The Effects of Simultaneous Sensory Stimulation on Creativity and Field Dependence

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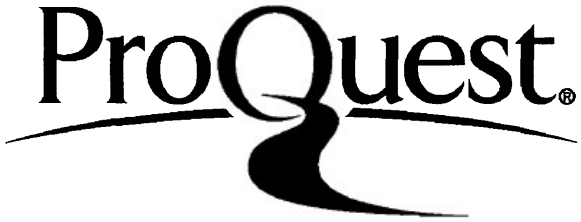

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Abstract

The purpose of this research was to investigate the effects of simultaneous sensory stimulation (SSS) on creativity and field dependence. The hypotheses tested were: 1) subjects receiving SSS would increase significantly in creativity on a posttest as compared to control subjects receiving neutral stimulation (NS); 2) subjects receiving SSS would increase significantly in field independence scores on a posttest as compared to control subjects receiving NS; 3) subjects receiving SSS who scored high on a creativity pretest would show significantly greater increases in creativity on a posttest than would subjects receiving SSS who scored low on a creativity pretest; 4) subjects receiving SSS who scored high on a creativity pretest would show significantly greater increases in field-independence on a posttest than would subjects receiving SSS who scored low on a creativity pretest.

Forty undergraduate university students (20 males and 20 females) were divided into two groups with 10 males and 10 females in each group. Group 1 received SSS and Group 2 received NS.

Simultaneous sensory stimulation consisted of visual, auditory, somesthetic, thermal, olfactory, and gustatory

stimulation for a period of 15 minutes. Neutral stimulation consisted of a 15 minute taped reading from an introductory psychology text. Prior to SSS and NS all subjects were administered a creativity pretest, the Torrance Tests of Creative Thinking (TTCT) (Figural) and a field dependence pretest, the Group Embedded Figures Test (GEFT). Immediately following SSS or NS all subjects were administered posttests of the TTCT (Figural) and the GEFT.

A main effect of SSS on the originality measure of the TTCT (Figural) was found, $p < .01$, thus partially supporting the first hypothesis. No significant effect of SSS on the GEFT was found, thus not supporting the second hypothesis. Only one of twenty differences calculated between SSS and NS group correlations between creativity pretest scores and change scores for creativity and field dependence was significant, $p < .05$. This significant difference was assumed to be due to chance, thus the third and fourth hypotheses were not supported.

The Effects of Simultaneous Sensory Stimulation on Creativity and Field Dependence

The purpose of this experiment was to investigate the effects of simultaneous sensory stimulation (SSS) on creativity and field dependence. An experimental condition of SSS and a control condition of neutral stimulation (NS) were employed. The dependent measures were: (1) the Torrance Tests of Creative Thinking (TTCT) (Figural) (Torrance, 1966a), and (2) the Group Embedded Figures Test (GEFT) (Oltman, Raskin and Witkin, 1971).

In this experiment, two specific hypotheses were tested. First, subjects receiving SSS would increase significantly in creativity on a posttest. This hypothesis was based on the assumption that SSS produces psychological openness and initiates the creative process (Taylor, 1975). This part of the experiment was a replication of previous studies by Taylor (1970, 1972a) and Taylor and Knapp (1971), and was also designed to clarify the role of field dependence in creativity.

Second, subjects receiving SSS would increase significantly in field-independence scores on a posttest. This hypothesis was based on the assumption that field-independence is an integral component of the process of transaction, which Taylor (1975) defines as shaping the environment in accordance with personal perceptions.

Since SSS is viewed as initiating transactional motivation (Taylor, 1975), it followed that field-independence would increase following treatment.

A control group was used to allow for possible practice effects. It was predicted, however, that no significant changes would occur in this control group, as it was exposed to NS.

Two secondary hypotheses were tested. First, subjects receiving SSS who scored high on a creativity pretest would show significantly greater increases in creativity on a posttest than would subjects receiving SSS who scored low on a creativity pretest. Taylor, Austin and Sutton (1974) reported evidence suggestive of this effect. Further, Taylor (1975) has postulated that "openness and the ability to assimilate large amounts of complex information can be enhanced if there is a suitable framework for receiving information" (p. 311). It was presumed that a more highly creative person would possess such a cognitive framework, and therefore would profit more from SSS than a less creative person.

Second, subjects receiving SSS who scored high on a creativity pretest would show significantly greater increases in field-independence on a posttest than would subjects receiving SSS who scored low on a creativity pretest. Since it was hypothesized that more creative

subjects would show greater increases in creativity, it followed that the field-independence aspect of creativity would also emerge to a greater degree.

Creativity

Definitions of creativity tend to be diverse, ranging from relatively simple unitary conceptualizations, (e.g., Barron's (1969) definition of creativity as the ability to bring something new into existence), to multiordinal conceptions (e.g., Taylor's (1972b) view of five different creative dispositions or styles). Within the context of this experiment, the phenomenon of transaction is viewed as central to creativity, which is operationally defined by the TTCT. Transaction refers to the process of shaping the environment in accordance with personal perceptions rather than altering personal perceptions in accordance with environmental demands (Taylor, 1975). In other words, transaction is the process through which creativity is expressed.

Creativity is defined here as the degree to which fluency, flexibility, originality and elaboration are expressed on the tests required by the TTCT. For a given individual, then, his creativity score(s) will reflect the creative quality of his personal perceptions, and the degree to which he expresses this creativity. These two factors need not be related, that is, a person may be

high on one factor but not the other. For this reason, creativity is viewed here as a function of the interaction between personal perceptions and transactional tendencies. In sum, creativity is seen as occurring to the extent that transaction occurs, that is, to the extent that creative personal perceptions are expressed.

In this experiment, an attempt was made to increase transaction. Simultaneous sensory stimulation was assumed to reduce defensiveness in subjects, thus allowing the natural process of transaction to emerge. It was also assumed that the measurement of field-independence operationalized transaction. Hence, it was predicted that both creativity and field-independence would increase following SSS.

Creativity and Stimulation

It should be pointed out that not all experiments utilizing various types of sensory stimulation can be grouped together, as implied by Ludwig (1971), who proposed that sensory stimulation is the "opposite side of the coin" with respect to sensory deprivation. Sensory deprivation studies share the common property of attempting to reduce sensory stimulation to an absolute minimum (Shultz, 1965). Sensory stimulation studies, in contrast, vary along a large number of dimensions, the most obvious

being sensory modality, intensity of stimulation, stimulation novelty and stimulation value (e.g., pleasant vs. unpleasant). It is essential, then, that in sensory stimulation experiments the treatment variable be operationally defined so as to avoid confusion resulting from the use of different types of stimulation.

In the present experiment, SSS involved optimal stimulation of several sense modalities simultaneously. Leuba (1962) has elaborated on the concept of optimal stimulation, which he describes as follows:

> ... the totality of excitation of the sense organs, both those on the surface of, and those inside, the body. More precisely, it refers to a state of optimal innervation, arousal, or activation within the central nervous system. Still more precisely, it refers to a balance at an optimal level between input and outgo of innervation in the central nervous system. (p. 64)

Simultaneous sensory stimulation is an operationalization of this concept in two ways (Taylor, 1970; Taylor, Austin and Sutton, 1974): (1) 12-15 minutes of SSS treatment has been found to produce optimal increases on measures of creativity, and (2) 12-15 minutes marks the point at which subjects report satiation, that is, stimulation-seeking behavior is satisfied without inducing stimulation-rejecting behavior.

It has been found, then, that SSS enhances creativity, specifically as measured by tests of divergent thinking and of artistic production. The theoretical

explanation of this effect is rooted in the creative process. Taylor (1975) states:

> The initial phase [of the creative process] can be described as exposure, a period in which the environment is perceived, similar to Rogers's "openness". Sensory stimulation to the point of saturation, for example, may be one way of producing psychological openness and initiating the creative process. Exposure is essentially characterized by high receptivity of raw sensory data, deferred judgment, or a posture of open acceptance to information, cognitive complexity, and a set for unexpected or serendipitous findings. (p. 311)

Simultaneous sensory stimulation can be viewed, then, as possibly stimulating and initiating this stage of the creative process.

Creativity and Field Dependence

At this point, it is important to determine the role of field dependence in the creative process. In its most fundamental form, the field-independence-dependence dimension is viewed as a perceptual style which the person "brings with him to an array of situations of a given structure" (Witkin, Oltman, Raskin and Karp, 1971, p. 4). Field-dependent perception is defined here, following Witkin et al. (1971), as perception which is strongly dominated by the overall organization of the surrounding field, where parts of the field are experienced as "fused". Field-independent perception, also following Witkin et al. (1971), is defined here as perception which is relatively

unaffected by the overall organization of the surrounding field and parts of the field are experienced as discrete from organized ground. Over the past twenty years this simple perceptual mode of functioning has been found to relate strongly to broad areas of cognitive functioning, and tests of field dependence are now viewed as assessing an aspect of the given individual's cognitive style (Witkin et al., 1971).

There is considerable face validity in the suggestion that the field-independent style is related to creativity. For example, one established measure of field dependence, the rod-and-frame test (RFT), can be seen as exemplifying creative motivation. In the RFT the subject sits in a totally darkened room and must adjust to the upright, a luminous rod within a tilted luminous frame, while the frame remains in its initial position of tilt (Witkin, Lewis, Hertzman, Machover, Meissner and Wapner, 1954). The frame tends to influence the subject's judgment. To the extent that the subject adjusts the rod vertical to the frame rather than his body, he is said to be field-dependent.

This bears a close resemblance to transactional motivation, which Taylor (1972b) views as an alteration or reorganization of the environment in accordance with personal perceptions. To elaborate, the position is

that individuals have the choice of either altering personal perceptions to correspond with the external world or altering the external world to correspond with personal perceptions. The latter choice is seen as necessary to creativity, and appears to correspond with field-independence in that the field-independent subject alters the external world (the rod) in accordance with personal perceptions (body cues) rather than altering his perception in accordance with the external world (the frame).

Another standard measure of field dependence which appears to be related to creativity is the Embedded Figures Test (EFT). The subject's task on each item of this perceptual test is "to locate a previously seen simple figure within a larger complex figure [the field] which has been so organized as to obscure or embed the sought-after simple figure" (Witkin et al., 1971, p. 3). Witkin et al. (1971) state that field-independent perception on this test requires "specifically the 'breaking up' of an organized field in order to separate out a part of it" (p.5).

This bears a close resemblance to Crutchfield's (1973) description of the necessary conditions for the elements of a problem to be creatively organized. He states as one of these conditions:

> The elements must also exist in a sufficiently free or unbound state. That is, they must not be so rigidly embedded or confined with respect to other cognitive structures that the new combination is prevented. Thus, it may be necessary first to destroy the initial context or structure within which the items are embedded before the creative reorganization can occur. (p. 59)

Field-independent performance on the EFT thus appears to be related to creative problem-solving to the extent that field-independent perceptual processes generalize to cognitive processes.

Accordingly, Crutchfield (1973) states:

> Another main source of failure in insightful cognitive reorganization is certain basic perceptual and cognitive tendencies in the person which serve to mask or suppress essential elements and attributes (emphasis in the original). Thus on a simple perceptual level an object can be made unavailable by being embedded and camouflaged in its spatial surroundings. The same kind of phenomenon occurs on a more complex cognitive level when an attribute of an object which is essential for problem solution cannot be readily perceived because the object is embedded in a particular function context. Good examples are found in experiments by Duncker demonstrating what he called functional fixedness (emphasis in the original). (p. 61)

Witkin et al. (1971) cite an unpublished study by Harris in which field dependence was found to be significantly correlated with the ability to solve problems of the type developed by Duncker. He found that field-independent subjects were more able than field-dependent subjects to use a critical element in a different functional context (e.g., removing a stopper which was embedded in

a bottle and using it as a wedge) in order to attain problem solution. Karp (1963) also found that field-independent subjects performed better than field-dependent subjects at problem-solving tasks where solution depended on using a critical element in a different context from the one in which it had been presented. If field-dependence can block, and SSS facilitate, creativity, it is plausible to assume that SSS will increase field-independence in subjects.

Additional support for the hypothesis that SSS would increase field-independence was reflected in the finding that SSS increases "openness" (Taylor, 1970). "Openness" was operationalized in terms of artistic production, specifically drawing area as measured by a planimeter, and by the independent ratings of three psychologists. Rogers (1961) emphasized the concept of openness as one of the conditions of constructive creativity. He described openness as being the opposite of psychological defensiveness, with each stimulus being freely relayed through the nervous system without being distorted by defensive processes.

Witkin, Dyk, Faterson, Goodenough and Karp (1962) have shown that field-independent persons tend to use specialized defenses, such as isolation, while field-

dependent persons tend to use indiscriminative defenses, such as massive repression, which involve a total blotting out of memory for past experiences and of the perception of stimuli. Simultaneous sensory stimulation, then, may reduce the degree of defensiveness in subjects, causing them to experience the world in a manner more characteristic of field-independent persons.

Finally, a comparison between the stimulation paradigm and the reinforcement paradigm may aid in demonstrating why an increase in field-independence could be expected. According to Taylor (1975),

> Both stimulation and reinforcement involve creative use of the environment for producing novel behavior. In the latter, predictable outcomes are achieved through rewards; in the former, the purpose is to arouse, initiate, and facilitate organismically-directed behavior that will actualize unique potentials. (p. 317)

In other words, SSS is viewed as initiating behavior which is independent of the environment, rather than contingent upon it.

In terms of a person-environment paradigm, stimulation is assumed to effect transaction, i.e., organismically directed behavior, rather than reaction, i.e., environmentally directed behavior (Taylor, 1972b). In transaction, the person actively shapes the environment, while in reaction the person is shaped by the environment. This con-

ception of transaction and reaction has direct implications for the field-independence-dependence dimension, as field-dependent subjects have been found to be more conforming to environmental demands than field-independent subjects (Linton, 1955). Further, Witkin et al. (1962) found that field-independent subjects tended to impose a structure on stimulus material lacking internal organization (e.g., the ink blots of the Rorschach), while field-dependent subjects tended to leave such material "as is". This corresponds closely to Taylor's (1973) operationalization of transactional success as the ability to superimpose the perception of a separately developed concept on an inkblot. The implication is that field-independent subjects tend to be transactive, while field-dependent subjects tend to be reactive.

A theoretical position regarding creativity and transaction is that "whereas not all transacting people are creative, all creative people are transacting. Creativity occurs to the extent that transaction occurs" (Taylor, 1972b, p. 5). In terms of field dependence, then, it would be expected that field-independence is necessary, but not sufficient for the occurrence of creativity. This in fact is the tentative conclusion put forth by Bloomberg (1973) who states: "In short, perhaps all creative persons are field-independent, but not all field-independent persons are creative" (p. 18).

Empirical investigations into the relationship between creativity and field-independence tend to yield irregular results, despite the strong face validity of the relationship. Numerous studies report finding that field-independent persons are more creative than field-dependent persons (e.g., Bierri, Bradburn and Galinsky, 1958; Gensemer, 1968; Kernaleguen, 1968; McWhinnie, 1967; Spotts and Mackler, 1973). In contrast to these findings, Bader (1970) and Ohnmacht and McMorris (1971) found no significant relationships between creativity and field-independence, while McWhinnie (1969) found a mixed pattern of both positive and negative correlations. In general, the empirical evidence appears somewhat consistent with Bloomberg's (1973) conclusion: "Field independent subjects are slightly more creative than field dependent subjects" (p. 17).

Ohnmacht and McMorris (1971) and Stevens (1970) examined the combined relationship of field dependence and dogmatism with creativity. Ohnmacht and McMorris (1971) found that taken separately neither field dependence nor dogmatism were useful in predicting creative performance, but taken together these variables had greater explanatory power. Stevens (1970), however, found no significant interaction between dogmatism and

field-independence. Further, Stevens (1970) found that significant correlations between field-independence and creativity, and between dogmatism and creativity, all fell short of significance once the variance due to general mental ability was partialled out.

In an attempt to clarify the creativity/field dependence relationship, Bloomberg (1971) utilized the concept of mobility, which Witkin et al. (1971) described as follows:

> Mobility can be characteristic of highly differentiated persons only, i.e., of persons who have available to them both a developmentally advanced mode of functioning (field independence) and a developmentally earlier mode (field dependence). Shifting of levels, implied by mobility, is thus not a possible feature of field-dependent persons. ...While field-independent persons have been found to be more creative as a group (e.g., Stevens, 1969), we may expect creativity to be a particular feature of those field-independent persons who are mobile. (p. 11)

Bloomberg's (1971) two hypotheses were that all creative subjects would be field-independent, and mobile field-independent subjects would be significantly more creative than rigid (incapable of mobility) field-independent subjects and rigid field-dependent subjects. Neither hypothesis was borne out, the findings indicating that "both field independent and field dependent perceivers can thus be mobile" (Bloomberg, 1971, p. 8), and "creative persons can be field dependent" (Bloomberg, 1971, p. 10).

Bloomberg's (1971) research, then, suggests that field-independence is not necessarily essential to creativity. The major theoretical proposition which Bloomberg (1971) attempted to test was that all creative persons are field-independent, but not all field-independent persons are creative. This proposition contains the implicit assumption that the population of field-independent persons is larger than the population of creative persons. That is, of the population of field-independent persons, only some of them are creative. Of the population of field-dependent persons, none of them are creative. Therefore, the population of field-independent persons must be larger than the population of creative persons.

To overcome this problem, Bloomberg (1971) designated those subjects falling above a median creativity score as creative and those falling below the median creativity score as non-creative. He then found the median RFT score for the non-creative group, and hypothesized that the creative group should tend to fall below the median RFT of the non-creatives (low scorers on the RFT are field-independent). His results did not support this hypothesis.

The theoretical view of creativity taken in this paper may be useful in explaining Bloomberg's (1971) re-

sults. From this viewpoint, creativity is seen as a function of both personal perceptions and transaction, which is operationalized by field dependence. It would be expected that extremely creative persons would be characterized by highly creative personal perceptions and would also be field-independent. Moderately creative persons, however, might possess extremely creative personal perceptions, but be relatively low on field-independence. Since Bloomberg (1971) divided his sample into creatives and non-creatives on the basis of a median split, the relationship he was postulating may have been obscured by the moderately creative subjects falling slightly above the median. It is suggested here that had Bloomberg (1971) utilized an extremely creative group, he may have found support for the hypothesis that creative persons are field-independent.

The present experiment can be distinguished from Bloomberg's (1971) study with respect to the assumptions made concerning the concept of mobility. Bloomberg's (1971) study was based on the assumption that mobility occurs only as regression, and never as progression. As Witkin et al. (1971) state: "Perceptual tests like the EFT press the subject to perform analytically if he possibly can; they do not allow us to distinguish between mobile and fixed field-independent persons" (p. 11). In other words, it was assumed that field-independence is

a stable trait which the subject can exhibit to a maximal degree at will.

The assumption made in the present experiment was somewhat different, that is, mobility was viewed as occurring as progression in some instances. Field-independence was seen as operationalizing transaction, which is heightened during creative processes (Taylor, 1972b). Since SSS facilitates subjects' creativity, it follows that transaction (and thus field-independence) will also be facilitated. In other words, it was assumed that creative persons are exceptionally field-independent when optimally aroused during creative processes, and that SSS would induce this optimal arousal state.

Method

Design and Subjects

Forty subjects were drawn from a pool of Lakehead University students enrolled in undergraduate psychology courses. Of these, 19 were drawn from the introductory psychology pool and received a one mark credit toward their final grade. This depleted the introductory psychology pool. The other 21 subjects were drawn from other undergraduate courses for no credit. Only volunteers were used, and all subjects were screened for epilepsy and drug taking, as SSS may induce epileptic seizures and have interaction effects with drugs. All subjects were randomly assigned to one of two groups: Group 1, the experimental group, which received SSS, and Group 2, the control group, which received NS. Each of these groups consisted of 10 males and 10 females, so as to control for sex differences. The issue of sex differences has been noted in both creativity (e.g., Gall and Mendelsohn, 1973; Torrance, 1973) and field dependence (e.g., Bennett, 1956; Sherman, 1967). Group size per session ranged from three to seven.

Tests and Apparatus

The Group Embedded Figures Test (GEFT) (Oltman et al., 1971) was used to assess field dependence. The GEFT

is modelled after the individually administered Embedded Figures Test, the subject's task being to locate and trace a simple figure within a larger complex figure. The test is divided into three sections: the First Section contains seven simple practice items and the Second and Third section each contain nine more difficult items. For each of these latter two sections, the subject's score is the number of correctly traced simple forms within a five minute time limit, a higher score reflecting greater field-independence. Witkin et al. (1971) report a parallel from reliability estimate of .82 for males and females on the GEFT.

The Torrance Tests of Creative Thinking (Figural) (Torrance, 1966a) were used to assess creativity. Each form (Figural A and Figural B) of the tests consists of three ten-minute activities: Picture Construction, Picture Completion and Circles (Figural B) or Lines (Figural A). Scoring for each test form is performed according to a scoring guide (Torrance, 1972; Torrance, 1974).

Each form of the Figural Tests yields four scores: figural fluency, figural flexibility, figural originality and figural elaboration (Torrance, 1966b). Figural fluency refers to the subject's ability to generate a large number of ideas with pictures, and is seen as primarily useful in understanding the other figural scores. Figural

flexibility refers to the subject's ability to produce a variety of kinds of ideas, to shift from one approach to another, or to use a variety of strategies. Figural originality refers to the subject's ability to produce ideas that deviate from the obvious, commonplace, banal or established. A high score on figural originality requires an ability to delay gratification or reduction of tension. Figural elaboration refers to the subject's ability to develop, embroider, embellish, carry out or otherwise elaborate ideas. These four scores reflect an attempt to interpret overall performance on the three test activities in terms of Guilford's divergent thinking factors (Torrance, 1966b).

Simultaneous sensory stimulation occurred in a laboratory setting consisting of several strobe and coloured lights reflecting off walls and ceiling of silver paper for visual stimulation; an original composition of strings and percussion music stereophonically presented through headphones for auditory stimulation; comfortable reclining chairs which vibrate and heat for somesthetic and thermal stimulation; mentholated candies for gustatory stimulation; and incense permeating the air for olfactory stimulation. All stimulation occurred simultaneously in a darkened room for a period of 15 minutes.

Neutral stimulation was administered in a separate room, where subjects listened to a 15 minute taped reading on the topic of thinking, taken from an introductory psychology text.

Procedure

All subjects were initially administered the GEFT and the TTCT (Figural), in that order. Each group was then randomly assigned to either SSS or NS. Treatment was preceded by the following statement from the experimenter: "In this session, you are about to receive various experiences to see what effects they may have on your thinking."

Immediately following SSS or NS, each group was administered parallel forms of the GEFT and the TTCT. The Figural Tests (Forms A and B) of the TTCT and the equivalent forms of the GEFT (Sections 2 and 3) were counterbalanced such that there were an equal number of pretest and posttest Form A's, Form B's, Section 2's, and Section 3's for each level of stimulation and sex member. After the experiment, the subjects were debriefed as to the nature and purpose of the experiment.

To control for experimenter bias, the study was run blind, that is, two experimenters were involved in this experiment: Experimenter A administered the SSS and NS treatments; Experimenter B administered the TTCT and

the GEFT without knowledge of the subjects' stimulation group. Experimenter A scored the TTCT without knowledge of the subject's identity or which group the subject was in. Of the 80 test forms, eight Figural A and eight Figural B booklets were also scored by Experimenter B, under the same blind conditions as for Experimenter A. The inter-rater reliability coefficients were .99 for fluency, .97 for flexibility, .96 for originality, and .92 for elaboration.

Analytic Procedures

On the basis of pilot study data, the time limit for each section of the GEFT was altered from five minutes to three minutes. This procedure was introduced to reduce possible ceiling effects wherein subjects might obtain maximum scores on the pretest, thereby eliminating the possibility of positive changes on the test. In accordance with the Torrance Tests of Creative Thinking Norms-Technical Manual (Torrance, 1966b), the four raw scores derived from the TTCT (Figural) were used for data analyses rather than a composite total figural score.

Results

Separate 2(SSS-NS) x 2(Male-Female) analyses of variance were performed on the change scores (posttest minus pretest) for each of the four measures of creativity (see Tables 1,2,3,4). Of these, the only significant effect was a main effect of SSS on originality $F(1,36)=7.317$, $p < .01$. The originality change scores for the SSS group ($\bar{X}=7.20$) were greater than for the NS group ($\bar{X}=-2.05$). The first hypothesis, therefore, was partially supported.

A 2(SSS-NS) x 2(Male-Female) analysis of variance was performed on the change scores (posttest minus pretest) of the GEFT (see Table 5). No significant effects were found in this analysis. The second hypothesis, therefore, was not supported.

In order to test the two secondary hypotheses, correlation matrices of the pretest creativity scores with creativity and field dependence change scores were generated for the SSS group (see Table 6) and the NS group (see Table 7). A test of the significance of the difference between two correlation coefficients was calculated for each of the corresponding pairs of correlations in the matrices (see Table 8). Only the correlations for

Table 1

Complete Analysis of Variance on the Change Scores for the Fluency Measure of Creativity

Source	SS	DF	MS	F
Simultaneous Sensory Stimulation (SSS)	2.02	1	2.02	.05
Sex	13.22	1	13.22	.33
SSS x Sex	2.02	1	2.02	.05
Error	1433.69	36	39.82	

Table 2

Complete Analysis of Variance on the Change Scores for the Flexibility Measure of Creativity

Source	SS	DF	MS	F
Simultaneous Sensory Stimulation (SSS)	3.60	1	3.60	.18
Sex	0.10	1	0.10	.00
SSS x Sex	8.10	1	8.10	.40
Error	721.79	36	20.05	

Table 3

Complete Analysis of Variance on the Change Scores for the Originality Measure of Creativity

Source	SS	DF	MS	F
Simultaneous Sensory Stimulation (SSS)	855.62	1	855.62	7.32 **
Sex	416.02	1	416.02	3.56
SSS x Sex	342.22	1	342.22	2.93
Error	4209.87	36	116.94	

**$p < .01$.

Table 4

Complete Analysis of Variance on the Change Scores for the Elaboration Measure of Creativity

Source	SS	DF	MS	F
Simultaneous Sensory Stimulation (SSS)	1081.60	1	1081.60	1.42
Sex	592.90	1	592.90	.78
SSS x Sex	0.10	1	0.10	.00
Error	27344.92	36	759.58	

Table 5

Complete Analysis of Variance on the Change Scores for the Group Embedded Figures Test

Source	SS	DF	MS	F
Simultaneous Sensory Stimulation (SSS)	0.90	1	0.90	.22
Sex	0.00	1	0.00	.00
SSS x Sex	0.40	1	0.40	.10
Error	150.20	36	4.17	

Table 6

Correlation Matrix of Pretest Creativity Scores with Creativity and Group Embedded Figures Test Change Scores for the Simultaneous Sensory Stimulation Group

	CFLU[5]	CFLEX[6]	CORIG[7]	CELAB[8]	CEFT[9]
PREFLU[1]	-.428	-.452	-.301	-.243	-.208
PREFLEX[2]	-.348	-.501	-.227	-.236	-.170
PREORIG[3]	-.036	-.124	-.694	-.099	.160
PREELAB[4]	-.259	-.302	.018	-.556	.022

1 - Pretest of the Fluency Measure of Creativity

2 - Pretest of the Flexibility Measure of Creativity

3 - Pretest of the Originality Measure of Creativity

4 - Pretest of the Elaboration Measure of Creativity

5 - Change Score of the Fluency Measure of Creativity

6 - Change Score of the Flexibility Measure of Creativity

7 - Change Score of the Originality Measure of Creativity

8 - Change Score of the Elaboration Measure of Creativity

9 - Change Score of the Group Embedded Figures Test

Table 7

Correlation Matrix of Pretest Creativity Scores with Creativity and Group Embedded Figures Test Change Scores for the Neutral Stimulation Group

	CFLU[5]	CFLEX[6]	CORIG[7]	CELAB[8]	CEFT[9]
PREFLU[1]	-.651	-.687	-.227	-.732	-.248
PREFLEX[2]	-.346	-.510	-.257	-.702	-.154
PREORIG[3]	.005	.000	-.785	-.333	.081
PREELAB[4]	-.053	-.257	-.117	-.750	.163

1 - Pretest of the Fluency Measure of Creativity

2 - Pretest of the Flexibility Measure of Creativity

3 - Pretest of the Originality Measure of Creativity

4 - Pretest of the Elaboration Measure of Creativity

5 - Change Score of the Fluency Measure of Creativity

6 - Change Score of the Flexibility Measure of Creativity

7 - Change Score of the Originality Measure of Creativity

8 - Change Score of the Elaboration Measure of Creativity

9 - Change Score of the Group Embedded Figures Test

Table 8

Tests of the Significance of the Difference Between the Simultaneous Sensory Stimulation and Neutral Stimulation Correlation Coefficients Between the Creativity Pretest Scores and the Creativity and Group Embedded Figures Test Change Scores

	CFLU[6]	CFLEX[7]	CORIG[8]	CELAB[9]	CEFT[10]
PREFLU[1]	.953	1.029	-.250	1.979*	.151
PREFLEX[2]	-.014	.040	.107	1.830	-.046
PREORIG[3]	-.116	-.367	.583	.723	.236
PREELAB[4]	1.594	-.142	.396	1.011	-.434
PREEFT[5]	-1.696	-.930	-2.008	.014	-1.297

*$p < .05$.

1 - Pretest of the Fluency Measure of Creativity

2 - Pretest of the Flexibility Measure of Creativity

3 - Pretest of the Originality Measure of Creativity

4 - Pretest of the Elaboration Measure of Creativity

5 - Pretest of the Group Embedded Figures Test

6 - Change Score of the Fluency Measure of Creativity

7 - Change Score of the Flexibility Measure of Creativity

8 - Change Score of the Originality Measure of Creativity

9 - Change Score of the Elaboration Measure of Creativity

10 - Change Score of the Group Embedded Figures Test

fluency pretest scores with elaboration change scores were significantly different, the SSS group correlation being of lesser magnitude in a negative direction than the NS group correlation. The secondary hypotheses, therefore, were not supported.

The pretest and posttest means and standard deviations in the SSS and NS conditions were calculated (see Appendix A). Also, the pretest and posttest correlations between the GEFT and each subtest of the TTCT were calculated (see Appendix B). At pretest, the GEFT was significantly related to elaboration ($r=.277$, $p < .05$), but not fluency, flexibility, or originality. At posttest, the GEFT was significantly related to elaboration ($r=.307$, $p < .05$) and originality ($r=.289$, $p < .05$), but not fluency or flexibility.

Discussion

The present experiment was essentially based on two assumptions. First, it was assumed that SSS would initiate behavior with unique, unpredictable, and possibly creative outcomes (Taylor, 1975). This assumption was at least partially supported, as the originality score of the TTCT reflects responses which are unique (statistically infrequent) and unpredictable (away from the obvious).

The second assumption was that the measurement of field-independence operationalized transaction. This assumption was not supported by the results. It appears that either field-independence is not significantly related to creativity, or the measuring instrument used to assess field-independence was not adequate. Until further research is performed, the former interpretation must be accepted.

The first hypothesis was partially supported by the finding that SSS increased originality. This increase in originality is consistent with previous findings by Taylor (1972a), using the Guilford Consequences Test. The question arises, however, as to why the creativity

measure of originality was affected by SSS while fluency, flexibility and elaboration were not. It may be that originality is more strongly related to creativity than are the other measures. The element of originality is stressed in most definitions of creativity (Torrance, 1966b) while fluency, flexibility and elaboration appear less central to the creativity construct. This explanation assumes that SSS initiates the originality component of transactional motivation which is central to creativity, and therefore SSS has direct bearing on this most central criterion. From this view, fluency, flexibility and elaboration can be viewed as relatively specific aspects of creativity which, unlike originality, are not necessarily the essential manifestations of creativity.

The second hypothesis was not supported by the data. At least two alternative explanations can be offered for this finding. First, that SSS has no effect on field-independence, as was the finding in this study. This is partially consistent with the irregular findings in the experimental literature concerning field-independence and creativity, which indicate that field-independence may not be significantly related to creativity. Second,

that the GEFT may be an inadequate measure of field independence. Dumsha, Minard and McWilliams (1973) found that in a sample of 30 college males the GEFT shared approximately 50 percent of the variance (r=-.691) of the Rod-and-Frame Test (RFT), which is generally considered the strongest measure of field dependence. However, the GEFT also correlated highly with the Hidden Figures Test (HFT) (r=.749), which did not correlate well with the RFT. The authors concluded that the GEFT and the HFT "may be measuring some characteristic(s) that the RFT is not" (p. 254). Also, Kurie and Mordkoff (1970) found that an experimental condition of somatic concentration, designed to increase subjects' awareness of somatic activity, produced significant changes toward field-independence on the RFT but not on the EFT. The implication is that the use of an alternative measuring instrument to the GEFT may have led to different results in the present experiment.

In general, it appears that the relationship between creativity and field-independence is characterized by strong face validity, but very little empirical support. Until adequate empirical support is marshalled through the careful use of strong indices of both field dependence and creativity, the relationship must be considered as obscure.

The secondary hypotheses were not supported by the results. It appears from the results obtained in the present study that SSS affects subjects of high and low creativity in a similar fashion. The significant difference between the SSS and NS group correlations between the Fluency pretest score and the change in Elaboration scores is assumed to be due to chance, as twenty such differences were tested, and statistically it would be expected that one of the twenty would be significant.

It was noted that the main effect of sex on originality bordered on significance, $p < .07$. Had this effect been significant, it would have indicated that males showed greater increases in originality than females in both the SSS and NS conditions. A replication study would be necessary to evaluate this result.

A general explanation of the effects of SSS may fruitfully be seen by examining the area of psychophysiology. Tuokko (1976), in her Master's Thesis, found that immediately following SSS subjects showed significant increases in theta wave production, a variable thought to be strongly related to creativity (Green, Green and Walters, 1970). However, no effect of SSS on the TTCT (Figural) was found, presumably due to the twenty minute time period between SSS exposure and administration of the creativity test. In the present experiment, a significant

main effect of SSS on originality was found with a five minute time period between SSS exposure and administration of the creativity test. The combined findings of these two experiments implies that increased theta production is associated with increased originality scores on the TTCT (Figural). Further investigation into this relationship appears justified and may help to clarify the physiological correlates of creative processes.

Implications

Simultaneous sensory stimulation appears to have implications for at least two related areas: education and personality. In education, the implication is that the level of sensory stimulation in educational climates is an important consideration in releasing the creative or originality potential of students. Richmond, Phillips and Blanton (1972) found that first grade children exposed to a program which emphasized factual content without divergent experience increased significantly on elaboration measures, but not on originality measures. In contrast, it has been found that emphasizing such variables as humour (Zivi, 1976) and working in a stimulating dyadic situation (Torrance, 1971) is associated with increased originality in students. It appears that an educational climate involving sensory stimulation may also enhance original expression in students.

In regard to personality, the implications of sensory stimulation are similar to those for education. It has been found that the personality characteristics associated with high figural elaboration and high figural originality are somewhat different, with the highly original person being characterized as: "...curious, versatile, a self-starter" (Ashton, 1974, p. 650). To the extent that the educational environment affects such variables as originality and elaboration, and these variables are associated with relatively specific personality characteristics, educational climates may effect personality changes. Sensory stimulation, as a potential means of increasing students' originality, has the implication of possibly affecting students' personalities. It is suggested here that the implications of providing more stimulation in educational environments for producing personality change may prove to be an important consideration in designing such environments.

Limitations

Certain limitations of this study should be noted. The experimental design that was used required that the measure of field dependence be of a short duration in order to assess creativity changes before the transitory effects of SSS expired. It has been suggested that single measurements of field dependence may be misleading (Wach-

tel, 1972), and that a combined index of field dependence is preferable to a single measurement (Arbuthnot, 1972). Unfortunately, the design of the present experiment did not allow for the use of such an index. Also, the SSS laboratory might have better simulated the original laboratory (Taylor, 1972a) had it been possible to include, for example, an Archimedes colour wheel. Finally, the inclusion of an extremely creative group may have been appropriate for examining the differential effects of SSS on subjects of high and low creativity.

Suggestions for further research with SSS would involve selecting an extremely creative group in addition to normal subjects and utilizing several indices of field dependence in a pretest-posttest design. This could provide a basis for examining the propositions that extremely creative persons are field-independent and extremely creative persons are more greatly affected by SSS than less creative persons.

Conclusion

The following conclusions may be drawn from the present experiment. First, SSS significantly increases subjects' originality, as measured by the TTCT. Second, SSS does not affect field-independence, at least as measured by the GEFT. Finally, SSS affects subjects of high

and low creativity in a similar fashion with respect to both creativity and field-independence.

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Appendix A

Pretest and Posttest Means and Standard Deviations (SD) of Scores on the Torrance Tests of Creative Thinking Figural Subtests and the Group Embedded Figures Test (GEFT) for Simultaneous Sensory Stimulation (SSS) and Neutral Stimulation (NS)

	SSS		NS	
	Pretest	Posttest	Pretest	Posttest
Fluency				
Mean	18.05	19.50	18.75	19.75
SD	4.74	5.61	6.27	5.41
Flexibility				
Mean	14.40	16.30	15.20	16.50
SD	3.96	4.11	4.77	4.61
Originality				
Mean	21.40	28.60	26.35	24.30
SD	9.71	7.47	12.33	7.44
Elaboration				
Mean	91.80	97.40	92.00	87.20
SD	32.62	27.23	34.32	23.10
GEFT				
Mean	4.00	5.90	3.65	5.25
SD	2.59	2.59	1.57	2.77

Appendix B

Correlations Between the Pretest and Posttest Group Embedded Figures Test (GEFT) and the Pretest and Posttest Scores for each Subtest of the Torrance Tests of Creative Thinking (TTCT, Figural)

	Group Embedded Figures Test	
	Pretest	Posttest
Fluency	.037	-.017
Flexibility	.027	.042
Originality	.016	.289 *
Elaboration	.277 *	.307 *

$p < .05$.