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THE RELATIONSHIP BETWEEN ANXIETY AND PROJECTIVE DRAWINGS WITHIN GEOMETRIC SHAPES

By

Todd Douglas Eaton

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ABSTRACT

THE RELATIONSHIP BETWEEN ANXIETY AND PROJECTIVE DRAWINGS WITHIN GEOMETRIC SHAPES

By

Todd Douglas Eaton

The purpose of the present study was to explore the relationship between anxiety and Carl Jung's theory of mandala drawings. Subjects were randomly assigned to draw either in a circle (mandala) or a triangle with downward pointing vertices (disturbed mandala). The drawings were made immediately after a task (Stroop performance) used to induce anxiety or psychic chaos.

As predicted, subjects drawing within a circle experienced a greater reduction in anxiety than those drawing within a triangle on the indices of heart rate, blood volume, pulse pressure, and electrodermal responses. However, skin conductance level and a self-report inventory (STAI) revealed no significant differences between the circle and triangle groups. Sex of subject and sex of experimenter effects were also observed. Applications, explanations, and possibilities for future research are discussed.

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INTRODUCTION

The link between shape and emotion has been the subject of much research and theorizing in as widely different fields as ethology, Eastern religious practices, and psychodynamic psychology. Although there is no consensus on the underlying causal mechanism, these perspectives do agree that certain shapes and lines have an important influence on affective experience. Circular, rounded shapes and lines are associated with more positive mental states, such as care giving responses, increased relaxation, and order, whereas angular lines and shapes are associated with negative mental states such as threat, hostility, and disequilibrium (e.g. Aronoff, Woike, & Hyman 1992; Jung, 1959; Lundholm, 1921; Osgood, 1960).

The present investigation primarily takes a Jungian approach to the effect of shapes on anxiety. Carl Jung studied the mandala in his work with psychotherapy, anthropology, and religion. Mandala is a Sanskrit term for "circle," denoting "all concentrically arranged figures, round or square patterns with a centre, and radial or spherical arrangements" (Jung, 1953, p. 116). According to Jung, mandalas express balance and order (1959), often

occurring in dreams and fantasies. Jung noted the use of mandalas in Tantric yoga, in which they are used as yantras, or aids to contemplation. In Eastern religions such as Lamaism, Tibetan Buddhism, and Hinduism, mandalas are used to foster and maintain relaxed states of meditation (Zimmer, 1946). Jung opined the value of mandalas, and employed them as a type of art psychotherapy. Mandalas spontaneously produced by patients in analytic therapy, claimed Jung, provided an ideogram of unconscious material. Jung maintained that mandalas often occur in times of chaotic and disoriented psychic states, serving a healthy compensatory purpose. Mandalas bring about "a kind of new centering...they have the purpose of reducing the confusion to order...Patients themselves often emphasize the beneficial or soothing effect of such pictures" (Jung, 1959, pp. 360-361). According to Jung, drawing within the mandala or circular form helps to elicit unconscious fantasies by virtue of its relaxing, centering effects.

For Jung, the mandala shape may facilitate the expression and experience of internal states. This experience of these states may in turn contribute to psychic integration. Jung asserted that mandalas express a process striving toward individuation, or psychic equilibrium, as seen in the union of the opposites (e.g. conscious and unconscious). The pure geometric form of the circle lends itself to its symbolic meanings of order and symmetrical arrangement (Jung, 1964). The circle is an unbroken,

smooth, continuous line which creates a shape that is perfectly balanced, representing a secure, enclosed, and protective boundary. According to Jung, the circular line of the mandala means, in one aspect, "the marking off of the sacred precinct, and on the other, fixation and concentration" (Jung, 1935, p. 101).

As Jung asserted, mandalas ameliorate psychic chaos and arousal by the symbolically protective aspect of the circle (1964). For Jung, the circular mandala figure is symbolic of the totality or wholeness of the self, which is the ultimate goal in the individuation process. Often produced in times of psychological chaos or confusion, Jung claimed that psychological turmoil is held together by the symbolic security inherent in the shape of a circle. At the same time, mandalas provoke focus and concentration, bringing order into being by their natural balance and symmetry. Taking Jung's perspective, the circular mandala figure may serve to reduce anxiety by providing a symbolically protective, holding, and balanced visual stimulus.

But to equate drawing within a mandala with completed individuation is an erroneous notion. As mentioned above, mandala drawings often appear in times of psychic chaos. When speaking of mandala drawings in analytic psychotherapy, Jolande Jacobi (1973) asserts, "for the most part the mandalas...are only preliminary sketches, more or less successful steps towards ultimate perfection and wholeness...it would be a mistake to interpret their

appearance as an indication of a particularly advanced stage of development" (p. 138). Since mandalas only provide the preparatory stages of individuation, they are not in themselves sufficient for psychological healing and wholeness. The integration of unconscious material, rather than mandalas in themselves, brings about individuation. However, mandala drawings very well may provide the state of relaxation and concentration needed for subjects to convey visually critical life experiences and emotions, which in conjunction with competent interpretation and analytic therapy, can bring about individuation.

While complete mandalas take the form of circles, squares, or quartered circles, Jung referred to three-sided shapes as "disturbed" mandalas (Jung, 1959). Jung claimed that shapes deviating from the circle or square signal psychic fragmentation, incompletion, and a departure from totality. In Jung's "A Study in the Process of Individuation" (1959), this phenomenon of threeness being linked with psychological disturbance is visually illustrated in a case study. In the case study of "Miss X," one can see that her early pictures are dominated by triangular shapes, while her later pictures are characterized by circular forms with increased symmetry, balance, and differentiation.

Relevant Research

In addition to the approach taken by Jung, there are

several other theories that investigate the connection between shape and affect. For example, Aronoff, Barclay, and Stevenson (1988) examined facial characteristics that distinguished threatening from nonthreatening facial displays. They found that curvilinear lines were perceived as less threatening. Similarly, Aronoff, Woike, and Hyman (1992), discovered that a rounded, curvilinear stimuli is associated with "goodness;" Aronoff et al. point out that increasing roundness accompanies increased happiness in the facial display. Their study represents an ethological perspective that was influenced by McArthur & Baron's (1983) ecological approach to social perception as well as Darwin's (1872) hypothesis that emotional expression is connected to a common neuromuscular foundation. This perspective can be used to explain the evolutionary value of phenomena such as infants having rounded heads, a stimulus display that elicits a warm, care giving response from the mother (Lorenz, 1943). Likewise, research on the physiognomic attractiveness has shown that adults view infants with more rounded faces as more cute (Hildebrandt & Fitzgerald, 1979). Cunningham (1986) has also found that subjects perceive young women with more rounded faces as more attractive. Finally, Lundholm (1921) conducted an experiment which analyzed the connection between affect and different types of lines. She found that curvilinear lines were associated with serenity, gentleness, mildness, uniformity, and consistency (pp. 52-53). As in the Jungian perspective,

curvilinear lines are associated with positive mental states.

In contrast to the perception of curvilinear lines, angularity and diagonality in the visual stimulus has been shown to evoke subjective responses that conveyed the meaning of threat, anger, and discomfort (Aronoff et al., 1988). Moreover, Aronoff et al. (1992) found that triangles per se are not sufficient to evoke the subjective meaning of threat. Only a downward pointing vertex, like that seen in angry eyebrows, produced the threatening conveyance. Aronoff et al. (1992) have established that "badness" in a visual stimulus is perceived in acute angles with downward pointing vertices; these properties are similar to those produced by a facial display of anger. Likewise, Lundholm (1921) found that subjects associated sharp angles with furiosity, anger, excitement, violence, and distress.

In a similar experiment with a Jungian frame of reference, Slegelis (1987) found that drawing within circles was more "relaxing" than drawing within squares. She defined "relaxed" as the number of angles drawn, with a greater number of angles indicating greater anxiety. In her study, she used two groups. One group made drawings within a circle and another group drew within a square. The hypothesis was that the number of angles drawn within circles would be fewer than the number of angles drawn within squares. Slegelis' findings corroborated her hypothesis. As Slegelis noted, this finding has practical

applications in art psychotherapy. If a person's arousal can be manipulated by drawing within a certain shape, then a psychotherapist may utilize the shape being drawn within as a means to influence the client's psychological state. However, Slegelis' conclusions were seriously undermined by certain demand characteristics. By using the number of angles drawn as her dependent measure of anxiety, her experiment is open to the chance that the shape influenced the dependent measure. In other words, the angles found in a square (or the lack of angles in a circle) could unduly influence the number of angles a subject draws, with relaxation being unrelated. Also, Slegelis failed to realize that using drawings within squares as a control group is invalid from a Jungian perspective since Jung (1959) asserted that squares as well as circles are complete and balanced mandalas.

The present investigation sought to ascertain more securely whether the connection between shape and affect is strong enough to significantly alter subjects' anxiety levels while drawing within geometric shapes. Reviewing past theory and research, there seems to be a convergence of findings that circular lines are associated with balance, serenity, attractiveness, and overall "goodness." Contrastingly, angularity, most notably angles with downward pointing vertices, are commonly associated with imbalance, disturbance, threat, violence, anger, and overall "badness." Based on these findings and their congruence with Jungian

theory, the present study compared subjects drawing within a circle to subjects drawing within a triangle with downward pointing vertices. Thus, the present experiment investigated the following hypothesis: **subjects drawing within a circle will have lower anxiety than subjects drawing within a triangle on self-report and psychophysiological measures.**

Jung's concept of anxiety does not easily lend itself to operationalization. Descriptions such as "psychic chaos" and "disequilibrium" are rather ambiguous, lacking concrete corresponding measurements. Jung never exactly specified whether the calming, centering effects of drawing within a mandala take place exclusively on an unconscious level or also on a conscious level. Nor did Jung specify whether these relaxing effects are physical, psychological, or both. These ambiguities were taken into account in the selection of dependent measures.

Dependent Measures

Electrodermal Response. From a Jungian perspective, the electrodermal response (EDR) is the most valid and congruent measure of anxiety, since Jung himself used this measure in experiments assessing unconscious activity and arousal (Jung, 1907). Jung viewed the EDR as an objective window that physiologically measures unconscious processes. He noted that the greater the emotional arousal, the greater the electrodermal response (Hassett, 1978). By using the

EDR as an indicant of psychic processes, Jung assumed that what affects the psyche has a similar effect on the body. In a general sense, Jung contended that the intensity of psychic experience is reflected in the amount of EDRs.

Research since Jung's early work (Hassett, 1978; Stern, Ray, & Davis, 1980) has shown that EDR is a reliable measure of autonomic arousal, revealing short-term changes in electrodermal activity. This measure is sensitive to the arousal of the sympathetic branch of the autonomic nervous system, and will be considered the foremost index of anxiety given the theoretical underpinning of this experiment. Sympathetic activity is responsible for arousal and preparing the body for action. In contrast, parasympathetic activity is responsible for restorative functions, being indicative of rest. An increase in EDRs indicates sympathetic nervous system activity. For the present investigation, if drawing within a circular mandala causes an increase in psychic equilibrium, there should be more physical relaxation as indicated by less EDRs for subjects drawing within a circle than those drawing within a triangle.

In addition to EDR, four other measures of psychophysiological activity were used: heart rate, blood volume, pulse pressure, and skin conductance level. These measures were included to provide indications of phasic and tonic activity. Phasic activity reveals transitory changes in autonomic arousal. This type of activity reveals short

duration changes (lasting only a few seconds) and adjustments to the immediate situation. Tonic activity indicates a temporally averaged measure of autonomic arousal, relating to longer or extended periods of time (Hassett, 1978). Whereas phasic activity reflects transient responses to stimuli, tonic activity reflects relatively long-term responses. More details concerning the specific physiological measures are given below.

State Anxiety. In addition to psychophysiological arousal, anxiety may be also conceptualized as occurring on a more self-aware, conscious level. Because of the multifaceted nature of anxiety and the ambiguity of Jung's conception of anxiety, a self-report measure of anxiety was included. The Spielberger State-Trait Anxiety Inventory supplements the physiological indices by providing a self-report measure of anxiety that may not be tapped by the physiological measures. If changes in anxiety take place on a conscious level, a conscious self-report measure of anxiety is useful in assessing the psychic disequilibrium that occurs within a person's awareness. The STAI supplies a self-reported means for measuring the affective, cognitive, and somatic aspects of anxiety that are consciously experienced by the subject. In this experiment the State form of the STAI was used. The STAI is a paper and pencil instrument on which a subject answers questions on a four point Likert scale concerning how he or she feels "at this moment." A complete discussion concerning the

reliability, validity, and scoring procedures of the STAI can be found in Spielberger (1983).

Manipulation of Anxiety

As mentioned above, Jung claimed that mandala drawings often occur in times of psychic chaos and disorientation. A revised version of the interference task of the Stroop Color-Word Test (Stroop, 1935) was used to induce anxiety before the drawing. This version of the Stroop was a page of color words printed in a different color of ink (e.g. the word "blue" printed in red ink). The subject's task was to report the color of the ink of three columns of words, suppressing the reading response and naming only the color. The Stroop is usually used as a measure of attentional resources. However, in the present experiment, the conflicting stimuli of the word and the actual color of the word was assumed to induce considerable confusion and anxiety in the subject. Therefore, Stroop performance was assumed to act as a type of prime for mandala drawing by inducing psychic chaos.

Expermental Design

The design of this experiment considers three factors: the shape being drawing within (circle or triangle), the gender of the subject, and the gender of the experimenter. The gender of the subject and the gender of the experimenter were taken into account because they are potentially

confounding variables. Keeping with Jung's theory on the universal effect of mandala drawings, no gender effects were hypothesized to occur as a function of the shape being drawn within. Although not hypothesized, gender-specific variables have the potential to influence and interact with the main effect of drawing within a mandala figure. The sex of the subjects and experimenters were therefore taken into account to explore these possibilities. There were one male and one female experimenter. A limitation of using only one experimenter of each sex is that the experimenter's individual style may effect the subjects rather than more generalized effects of the experimenter's gender. The result is a 2 x 2 x 2 representative design in which sex of experimenter and sex of subject are examined as samples from their gender-specific populations (Maher, 1978).

METHOD

Subjects

After obtaining approval from UCRIHS, 110 subjects were obtained from introductory psychology classes at Michigan State University who had signed up to participate in an experiment entitled "Naming and Sketching." Of the 110 subjects, 55 were male and 55 were female. The subjects were randomly assigned to draw within a circle or draw within a triangle. Each subject was tested individually by one of the two experimenters.

Setting and Equipment

The first room entered from the hallway contained a computer, a desk, a straight-backed chair, and a cabinet in which various experimental supplies were kept. In the adjoining room was a six-channel Grass (model #5) polygraph, a vinyl upholstered reclining chair adjacent to the polygraph, and a table. Upon the table was a tray containing cotton balls, alcohol, and electrolyte gel. A straight-backed chair was situated in front of the polygraph. The polygraph, finger electrodes, and a metal cuff were used to monitor physiological responses.

Booklets were constructed, which included the pre-test STAI, the Stroop, the drawing page (with either the circle or triangle), and the post-test STAI. These booklets were used in order to increase standardization and keep the experimenters blind to each subject's condition. Drawings were made on 8.5" x 11" white unlined paper. The circles and triangles were drawn in heavy black ink so that both figures contained approximately the same area (43 square inches). A lap board was used to give the subjects a firm surface on which to write and draw. This board was painted white in order to minimize the effect of the contours of the paper.

Procedure

When the subject arrived at the appointed time, the experimenter conducted him or her into the laboratory room. The subject was asked to sit in the large reclining chair and sign a consent form. After the subject signed this form, the experimenter filled the electrodes with electrolyte gel. The proximal phalanges of the second and third finger of the subject's nondominant hand were cleansed with cotton dipped in alcohol, and an electrode was attached to each finger. The metal cuff was then attached and sealed to the subject's thumb. The nondominant hand was used so that the subject could have the dominant had free to write and draw. The experimenter sat in front of the polygraph.

The booklet attached to the lapboard was then given to the subject. The cover page of this booklet read as follows: "This booklet contains various tasks to be completed, including brief questionnaires, a color naming task, and a drawing. Directions for each task are included. After you finish a task, proceed to the next page. Please remember that your responses are completely anonymous and are held under strict confidentiality; do not put your name or student number on any of the pages of this booklet. The experimenter will tell you when you can begin." During the first ten minutes of the session, the experimenter calibrated the polygraph. This time also allowed the experimenter to get a baseline reading and the subject to get adapted to the laboratory setting.

After this initial period, the experimenter said, "please turn to the first questionnaire and begin." This first questionnaire was the State form of the STAI. The instructions for the STAI were included in the booklet. On the opposing page, the booklet read "After you have finished this questionnaire, please go to the next page."

The next page of the booklet contained the Stroop with directions on the opposing page. The specific directions for the Stroop were as follows: "This is a test of how fast you can name the <u>COLOR</u> in which the words on the opposite page are printed. Remember, name the color of the word, and not the word itself. For example, for the first item you would say 'blue,' for the second item (going downward), you

would say 'red,' etc. Go through the entire page, saying each item aloud. If you make a mistake, correct your error and continue without stopping. After you have completed this task, proceed immediately to the next task." The experimenter allowed the subject to read through the columns.

After the Stroop performance, subjects made the drawing. The booklet had either a circle or a triangle with the following directions on the opposite page: "For the next three minutes, make a drawing within the shape on the opposite page. There is no right or wrong way to draw, and your drawing will not be graded. Draw whatever comes to mind. Please tell the experimenter when you begin to draw; the experimenter will tell you when to go on the next page." When the subject told the experimenter that he or she had begun to draw, the experimenter marked the point on the polygraph print out. After 3 minutes had elapsed, the experimenter said "Please proceed to the next task."

The last page of the booklet contained the State form of the STAI in order to attain a self-reported measure of the subject's anxiety level immediately after making the drawing. Subjects were then disconnected from the polygraph and debriefed. The debriefing consisted of an open ended interview, which included questions inquiring how the subject felt and what went through the subject's mind while he or she was making his or her drawing. These questions were asked to better understand what the subject experienced

while drawing. The experimenter then gave the subject more information about the experiment.

Scoring Methods

The psychophysiological data was scored using the following procedures. Equidistant ten-second sampling periods were used to measure anxiety during the baseline, Stroop performance, and drawing period. These sampling periods were obtained by dividing the total condition into equidistant sections, then using the last ten seconds of each section as the sampling period.

Heart rate. While an increase in heart rate indicates sympathetic nervous system (SNS) activity, a decrease in heart rate indicates parasympathetic nervous system (PNS) activity (Hassett, 1978). The heart rate is taken from the phasic pulse pressure wave, which appeared as a spiked wave on the polygraph print out. The number of heartbeats within each ten-second sampling period was recorded, averaged, and multiplied by six. This procedure, recommended by Hassett (1978), yielded the number of heartbeats per minute.

Pulse Pressure. Pulse pressure refers to the pressure wave, a phasic measure of plethysmographic response. Pulse pressure is measured by taking the amplitude of the pressure wave. In other words, the pulse pressure is obtained by measuring the height, from trough to peak, of the wave. A shorter wave amplitude indicates decreased blood flow in the finger and a hardening of the arteriole walls, marking

greater SNS activity (Brown, 1967). This response increases the return of blood to the heart, allowing more blood to be sent to the muscles. The average amplitude of the pulse pressure wave was obtained for each sampling period. This average was then converted to cubic millimeters by multiplying the overall average by ten cubic millimeters and dividing by the amplitude of the pen deflection during calibration. This conversion compensated for the differing sensitivity settings from subject to subject, given that pen deflection during calibration varied in proportion to the sensitivity setting.

Blood Volume. Blood volume refers to the distention or enlargement of the finger due to increased blood flow, and provides a tonic measure of plethysmographic activity. An increase in blood volume was interpreted as PNS activity, while a decrease was interpreted as SNS activity. An average baseline level of blood volume was taken before the drawing period by obtaining the average level of the troughs of each pressure wave. The distance from this baseline for each sampling period was measured in millimeters. These distances were then averaged for an overall measure of blood volume change. This averaged distance was then converted to cubic millimeters using the equation mentioned for pulse pressure.

Electrodermal Responses. The number of electrodermal responses provided a phasic measure of electrodermal activity. As recommended by Stern, Ray, and Davis (1980), a

criteria was established before the outset of data collection. The criterion for determining an EDR was set at 500 ohms, which allowed recording of EDRs with smaller amplitudes as well as larger EDRs. Thus, the EDR measure was a count of the number of electrodermal skin responses above the criterion of 500 ohms.

Skin Conductance Level. Skin conductance level provides a tonic measure of electrodermal activity. A greater conductance level signifies increased SNS activity. This measure was an average of the reciprocal of the skin resistance at the beginning of each sampling period. A conductance score is often preferred to a resistance score since skin conductance gives a directly proportional representation of the number of sweat glands coming into play (Hassett, 1978). Hassett contends that more intense experiences yield more intense sweat-gland responses (for both EDR and SCL), being under the control of the sympathetic nervous system.

STAI. The State form of the STAI was given before and after the drawing. The possible scores for the STAI range from 20 to 80, with a higher score indicating higher self-reported anxiety. The difference between these two test scores was used to assess the degree of change in self-reported anxiety.

RESULTS

Manipulation Check

A paired samples two tailed t-test was used to check the manipulation of "chaos" during Stroop performance. Each subjects' heart rate, blood volume, and pulse volume during Stroop performance was compared to initial values obtained at baseline on the assumption that anxiety would increase during Stroop performance (see Table 1). Omega squared was used to determine effect size. This formula takes the difference between sum of squares for the factor under consideration and mean square within. This difference is then divided by the sum of SS total and MS within.

Table 1

t-tests for Paired Samples (Initial Values and Stroop)

Source	df	t	w
Pulse Pressure	109	11.90****	.429
Blood Volume	109	5.39****	.209
Heart Rate	109	-13.06****	.604

**** p < .001

Each psychophysiological index checking the manipulation of anxiety during the Stroop was significant beyond the .001 level of confidence in the predicted direction of increased

SNS activation. The mean baseline of subjects' pulse pressure was 3.75 cubic mm, in contrast to the mean pulse pressure of 2.01 cubic mm during Stroop performance ($t=11.9$, $p<.001$), having an effect size of .429. The average initial increase in blood volume was 1.46 cubic mm, compared to an average decrease of 3.89 cubic mm during Stroop performance ($t=5.39$, $p<.001$), having a treatment magnitude of .209. The average initial heart rate was 78.33 heartbeats per minute, which increased to 91.51 heartbeats per minute during Stroop performance ($t=-13.06$, $p<.001$), having an effect size of .604. All three of these indices are consistent with the postulate that Stroop performance induced anxiety in the subjects. Measurements of electrodermal responses and skin conductance level were unobtainable during Stroop performance. Many subjects had extreme reactions, causing the polygraph pen printing electrodermal activity to go to and remain at the top of its limit. This ceiling effect precluded accurate measurement of electrodermal responses and skin conductance level.

Experimental Hypothesis

The experimental hypothesis was evaluated by each of the aforementioned dependent measures using the following procedure. First, each of the distributions were examined. Those for heart rate, pulse pressure, blood volume, electrodermal responses, and skin conductance level were all found to be highly skewed. Consequently, each was subjected

to a square root transformation. This transformation satisfactorily removed skewness for heart rate, electrodermal responses and pulse pressure, but not for skin conductance level and blood volume. For these, a non-parametric test was used. In addition, to take account of any correlations between baseline and treatment scores (Law of Initial Values), analyses of covariance were used so that each subject's initial value scores could be taken into account as covariates. An analysis of variance was applied to the STAI.

Table 2

Analysis of Covariance for Heart Rate

Source	df	MS	F	w
Shape	1	2.26	12.20***	.060
Sex of Subject	1	.18	.96	.009
Sex of Experimenter	1	1.63	8.81***	.044
Sex of Exp. X Sex of Subject	1	.03	.15	.005
Sex of Experimenter X Shape	1	.09	.49	.007
Sex of Subject X Shape	1	.03	.16	.005
Sex of Exp.X Sex of Sub.X Shape	1	.18	.99	.009

*** $p < .005$

Heart rate. As predicted, heart rate was significantly greater for subjects drawing within a triangle than for those drawing within a circle (see Table 2), with an effect size of .06. Subjects drawing with a circle had an average heart rate of 79.90 heartbeats per minute, while subjects drawing within a triangle had an average heart rate of 83.69 heartbeats per minute. In addition to the significance of the shape being drawn within, the sex of experimenter was

also significant, having an effect size of .044. During the experimental condition, subjects having the male experimenter had an average heart rate of 80.82 heartbeats per minute, while subjects having the female experimenter had an average heart rate of 82.08 heartbeats per minute.

Table 3

Analysis of Covariance for Pulse Pressure

Source	df	MS	F	w
Shape	1	3.45	27.91****	.159
Sex of Subject	1	.25	2.05	.017
Sex of Experimenter	1	.30	2.44	.019
Sex of Exp. X Sex of Sub.	1	.22	1.79	.015
Sex of Experimenter X Shape	1	.01	.09	.006
Sex of Subject X Shape	1	1.33	.25	.001
Sex of Exp.X Sex of Sub.X Shape	1	.04	.32	.007

**** $p < .001$

Pulse Pressure. Shape being drawn within was significant on the pulse pressure index as anticipated (see Table 3), with a treatment magnitude of .109. The average pulse pressure of those drawing within a circle was 4.60 cubic mm, as contrasted to an average pulse pressure of 3.26 cubic mm for those drawing within a triangle.

Table 4

Analysis of Covariance for Electrodermal Responses

Source	df	MS	F	w
Shape	1	23.63	15.16****	.109
Sex of Subject	1	12.84	8.24**	.062
Sex of Experimenter	1	.19	.12	.008
Sex of Exp. X Sex of Subject	1	.66	.43	.010
Sex of Experimenter X Shape	1	.01	.00	.007
Sex of Subject X Shape	1	1.67	1.07	.014
Sex of Exp.X Sex of Sub.X Shape	1	.99	.63	.011

** p < .01
**** p < .001

Electrodermal Responses. As expected, the shape being drawn within was significant on the index of electrodermal responses (see Table 4), resulting in an average of 15.35 electrodermal responses for subjects drawing within a circle, 20.19 electrodermal responses for subjects drawing within a triangle, and an effect size of .109. The sex of the subject was also significant, with an average of 21.75 electrodermal responses for male subjects, 14.18 electrodermal responses for female subjects, and an effect size of .062.

Table 5

Analysis of Covariance for Skin Conductance Level

Source	df	MS	F	w
Shape	1	.00	.11	.001
Sex of Subject	1	.03	.97	.002
Sex of Experimenter	1	.06	1.99	.003
Sex of Exp. X Sex of Subject	1	.00	.04	.001
Sex of Experimenter X Shape	1	.39	.39	.002
Sex of Subject X Shape	1	.00	.00	.001
Sex of Exp.X Sex of Sub.X Shape	1	.03	1.03	.003

Skin Conductance Level. Because of the skewed

distribution, the Mann Whitney U was applied to skin conductance level. This test was not significant (U=1490, p>.05). There were also no significant effects for the index of skin conductance level when the ANCOVA was applied (see Table 5).

Table 6

Analysis of Covariance for Blood Volume

Source	df	MS	F	w
Shape	1	1582.36	10.77***	.065
Sex of Subject	1	2513.18	17.10****	.106
Sex of Experimenter	1	474.16	3.22	.014
Sex of Exp. X Sex of Subject	1	61.96	.42	.000
Sex of Experimenter X Shape	1	42.25	.29	.000
Sex of Subject X Shape	1	798.40	5.43*	.028
Sex of Exp.X Sex of Sub.X Shape	1	145.14	.99	.000

* p < .05
*** p < .005
**** p < .001

Blood Volume. The Mann-Whitney U test (for skewed distribution) for blood volume was significant in the predicted direction (U=954.5, p<.005). Equivalent results were reached using the ANCOVA (see Table 6). The shape being drawn within was significant, resulting in an effect size of .065, an average blood volume increase of 8.12 cubic mm for those drawing within a circle, and an average increase of 1.12 cubic mm for those drawing within a triangle. The sex of subject was also significant, showing an average increase of 9.55 mm for male subjects, an average decrease of .81 mm for female subjects, and an effect size of .106. Finally, the shape by sex of subject interaction

was significant (see Figure 1 in Appendix A), having an effect size of .028. Males drawing within a circle had an average blood volume increase of 15.51 cubic mm, while males drawing within a triangle had an average blood increase of only 4.20 cubic mm. The difference was less dramatic for female subjects, who had an average blood volume increase of .44 cubic mm while drawing within a circle, and a decrease of -1.85 cubic mm while drawing within a triangle. When this interaction was probed for simple effects, the difference between males and females drawing within a circle ($t=3.3$, $p<.005$), the difference between males and females drawing within a triangle ($t=2.67$, $p<.05$), and the difference between males drawing with a circle and males drawing within a triangle ($t=2.41$, $p<.05$) were found to be responsible for the interaction. The difference between females drawing within a circle and those drawing within a triangle was not significant ($t=1.70$, $p>.05$).

The means for blood volume reveal that subjects drawing within a circle had greater parasympathetic activation than subjects drawing within a triangle. Additionally, female subjects had greater sympathetic activation than male subjects. Finally, male subjects showed a significantly greater difference than female subjects when drawing within the two shapes.

Table 7 - Analysis of Variance for STAI

Source	df	MS	F	w
Shape	1	111.72	1.92	.008
Sex of Subject	1	141.89	2.44	.013
Sex of Experimenter	1	27.10	.47	.000
Sex of Exp. X Sex of Subject	1	38.09	.66	.000
Sex of Experimenter X Shape	1	10.94	.19	.000
Sex of Subject X Shape	1	1.69	.03	.000
Sex of Exp.X Sex of Sub.X Shape	1	4.58	.08	.000

STAI. When an ANOVA was applied to the STAI, there were no significant effects (see Table 7).

Summary. Examining the general findings of this study, a uniform and significant effect for the shape within which the subjects drew was shown with the exceptions of skin conductance level and STAI. The results revealed that, as predicted, subjects drawing within a circle showed significantly less anxiety (electrodermal responses, pulse pressure) and more parasympathetic effects (blood volume, heart rate) than subjects drawing within a triangle. As for experimenter effects, subjects having the female experimenter showed greater anxiety on the heart rate index than subjects having the male experimenter. Considering the effects of the sex of subject, the results are less uniform. Male subjects showed greater anxiety than female subjects on electrodermal responses, while females showed greater anxiety than males on blood volume. Furthermore, the main effects of shape and sex of subject found on the blood volume index cannot be interpreted alone because of the significant interaction between shape and sex of subject (see Figure 1). Upon examining the heart rate, blood volume

change, and pulse pressure indices, the following trend was observed: increased anxiety during Stroop performance followed by a significantly greater decrease in anxiety in the circle group than in the triangle group (see Figures 2, 3, 4 in Appendix A). Tables of correlations, means, and standard deviations were included for further information (see Appendix A).

DISCUSSION

One of the potential shortcomings in this experiment was the assumption the anxiety or psychic "chaos" that the Stroop performance induced was maintained during the drawing period. Although one may be confident in asserting that Stroop performance did in fact induce anxiety, the question of whether this anxiety was carried over across the entire drawing period is uncertain.

Another potential limitation of this study is that only one male and female experimenter were used. Even though experimenter effects were not prominent, the heart rate index did yield a significant difference. Subjects having the female had a significantly greater heart rate than those having the male experimenter. Because of the shortcoming of having only one experimenter of each gender, one cannot be sure if the sex of experimenter effect was due to the general sex effects of the experimenters or the non-gender, idiosyncratic effects that the experimenters may have had on the subjects. Such factors as the physical attractiveness or personality of the experimenters may have been responsible for producing this difference. Despite this shortcoming, taking sex of experimenter into account was

informative, as it identified a source of variance (in HR), thereby increasing the power and efficiency of the design. Future research could more accurately study the sex of experimenter by using more than one experimenter of each gender. Finally, one should be cautious in interpreting the results of this study. One may safely say that drawing within a circle resulted in a greater reduction in anxiety or SNS activity than drawing within a triangle (with the exception of skin conductance level). However, it is unwarranted to assert that relaxation or PNS activity was experienced for those drawing in a circle while increased anxiety was experienced for those drawing within a triangle. Only the blood volume index gave a distinct indication of PNS dominance in addition to reduced anxiety for those drawing within a circle. Future research could investigate the questions of whether circular mandala drawings induce PNS dominance and triangle drawings induce SNS dominance.

Stroop performance induced a significant increase in anxiety for heart rate, pulse pressure, and blood volume. This effect is noteworthy. In a recent review (MacLeod, 1992), no mention was made of the anxiety inducing properties of Stroop performance. In the past and present, the Stroop has been viewed mainly as a measure of attentional resources and not as a test with the ability to produce general arousal (Thackray & Jones, 1971). In the manual for clinical and experimental uses of the Stroop,

Golden (1978) observed that most studies have "failed in attempts to show autonomic changes during the administration of the Stroop." Golden cited Houston (1969), who did not find any differences in pulse rate when using two different versions of the Stroop (one with easily distinguishable colors, the other without easily distinguishable colors). Similarly, Thackray and Jones (1971) found no evidence of Stroop performance affecting heart rate and respiration. However, the results of this study strongly suggest that Stroop performance does in fact have the ability to induce sympathetic nervous system arousal in subjects. Likewise, Frankenhaeuser et al. (1967) found an increase in skin conductance during Stroop performance. Taken together, these results suggest that the anxiety-inducing properties of Stroop performance, being inconsistent with the frame of reference of cognitive processing, may have been overlooked.

When taken together, the physiological measures yielded varying results. None of the main effects or the interaction effects were significant or consistent across all five measures. For instance, the sex of experimenter effect was significant for heart rate, but not for the other indices. And as mentioned above, the effects for sex of subject were logically inconsistent, revealing contradictory results for blood volume and electrodermal responses. These inconsistencies suggest that each measure may be tapping a unique physiological process, and that these processes are not necessarily related or convergent. For example, Moore &

Baron (1983) and Kilpatrick (1972) have proposed that electrodermal responses may reveal a motivation process associated with threat or stress, while skin conductance level reveals cognitive processing. Applied to the findings of this study, these suggestions show that drawing within a triangle is more likely associated with threat or stress rather than cognitive processing.

However, other research (Bundy, 1978; Edelberg & Muller, 1978) has suggested that EDR and SCL may be the result of one effector system, which would make unlikely the possibility that EDR and SCL operate individualistically. Yet the differing results obtained for EDR and SCL in this study are in need of explanation. Adams (1982) states that sweat glands receive nerves from only the sympathetic nervous system; water remains in the outer layers of the skin, reflecting both current and past sweating secretions. Thus, a high concentration of water in the skin due to sweating bursts in the recent past can influence the skin conductance level. On this basis, Leigh (1983) explains the reason electrodermal responses may appear to more sensitively measure autonomic activity than skin conductance level: "since SCL reflects not only immediate but also recent past SNS activity, the SCL data of a particular experimental treatment is likely to reflect not only responses to that treatment but also to the prior treatment. Consequently these findings necessitate caution in interpreting the SCL data" (p. 20). Applied to this study,

Stroop performance may have unduly distorted the SCL index during the drawing period. Stroop performance, present in all conditions, could have overshadowed SCL treatment effects the shapes may have had. In conclusion, the notion that different indices of autonomic activity measure the same underlying psychological and physiological states is likely to be erroneous, given the results of this study. Further studies are needed to sort out the inconsistencies observed on the psychophysiological indices.

The fact that the main effect for shape was significant on four of the autonomic measures but not on the self-report measure is noteworthy. This finding suggests that the effect of drawing within a circle or a triangle is more likely to be experienced on a physiological level rather than a conscious level. In other words, the effects of perceiving and drawing with a mandala figure may be largely unconscious. This idea seems to fit well into Jung's theory, given the emphasis he places on the personal and collective unconscious. According to Jung, the mandala figure, whether complete or disturbed, is a symbol of the self archetype, stemming from unconscious origins. Likewise, the results from this study suggest that differential effects of drawing within a circle or a triangle do take place, but on a level beyond conscious awareness. The results of this study, as well as others (e.g. Murray, 1963), suggest that self-reported anxiety may not be sensitive to or correlated with psychophysiological

anxiety. From a psychodynamic frame of reference, these findings should serve as a caution not to use the STAI as an exclusive measure of anxiety.

Jung's theory of mandalas and the ethological theory of facial expressions, as discussed above, certainly apply well to this study's findings. But other theories can offer substantial explanations for the observed findings also. A Freudian analysis of the results might also help to explain the findings of this study. Freud, in his discussion on femininity (1933), proposed that libido is originally masculine in both males and females: "a boy's mother is the first object of his love...For a girl too her first object must be her mother. The first object-cathexes occur in attachment to the satisfaction of the major and simple vital needs" (p. 118). Later in development, as a result of the female child's "inevitable disappointments from her father, she is driven to regress into her early masculinity complex" (p. 130). Freud believed that the pre-Oedipal attachment and attraction to the mother is "left over for the future" and is not "adequately surmounted in the course of development" (p. 134). Additionally, a rounded shape such as circle would be more symbolic of a female (Freud, 1920). Because sexual arousal is primarily a parasympathetic response (Hassett, 1978), psychoanalytic theory might therefore suggest that both males and females would show a decrease in anxiety while drawing within the female-symbolic circle.

Psychoanalytic theory can also offer an explanation of the interaction between shape and sex of subject for blood volume (see Figure 1). Blood volume has been proposed as analogous to distention of the genitalia (Reyher, 1987; Gaines, in progress). And because there is not as much erectile tissue in the clitoris as there is in the penis, Freudian theory would predict a greater parasympathetic blood volume response for males. Consistent with this explanation, a remarkable increase in blood volume was observed in males who drew within a circle, which could be interpreted as a parasympathetic sexual response to a symbolically female shape. Employing Freudian symbolism, the pencil with which the subjects drew could have symbolized the penis, while the circle within which they drew could have been symbolic of the vagina.

Moreover, Jung's theory of typology also provides an explanation of the shape by sex of subject interaction found on the blood volume index. Jung believed that the introvert is characterized by a greater interest in the subject (self) than in objects (others), revealing a tendency to turn inward. For the introvert, the subject is the prime motivating factor, and the object is only of secondary importance. In contrast, the extravert has greater interest in others than in the self, with a tendency to think, feel, and act in relation to the object (Jung, 1971). Introversion accompanies an inward turning of libido while extraversion is characterized by an outward turning of

libido. Moreover, femininity is linked to introversion, fostering introspection and subjectivity. Masculinity, on the other hand, is in closer relation to extraversion, signifying interest in objective structure (Jung, 1964). Given this sex difference and the implication that males have greater external, object-oriented libido while females have more accumulated or dammed up libido in the self, one might expect a sex difference on the blood volume index. In addition to the anxiety reducing effect of the circular mandala, Jungian theory might predict greater PNS activity in males than in females, given that males have greater libidinal investment in external objects (in this case, the mandala figure) than females. The only shortcoming of this explanation is that unlike Freud's definition of libido as primarily sexual energy, Jung regarded libido as general psychic energy. Nonetheless, sexual energy is included as an important component in Jung's theory of libido, thereby making the connection between blood volume and greater parasympathetic activity in males plausible.

A sex of subject difference was also found for electrodermal responses, with males having a greater number of EDRs than females. In a comparable experiment investigating anxiety and projective drawings, Hamernik (1985) also found this trend. These results suggest that the completion of projective drawing tasks appears to arouse greater phasic electrodermal anxiety in males than in females. Reyher (1959) has proposed that the clinical

significance of projective drawings may be due to the intrapsychic conflict arouse and reveal. Given the similar findings of Hamernik and the present study, males may be more responsive or susceptible to this intrapsychic conflict provoked by projective drawings on the EDR index.

Lacey's (1967) intake-rejection theory of heart rate seems to fit well with Jungian theory and the findings of this study. Lacey has argued that while environmental intake, or attention to external events, may lead to a decrease in heart rate, environmental rejection may lead to an increase in heart rate. Additionally, Lacey has suggested that deceleration in heart rate may trigger an increase in cortical processing of environmental information, while an acceleration in heart rate may trigger a decrease in such processing. Likewise, Jung argued that the mandala figure fosters concentration and focusing conducive to meditational states. According to Tantric Buddhism, the religious sect that influenced Jung's emphasis on the mandala, the mandala can assist in developing "the inner relationship of the external world and the world of the spirit" (Kapleau, 1989). Using Lacey's terminology, mandala figures may elevate environmental intake (or focusing), thereby stimulating cortical processing of these figures. Hence the meditational value of the mandala may lie in its ability to foster concentration and subsequent psychic processing of environmental stimuli, providing a meaningful link between external and internal realities.

Despite the heuristic value of these interpretations, they must be viewed as ex post facto hypotheses in need of further testing and empirical backing. Ex post facto explanations, unable to be falsified, require subsequent research to empirically substantiate their claims.

The results of this study suggest that autonomic arousal can be altered by the perception of and drawing within certain shapes. As Jung and others have noted, this finding has applications for art psychotherapy. An by giving a subject a circle or a triangle within which to draw, his or her psychophysiological state may be significantly altered. A circular, mandala-like figure may be used when a reduction in anxiety is desired while making a drawing. Furthermore, this reduction in anxiety may be conducive to greater expression of emotional material. With an decrease in anxiety or lessened SNS activity a person may feel more comfortable in expressing himself or herself openly. This feeling of comfort and acceptance could clearly be beneficial for the elicitation of significant clinical material and subsequent attainment of insight into the person's emotional concerns. As Jung maintained, mandala drawings enable the therapist to appreciate the full significance of the client's concerns and his or her progress toward conscious realization. Conversely, a triangle with downward pointing vertices may be used to induce greater SNS activity while drawing. From a Jungian perspective, having a person draw within a triangle may very

well be contraindicated. One might consider what Jung says about anxiety states: "in psychopathology there are many such cases [e.g. anxiety states] where a given stimulus is followed by a definite and relatively disproportionate reaction comparable to an instinctive reaction" (p. 131, 1960). This "disproportionate reaction" could include an irruption of an unconscious complex; "when excited by an external stimulus, complexes can produce sudden confusions, or violent affects, depressions, etc." (p. 313, 1960). While a violent reaction to drawing within a triangle does seem extreme and unlikely, the fact that the process could lead to greater psychological turmoil and imbalance seems plausible.

The possibilities for further research in this area are abundant. The paucity of well researched studies in both Jungian psychology and art psychotherapy has diminished their potential impact. Critical aspects in both of these fields are in need of empirical corroboration or refutation. For a Jungian study, one might consider race, geographical region, and other demographic variables; this procedure could be used to test the archetypal universality of drawing within a mandala figure. Furthermore, the psychological and physiological effects of self-generated mandalas may be quite different than the experience of drawing within a pre-made mandala figure; future studies could examine this difference. Additionally, one could alter the shapes given to a subject to draw within; Jung claimed that square

figures are also symbolic of balance and wholeness. Using a blank page with no shape to compare the effects of drawing within a mandala figure to drawing in an open field might also prove to be enlightening.

Although Slegelis' (1987) findings were supported in the present investigation, the validity of the dependent measure that she used is still in question. Future research could seek to determine if the number of angles drawn is a valid index of anxiety. Finally, a researcher could use different and more enduring manipulations of psychic chaos. As mentioned above, using Stroop performance to induce anxiety assumes that this effect will persevere through the drawing period. But by inducing anxiety while the subject actually makes the drawing (e.g. embarrassing the subject), a researcher could be more assured of maintaining psychic chaos during the drawing period. The synthesis of Jungian psychology and art psychotherapy, while rich in theory, is lacking in empirical support. Studies such as the ones mentioned might provide a scientific foundation to their theory and application.

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APPENDIX

APPENDIX A

ADDITIONAL TABLES AND FIGURES

Table 8

Means and (Standard Deviations)

			Drawing	
	Baseline	Stroop	Circle	Triangle
HR	78.33 (11.92)	91.51 (12.02)	79.90 (10.49)	83.69 (10.98)
PP	3.75 (1.95)	2.01 (1.21)	4.60 (2.13)	3.26 (1.42)
BV	1.46 (4.11)	-3.89 (8.77)	8.12 (17.83)	1.12 (9.13)
EDR	15.55 (11.99)	----------	15.35 (10.08)	20.19 (12.35)
SCL	2.11 (1.62)	----------	2.56 (2.02)	2.43 (1.55)
STAI	33.91 (8.60)	----------	32.71 (8.11)	32.78 (9.10)

HR=Heart Rate
PP=Pulse Pressure
BV=Blood Volume Change
EDR=Electrodermal Responses
SCL=Skin Conductance Level
STAI=State Trait Anxiety Inventory

Table 9

Correlations between dependent measures

	HR	PP	BV	EDR	SCL	STAI
HR	----	.08	.01	.14	.10	-.12
PP		----	.43**	.04	-.03	.09
BV			----	-.13	.03	.03
EDR				----	.29**	-.09
SCL					----	-.05
STAI						----

**p<.01

HR=Heart Rate
PP=Pulse Pressure
BV=Blood Volume
EDR=Electrodermal Responses
SCL=Skin Conductance Level
STAI=State Trait Anxiety Inventory

Table 10

Correlations between dependent measures for the circle group

	HR	PP	BV	EDR	SCL	STAI
HR	----	-.13	-.10	-.01	.11	-.08
PP		----	.44**	.10	.07	.06
BV			----	-.17	.07	-.05
EDR				----	.11	-.19
SCL					----	-.13
STAI						----

**p<.01

HR=Heart Rate
PP=Pulse Pressure
BV=Blood Volume
EDR=Electrodermal Responses
SCL=Skin Conductance Level
STAI=State Trait Anxiety Inventory

Table 11

Correlations between dependent measures for the triangle group

	HR	PP	BV	EDR	SCL	STAI
HR	----	.20	.07	.19	.11	-.19
PP		----	.23	-.21	-.16	.04
BV			----	-.26	.02	.07
EDR				----	.48**	-.09
SCL					----	-.03
STAI						----

**p<.01

HR=Heart Rate
PP=Pulse Pressure
BV=Blood Volume
EDR=Electrodermal Responses
SCL=Skin Conductance Level
STAI=State Trait Anxiety Inventory

Figure 1

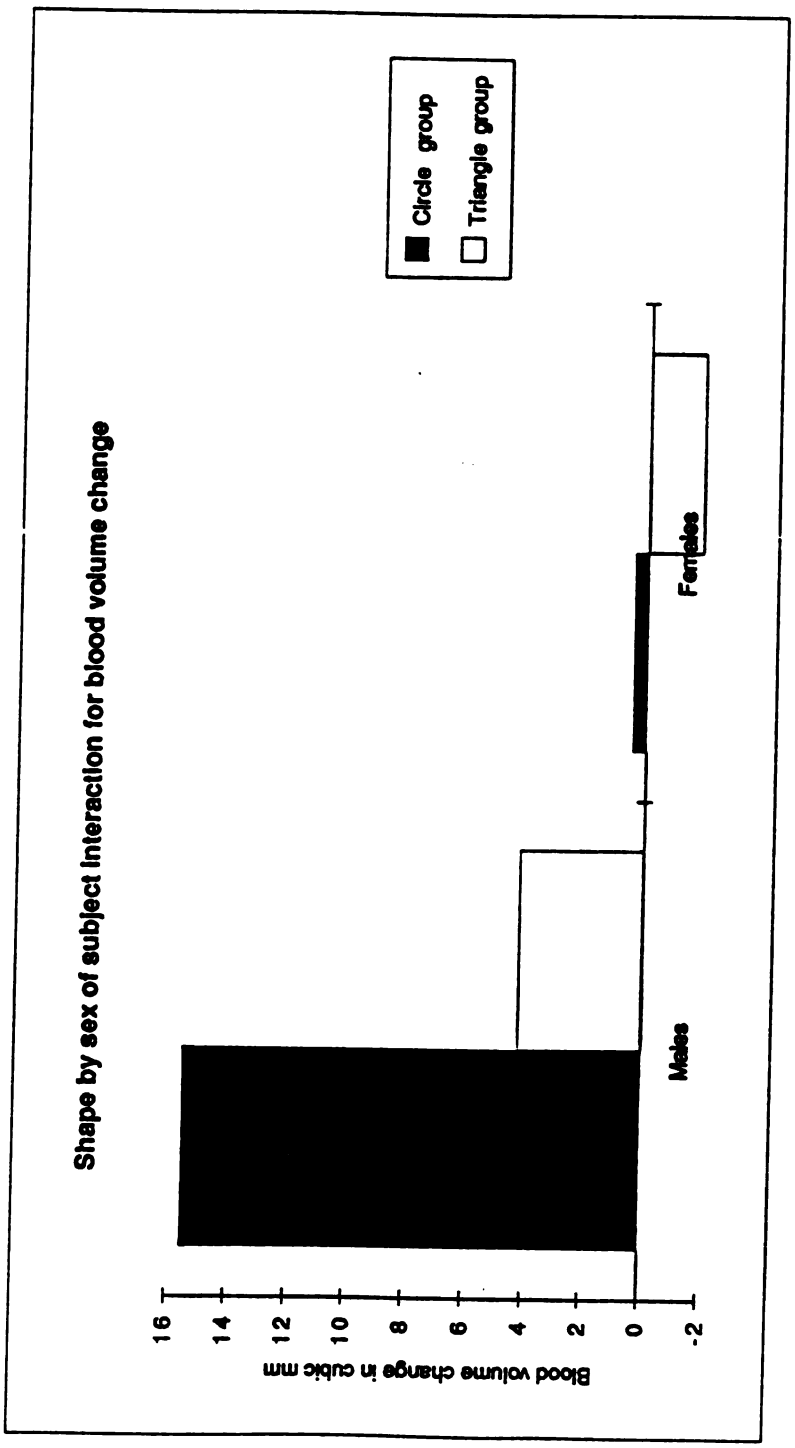

Shape by sex of subject interaction for blood volume change
Circle group
Triangle group
Blood volume change in cubic mm
16
14
12
10
8
6
4
2
0
-2
Males
Females

Figure 2

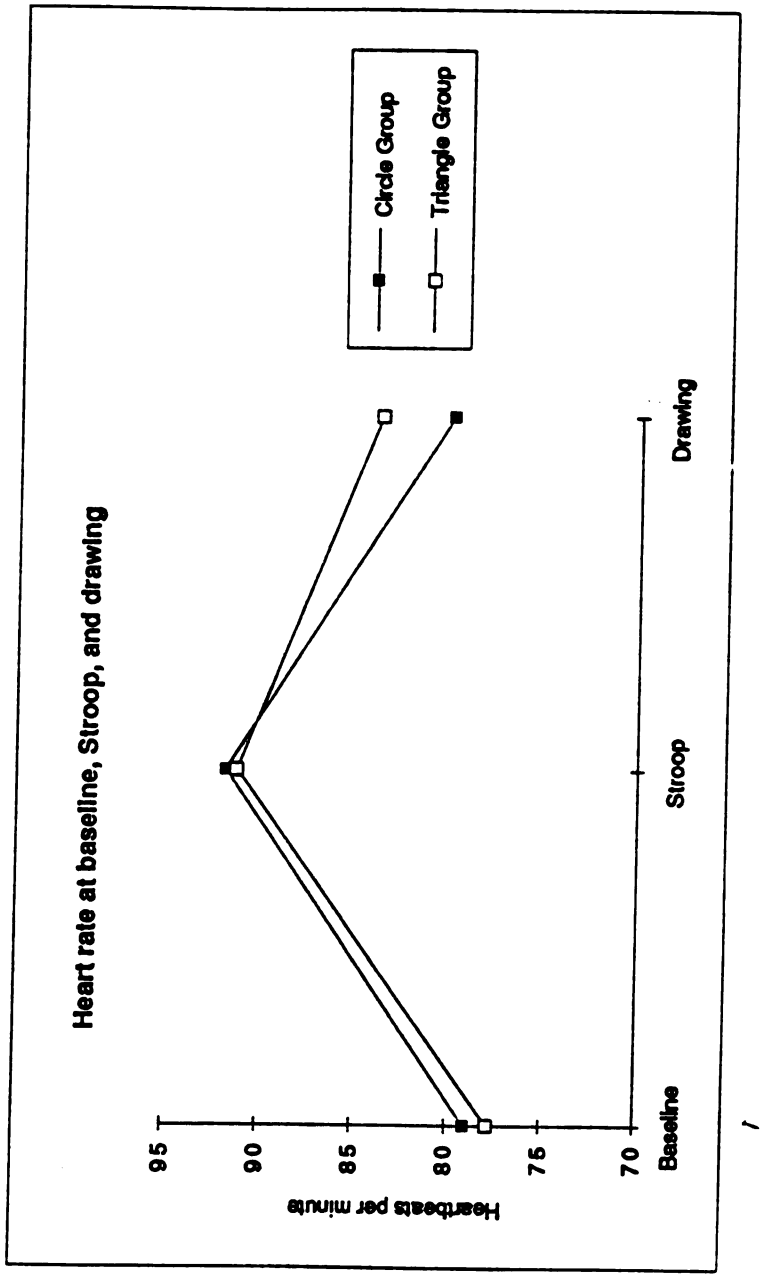

Heart rate at baseline, Stroop, and drawing
Circle Group
Triangle Group
Heartbeats per minute
95
90
85
80
75
70
Baseline
Stroop
Drawing

Figure 3

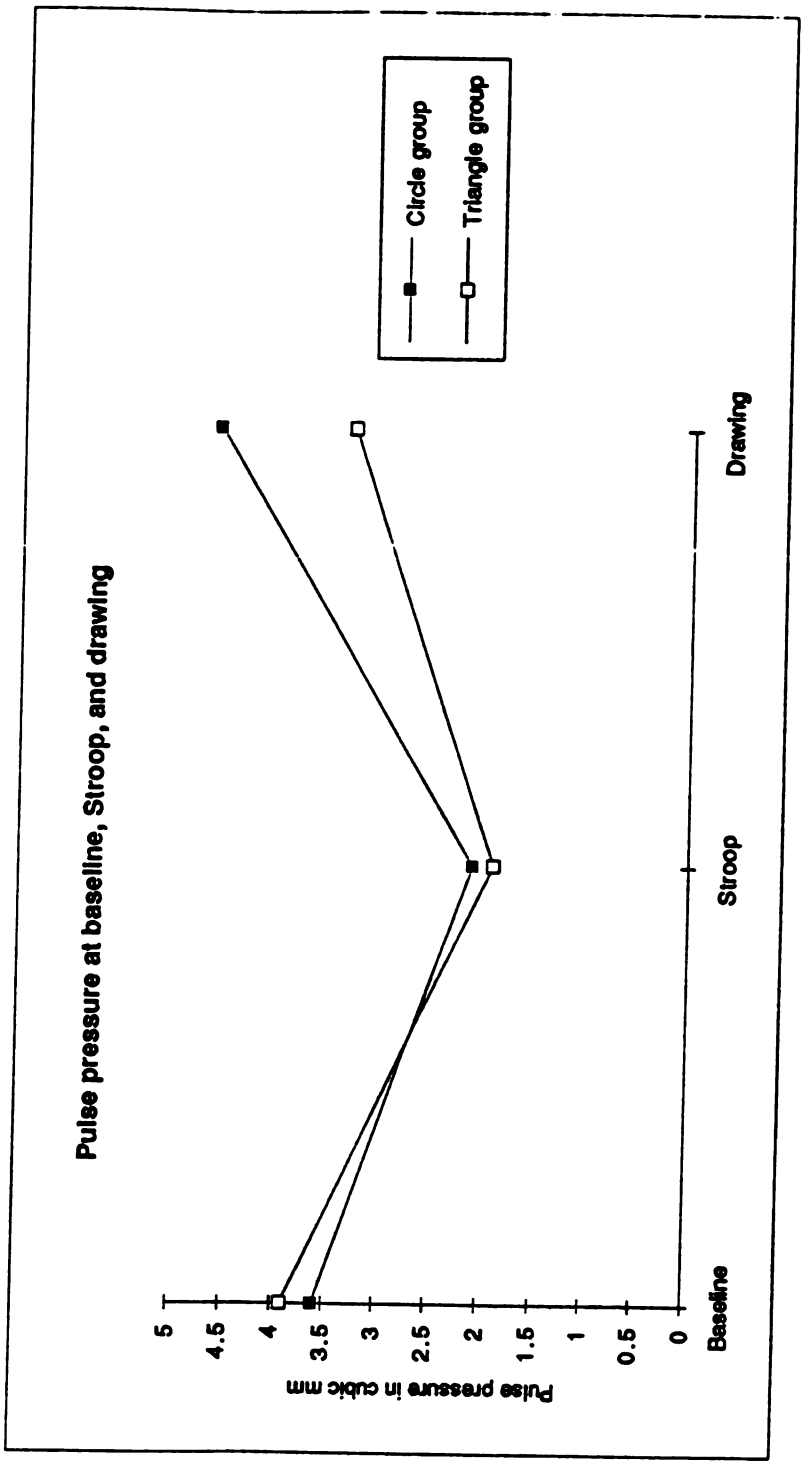

Pulse pressure at baseline, Stroop, and drawing
Circle group
Triangle group
Pulse pressure in cubic mm
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
Baseline
Stroop
Drawing

Figure 3

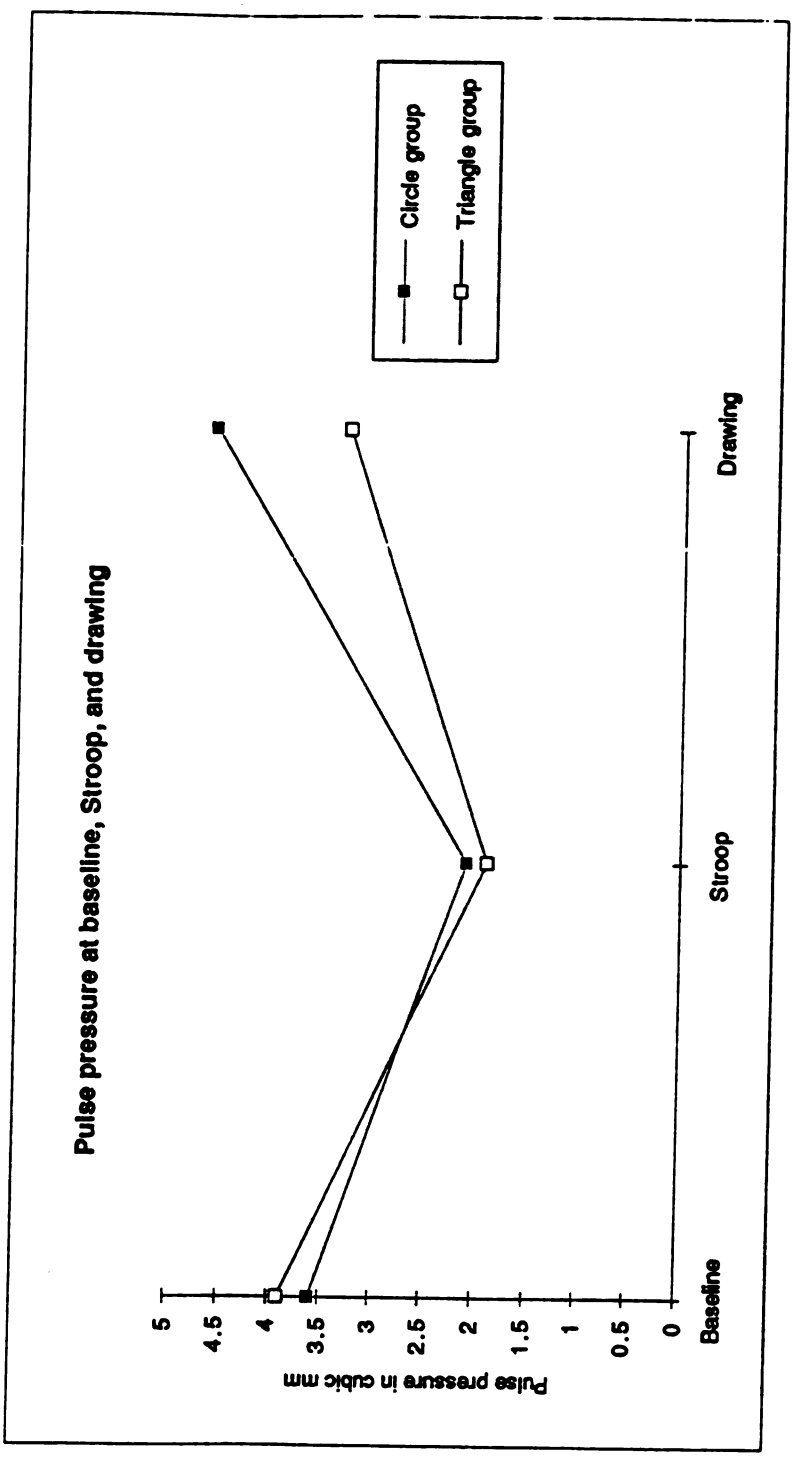
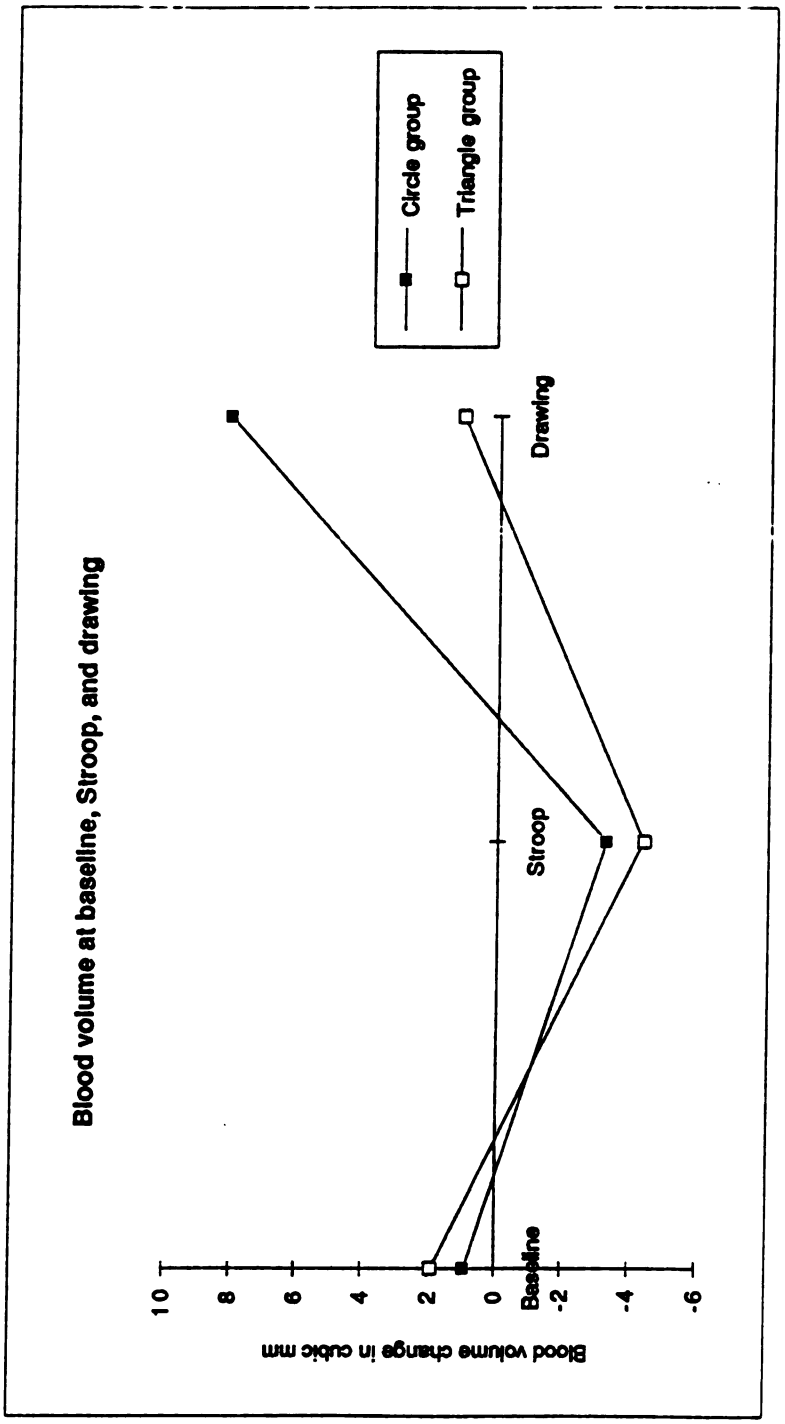

Pulse pressure at baseline, Stroop, and drawing
Circle group
Triangle group
Pulse pressure in cubic mm
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
Baseline
Stroop
Drawing

Figure 4


Blood volume at baseline, Stroop, and drawing
Circle group
Triangle group
Blood volume change in cubic mm
10
8
6
4
2
0
-2
-4
-6
Baseline
Stroop
Drawing