 ($P < .01$). This significant difference is due to the fact that the experimental groups were affected by the "inspection" of the inspection

Table 4

Analysis of Variance of the immediate after-effects on Day 1 (Exp II)

Source	SS	df	MS	F	P
Intro-ambi-extravert (A)	60.09	2	30.05	.11	>.5
Experimental-control (B)	31461.84	1	31461.84	113.28	<.01
A x B interaction	61.29	2	30.65	.11	>.5
Error within	16664.10	60	277.74		
Total	48247.32	65			

Table 5

Analysis of Variance of the residual after-effects (Exp II)

Source	SS	df	MS	F	P
Intro-ambi-extravert (A)	308.22	2	154.11	.76	>.5
Experimental-control (B)	1080.14	1	1080.14	5.30	<.05
A x B interaction	60.80	2	30.40	.15	>.5
Error within	12230.37	60	203.84		
Total	13679.53	65			

Table 6

Analysis of Variance of the immediate after-effects on Day 2 (Exp II)

Source	SS	df	MS	F	P
Intro-ambi-extravert (A)	77.55	2	38.78	.36	>.5
Experimental-control (B)	4751.22	1	4751.52	43.50	<.01
A x B interaction	553.82	2	276.91	2.54	<.05
Error within	6553.11	60	109.22		
Total	11936.00	65			

stimuli. Table 4 also reveals that the interaction between the three major and the two subgroups is not significant ($P>.5$), this indicates that the difference between the means of the experimental and the control groups is not dependent on introversion, ambiversion, or extraversion.

Turning next to the results of the residual after-effects or retention of after-effects, Table 5 shows that there is no significant difference between the three major groups as a whole ($P>.5$). When the results are considered for the two subgroups, it is noted that a significance was reached at the 5% level, this indicates that the experimental groups differed significantly from the control groups in their retention of after-effects. This means that the residual after-effects of the experimental groups were due to inspection. The interaction between the introverts, ambiverts, extraverts, and the experimental, control groups is not significant ($P>.5$). This again indicates that the difference between the means of the experimental and the control groups is not dependent on introversion, ambiversion, or extraversion.

When introverts, ambiverts, and axtraverts are compared with each other with reference to the immediate after-effects on Day 2, it is evident that they do not differ significantly from each other ($P>.5$). The results of Table 6 indicate that the means of the experimental groups once again differ significantly from the means of the control group ($P<.01$). This again indicates that the experimental groups were affected by the "inspection" of the inspection stimuli and therefore

showed greater after-effects than the control groups. Considering the interaction between the three major and the two subgroups it is concluded that the interaction is not significant. Since the interaction is not significant ($P > .05$), it is concluded that the difference between the means of the experimental and the control groups is not dependent on introversion, ambiversion, or extraversion.

Although Figure 3 indicates that the extraverts showed greater residual after-effects than the ambiverts and the introverts, the statistical analyses do not indicate that there is a relationship between either size of after-effect or retention of after-effect and extraversion-introversion.

DISCUSSION

The first experiment was a partial replication of an experiment by Wertheimer and Leventhal (1958). The results support their findings in showing that there is an increase in the size of the kinesthetic after-effects as total amount of inspection is increased from the first to the third day. In contrast there is no build-up in a control group. This finding supports the general idea of analogy or similarity between the behavioral changes more traditionally found in learning experiments.

Working within the framework of this analogy the experiment was extended to include a longer range measure of retention of the kinesthetic after-effects two weeks after the last day of kinesthetic inspection. The finding of a residual after-effect after two weeks suggests that an induced after-effect need not be considered as a transient phenomenon. On the other hand, there is obviously a decrement in size of kinsethetic after-effect over the two week period. Here again the phenomenon, or change in behavior, seems to be behaving in a manner analogous to that of learning phenomena. There is both decrease over time and retention over time.

The second experiment was designed to give subjects a long inspection period (10 minutes) and then to see whether there was residual after-effect two weeks later. Retention a month later was reported by Bakan and Thompson (1962), but

in their study the results are equivocal since there was no control group for whom a measure of PSE was taken, and then taken again a month later. In order to be sure that the change in PSE measured later was due to the inspection, a control group was introduced which was treated the same as the experimental group except for the kinesthetic inspection period. It is concluded that the residual after-effect two weeks after inspection was due to the after-effect induced by the inspection, since there was no rise in the PSE with mere passage of time. From this result it may be inferred that the finding of Bakan and Thompson was also a function of residual after-effect due to prior inspection.

The second experiment was designed to allow for a study of the relationship between after-effects and the extraversion-introversion dimension. The results do not indicate that there is a relationship between either size of after-effect or retention of after-effect and extraversion-introversion. Though such a relationship has been predicted and reported by Eysenck (1955) it has not been confirmed by other investigators (Broadbent, 1961, and Rechtschaffen, 1958). The present study adds further negative evidence relevant to the Eysenck hypothesis.

SUMMARY

Two experiments bearing on the problem of retention of kinesthetic after-effects were carried out. A kinesthetic after-effect is defined as the change in the point of subjective equality (PSE) of the width of a wooden bar (standard) after kinesthetic exposure (inspection) of both hands, one to a bar wider than the standard and one to a bar narrower than the standard. In the first study it was found that over a period of three days, with kinesthetic inspection on each day there is growth in size of the after-effect, due to the fact that on each day but the first the pre-inspection PSE is higher than on the previous day, indicating a residual after-effect or retention of the after-effect. It was also found that there was still significant retention of the after-effect two weeks after the last inspection period.

The second experiment also involved retention of after-effect. Two weeks after a 10 minute kinesthetic inspection period, there was still significant retention of the after-effect. A control group, having no kinesthetic inspection showed no systematic change in PSE over a two week period.

The design of the second experiment allowed for a test of Eysenck's hypothesis that there should be a relationship between size of after-effect, retention of after-effect, and extraversion-introversion. Six groups were tested. There was an extravert, ambivert, and introvert control group and experimental group. None of the analyses showed any significant main effect or interaction involving the extraversion variable. The results do not support the Eysenck hypothesis.

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APPENDIX I

MAUDSLEY PERSONALITY INVENTORY

Questionnaire

Instructions: Please answer each question by filling in one of the spaces on the answer sheet next to the number corresponding to the question number on the survey sheet.

If your answer is yes fill in the first space. If your answer is no fill in the second space. If you simply cannot make up your mind for a question fill in the third space.

Work quickly and do not ponder too long about the exact shade of meaning of each question. There are no right or wrong answers, and no trick questions.

All your answers should appear on the answer sheet. Do not make any marks on the sheet with the questions.

Do not put your name on the answer sheet.

Remenber to answer each question.

1. Are you inclined to limit your acquaintances to a select few?
2. Do you prefer action to planning for action?
3. Do you always have a "ready answer" for remarks directed at you?
4. Are your daydreams frequently about things that can never came true?
5. As a child, did you always do as you were told, immediately and without grumbling?
6. Are you inclined to be quick and sure in your actions?
7. Do you have difficulty in making new friends?
8. Do you sometimes put off until tomorrow what you ought to do today?
9. Are you inclined to take your work casually, that is, as a matter of course?

10. Do you often feel disgruntled?
11. Are you inclined to ponder over your past?
12. If you say you will do something, do you always keep your promise no matter how inconvenient it might be to do so?
13. Do you like to mix socially with people?
14. Are you inclined to be shy in the presence of the opposite sex?
15. Do you sometimes get cross?
16. Do you often experience periods of loneliness?
17. Are you touchy on various subjects?
18. Do you often find that you have made up your mind too late?
19. Are you completely free of prejudice of any kind?
20. Are you inclined to be overconscientious?
21. Do you often "have the time of life" at social affairs?
22. Do you ever change from happiness to sadness, or vice versa, without good reason?
23. Do you like to play pranks upon others?
24. Do you sometimes laugh at a dirty joke?
25. Does your mind often wander while you are trying to concentrate?
26. Would you rate yourself as a tense or "high-strung" individual?
27. After a critical moment is over, do you usually think of something you should have done but failed to do?
28. Would you rather win, than lose a game?
29. Do you find it easy, as a rule, to make new acquaintances?
30. Do you ever have a queer feeling that you are not your

old self?

31. Do you ever take your work as if it were a matter of life or death?

32. Are you frequently "lost in thought" even when supposed to be taking part in a conversation?

33. Do you always feel genuinely pleased when a bitter enemy achieves a merited success?

34. Do you derive more real satisfaction from social activities than from anything else?

35. Do ideas run through your head so that you cannot sleep?

36. Do you sometimes boast a little?

37. Can you usually let yourself go and have an hilariously good time at a gay party?

38. Do you like to indulge in a reverie (daydreaming)?

39. Have you often felt listless and tired for no good reason?

40. Are <u>all</u> your habits good and desirable ones?

41. Are you inclined to keep quiet when out in a social group?

42. Are you sometimes bubbling over with energy and sometimes very sluggish?

43. Do you always answer a personal letter as soon as you can after you have read it?

44. Would you rate yourself as a talkative individual?

45. Do you occasionally have thoughts and ideas that you would not like other people to know about?

46. Would you be very unhappy if you were prevented from

making numerous social contacts?

47. Are you happiest when you get involved in some project that calls for rapid action?
48. Do you spend much time in thinking over good times you have had in the past?
49. Do you sometimes talk about things you know nothing about?
50. Have you ever been bothered by having a useless thought come into your mind repeatedly?
51. Do other people regard you as a lively individual?
52. Do you sometimes gossip?
53. Do you usually keep fairly uniform spirits?
54. Are your feelings rather easily hurt?
55. At times, have you ever told a lie?
56. Do you generally prefer to take the lead in group activities?
57. Would you rate yourself as a happy-go-lucky individual?
58. Have you money worries at times?
59. Do you have periods of such great restlessness that you cannot sit long in a chair?
60. Are you usually a "good mixer"?
61. Would you rate yourself as a lively individual?
62. Have you ever been late for an appointment or work?
63. Do you ever feel "just miserable" for no good reason at all?
64. Are you often troubled with feelings of guilt?
65. Are you inclined to be moody?

66. Do you like to have many social engagements?
67. Once in a while, do you lose your temper and get angry?
68. Do you sometimes feel happy, sometimes depressed, without any apparent reason?
69. Is it difficult to "lose yourself" even at a lively party?
70. Are you ordinarily a carefree individual?
71. Do you have frequent ups and downs in mood, either with or without apparent cause?
72. Would you always declare everything at the customs, even if you knew that you could never be found out?
73. Do you like work that requires considerable attention to details?
74. Are there times when you seek to be alone and you cannot bear the company of anyone?
75. Are you inclined to keep in the background on social occasions?
76. Have you often lost sleep over your worries?
77. Of all the people you know are there some whom you definitely do not like?
78. Do you usually feel disappointment so keenly that you cannot get them out of your mind?
79. Do you usually take the initiative in making new friends?
80. Do you enjoy participating in a showing of "Rah Rah" enthusiasm?

APPENDIX II

Data from Experiment I

PSE of Experimental Group

S	PRE 1	POST 1	PRE 2	POST 2	PRE 3	POST 3	PRE 4	POST 4
1	1.34	1.45	1.37	1.64	1.49	1.56	1.48	1.51
2	1.74	1.83	1.64	1.73	1.63	1.80	1.59	1.61
3	1.52	1.60	1.63	1.69	1.53	1.70	1.50	1.51
4	1.35	1.54	1.48	1.54	1.50	1.67	1.53	1.65
5	1.55	1.62	1.53	1.80	1.74	1.77	1.58	1.66
6	1.46	1.56	1.43	1.64	1.70	1.73	1.61	1.61
7	1.41	1.41	1.45	1.58	1.44	1.54	1.53	1.69
8	1.44	1.57	1.43	1.52	1.52	1.49	1.43	1.57
9	1.50	1.69	1.61	1.71	1.69	1.72	1.77	1.75
10	1.41	1.69	1.59	1.74	1.52	1.64	1.49	1.58
11	1.42	1.56	1.42	1.67	1.49	1.61	1.67	1.89
12	1.70	1.78	1.77	1.69	1.83	1.80	1.78	1.80
13	1.38	1.45	1.43	1.52	1.69	1.78	1.63	1.64
14	1.44	1.54	1.46	1.55	1.60	1.66	1.63	1.74
15	1.39	1.47	1.47	1.46	1.57	1.58	1.50	1.52
16	1.59	1.65	1.51	1.58	1.59	1.61	1.48	1.59
17	1.33	1.63	1.52	1.72	1.71	1.79	1.60	1.83

APPENDIX II Continued

PSE of Control Group

S	PRE 1	POST 1	PRE 2	POST 2	PRE 3	POST 3	PRE 4	POST 4
1	1.72	1.52	1.61	1.67	1.65	1.72	1.74	1.73
2	1.51	1.51	1.53	1.50	1.49	1.51	1.50	1.48
3	1.49	1.41	1.43	1.62	1.51	1.48	1.61	1.52
4	1.15	1.21	1.31	1.28	1.35	1.18	1.10	1.05
5	1.34	1.45	1.43	1.45	1.46	1.47	1.56	1.63
6	1.39	1.51	1.57	1.43	1.44	1.41	1.52	1.52
7	1.48	1.50	1.45	1.53	1.50	1.43	1.51	1.38
8	1.49	1.42	1.47	1.36	1.39	1.30	1.45	1.45
9	1.68	1.55	1.50	1.55	1.52	1.68	1.74	1.78
10	1.45	1.66	1.45	1.43	1.53	1.54	1.53	1.54
11	1.41	1.38	1.27	1.35	1.36	1.41	1.41	1.41
12	1.44	1.55	1.50	1.46	1.45	1.46	1.51	1.50
13	1.56	1.58	1.56	1.60	1.48	1.55	1.49	1.53
14	1.40	1.41	1.34	1.30	1.29	1.35	1.48	1.41
15	1.58	1.32	1.41	1.34	1.38	1.41	1.41	1.44
16	1.60	1.52	1.55	1.58	1.63	1.60	1.62	1.66
17	1.48	1.47	1.46	1.47	1.46	1.47	1.51	1.50

APPENDIX III

Data from Experiment II

PSE of INTROVERTS

Experimental group

S	PRE 1	POST 1	PRE 2	POST 2
1	1.46	1.71	1.61	1.73
2	1.16	1.91	1.23	1.36
3	1.34	1.58	1.40	1.59
4	1.39	1.74	1.54	1.66
5	1.60	1.78	1.50	1.61
6	1.45	1.79	1.53	1.67
7	1.53	1.56	1.53	1.55
8	1.72	2.05	1.69	1.87
9	1.51	1.91	1.49	1.72
10	1.28	1.71	1.51	1.58
11	1.43	1.60	1.32	1.49

Control group

S	PRE 1	POST 1	PRE 2	POST 2
1	1.27	1.20	1.30	1.27
2	1.46	1.32	1.43	1.34
3	1.50	1.34	1.55	1.39
4	1.49	1.45	1.43	1.32
5	1.43	1.52	1.64	1.55
6	1.45	1.55	1.46	1.45
7	1.40	1.34	1.34	1.30
8	1.63	1.47	1.48	1.38
9	1.20	1.35	1.52	1.52
10	1.71	1.55	1.64	1.59
11	1.41	1.45	1.32	1.40

Appendix III continued

PSE of Ambiverts

Experimental group

S	PRE 1	POST 1	PRE 2	POST 2
1	1.41	1.84	1.44	1.63
2	1.40	1.65	1.57	1.64
3	1.47	1.80	1.59	1.85
4	1.29	1.56	1.29	1.33
5	1.40	1.61	1.45	1.59
6	1.44	1.80	1.48	1.61
7	1.59	1.79	1.58	1.53
8	1.38	1.70	1.64	1.62
9	1.34	2.09	1.49	1.84
10	1.41	1.56	1.38	1.49
11	1.39	1.80	1.48	1.61

Control group

S	PRE 1	POST 1	PRE 2	POST 2
1	1.47	1.60	1.63	1.54
2	1.31	1.37	1.38	1.38
3	1.49	1.41	1.41	1.41
4	1.77	1.72	1.66	1.75
5	1.45	1.44	1.54	1.52
6	1.48	1.50	1.48	1.51
7	1.55	1.56	1.55	1.50
8	1.48	1.44	1.63	1.57
9	1.60	1.41	1.82	1.68
10	1.75	1.65	1.57	1.52
11	1.45	1.51	1.36	1.33

Appendix III continued

PSE of EXTRAVERTS

Experimental group

S	PRE 1	POST 1	PRE 2	POST 2
1	1.65	1.80	1.76	1.71
2	1.55	2.00	1.73	1.85
3	1.45	1.82	1.52	1.60
4	1.24	1.63	1.61	1.77
5	1.60	2.15	1.80	2.07
6	1.47	1.69	1.35	1.39
7	1.44	1.72	1.49	1.63
8	1.41	1.44	1.46	1.48
9	1.48	1.87	1.56	1.58
10	1.52	1.76	1.64	1.52
11	1.39	1.70	1.35	1.59

Control group

S	PRE 1	POST 1	PRE 2	POST 2
1	1.68	1.60	1.53	1.55
2	1.58	1.55	1.52	1.52
3	1.37	1.41	1.41	1.41
4	1.45	1.39	1.45	1.48
5	1.44	1.43	1.46	1.45
6	1.44	1.46	1.60	1.50
7	1.60	1.62	1.63	1.60
8	1.50	1.53	1.47	1.43
9	1.70	1.49	1.65	1.68
10	1.39	1.56	1.43	1.54
11	1.34	1.31	1.38	1.32