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AUTHOR Watt, James H., Jr.; Krull, Robert
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ABSTRACT

In research reported in this paper, an attempt was made to isolate arousal components due to the "form" of a television program from arousal components due to the "content" of the program. The following hypotheses were formulated: (1) emotional arousal will take place in programing segments depicting violent acts, (2) arousal due to the cognitive task of decoding complex program form will take place in highly active programing segments, and (3) these two components of arousal occur independently of one another. The subjects in this study were upper-level undergraduates in a mass media course. Hypotheses one and three were confirmed, while hypothesis two was not. The results of the study are presented in both narrative and table format. (RB)

AROUSAL MODEL COMPONENTS IN TELEVISION PROGRAMMING: FORM ACTIVITY AND VIOLENT CONTENT

James H. Watt, Jr.
Assistant Professor
Department of Speech
Division of Communication
University of Connecticut
Storrs, Connecticut 06268

AND

Robert Krull
Assistant Professor
Department of Language, Literature, and Communication
Rensselaer Polytechnic Institute
Troy, New York 12181

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AROUSAL MODEL COMPONENTS IN TELEVISION PROGRAMMING: FORM ACTIVITY AND VIOLENT CONTENT

Research examining the relationship between television viewing and aggressive behavior can be summarized as belonging to one of three basic kinds of theoretical models: The Catharsis Model, or the reduction of aggression through vicarious participation in television violence (cf. Feshbach, 1971; Feshbach and Singer, 1971); the Facilitation Model featuring legitimization or learning of aggression from television violence (cf. Bandura, Ross and Ross, 1963; Berkowitz. Corwin and Hieronimus, 1963; McLeod, Atkin and Chaffee, 1971); and the Arousal Model which considers television programming as an agent of arousal, generating a predisposition to action, with the nature of the action being shaped by situational factors (cf. Tannenbaum, 1971; Zillman, 1971; Zillman, et al., 1974).

All these paradigms consider only the content of the programming. Recent research findings (Krull and Watt, 1973; Watt, 1973) have indicated that an elaboration of the Arousal Model to consider the form or stimulus characteristics of the programming is necessary to more completely explain the consistently found link between the viewing of violent television fare and aggressive behavior.

In this research, it was hypothesized that the cognitive difficulty involved in decoding a communication which involves rapidly changing visual and auditory events might generate arousal in the viewer. If the Arousal Model holds, this arousal might be transferred into increased levels of aggressiveness.

A previously developed content-free measure of form complexity, (Watt and Krull, 1974) based on Information Theory, was used as a measure of the form arousal potential of programming. This permitted the contrasting the three models, and lead to these general conclusions:

1. The Catharsis Model was not supported.
2. The Facilitation Model was supported, and found to be operating independently of the Arousal Model.
3. The Arousal Model, when the agent of arousal was considered to be only the form characteristics of the programming, was supported and found to be operating independently of the Facilitation Model.

There were two basic problems with this research. First, the link between the form characteristics of the programming and the arousal of the viewer was assumed, based on similar but not identical findings reported in the literature. Second, the effects of arousal due to the form of the program could not be separated from the effects of arousal due to the content of the program. In Tannenbaum's formulation of the Arousal Model, all arousal effects are assumed to be the result of emotional reactions to the overt content of the communication.

Other studies have also found indications of the arousal potential of violent communications. Zillman, et al. (1974) found significant differences in heart rate and blood pressure between neutral communications and violent communications. They also found evidence of greater arousal as a result of viewing an erotic communication, and observed that the higher arousal condition was associated with an increased level of aggressiveness. Interestingly, the heart rate observed for erotic communications was significantly higher than that observed for neutral communications, while the heart rate for the violent communication was significantly lower. This parallels the data of Wotring and Porter (1974). Wotring and Porter found evidence of positive heart rate gains in viewers of violent programming in which the consequences of the violence were not shown. When the bloody consequences were shown, heart rate decreases were found. Wotring and Porter attribute this effect to inhibition resulting from exposure to the explicit consequences of violent acts, and conclude that this mechanism might produce less subsequent aggression than presentation of violence without consequences.

There is some question as to whether decreased heart rate indicates decreased arousal. Lacey, et al. (1963) found decreased heart rates associated with increased attention to outside stimulation. Wotring and Porter find the Lacey explanation inconsistent with their film violence data, as it implies that subject paid more, rather than less, attention to the aversive stimuli of blood and pain.

Another interpretation of the Lacey data is that heart rate decreases with outside information processing. This interpretation may have value in explaining the Wotring and Porter data.

The stimulus material for the violence with consequences experimental condition featured a fight scene. This type of dramatic action is usually presented in a very rapidly edited, visually complex way. The non-consequences version had most of the explicit violence edited out, and consequently could have been a slower, less complex visual presentation. Thus the differences found in response between the conditions could conceivably be at least partially the result of differences in the form complexity of the stimulus material.

It appears that both the form arousal potential and the emotional arousal potential of communications should be assessed in order to refine the Arousal Model. The research reported in this paper represents an attempt to isolate arousal components due to the form of the program from arousal components due to the content of the program. By discriminating between these two sources of arousal due to television programming, an addition to the Arousal Model can be made. The basic research hypotheses are these:

H1: Emotional arousal will take place in programming segments depicting violent acts.
H2: Arousal due to the cognitive task of decoding complex program form will take place in highly active programming segments.
H3: These two components of arousal occur independently.

METHOD

A network crime-detective show was video taped off-the-air. The commercials were edited out, leaving a 50-minute drama. The show featured a popular bald detective, several loud and abusive arguments and threats, one pushing incident, one on-camera murder, and one near murder saved only by the timely arrival of the detective.

The videotape was viewed by a panel of 31 judges, who were students in an upper-level undergraduate mass media course. The tape was played in two-minute segments, and all the judges were asked to rate the amount of violence in each separate two-minute segment on a five-point bipolar scale which ranged from "non-violent" to "very violent." Thus 25 ratings, one for every two-minute segment, were obtained from each judge. The means of these ratings were used as the overt violence scores for the two-minute program segments.

The program was also scored on the measure of form complexity (Watt and Krull, 1974). The measure of overt violent content served as the independent variable representing the emotional arousal potential (content dimension) of the program, while the form complexity measure represented the independent variable of form arousal potential (form dimension).

Two measures of physiological arousal, heart rate and galvanic skin resistance (GSR), were taken while subjects viewed the entire videotape. These measures served as the dependent variables in testing the hypotheses.

Several analysis strategies were carried out to test the hypotheses. Since there were two dependent variables representing arousal, it was necessary to use multivariate statistics.

Hypothesis One, which involved the relationship of arousal to the appearance of violent acts, was tested by multiple linear regression, with the overt violence rating being the criterion variable and the heart rate and GSR readings being the predictor variables.

Testing Hypothesis Two, which concerned the relationship of arousal to the form aspects of the program, required the use of canonical correlation, as the form complexity measure consisted of six indicators which were related to the two arousal measures.

Hypothesis Three, which stated that the two components of arousal occur independently, was tested by multiple partial correlation. The relationship between each of the arousal measures and the violence rating was examined while holding constant the six indicators of form complexity. The relationship between the arousal measures and the six indicators was then computed, while holding constant the overt violence rating. If either the form complexity-arousal link or the overt violence-arousal link were spurious because of covariance between overt violence and form complexity, this procedure will cause the partial correlation representing the spurious link to go to zero (see Blalock, 1964 for a discussion of this partialing procedure). If neither of the partial correlations are reduced to non-significance, it can be concluded that the relationship between program violence and arousal is independent of the relationship between form complexity and arousal.

Two tests of each hypothesis were carried out. The first examined the relatively long-term relationship among the variables by considering changes in the variables throughout the entire program. The second test considered only the short-term changes in variable levels from one two-minute segment to the next. Thus the preceding segment provided a baseline figure for the next segment, and changes in one variable from the previous segment baseline were compared with changes in another variable, from its previous baseline.

EXPERIMENTAL PROCEDURE

Twenty-two female and 19 male subjects were drawn from a freshman and sophomore introduction to communication course. Each subject was scheduled individually for an experimental session, which lasted approximately one hour.

When the subject arrived, he or she was led into a room set up to simulate a normal living-room viewing environment, with easy chairs, a couch, table lamps, etc. A large TV monitor was on a table at a normal viewing distance. The subject was asked to take a seat in an easy chair, and fill out a preliminary questionnaire. This questionnaire contained questions on television viewing habits, and other simple items not analysed here.

The subject was then told that the purpose of the experiment was to measure his or her physiological responses while viewing television. GSR electrodes were attached to the hand, and a small photo-plethysmograph transducer for heart rate measurement was attached to the thumb of the same hand. The subject was reassured that no discomfort would be involved, and that the experimenter requested only that the subject should move about only when necessary. The subject was informed that the experimenter would be in the next room, monitoring the equipment, and would be observing through an unobtrusive one-way observation window.

The sound-proof control room contained a Grass Model 7 Polygraph and videotape equipment. Leads to the transducers were routed through a small hole in the wall to the viewing room. The subject was thus in a fairly natural viewing situation, with the exception of the small transducers and several fine, flexible wires which connected them to the polygraph.

No picture appeared on the television monitor at the beginning of the experiment. The subject sat in the chair for 3 to 5 minutes as base-line measurements were taken. After the initial novelty of the situation faded, and the subject's GSR reading became stable, the videotape was started.

The subject's GSR value immediately prior to the beginning of the videotape was set at the base-line value and all subsequent measurements were deviations from this baseline. This procedure was used to control for natural differences in skin resistance values. The plethysmograph amplifier was set to produce "tick-marks" corresponding to the blood-pressure peaks associated with each heartbeat.

Continuous GSR and heart rate measurements were recorded on chart paper at 2.5 cm/sec. The experimenter observed any motion by the subject, and recorded it by pushing an event recording button on the polygraph. This placed a coded mark on the time track of the chart paper.

When the program was over, the transducers were removed from the subject's fingers, and he or she was debriefed and asked to fill out another short questionnaire. Among the questions was one asking if the subject had viewed the crime drama episode previously. Only two of the subjects had seen the episode used.

DATA ANALYSIS

The data were first transfered from the chart paper to IBM cards. The GSR values were sampled at 12-second intervals and recorded. If a movement had been recorded in the 12-second interval, this was also coded onto the card by means of a "0--no movement," "1--movement" code. The number of heartbeats in each two-minute segment were counted and recorded.

The final data set consisted of the following variables for each subject for each two-minute interval:

[illegible]. Each GSR reading was first corrected for the effects of subject movement, since GSR is very sensitive to body movement. By means of a test on several volunteers, it was determined that about two minutes was required for a GSR reading to return to baseline after a movement. This return time, because it depends on evaporation of perspiration from the skin, would vary under different temperature and humidity conditions but remained remarkably constant in the air-conditioned testing rooms.

To correct for body movement by the subjects, a computer program examined the difference in GSR reading between the 12-second interval in which the motion occurred and the immediately succeeding reading. Any drop in GSR was assumed to be the result of body motion, rather than response to the television. This difference was added to the GSR readings for the next two minutes after the subject movement by a "straight line depreciation" method. One-hundred per cent of the difference was added to the next reading, 90% to the one after that, then 80%, etc.

Other problems with GSR as an arousal measure required different correction procedures. There are wide differences in the magnitude of response to stimuli, and these differences may be systematic, varying according to sex, race, and other variables. Put another way, the variance of the GSR responses is expected to be unequal between subjects, even if the direction of the responses is identical. To correct for this unequal variance, standard scores (z-scores) were computed as the GSR score for each subject, based on the GSR mean and standard deviation for each subject. This standard score of the deviations from the original baseline after correcting for body motion is the GSR score referred to hereafter.

Standardized Heart Rate. Because the magnitude of heart rate changes may depend on factors such as normal resting heart rate, which in turn depends on age, physical condition, sex, etc., a standard score for heart rate was also computed, based on the mean and standard deviation of the heart rate for each subject.

Standard GSR Deviation. The Standard GSR described above is essentially a long-term measure, since it is based on the mean and standard deviation of scores over the entire program. A parallel measure, the Standard GSR Deviation, was computed to provide a short-term measure of changes in GSR. It was computed by considering the GSR reading for the previous two-minute program segment as the baseline, and subtracting the next GSR reading from it. This produced 25 difference scores between each of the adjacent program segments. To standardize the variance of these deviation scores between subjects, standard scores were computed, based on the mean and standard deviation of the difference scores.

Heart Rate Deviation. A short-term measure of heart rate variation was computed. This was simply the difference in heart rate between adjacent two-minute segments. Each segment served as a baseline for the next segment, as in the Standard GSR Deviation computation. For example, if a subject had a heart rate of 140 beats/segment in segment 13, and 145 beats/segment in segment 14, the Heart Rate Deviation score would be +5. If the same subject's heart rate was 140 beats/segment in segment 15, the score would be -5. These deviations were initially standardized by the same procedure as Standard GSR Deviations, but the correlation between the raw deviations and the standardized deviations was .99, so the unstandardized scores were used. Apparently short-term heart rate variations are less subject to systematic outside influences than long-term heart rates.

Degree of Violence. This variable was the mean of the judges' ratings for each two-minute interval, as discussed previously.

Violence Difference. This variable represents short-term changes in the degree of violence from one two-minute segment to another. It was computed by subtracting the violence score of each segment from the violence score of the previous segment.

Form Complexity. This variable is actually a set of six previously developed indicators. They were conceptualized by defining some of the elements of television program production which appeared to be related to human information processing. These elements were operationalized in terms of Information Theory entropy scores. These indicators are defined as follows (operational definitions are contained in Appendix A):

> Set Time Entropy is defined as the degree of randomness of the time of visual duration of discrete physical locations in a program.
>
> Set Incidence Entropy is defined as the degree of randomness of the appearance of discrete physical locations in a program.
>
> Verbal Time Entropy is defined as the degree of randomness of the time of audible behavior on the part of characters in a program.
>
> Verbal Incidence Entropy is defined as the degree of randomness of the performance of audible behavior on the part of characters in a program.
>
> Set Constraint Entropy is defined as the degree of randomness of the constraints of the discrete physical locations in a program.
>
> Non-Verbal [illegible] Entropy is defined as the degree of randomness of the time of non-verbalization by the characters in a program.

RESULTS AND CONCLUSIONS

The first hypothesis predicts that increases in violence will lead to observed physiological arousal. Table I summarizes the results of the test of this hypothesis. The degree of violence is significantly associated with the indicators of arousal. The long-term and short-term results differ in which arousal indicator is most strongly associated with program violence, however. The long-term analysis indicates that most of the covariance is a result of the relationship between violence and GSR. The short-term analysis indicates that heart rate deviation, rather than GSR deviation, is the variable most strongly associated with differences in violence.

The second hypothesis predicts that an increase in the form complexity of the program is associated with the physiological arousal of the viewer. As Table II shows, the zero-order correlations between the two indicators of arousal and the six indicators of form complexity give little immediate indication of support for this hypothesis. The actual test of the hypothesis concerns the overall relationship between the two sets of variables, however. This test was made by canonical correlation, and summarized in the second part of Table II. The canonical correlation between the two sets of variables is a relatively strong [illegible], indicating support for the second hypothesis. Strikingly, almost all the covariance between the two sets of indicators is along a single dimension, as indicated by a remaining eigenvalue of only .06 after the removal of the single dimension representing maximum covariance. The large chi-square indicates the definite non-randomness of the covariation between the criterion and predictor variables.

The canonical coefficients, which are similar to raw regression weights, indicate that the direction of the covariance is correct. If the form complexity indicators increased in value, the standard GSR would decrease as shown by the neg[illegible] coefficient; and the standard heart rate would increase. This increase in heart rate and decrease in GSR are indicative of an arousal condition.

The second part of Table II, which summarizes the short-term covariance of the variables, follows the same pattern. The form complexity indicators appear more strongly related to heart rate deviations than to GSR deviations in the zero-order form. The overall canonical correlation between the two sets of variables is less strong in the short-term analysis than it is in the long-term, although it is still highly significant.

Further differences in short-term versus long term analyses are apparent in Table III, when the relationships between the form complexity indicators and each of the physiological indicators are examined separately. GSR levels are more strongly associated with differences in form complexity than are heart rates when the entire program is analysed. The reverse is true when segment-to-segment differences in indicators are examined. All analyses are significant in the predicted direction, however, providing further support for Hypothesis Two.

Hypothesis Three predicts that the arousal effects of violence should be separate from the arousal effects of form complexity. However, as Table IV shows, there is a definite relationship between program violence and form complexity. The multiple R between violence and form complexity found in the program used in this experiment was .53, which does not reach significance, since there are only 25 two-minute segments on which to compare scores, but which indicates a substantial covariance. Interestingly, the zero-order correlations indicate a negative relationship between form complexity and violence. This is in contrast to the results for all prime-time shows (Watt and Krull, 1974, which produced a highly significant positive association between form complexity and violence. The show used in this experiment was apparently atypical in this respect. The segment-to-segment differences in form complexity and violence scores were similarly related, but less strongly, with a multiple R of .38.

There is too much covariance in both long-term and short-term complexity and violence scores to allow any obvious conclusions to be drawn about the real source of variation in the physiological arousal indicators. An additional analysis is necessary to test Hypothesis Three.

If the real source of variation is the degree of violence in programming, and not the form complexity of the program, then holding constant the violence should remove the relationship between form complexity and arousal. This partial correlation procedure was carried out, and the results are in Table V.

For the long-term analysis of GSR, controlling for violence reduces all correlations between form complexity indicators and Standard GSR to non-significance. This indicates that the true source of variation in long-term GSR is the degree of violence in the program. Long-term Standard Heart Rate presents a mixed picture. Controlling for violent content reduces three of the indicators of form complexity to non-significance, but three others remain significant.

Short-term changes in GSR are not as clearly the result of changes in violence, as the second part of Table V shows. Four of the form complexity indicators are reduced to non-significance by controlling for changes in violence, but two remain significant. Short-term heart rate deviations, however, are clearly not affected by changes in the degree of violence, since the zero-order correlations between form complexity changes and heart rate changes are essentially not modified by controlling for changes in violence.

Table VI shows the results of controlling for the form complexity indicators on the relationship between physiological indicators and violence. If the true source of variation in arousal is form complexity, this partialling should reduce the arousal-violence link to non-significance.

For the long-term GSR, controlling for form complexity does not reduce the relationship between GSR and violence to non-significance. This further reinforces the conclusion that long-term GSR scores are related to the program violence, not to the form complexity.

The short-term GSR deviations give opposite results, with the association between GSR changes and violence changes being reduced almost to zero by controlling for form complexity changes. This indicates that short-term GSR differences are more likely caused by form complexity changes than by changes in the degree of violence.

The long-term Standard Heart Rate association with the degree of violence is not reduced to non-significance by controlling for form complexity. Since the form complexity-arousal link also was not reduced to non-significance by controlling for violence (Table V), the result is support for Hypothesis Three, i.e. that form complexity and violence are independent causes of arousal, at least in the case of long-term heart rate changes.

This conclusion is more strongly indicated when examining the short-term heart deviation. Controlling for changes in violence left the associations between all the form complexity indicators and heart rate deviation highly significant, (Table V), and controlling for form complexity still leaves a highly significant association between changes in violence and heart rate deviation (Table VI).

The results of the partial correlational tests of Hypothesis Three can be generally summarized:

1. Long-term changes in GSR are produced by changes in program violence, not by changes in form complexity. No support for the independence of arousal causes is found.

2. Short-term changes in GSR are produced by changes in program form complexity, and not by changes in program violence. No support for Hypothesis Three is found.

3. Long-term changes in heart rate are produced independently by both changes in program form complexity and changes in program violence. The results are somewhat weak but can be interpreted as mild support for Hypothesis Three.

4. Short-term changes in heart rate are clearly produced independently by both changes in form complexity and changes in violence. Hypothesis Three is definitely supported.

DISCUSSION

The results of this experiment in general support the idea that content-free form aspects of television can produce arousal in the viewer, and can do so independently of the arousal produced by violent content. This conclusion is subject to some observed limitations, however.

The conclusion holds most strongly if one considers changes in heart rate over short periods of time. Since it is a common research procedure to present only several minutes of film or television to a group of experimental subjects, and to measure changes in heart rate as a single indicator of arousal, we might have ended this paper with the strong, unequivocal conclusion stated above, if we had had the luck to limit the experimental procedure to the correct time frame and the correct indicator of arousal.

If we had measured only GSR, another standard indicator of arousal, over a short period of time, we would have concluded that the degree of violence was not directly producing arousal in the viewer, but was rather covarying with the real cause of viewer arousal, the content-free form complexity of the program. This would have been a fairly startling, McLuhan-like statement, and we almost wish we could make it.

On the other hand, if we had used GSR over a longer period of time as the indicator of viewer arousal, we would have had clear evidence that the degree of violence is the true source of arousal in the viewer, and that the seeming link between form complexity and arousal is spurious.

How can we explain these seemingly inconsistent results? First, by distinguishing between long-term and short-term arousal, and hypothesizing different causal mechanisms for each. If violence produces long-term arousal and form complexity produces short-term arousal, some of the results become more plausable.

For example, in the long-term GSR analysis arousal due to form complexity would appear as transient changes over short time periods, and thus would be likely to look like error. In the short-term GSR analysis, the arousal produced by violence would look more like a baseline shift of GSR, and would be ignored. The variance would then appear to be produced mainly by the changes in form complexity.

This short- and long-term distinction can provide a post hoc explanation of the heart rate results, too. Although both the short- and long-term analyses lead to the conclusion that increases in program violence and in form complexity were independently associated with increases in heart rate, the association was much stronger for form complexity in the short-term case. This would be the case if form complexity produced short-term heart rate changes, and violence produced long-term changes.

The differences between the results obtained when GSR was used as the indicator of arousal and when heart rate was used bears some discussion. The first noteworthy fact is that the Standard GSR and the Standard Heart Rate correlated at only -.15. This represents a very low covariance for two indicators presumed to be tapping the same concept, viewer arousal. Some of this lack of covariance is due to measurement error, some sources of which are discussed below. But our suspicion is that heart rate and GSR may be indicators of different kinds of arousal. Although this is completely speculative, it may be that heart rate changes are more closely linked to cognitive information processing as suggested by the work of Lacey, while GSR is linked more strongly to affective, higher level reactions. This would be consistent with our results which indicate that heart rate changes over a short period of time covary most strongly with form complexity, while GSR levels over a longer period of time are tied most strongly to violence levels, which presumably represent agents of emotional arousal.

If this time-frame distinction between arousal produced by violence and arousal produced by form complexity proves to be true, then it has some implications when applied to predictions of viewer aggressiveness. The Arousal Model predicts that viewers are more likely to be aggressive when in an aroused state. However, if the arousal is short-term, such as that produced by form complexity, then its effect on viewer aggressiveness should be slight, unless viewers leap from in front of the set to carry out aggressive acts.

Long-term arousal, on the other hand, would be likely to produce increased levels of aggressiveness. A residual of long-term arousal caused by viewing violence could be present in the viewer at a later time, when an aggressive act is called for.

Should this speculation be verified, its implications to television producers is clear. Short-term arousal produced by visual and auditory editing and plot techniques may be beneficial in gaining viewer attention, and aiding learning (cf. Wartella and Ettema, 1974). This type of arousal would not have lasting consequences. But arousal produced by violent acts could have adverse social effects. Sesame Street might arouse briefly with its quick transitions and varied format, but the arousal should disappear quickly. Mannix might arouse to the same degree, but the arousal might persist. Obviously, this is an empirical question which must be investigated.

Research findings which seemed to link levels of aggressiveness to form complexity (Krull and Watt, 1973) would at first appear to provide evidence against this speculation. However, as the introduction to this paper indicated, the form complexity and violence arousal components of programming have not been previously separated, and they do covary. Thus the measures of form complexity in the previous research, which were taken as representing arousal potential, may have been actually representing long-term emotional arousal potential, via covariance with form complexity, rather than form arousal potential. The resolution of this question awaits further research.

One last aspect of this experiment warrants discussion: the relatively low correlations and estimates of covariance found among all variables. Typical ranges of variance explained in one variable by another variable were 3-9%. Here are some possible sources of the unexplained error variance.

1. Physiological Measurement Validity. It was very clear during the course of the experiment that subjects' physiological responses were varying systematically with events other than program form changes and program violence. Other variables which might have produced physiological changes are:

a. response to sexual attractiveness of actors.
b. "internal" information processing, i.e. daydreaming.
c. novelty and suspense of the plot (cf. Berlyne, 1963; 1971).
d. subject movement.
e. humor in the plot.
f. the novelty of the experimental situation.
g. subject fatigue over the course of the experiment.

Only one of these, subject movement, was accounted for by the experimental data processing procedure. This correction for movement might have introduced some error of its own, however.

2. Physiological Measurement Reliability. Some error could be due to measurement and data analysis problems, like:

a. GSR contact resistance changes over the long period of measurement. There was a definite problem with the contact paste drying, producing a slowly increasing resistance.
b. erroneous corrections for movements which did not actually affect physiological readings.
c. experimenter error in observing movement.
d. the use of standard scores, which may mask large differences in some subjects, while exaggerating differences in other subjects.
e. "ceiling" and "floor" effects in measurements. Some subjects had such low skin resistance that almost no variation in GSR was observed.

3. Program Attribute Reliability and Validity. Measurement of the degree of violence and the form complexity of programming was also subject to errors like these:

a. The attribute "violence" may have been interpreted differently by different judges, leading to errors in assessing violence levels in the program segments.
b. The form complexity indicators tap only some of the form aspects of television programming. Other unmeasured aspects related to human information processing would appear as error.

4. Experimental Design. Because of the naturalistic nature of the experiment, certain possibly relevant factors could not be controlled. These include:

a. order of presentation of the various levels of violence and form complexity.

b. combinations of levels of form complexity and violence. There may be hidden interaction effects which appear as error variance.
c. repeated time-series measurements on the same subjects may introduce autocorrelation errors in variable levels.

Control of as many as possible of these sources of error in future research should give better measurement and more convincing results. The results of this experiment seem to warrant this effort in the future.

TABLE I

RELATIONSHIPS BETWEEN PHYSIOLOGICAL MEASURES AND VIOLENCE

Criterion Variable	Predictor Variables	Simple Correlation	Beta Weight
VIOLENCE	STANDARD GSR	-.19	-.18
	STANDARD HEART RATE	.07	.05
	Multiple R = .19		
	F-Value of Regression = 19.8 with 2 and 1022 d.f.; p < .001		
VIOLENCE DIFFERENCE	STANDARD GSR DEVIATION	-.02	-.01
	HEART RATE DEVIATION	.15	.15
	Multiple R = .15		
	F-Value of Regression = 5.38 with 2 and 1022 d.f.; p < .005		

TABLE II

RELATIONSHIPS BETWEEN PHYSIOLOGICAL MEASURES AND FORM COMPLEXITY

Simple Correlations

	STANDARD GSR	STANDARD HEART RATE
SET TIME ENTROPY	.09**	.07*
SET INCIDENCE ENTROPY	.07*	.06*
VERBAL TIME ENTROPY	.06*	-.02
VERBAL INCIDENCE ENTROPY	.02	-.02
SET CONSTRAINT ENTROPY	.00	.10**
NON-VERBAL DEPENDENCE ENTROPY	-.08**	.02

N = 1025

* $p < .05$

** $p < .01$

Canonical Correlation

		Canonical Coefficients
Criterion Variables:	SET TIME ENTROPY	-14.86
	SET INCIDENCE ENTROPY	12.33
	VERBAL TIME ENTROPY	-23.43
	VERBAL INCIDENCE ENTROPY	23.97
	SET CONSTRAINT ENTROPY	2.05
	NON-VERBAL DEPENDENCE ENTROPY	7.33
Predictor Variables:	STANDARD GSR	-15.06
	STANDARD HEART RATE	15.12

Eigenvalues Removed: 1

Eigenvalue Remaining: .06

Canonical Correlation: .24

Chi-Square: 59.9 with 12 d.f.; $p < .001$

TABLE II
(Continued)

Simple Correlations

	STANDARD GSR DEVIATION	HEART RATE DEVIATION
SET TIME ENTROPY DIFFERENCE	-.07*	.14**
SET INCIDENCE ENTROPY DIFFERENCE	-.10**	.13**
VERBAL TIME ENTROPY DIFFERENCE	.00	.09**
VERBAL INCIDENCE ENTROPY DIFFERENCE	.02	.11**
SET CONSTRAINT ENTROPY DIFFERENCE	-.02	.11**
NON-VERBAL DEPENDENCE ENTROPY DIFFERENCE	-.05	.18**

N = 1025

* $p < .05$

** $p < .01$

Canonical Correlation

		Canonical Coefficients
Criterion Variables:	SET TIME ENTROPY DIFFERENCE	38.25
	SET INCIDENCE ENTROPY DIFFERENCE	-11.54
	VERBAL TIME ENTROPY DIFFERENCE	44.47
	VERBAL INCIDENCE ENTROPY DIFFERENCE	-50.82
	SET CONSTRAINT ENTROPY DIFFERENCE	13.18
	NON-VERBAL DEPENDENCE ENTROPY DIFFERENCE	-1.16
Predictor Variables:	STANDARD GSR DEVIATION	-22.49
	HEART RATE DEVIATION	22.96

Eigenvalues Removed: 1

Eigenvalue Remaining: .03

Canonical Correlation: .17

Chi-Square: 49.7 with 12 d.f.; $p < .001$

TABLE III

MULTIPLE REGRESSIONS BETWEEN PHYSIOLOGICAL MEASURES AND FORM COMPLEXITY

Criterion Variable	Predictor Variables	Simple Correlation	Beta Weight
STANDARD GSR	SET TIME ENTROPY	.09	.32
	SET INCIDENCE ENTROPY	.07	-.27
	VERBAL TIME ENTROPY	.06	.57
	VERBAL INCIDENCE ENTROPY	.02	-.59
	SET CONSTRAINT ENTROPY	.00	.07
	NON-VERBAL DEPENDENCE ENTROPY	-.08	-.13
	Multiple R = .21		
	F-Value of Regression = 7.7 with 6 and 1018 d.f.; $p < .001$		
STANDARD HEART RATE	SET TIME ENTROPY	.07	.12
	SET INCIDENCE ENTROPY	.06	-.09
	VERBAL TIME ENTROPY	-.02	.18
	VERBAL INCIDENCE ENTROPY	-.02	-.21
	SET CONSTRAINT ENTROPY	.10	.11
	NON-VERBAL DEPENDENCE ENTROPY	.02	-.03
	Multiple R = .12		
	F-Value of Regression = 2.57 with 6 and 1018 d.f.; $p < .025$		

TABLE III
(Continued)

Criterion Variable	Predictor Variables	Simple Correlation	Beta Weight
STANDARD GSR DEVIATION	SET TIME ENTROPY DIFFERENCE	-.07	.10
	SET INCIDENCE ENTROPY DIFFERENCE	-.10	-.11
	VERBAL TIME ENTROPY DIFFERENCE	.00	-.19
	VERBAL INCIDENCE ENTROPY DIFFERENCE	.02	.22
	SET CONSTRAINT ENTROPY DIFFERENCE	-.02	-.02
	NON-VERBAL DEPENDENCE ENTROPY DIFFERENCE	-.05	-.06
	Multiple R = .13		
	F-Value of Regression = 3.10 with 6 and 1018 d.f.; $p < .005$		
HEART RATE DEVIATION	SET TIME ENTROPY DIFFERENCE	.14	-.16
	SET INCIDENCE ENTROPY DIFFERENCE	.13	.26
	VERBAL TIME ENTROPY DIFFERENCE	.09	-.42
	VERBAL INCIDENCE ENTROPY DIFFERENCE	.11	.54
	SET CONSTRAINT ENTROPY DIFFERENCE	.11	-.04
	NON-VERBAL DEPENDENCE ENTROPY DIFFERENCE	.18	.24
	Multiple R = .28		
	F-Value of Regression = 13.93 with 6 and 1018 d.f.; $p < .001$		

TABLE IV

RELATIONSHIPS BETWEEN PROGRAM VIOLENCE AND FORM COMPLEXITY

Criterion Variable	Predictor Variables	Simple Correlation	Beta Weight
VIOLENCE	SET TIME ENTROPY	-.35	-.86
	SET INCIDENCE ENTROPY	-.29	.63
	VERBAL TIME ENTROPY	-.28	-1.29
	VERBAL INCIDENCE ENTROPY	-.19	1.24
	SET CONSTRAINT ENTROPY	-.04	-.17
	NON-VERBAL DEPENDENCE ENTROPY	.13	.24
	Multiple R = .53		
	F-Value of Regression = 1.177 with 6 and 18 d.f.; n.s.		
VIOLENCE DIFFERENCE	SET TIME ENTROPY DIFFERENCE	-.09	-.16
	SET INCIDENCE ENTROPY DIFFERENCE	-.09	.20
	VERBAL TIME ENTROPY DIFFERENCE	-.08	-1.41
	VERBAL INCIDENCE ENTROPY DIFFERENCE	-.04	1.34
	SET CONSTRAINT ENTROPY DIFFERENCE	-.14	-.46
	NON-VERBAL DEPENDENCE ENTROPY DIFFERENCE	.11	.27
	Multiple R = .36		
	F-Value of Regression = .49 with 6 and 13 d.f.; n.s.		

TABLE V

PARTIAL CORRELATIONS BETWEEN PHYSIOLOGICAL MEASURES AND FORM COMPLEXITY

Partial Corr. Between	And	Controlling For	Is	p<
STANDARD GSR	SET TIME ENTROPY	VIOLENCE	.03	n.s.
	SET INCIDENCE ENTROPY		.03	n.s.
	VERBAL TIME ENTROPY		.01	n.s.
	VERBAL INCIDENCE ENTROPY		-.01	n.s.
	SET CONSTRAINT ENTROPY		-.01	n.s.
	NON-VERBAL DEPENDENCE ENTROPY		-.07	n.s.
STD HEART RATE	SET TIME ENTROPY	VIOLENCE	.10	.002
	SET INCIDENCE ENTROPY		.08	.01
	VERBAL TIME ENTROPY		.00	n.s.
	VERBAL INCIDENCE ENTROPY		-.01	n.s.
	SET CONSTRAINT ENTROPY		.10	.001
	NON-VERBAL DEPENDENCE ENTROPY		.01	n.s.
STD GSR DEVIATION	SET TIME ENTROPY DIFFERENCE	VIOLENCE DIFFERENCE	-.08	.01
	SET INCIDENCE ENTROPY DIFFERENCE		-.10	.001
	VERBAL TIME ENTROPY DIFFERENCE		.00	n.s.
	VERBAL INCIDENCE ENTROPY DIFFERENCE		.02	n.s.
	SET CONSTRAINT ENTROPY DIFFERENCE		-.02	n.s.
	NON-VERBAL DEPENDENCE ENTROPY DIFFERENCE		-.05	n.s.
HEART RATE DEVIATION	SET TIME ENTROPY DIFFERENCE	VIOLENCE DIFFERENCE	.15	.001
	SET INCIDENCE ENTROPY DIFFERENCE		.14	.001
	VERBAL TIME ENTROPY DIFFERENCE		.10	.001
	VERBAL INCIDENCE ENTROPY DIFFERENCE		.12	.001
	SET CONSTRAINT ENTROPY DIFFERENCE		.13	.001
	NON-VERBAL DEPENDENCE ENTROPY DIFFERENCE		.17	.001

TABLE VI

PARTIAL CORRELATIONS BETWEEN PHYSIOLOGICAL MEASURES AND VIOLENCE

Partial Corr. Between	And	Controlling For	Is	p <
STANDARD GSR	VIOLENCE	SET TIME ENTROPY SET INCIDENCE ENTROPY VERBAL TIME ENTROPY VERBAL INCIDENCE ENTROPY SET CONSTRAINT ENTROPY NON-VERBAL DEPENDENCE ENTROPY	-.10	.002
STD HEART RATE	VIOLENCE	SET TIME ENTROPY SET INCIDENCE ENTROPY VERBAL TIME ENTROPY VERBAL INCIDENCE ENTROPY SET CONSTRAINT ENTROPY NON-VERBAL DEPENDENCE ENTROPY	.13	.001
STD GSR DEVIATION	VIOLENCE DIFFERENCE	SET TIME ENTROPY DIFFERENCE SET INCIDENCE ENTROPY DIFFERENCE VERBAL TIME ENTROPY DIFFERENCE VERBAL INCIDENCE ENTROPY DIFFERENCE SET CONSTRAINT ENTROPY DIFFERENCE NON-VERBAL DEPENDENCE ENTROPY DIFFERENCE	-.03	n.s.
HEART RATE DEVIATION	VIOLENCE DIFFERENCE	SET TIME ENTROPY DIFFERENCE SET INCIDENCE ENTROPY DIFFERENCE VERBAL TIME ENTROPY DIFFERENCE SET CONSTRAINT ENTROPY DIFFERENCE NON-VERBAL DEPENDENCE ENTROPY DIFFERENCE	.13	.001

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APPENDIX A

DEFINITIONS OF FORM COMPLEXITY INDICATORS

Set Time Entropy is defined as the degree of randomness of the time of visual duration of discrete physical locations in a program. Its operational definition is:

$$HST = -\sum_{i=1}^{k} \frac{t_{set_i}}{t_{show}} \log_2 \frac{t_{set_i}}{t_{show}}$$

Where t_{set_i} = total time the ith set appears.

t_{show} = total time of the show

k = no. of sets

Set Incidence Entropy is defined as the degree of randomness of the appearance of discrete physical locations in a program. Its operational definition is:

$$HSI = -\sum_{i=1}^{k} \frac{n_{set_i}}{n_{set_{show}}} \log_2 \frac{n_{set_i}}{n_{set_{show}}}$$

Where n_{set_i} = number of times the ith set appears

$n_{set_{show}}$ = number of times all sets appear in the show

k = number of sets

Verbal Time Entropy is defined as the degree of randomness of the time of audible behavior on the part of characters in a program. Its operational definition is:

$$HVT = -\sum_{i=1}^{k} \frac{t_{char_i}}{t_{verbal}} \log_2 \frac{t_{char_i}}{t_{verbal}}$$

Where t_{char_i} = total time the ith character produces sound

t_{verbal} = total verbal time

k = number of characters

Verbal Incidence Entropy is defined as the degree of randomness of the performance of audible behavior on the part of characters in a program. Its operational definition is:

$$HVI = -\sum_{i=1}^{k} \frac{n_{char_i}}{n_{char_{show}}} \log_2 \frac{n_{char_i}}{n_{char_{show}}}$$

Where n_{char_i} = number of times the ith character verbalizes

$n_{char_{show}}$ = total verbalizations in show

k = no. of characters

Set Constraint Entropy is defined as the degree of randomness of the constraints of the discrete physical locations in a program. The operational definition of a constraint is the appearance of an interior wall. The operational definition of the indicator is:

$$HSC = -\frac{t_{inside}}{t_{show}} \log_2 \frac{t_{inside}}{t_{show}}$$

Where t_{inside} = total time spent with indoor locations

t_{show} = as above

Non-Verbal Dependence Entropy is defined as the degree of randomness of the time of non-verbalization by the characters in a program. Its operational definition is:

$$HNV = -\frac{t_{show} - t_{verbal}}{t_{show}} \log_2 \frac{t_{show} - t_{verbal}}{t_{show}}$$

Where t_{verbal} = total verbal time for all characters

t_{show} = as above