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TELEVISION AS THOUGHT-INHIBITOR:
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By

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ABSTRACT

TELEVISION AS THOUGHT-INHIBITOR: EFFECTS OF BACKGROUND TELEVISION ON COGNITIVE PERFORMANCE

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A significant body of correlational research exists relating television viewing to academic achievement. However, the causal mechanisms underlying that complex relationship have yet to be fully explicated. An explanatory model is proposed in which television, when used as a secondary activity, acts as a distracter, interfering with performance on otherwise intellectually-demanding tasks.

Four mechanisms are suggested through which television may interfere with concurrent cognitive processing. These are: (1) induction of arousal; (2) elicitation of orientation responses; (3) competition for use of limited central processing capacity; and (4) structural interference with language-based processing.

A laboratory experiment tested a series of derived hypotheses. Performance on seven different cognitive processing tests was examined for subjects in four television viewing conditions and a no-TV control group. Conditions varied in terms of instructions to subjects to ignore the TV or give some attention to it, and with respect to type of TV program content (high-talk versus high-action). Dependent variables included measures of short-term memory, linguistic processing speed, reading comprehension, complex problem solving abilities, and mental flexibility.

Analyses of Covariance revealed significant performance decrements in television conditions for three tests: The Nelson-Denny Reading Test (paragraph comprehension portion); the Tower of Hanoi puzzle (a spatial problem-solving test); and the "uses" test (a measure of cognitive flexibility). Television subjects did worse on the Nelson-Denny and uses tests under conditions in which they were asked to pay at least some attention to the TV. However, by far the strongest impact was obtained for the Tower of Hanoi puzzle, on which even subjects instructed to completely ignore the TV performed much more poorly than control subjects.

Overall, the pattern of results was seen as being most consistent with the causal mechanism of capacity interference. Tasks likely to be affected appear to be those which are difficult and complex. Suggestions are made for subsequent work within this paradigm. Results suggest that children may perform more poorly if they habitually watch TV while doing homework, studying, reading, or engaging in other intellectually-stimulating activities.

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INTRODUCTION

The impacts of television viewing on intellectual abilities, achievement, and style have been the focus of fairly consistent, albeit limited, attention from researchers and laypersons alike during the years following the rise of TV as the dominant American mass medium. In this respect, by far the greatest attention has been given to the possible effects of viewing on the intellectual development of children and adolescents, as portions of the population most directly in contact with the school system, and as (presumably) the population segments most susceptible to media influence. Conversely, relatively little research has concerned itself with the relationship between TV and intellect in adults. Within this age limitation, the volume and quality of correlational research are quite respectable.

Although there has been research focusing on possible positive influences of TV viewing on intellectual development with respect to such areas as language acquisition (cf., Rice, 1983) and analytical thinking (Solomon, 1979), by far the greater concern has been shown over possible negative impacts of television on imagination, intelligence, and academic achievement (e.g., Morgan & Gross, 1982; Singer, 1982; Williams, Haertel, Haertel, & Walberg, 1982; Zuckerman, Singer, & Singer, 1982). From such studies have come a reasonably consistent picture of the empirical relationship of TV viewing to intellectual performance.

A more difficult problem has been to develop and test explanatory processes which could account for the relationships observed in survey and time series studies (Hornik, 1981). The purpose of the present study therefore is to elucidate a process which could account for the patterns of observed correlation between television viewing and measures of intellectual performance, and to experimentally test the plausibility of this mechanism as an explanation for the empirical relationships between TV viewing and intellectual performance.

Television Viewing and Mental Performance

It is possible analytically to place the mental performance variables examined in earlier correlational research into three basic categories: (1) cognitive abilities (i.e., "intelligence"); (2) cognitive style ("imagination," "creativity," "flexibility," "field dependence/independence," etc.); and (3) academic achievement. Of course, it should be recognized that, in practice, the distinction between these categories is rarely as clean and sharp as the foregoing breakdown might imply.

The present argument and research will focus most directly on the third category of intellectual performance variable, academic achievement. This is also the type of variable for which the largest volume of previous research is available. However, research relating to the association of television viewing with measures of intelligence and cognitive style would also have relevance, even if these variables were not themselves important for understanding the TV/achievement relationship.

Television, intelligence, and cognitive style

Findings from studies over the past 20 years examining the relationship between "intelligence" and television viewing have been generally consistent. Negative relationships between amount of TV viewed and measures of IQ have been consistently obtained in studies of older adolescents and adults, while findings for younger children have been mixed, with a tendency toward either null effects or positive correlations (Himmelweit, Oppenheim & Vince, 1958; Himmelweit & Swift, 1976; Morgan & Gross, 1980, 1982; Ridley-Johnson, Cooper, & Chance, 1982; Schramm, Lyle, & Parker, 1961).

Since intelligence tends to be conceptualized as an enduring (even genetically determined) trait, correlations of measures of IQ with TV viewing are most often interpreted in terms of the effects of differing levels of intelligence on orientations toward the medium, rather than the other way around (e.g., Himmelweit and Swift's, 1976, interpretation of the TV/IQ relationship among different age groups).

On the other hand, a strong argument could be made that mental abilities as measured by conventional IQ tests are determined by factors relating to both heredity and environment. Environment may impact upon mental "ability" by providing or failing to provide appropriate mental stimulation, by cultivating particular cognitive styles, by providing (or failing to provide) opportunities for learning strategies for information processing or problem solving, or by imparting important cultural information (such as language resources).

This is the increasingly the perspective taken by psychologists and others who study intellectual abilities. Most modern researchers regard "intelligence" as a complex of abilities resulting from the interaction of innate potentials with environmental factors (e.g., Baron, 1985; Cattell, 1971; Gardner, 1983; Gould, 1981; Horn, 1979; Sternberg, 1985).

Thus, the assumption that "intelligence" is causally prior to television viewing may not be justified, if viewing has the potential of affecting the quality of intellectual stimulation experienced by the individual, his or her style of problem-solving, etc. Certainly, the presence of a correlation between measures of mental ability and television viewing does not in itself tell us whether intelligence affects the amount of television viewed, TV viewing affects intelligence, or a more complex (perhaps mutually causal) relationship exists between these variables.

A number of studies have examined the relationship between television viewing and variables which could be subsumed under the rubric of "cognitive style." With respect to cognitive style variables, the greatest amount of concern has been expressed regarding presumed effects of television on imagination or creativity (Singer, 1982), although other "style" variables have been the focus of study upon occasion (e.g., Furu, 1971).

Singer (1982), in a review of literature on television viewing and the development of imagination in children, suggests that TV may impede the growth of imagination and creativity by preempting play time and engaging children in a mode in which they are not required to actively interact or utilize television content. Findings from a number of studies may be regarded as lending at least partial support to this contention.

In a natural experiment involving the introduction of television into three Eskimo communities, Harrison and Williams (1977) found differences in children's scores on a measure of verbal flexibility (Alternate Uses Test) which related systematically to the availability of TV. Children in a village which did not have TV reception initially scored higher on this measure, but two years later, by which time all three villages had access to television, the researchers found no difference among them in children's verbal creativity scores. However, since it is well known that television influences time spent with other activities differently when it is first introduced than it does in the long term, these findings may not have much relevance to children who have grown with television a ubiquitous part of their daily lives.

Zuckerman, Singer, and Singer (1980), in a study of elementary school students (third, fourth, and fifth graders), reported a strong negative relationship between the viewing of fantasy-violent programs and teachers' evaluations of students' "imaginative behavior." Consistent with this was the finding reported by Singer and Singer (1980) of a negative association among preschoolers between a measure of "imaginative play" and preference for action/adventure shows. However, the same study reported a positive correlation between situation comedy viewing and imaginative play.

Experimental studies of children's cognitive responses to different media have been conducted by Meline (1976) and Meringoff (1980). When responses to televised versions of stories were compared to responses to audio, print, or picture-book versions, the former appeared to elicit fewer creative or stimulus-free responses.

Together, such studies provide limited support to the notion that television viewing may adversely affect the growth of immagination and creativity. However, overall, the research evidence in support of this contention is not as strong as that relating viewing and intelligence.

Television viewing and academic achievement

Probably the largest amount of research relating to the impact of television on intellect has concerned the relationship between television viewing and school achievement. Useful summaries of this research have been presented by Williams, et al. (1982), Hornik (1981), and Morgan and Gross (1982). These reviewers agree that there is evidence of a significant empirical relationship, though of relatively small magnitude, between hours of television viewed and some types of academic performance. They differ, however, in other conclusions and interpretations of research findings, and thus are worth individual examination and critique.

Williams, et al. (1982) examined 23 studies of television viewing and achievement using formal meta-analysis techniques. They concluded on the basis of this analysis that the set of studies supported the following generalizations: (1) that the relationship between viewing and achievement is (slightly) positive up to 10 hours per week of television, beyond which additional hours of TV viewing are negatively related to achievement measures; (2) that high IQ children are more strongly (negatively) affected by excessive viewing than children of lower intrinsic ability; and (3) that girls are more strongly affected than boys. The overall average TV/achievement correlation reported across studies was a minuscule -.05. However, for girls alone the average correlation was -.13, and for high IQ children alone the average correlation was -.14. Unlike other reviewers, Williams, et al. found no significant differences in the TV/achievement relationship according to the age or grade of the child, or according to the subject area tested (reading, math, science, etc.).

There is an almost natural tendency for researchers to take quantitative summaries of research literature as conclusive; however, several problems prevent the Williams, et al., meta-analysis from being regarded as the last word concerning the relationship between television viewing and achievement.

First, any attempt to empirically combine the results of different studies must face the problem of averaging apples and oranges, or in more prosaic language, the threat to validity that arises from taking an average result from studies which differ methodologically in very substantial ways. The "average" correlation between viewing and achievement is obtained by averaging studies with very small and unrepresentative samples with those using large-scale probability samples. Studies in which variables are measured relatively well are averaged with results from studies using highly questionable measurement procedures. Correlations from some studies in the Williams, et al. meta-analysis were partialled for some control variables, some for other control variables, and some represented zero-order correlations. Studies looking at television as it was first introduced into a community, or comparing viewers with nonviewers, were combined with studies comparing high and low viewers under conditions of essentially universal exposure.

In addition to the problems associated with attempting to mathematically combine correlations from such widely differing types of studies, this meta-analysis had some more specific problems which should cause one to accept its conclusions only with caution. First, the summary measure used by Williams, et al., to indicate the strength of the association between viewing and achievement was Pearson's r. The available evidence strongly suggests that the relationship between viewing and achievement is <u>curvilinear</u> (Morgan & Gross, 1982); therefore, the correlation coefficient r, which is a measure of <u>linear</u> association, is an inadequate statistic for summarizing that relationship, and is almost certain to underestimate the strength of association.

An additional problem with the Williams, et al., analysis regards the use (or non-use) of controls for variables which could enter into plausible rival hypotheses (i.e., potentially explaining the empirical relationship between viewing and achievement). First, no attempt was made to control for socio-economic status. In some studies, positive TV/achievement correlations could easily have been due to higher S.E.S. children having greater access to the medium (e.g., Greenstein, 1954).

On the other hand, for studies which compare heavy and light viewers in a "universal exposure" environment, social class becomes a plausible rival hypothesis to the degree to which children from lower S.E.S. backgrounds, or disadvantaged groups, tend to be heavier viewers (Comstock, Chaffee, Katzman, McCombs, & Roberts, 1978). However, this problem was lessened in the Williams, et al., meta-analysis by the fact that a number of studies used relatively homogeneous (with respect to S.E.S.) samples. More recent research suggests that, although S.E.S. cannot be seen as a variable explaining negative correlations between televiewing and achievement, different S.E.S. groups may be affected by exposure in different ways (Fetler, 1984; Ward, Mead, & Searls, 1983).

An additional problem with the Williams, et. al., meta-analysis had to do with the use of IQ as a control variable in seven out of the 23 studies. On the other hand, one of the studies (Lyle & Hoffman, 1972) used intelligence test scores as dependent measures, that is, as indicators of achievement. Clearly these two approaches are contradictory and cannot both be appropriate.

Morgan and Gross (1980; 1982) and Hornik (1981) have argued that intelligence should be statistically controlled in assessing the relationship between TV viewing and achievement, and have pointed to a number of studies (e.g., Childers & Ross, 1973; Thompson, 1964; Morgan & Gross, 1980) in which TV/achievement correlations were attenuated to the point of nonsignificance when controls for IQ were introduced.

However, there are genuinely serious questions concerning the appropriateness of using IQ as a control variable in assessing the relationship between TV viewing and achievement. Use of such a control must be based on the assumption that intelligence, as (presumably) hereditary ability, is something which can be measured independently of achievement. It was argued earlier (pp. 3-5) that intelligence should not be conceived of as imperious to environmental influence. In addition, even were intelligence purely genetically determined, the available _measures_ of IQ are _not_ independent of achievement. In actual fact, IQ tests do not provide pure measures of mental ability, but rather reflect a combination of cultural information, learned information about the world, learned information-processing strategies, and general "ability" (Gould, 1981).

In practice, there is a great deal of overlap between what is measured in IQ tests and what is measured in conventional achievement tests. Fetler (1984, p. 111) has pointed out that, "correlations between IQ and achievement scores typically range from .70 to .90." IQ and achievement tests measure in large part the same things: a combination of ability _and_ learning. When one partials out IQ, one is removing not only the impact of hereditary abilities, but also much of the variance in achievement itself. Therefore, it is quite understandable that estimates of TV/achievement relationships would be strongly attenuated by controls for IQ, regardless of the actual strength of association.[1]

In sum, although meta-analysis techniques such as those used by Williams, et al., can be useful in providing quantitative estimates of "average" findings, they are not a sufficient substitute for the sort of critical assessment of individual studies that occurs in a conventional review of research literature. Hornik (1981) and Morgan and Gross (1982) have presented critical interpretive reviews of the research literature relating TV viewing to academic achievement. Their conclusions are consistent in some ways with those of Williams, et al., and inconsistent in others.

Hornik (1981) drew several major conclusions about the relationship between viewing and achievement from his review of research. First, he noted that the great majority of relevant studies have found negative bivariate relationships between television viewing and achievement. Second, he argued that ability (IQ) was a plausible rival hypothesis explaining the TV/achievement relationship, and noted that, in a limited number of available studies, inclusion of IQ as a control resulted in TV/achievement relationships becoming nonsignificant for all achievement measures except reading achievement. Objections to this position have already been noted.

Finally, Hornik interpreted the available evidence as supporting the idea that the relationship between televiewing and achievement was affected by two other variables: socio-economic status, and age. The TV/achievement relationship, according to Hornik, is more consistently negative for older children and adolescents, and for children from higher S.E.S. families.

Conclusions of the review by Morgan and Gross (1982) are generally consistent with the observations of Hornik. First, the former noted the results of research by Morgan (1980) and Morgan and Gross (1980), showing that the only negative TV viewing/ achievement correlations that held up under controls for IQ were for measures involving reading and language abilities. Second, they concluded that the relationship between viewing and reading achievement was different for different levels of IQ. Among high IQ children, the relationship tended to be negative and linear. Among medium or low IQ children, curvilinear relationships were generally obtained, with the highest achievement scores occurring with middle levels of TV viewing (although positive TV/achievement relationships were found for some low-IQ groups). Third, age affected the relationship between viewing and achievement. Curvilinear relationships between viewing and achievement found among elementary school children became negative and linear when high school students were studied. Fourth, there was some evidence for sex differences, with achievement and viewing more strongly linked for female than for male students.

Overall, the body of research reviewed by Williams, et al. (1982), Hornik (1981), and Morgan and Gross (1982) would seem to justify the following conclusions: (1) the overall aggregate relationship between television viewing and academic achievement is curvilinear, with the highest achievement levels occurring among viewers of moderate amounts of television, and the lowest levels associated with extremely high amounts of viewing; (2) reading and language skills are most strongly affected (or at least are most resistant to attenuation by controls for IQ); (3) the relationship between viewing and achievement is most strongly negative for those who would ordinarily be expected to exhibit higher levels of academic competence: adults and adolescents rather than younger children, those of high intelligence rather than those of middle or low intelligence, those of higher educational or social status rather than those of lower education or status.

Findings from more recent studies have generally been consistent with this picture. Fetler (1984) reported on results of a study involving over 10,000 sixth grade students from a systematic sample of 292 California elementary schools. Dependent measures were scores on reading, written expression, and mathematics subtests from a standardized achievement test battery.

Fetler found that overall, students who reported viewing television for more than six hours each day scored sharply lower on all three achievement subtests. For reading and mathematics subtests, students who viewed one to two hours daily did best. Social class differences were found, such that the higher the social class group to which the child's family belonged, the stronger the negative relationship between viewing and achievement (although all groups showed a decline in test scores at greater than 4 hours per day of viewing). For children whose parents were unskilled workers, a clear curvilinear relationship was found, with those engaged in moderate amounts of viewing scoring substantially better than low viewers.

An analogous pattern can be discerned involving responses to the question asking how difficult the student found his or her homework. The relationship between viewing and achievement was more markedly negative for children who considered their homework "very easy" or "somewhat easy" than for children who considered their homework "neither hard nor easy" or "somewhat hard." If we take answers to this question as a general indicator of ability, this finding suggests that the negative relationship between excessive viewing and achievement test scores is stronger for students of greater intellectual ability.

Fetler also entered a large set of behavioral and demographic variables into a regression analysis predicting achievement scores. Amount of viewing remained a strong and significant predictor of achievement under such controls, and, in fact, made the strongest contribution of any variable except for parental occupation.

Fetler interpreted differences in the relationships between viewing and achievement obtained for different groups as bearing out suggestions "that students who would otherwise do well by virtue of aptitude or environment seem to be the most adversely affected." (Fetler, 1984, p. 113).

Additional evidence in favor of such an interpretation was provided by the 1979-1980 National Assessment of Educational Progress (NAEP) study of the relationship of televiewing to reading achievement (Ward, Mead, and Searls, 1983). The NAEP made use of a stratified national sample of over 6,000 9-year olds, 13-year olds, and 17-year olds. The relationship between TV viewing and a standardized measure of reading achievement was assessed for the overall sample, and also with respect to sex of student, area of the country in which the student resided, type of community in which he or she lived, parental educational level, racial/ethnic background, level of educational progress, private or public school attendance, time spent reading, and time spent doing homework. Results were consistent with the conclusions which have been drawn from consideration of other research findings.

The NAEP study found that reading achievement test performance among 9-year olds increased as TV viewing increased up to a level of 3-4 hours daily, and decreased beyond that amount. The lowest achievement levels occurred for the group viewing more than four hours per day. For 13-year olds, the highest achievement scores were associated with viewing 1-2 hours per day, with sharp decreases occurring beyond this level of viewing. The relationship between viewing and reading achievement was consistently negative and nearly linear for 17-year olds, although the greatest difference in scores was associated with the difference between viewing 3-4 hours per day and viewing over four hours. The higher the prior level of viewing, the greater the decrease in achievement test scores associated with an increase to the next viewing level. For 17- year olds at all viewing levels, however, increases in viewing were associated with decreases in reading achievement.

When differences among social groups are examined, results are consistent with earlier findings which suggested that those who would otherwise be expected to perform at a higher level experience more deleterious effects from TV viewing.

Ward, et al., reported mean achievement scores within age groups for four levels of parental education: non-high school graduates, high school graduates, some post high school education, and college graduates. The higher the parental education level, the stronger the apparent negative impact of high levels of viewing, and the lower the viewing level, at each age group, at which negative effects initially appeared.

The NAEP also examined differences according to whether students came from communities classified as "rural," "disadvantaged urban," and "advantaged urban." At each age level, the overall lowest reading achievement scores were obtained for the "disadvantaged urban" students; a middle level (still slightly below average) for the "rural" students; and the highest scores for the "advantaged urban" students. The most strongly negative TV/achievement relationship was found for the "advantaged urban" group, and the least detrimental association occurred for the "disadvantaged urban" group within each age level. (By age 17, however, the relationship between amount of viewing and achievement scores was consistently negative for all community groups).

A comparison between white, black, and Hispanic students was consistent with the pattern obtained with type of community and parental education level. Overall, at each grade level, the black students scored lowest and the white students highest on the reading achievement test. Blacks seemed to benefit more from moderate levels of TV viewing and to be harmed less by viewing at high levels, compared to whites and Hispanics.

Students attending private schools had higher overall reading achievement scores than students in public schools, and seemed to be affected more negatively by television viewing within each age level. Whereas for public school 9-year olds, achievement scores did not begin to fall until more than four hours were viewed on the average each day, for private school 9-year olds, optimal reading achievement was associated with 1-2 hours per day of viewing. At age 13, the highest mean reading achievement score for public school children occurred at the 1-2 hours per day TV viewing level, while for private school pupils, the highest achievement level was obtained among students viewing less than one hour.

The NAEP study also compared students who were placed in classes one grade lower than the average for their age to students who were placed at the normal grade level. To some degree, this can be seen as an indicator of ability, albeit at a rather gross level. There is evidence that the lower ability sub-group was influenced less by TV viewing than the normal-ability sub-group. In fact, the "one grade below average" students provided the sole exception to the finding of a negative near-linear relationship between viewing and achievement in the 17-year old age group.

Overall then, the NAEP results are consistent with the idea that television viewing has more strongly detrimental impacts on groups of students who would otherwise be expected to do better, or to operate at a more advanced level. Ward, et al. note:

> Television...appears to have a differential effect for students in different socioeconomic status groups.... Achievement falls off more rapidly with increased television viewing for students from more advantaged circumstances.... Disadvantage youngsters tend to exhibit achievement patterns of students younger than themselves, that is, higher than average levels of television viewing continue to benefit their performance as they become older. Advantaged youngsters, on the other hand, demonstrate achievement patterns like those of students older than themselves. Higher reading performance is associated with less television watching than the national average for pupils from advantaged groups. (1983, pp. 6-7)

<u>Processes Accounting for Observed Televiewing/Achievement Relationships</u>

Although recent research has done much to clarify, at the level of empirical correlations, the complex nature of relationships between TV viewing and intellectual abilities and achievement, progress in determining the causal processes which may underly these relationships has been much less.

Hornik (1981) has suggested that research relating television viewing to school achievement has been guided, implicitly or explicitly, by six types of hypotheses about TV effects: hypothesis positing the "displacement" of other activities, such as reading or homework, by television; "development of intolerance for the pace of schooling" hypotheses; "interest stimulation" hypotheses; "learning of school equivalent content" hypotheses; "learning of new cognitive skills" hypotheses; and "learning of instrumental information" hypotheses. Evidence relating directly to each of these processes is, Hornik argues, limited and for the most part unconvincing.

Four of these hypotheses -- interest stimulation, learning of school equivalent content, learning of new cognitive skills, and learning of instrumental information -- would lead one to expect that heavier viewers would perform better in school than lighter viewers, while the remaining two -- displacement and intolerance for the pace of schooling -- would seem to predict a consistent negative relationship between televiewing and school achievement. However, the actual empirical relationship between these two variables is, as has been demonstrated, considerably more complex than would be implied by any of these mechanisms alone.

If the overall predictions of any of these suggested causal processes are belied by the complexity of observed relationships, one explanation may be that television is doing several things at once. It may be that the inter-group differences found in correlational studies arise because different processes are more important with respect to different populations or sub-populations.

Few would be so uncharitable as to argue that young viewers learn absolutely no information from exposure to commercial television that is either "school equivalent" or enriching in a way that could relate to viewers' success in dealing with school-related material, though Hornik (1981,

p. 211) is certainly correct to point out that "the extent of overlap between television and school curricula and the extent of relevant learning from television have been studied only with regard to a few issues..., and then in ways that make general inference difficult."

On the other hand, one would also expect to hear little argument opposing the contention that normal TV entertainment fare is not of an exceedingly high intellectual level.

This suggests that, although viewers may be quite capable of learning information from natural exposure to television, there is simply little to learn from the general run of entertainment program content for one who already has a relatively broad base of personal experience, knowledge of the world, and language skill. On the other hand, the poor or disadvantaged may pick up a certain amount of information from TV entertainment about other sorts of people, places, events, and so on, and may add to their repertoire of behaviors and problem-solving techniques. Younger children may also add to their store of such information; in addition, they may use TV as an input to the language acquisition process, particularly with respect to vocabulary.

But even for the young and disadvantaged, there is little evidence to suggest a uniformly positive effect of television exposure on intellectual ability or achievement. Rather, we see a movement toward finding null or curvilinear relationships as age, status, education, and IQ decline. This suggests that positive impacts of (limited) exposure to TV on younger, disadvantaged, or less able viewers become offset at some level of viewing by influences related to excessive exposure. For older, advantaged, and more able students, negative linear relationships between viewing and achievement may appear because deleterious effects of exposure are not sufficiently offset when television takes a relatively less important role as a learning source.

In other words, it would be consistent with empirical findings if TV viewing were to act simultaneously, through different mechanisms, as both a resource for and an impediment to learning. As television's role as a source of new information and experience decreases in importance as the viewer becomes older, more experienced, or is more intelligent or advantaged, processes through which exposure exerts a less benign influence become relatively more important.

As noted, Hornik's typology suggests two possible processes which could exert the sort of negative influence on achievement implied by this model: the development of intolerance for the pace of schooling, and the displacement of other activities, such as reading or homework, which are positively related to academic performance. However, there are problems with both of these hypothesized mechanisms.

The intolerance for the pace of schooling hypothesis generally lacks solid, non-anecdotal, evidence in its support (Hornik, 1981; Mates, 1980; Watkins, et al., 1980). Perhaps even more importantly, the implications of this hypothesis for observed relationships between viewing and achievement are simply not borne out. If TV viewing exerted its negative effect by making it more difficult for youngsters to adapt to the school environment, as this mechanism suggests, one would expect stronger impacts on elementary and preschool children. Consistent age-related findings, however, demonstrate precisely the opposite. The older the student, the more likely that TV viewing will be negatively related to school performance.

The predictions which might be derived from the displacement hypothesis would seem to be more consistent with empirical findings. Reading is directly related to the skills which have appeared to be most strongly affected by TV viewing; reading would also be relatively more important as a learning source for older, more educated, and more intelligent students. Unfortunately, the direct evidence concerning displacement must be regarded as mixed at best.

Early studies (Coffin, 1955; Cunningham & Walsh, 1958; Himmelweit, Oppenheim, & Vince, 1958; Parker, 1963; Schramm, Lyle, & Parker, 1961) found limited evidence for displacement. The initial introduction of television was associated with decreases in time spent with a large number of other leisure activities, but as the novelty of the new medium wore off, time spent in other activities (with a few exceptions) increased back to close to former levels. The clearest impact was on activities which were "functionally equivalent" to television viewing: particularly radio listening, reading of fiction and of comic books, attendance at movies and social visiting among adults (Robinson, 1981). Similar findings were reported by Robinson and Converse (1972), who also noted, however, that the impact of television substantially increased the total time people spent with the mass media as a whole. On the other hand, there is little evidence that the overall amount of reading done by school age children and adolescents has declined since the advent of television (Hornik, 1981).

Whatever limited support these time use studies may give to the displacement hypothesis with respect to overall changes in the habits of populations, they do not directly address the issue of differences in achievement or ability associated with different levels of television viewing among children and adolescents. To do this, differences in reading and other activities between heavy and light viewers must be examined. When measures of reading time have been used in studies relating TV viewing to academic achievement, the result has most often been failure to support the displacement hypothesis.

For example, Lyle and Hoffman (1972) examined the media behaviors of 274 first graders, over 800 sixth graders, and approximately 500 tenth graders attending schools in suburban Los Angeles. They found that time spent viewing television was not significantly related to reading time or time spent in various social and recreational activities.

Ward, et al., (1983) in the National Assessment of Educational Progress study of television and reading achievement, found no evidence to support the displacement hypothesis with respect to reading, although there was some evidence with respect to the displacement of homework. In fact, a higher proportion of the heaviest viewers (over 4 hours/day) reported also being heavy readers (over 2 hours/day) than was true of any category of lighter viewers.

Results reported by Morgan (1980) may also be regarded as opposing the hypothesis of reading displacement. In the first year of a panel study of students in grades 6-9, Morgan found the expected negative relationship between viewing and time spent reading. However, by the second year of the study, the TV/reading time relationship was positive for most groups, and by the third year, for all groups.

Fetler (1984), using California State Assessment data, and a sample of over 10,000 sixth graders, obtained a correlation of only +.01 between amount of television viewing and amount of reading for pleasure.

Neuman (1982) attempted to test the hypothesis that, while heavy viewers might read as much as light viewers, the quality of their reading materials may be lower. Her results showed: (1) the amount of viewing did not predict the amount of reading for her sample of 4th, 5th, and 6th graders; (2) the difficulty of material read by the high

TV/high reading subgroup was not significantly lower than that of the material read by the low-TV subgroups; (3) the material read by the high TV/low reading subgroup was at a significantly lower level of difficulty than the material read by all other groups. Neuman (1982, p. 302) concluded that: "...high levels of television viewing combined with high levels of reading did not lead to the selection of lower quality reading materials."

In short, although there are variations in findings among several studies examining children's reading habits, television viewing, and achievement, it appears that, overall, the differences observed between heavy and moderate or light viewers in reading achievement levels cannot be attributed to reading displacement per se (In fact, the finding of Ward, et al. (1983), that heavy viewers who reported reading more than 2 hours per day on the whole scored more poorly than heavy viewers who spent less time reading is opposite to what would be expected if displacement were the process accounting for negative TV/achievement relationships).

What process, then, if left to account for negative empirical relationships between television viewing and achievement among older, higher status, and more able students? As Morgan and Gross (1982) appear to suggest, part of the answer may lie in differences in the quality of reading (and other) experiences when these occur in the presence of simultaneous television exposure, versus when they do not. Ward, et al. (1983, p. 8) appear to have a similar idea in mind:

> Students who watch TV extensively and also report spending a great deal of time doing spare-time reading or homework are among the poorest readers. Since the hours in a day are limited, the results suggest that these students may be watching television and reading or doing homework at the same time.

Both logic and direct empirical evidence may be used to support the notion that heavier viewers of television tend to conduct a variety of other activities, including reading, while the TV is on. Medrich (1979) noted that a substantial proportion of households could be classified as "constant television" households, or households:

> ...in which the TV is turned on for most of the day -- whether or not anyone is watching. In other words, television in these homes is a background to almost all family activities throughout the day. (p. 171)

If recent Nielsen figures are correct, the average American family has the set on over seven hours per day; for any particular individual, much of that seven hours constitutes time in which TV is a background to other primary activities. Large-scale time use studies indicate that, on the average, approximately one third of television viewing time for adults occurs under conditions in which viewing is secondary to other activities that are being conducted simultaneously (Robinson, 1969, 1981). Time use data reported by Ferge (1972) indicate that women are more likely than men to use TV as a secondary activity (even taking employment status into account). Other research which indicates that substantial amounts of viewing are combined with other activities include population studies reported by LoScuito (1972) and Robinson and Converse (1972).

General time use studies of this type have tended to focus on behaviors of adults rather than children or adolescents. However, data presented by Lyle and Hoffman (1972) on the media use of a sample of first, sixth, and tenth graders indicate that secondary use of television is not restricted to the adult population.

> The responses of students in all three age groups document that much of the time recorded as "television viewing time" is actually divided among the television set and other activities. Fewer than 20 percent of the first graders said that they never did other things while watching television. About half the older students said they sometimes study while the television set is on. (pp. 136-137)

Lyle and Hoffman also found that a substantial percentage of 6th and 12th graders of both sexes reported "usually" doing homework in front of the television: 19% of sixth grade boys, 18% of sixth grade girls, 12% of tenth grade boys, and 21% of tenth grade girls.

Time use studies also have the disadvantage of only indicating (1) the percentage of people who engage in televiewing as secondary to other activities or (2) the degree to which TV is so used by the "average" viewer. Differences between very heavy and light or moderate viewers in the degree to which television is used as a secondary activity, are thus obscured.

Results from Fetler's (1984) California State Assessment study, however, help to fill this gap. Fetler found that heavier viewers were substantially more likely to say that they did their homework in front of the television than were students who viewed less. In addition, doing homework in front of the TV was a significant predictor of lower academic achievement, controlling for other media-related behaviors and socio-economic status.

Morgan and Gross (1982), while observing that heavy television viewers report often reading or studying while watching television, suggest that the use of TV in this way provides a "strong distraction" which could negatively influence the acquisition and maintenance of intellectual skills. The term "distraction," as used by Morgan and Gross to describe the role of television as a background to homework and reading, is especially appropriate, in that it helps direct attention to bodies of psychological research and theory relevant to understanding the manner in which background TV may directly impact immediate intellectual performance, and indirectly impact long-term achievement.

Attentional Capacity and Effects of Background Television

A model from cognitive psychology which is useful in suggesting mechanisms whereby background television could affect the intellectual performance of viewers was put forward by Kahneman (1973). The model Kahneman proposed was a "capacity model" of attention and effort. According to Kahneman, the human organism as information-processer has a limited (but not invariant) capacity to perform mental work, which must be allocated to various information-processing tasks. "Attention" involves the allocation of limited processing capacity to different stimuli or tasks. Such allocation always involves the exertion of effort:

> Thus, the schoolboy who pays attention is not merely wide awake, activated by his teacher's voice. He is performing work, expending his limited resources, and the more attention he pays, the harder he works. (Kahneman, 1973, p. 4)

Kahneman argued that attention has the following attributes, each of which has implications for possible effects of television as a secondary activity on cognitive performance:

> (1) Attention is limited, but the limit is variable from moment to moment. Physiological indices of arousal provide a measure that is correlated to the momentary limit.
>
> (2) The amount of attention or effort exerted at any time depends primarily on the demands of current activities. While the investment of attention increases with demands, the increase is typically insufficient to fully compensate for the effects of increased task complexity.
>
> (3) Attention is divisible. The allocation of attention is a matter of degree. At high levels of task load, however, attention becomes more nearly unitary.

> (4) Attention is selective, or controllable. It can be allocated to facilitate the processing of selected perceptual units or the execution of selected units of performance. The policy of allocation reflects permanent dispositions and temporary intentions.
> (Kahneman, 1973, p. 201)

Attentional resources (capacity to perform mental work) are limited, but the value of the limit depends upon demands of activities to be performed. This limit increases with increased demands for information-processing capacity, but does not do so linearly. The greater the difficulty of the mental work to be performed, the less the efficiency of the individual in performing that work, with respect to both speed and accuracy.

One point which should be noted involves what does not influence the total amount of attention available at any one time: individual intentions. Attentional capacity is related to demands of the task(s) to be performed; human beings do not appear to be able to pay more attention than necessary to the performance of simple tasks (and thus, for example, to reduce error rates beyond a certain point), or to voluntarily allocate additional capacity to tasks beyond the limits determined by task difficulty, to more than a trivial degree (Kahneman, Peavler, & Onuska, 1968).

Although the individual has little control over the total attentional capacity available for information processing at any given time, he or she does have the ability to focus attention, or to influence the allocation of mental effort to different tasks. However, allocation of attention is only partially under volitional control. This is what Kahneman means when he states that the allocation of attention is influenced by both temporary intentions and permanent dispositions.

Apart from conscious intentions, human beings tend to allocate greater attention to stimuli which are novel, complex, or incongruous (Berlyne, 1951, 1960, 1970). In terms of visual attention, stimuli which exhibit many contours or movement elicit greater attention. In addition, stimuli which are especially significant (such as one's own name, familiar human voices, etc.) elicit attention without conscious control.

A special case of the control of attention by permanent dispositions concerns what has been called the orientation reaction, or OR, in psychological literature. The orientation reaction is found in other mammals, as well as in human beings. It occurs in response to novel and significant external stimuli, and involves an immediate and extremely rapid reorientation toward the novel stimulus, and an inhibition of ongoing perceptual or cognitive processing activity, which is replaced by a brief, but intense, effort to process and analyze the intruding stimulus, preparation for processing additional significant information, and physical and visual reorientation toward the source of the OR. The orientation reaction includes a set of physiological changes which appear to facilitate sensory intake, or readiness for perceptual processing.

Sokolov (1963, 1975) has theorized that the OR is initiated when sensory intake is inconsistent with a simplified construction of expectations for incoming stimuli, encoded in the brain, which he called a "neuronal model." A violation of expectations encoded in this neuronal model triggers an orientation ("what is it?") response. The resulting OR involves an involuntary redirection of attention, and physiological and other changes which appear to function to improve sensory reception and processing of sensory inputs. Physiological changes characteristic of the OR have thus been elicited by inserting incongruous stimuli within an otherwise consistent series of auditory or visual stimuli: for instance, tones of a different frequency from a series of immediately preceding tones, lights of different intensity, and so on. The OR has also been elicited when elements of more complex sensory stimuli have been eliminated, replaced, or changed in terms of order or time intervals between applications (see Sokolov & Vinogradova, 1975).

The neuronal model conducts basic analysis on incoming stimuli extremely rapidly; however, such rapid processing of incoming perceptual data does not allow for very sophisticated analysis of these data. Thus, changes in incoming sensory information which may be consciously expected on the basis of more intensive analysis of patterns of earlier stimulation, may nonetheless be processed as novel or unexpected in relation to the neuronal model, and thus elicit an OR (Maltzman, Harris, Ingram, & Wolff, 1971; Furedy & Scull, 1971; Epstein & Rock, 1960).

Although Sokolov conceived of a neuronal model primarily as a novelty-detector, and the OR as a reaction to stimulus change per se, at least one other factor stimulus factor seems to be related to the probability and duration of the OR: the significance of the stimulus to the individual or organism (Bernstein & Taylor, 1979). This factor may be exemplified by the reaction of a cat to the sound of a bird chirping, or of a person in a party to the sound of his or her own name. Also related to the concept of "significance" is the finding that a visual stimulus that appears to be an object approaching the individual will be more likely to result in an OR than one which does not appear to be getting any closer (Bernstein, et al., 1971).

Graham (1979) described the nature of stimuli which exhibit a potential for envoking in orienting response specifically in terms of information-value:

> The OR may be elicited by otherwise insignificant stimuli that carry information. Stimuli that carry information include changes in stimulation, "novel" stimuli (i.e., stimuli with a low probability of occurrence), stimuli too complex to be perceived fully on a single presentation, and stimuli that "signal" significance or informative events to follow. (p. 138)

The role of enduring dispositions in the allocation of attention, with the OR as perhaps the most dramatic manifestation, is important in that it suggests several ways in which television-as-background may serve to inhibit information processing with respect to primary activities. The first of these involves the capacity for attention-getting formal or collative features of television content to lead to momentary, involuntary, redirection of primary attentional focus. Indeed, recent research on child viewing processes seems to indicate that children may monitor auditory cues while directing visual attention elsewhere, and that they use these cues as signals to redirect primary attention to the TV at particular times. The degree to which the OR, as the most extreme type of involuntary attentional change, is involved in this process is unclear at present. Rice, et al. (1982) theorize that at younger ages, such redirection of attention is controlled by formal properties of the TV stimulus directly, while for older children, knowledge of TV's formal features and conventions is used to help anticipate upcoming content which may be of interest.

It may be argued that the high familiarity of audiences with television as a medium and with its conventions makes most events shown on TV very predictable, and therefore unlikely to elicit orientation responses (or, for that matter, rapid attentional shifts of any sort). However, it should be remembered that the neuronal model against which the novelty of new auditory and visual stimuli is evaluated is relatively primitive, and that therefore what are treated as unexpected or novel sensory stimuli may actually be following patterns which are consistent with conscious expectations derived from more complex (but more slowly elicited) models reflecting more complete cognitive processing (Furedy & Scull, 1971). Moreover, if neuronal model theory can be extended to apply to general cases in which secondary stimuli are monitored for significance while attention is focused elsewhere, the very awareness of the formal features of TV programs (indicating impending action or other content of interest) could conceivably result in elicitation of attentional shifts based on the occurrence of these features.

If television does at times elicit rapid attentional shifts on the part of viewers, and especially if such shifts involve other characteristics of what has been termed the orientation reaction, performance in other (primary) activities involving mental work could suffer in several ways. First, information in short-term memory at the time attention is shifted may be lost, both by displacement and by disruption of the sort of constant rehearsal which is necessary to prevent information in STM from decaying. At the very least, one's train of thought may be lost.

Second, redirection of attention toward incoming sensory information, especially in the OR, creates a physiological state which is optimal for perceptual processing, but which is not optimal for thinking. Intense, inward directed thinking, such as involved in solving difficult problems, planning, preparing to speak, decision-making, extensive memory search, etc., is associated with, among other indicators, increased heart rate and rate of eye movements, while orientation toward external stimuli is associated with decreased heart rate and inhibition of eye movements (fixation) (Campos & Johnson, 1966, 1967; Johnson & Campos, 1967; Lorens & Darrow, 1962). Exogenously manipulated changes in heart rate affect several measures of active cognitive processing (Cacioppo & Sandman, 1981), so this association would not appear to be merely coincidental.

Following redirection of attention or elicitation of an OR induced by properties of an external stimulus (such as television content), return to an optimal physiological state for active cognitive processing will not be instantaneous. Moreover, rapid redirection of attention from one task or mode of stimulus input to another is itself difficult, requiring a substantial investment of mental effort, and leading to increases in error rates in task performance (Kahneman, 1973). In general, any environmental condition which elicits orientation reactions or rapid shifts in the focus of attention with any frequency should act as an effective thought-disrupter.

Rapid redirection of attention is not the only mechanism whereby background television may influence one's performance on other mentally-demanding tasks. The term "primary focus of attention" employed in the foregoing discussion implies that there is also a secondary attentional focus; that is, that attention is often divided. This divisibility, the third attribute of attention in Kahneman's model, has implications for the performance of tasks making demands upon attention. Limits on attentional capacity noted earlier suggest that where attention is divided, interference may occur as a result of competition between the demands of the two or more foci of attention for available mental resources. When the attentional demands of one or both tasks are high, such interference is greatest. However, even when two perceptual or information-processing tasks are relatively easy, some interference often occurs: "...Capacity appears to be variable, and ... interference arises even among fairly undemanding tasks." (Kahneman, 1973, p. 202)

Attempting to read, study, etc., with a television operating in the background may be experienced as a "dual task" situation, in which attention is divided either voluntarily (as when the individual wishes to follow the plot of the program, or consciously monitor the content for significant events), or involuntarily, as the result of the operation of enduring dispositions or an inability to overcome distracting stimuli. Use of television as a secondary activity may thus result in reduced performance in mentally demanding activities.

Interference which results from limits on overall attentional capacity has been termed by Kahneman as "capacity interference," and contrasted with a second type of interference, called "structural interference," "which occurs because the activities occupy the same mechanisms of perception or response." (p. 196). Activities which are similar, either in terms of stimulus mode (in perception) or operation (in thinking) tend to be mutually interfering to a greater degree. For example, Allport, Antonis, and Reynolds (1972) had subjects attempt to learn a word list while shadowing an orally-presented message. There was greater interference with retention of the word list when it was also presented orally, than when it was presented in written form; that is, greater difficulty was experienced when both tasks involved the same mechanism of perception (i.e., hearing). When comparing written words with pictures, Allport, et al., found that a simultaneous auditory verbal message interfered more with retention of the verbal content (written word list) than with the nonverbal content (pictures).

There is evidence that linguistic activity is involved in reasoning and in processes of cognitive elaboration in general. Physiological measures which have been shown to be indicative of increases in active thought processes covary with measured increases in the electromyographic activity of the sets of muscles used for speech (speech EMG activity) (Cacciopo & Sandman, 1981). To the degree to which much (if not all) reasoning makes use of the linguistic faculty, we would expect TV dialog to represent an especially distracting type of television content, relative to complex thought processes in general.

The divided attention or "dual task" situation is, as has been noted, highly demanding of mental capacity. The demands of dual-task processing normally result in increased effort (to help compensate for the greater difficulty inherent in the division of attention), and corresponding increases in physiological arousal. Such arousal has its own effects on task performance; effects of background television on physiological arousal are thus also of importance in assessing overall TV influences on co-occurring mental processes.

The third major way, then, in which background television may affect cognitive processing is through impacts on the arousal level of the individual. Physiological arousal may be increased not only as a result of effort involved in attempting to divide attention, or directed at blocking out the TV distraction, but also as a result of the characteristics of the television program itself, such as high action, suspense, etc. (Zillman, 1982).

Effects of arousal on performance have long been a topic of research in experimental psychology. The most fundamental generalization concerning this relationship is known as the Yerkes-Dodson law (Yerkes & Dodson, 1908). According to the Yerkes-Dodson law, quality of task performance is related to arousal by a function shaped like an inverted U, and the optimal level of arousal (i.e., the level beyond which any subsequent increase leads to a decrement in performance) is greater for easier tasks than for more difficult tasks.

An application of the Yerkes-Dodson law that would appear to be relevant to the question of television effects has to do with the effects of background noise on task performance. The effort required to perform tasks under noisy conditions leads to physiological stress and arousal, but this arousal has different implications for tasks at differing levels of complexity. In general, less complex tasks are facilitated by the presence of noise, while performance on tasks of greater complexity deteriorates (Boggs & Simon, 1968; Broadbent, 1954; Hockey, 1969).

Analogously, TV impacts on arousal may not have either wholely negative or wholely positive implications for concurrent performance on information processing tasks. Efficiency on simpler tasks may be improved by presence of television or other sorts of background "noise" which increase arousal, while the ability to conduct difficult and complex intellectual operations may decrease. Since the performance/arousal relationship is shaped like an inverted U, an arousal level that is either too high or too low will lead to less than optimal information processing:

> ...a state of high arousal is associated with the following effects: (1) narrowing of attention; (2) increased lability of attention; (3) difficulties in controlling attention by fine discriminations; (4) systematic changes of strategy in various tasks. On the other hand, a state of extremely low arousal may cause: (1) a failure to adopt a task set; (2) a failure in the evaluation of one's performance, resulting in an insufficient adjustment of the investment of capacity to the demands of the task. (Kahneman, 1973, p. 42)

If background television at times serves to increase arousal from too low a level to a level which is closer to optimal for the performance of the task at hand, then it may in some cases have a positive impact. Thus, stress-producing distraction leads to increased variance in measures of task performance (Lazarus, Deese, & Osler, 1952); this is consistent with a perspective which sees the effects of induced arousal as dependent upon (at the least) the complexity of the task and the prior level of arousal of the person performing the task. It appears that even individual differences in chronic levels of arousal may influence the degree to which stress-inducing noice improves or harms task performance (Davies & Hockey, 1966).

To summarize, the effort/attention theory proposed by Kahneman (1973), and related research, suggest three possible ways in which background television may affect cognitive processing in reading or other activities:

> (1) By inducing periodic rapid shifts in attention, such as the orientation reaction, thereby disrupting ongoing information processing.

(2) By competing for limited attentional capacity with the primary information-processing task, leading to capacity- and/or structural interference.

(3) By affecting the level of physiological arousal experienced by the person while engaging in some primary task or activity.

Research on Distraction Effects

There has been a substantial amount of research performed on the effects of distraction, conducted from varying perspectives. It would be useful in assessing the implications of this research to organize discussion in terms of the major concerns and properties of the different studies. First, it will be useful to examine the social psychological research relevant to the impact of distraction on the processes of persuasion separately from research in cognitive, industrial, and educational psychology which has focused more directly on impacts on information processing.

Effects of distraction on persuasion

One area in which the influence of distraction has been extensively studied is in terms of its impact on the persuasive effectiveness of counter-attitudinal messages. In fact, the "distraction effect" has been one of the most thoroughly replicated effects demonstrated in persuasion research. Quite a large body of research evidence indicates that persuasive messages are more effective at eliciting attitude change when subjects are distracted than when they are allowed to concentrate exclusively on the message (Baron, Baron & Miller, 1973). The most common explanation for why this generalization should hold involves the impact of distraction on one's ability to actively defend oneself from a counter-attitudinal message through the production of subvocal counterarguments.

This "counterarguing hypothesis" holds that people are motivated to resist attempts at persuasion which involve strongly held beliefs or attitudes, and that an important mechanism for resisting involves the production of subvocal arguments which refute the persuasive message. Distraction increases the effectiveness of attempts at persuasion by interfering with the process of encoding counterarguments.

The persuasion/distraction paradigm, and the counterarguing hypothesis, are relevant to consideration of TV impacts on ability or achievement as long as we do not take counterarguing to be a mental operation qualitatively different from all other types of cognitive processing. The persuasion/distraction literature demonstrates the potential of a wide variety of distracters to interfere with effective use of mental faculties in defending oneself from persuasive attack. It is likely that distraction also potentially interferes with similar use of mental faculties for other purposes, particularly if those purposes involve mental operations similar to those required for counterarguing: Creation or encoding of original responses, or application of learned responses to new situations.

Several studies within the persuasion/distraction literature lend support to this contention. First, two studies provided information about retention of information from persuasive messages.

Information about retention is important in the present context because of the relationship between attention, depth of cognitive processing and long-term recall. Retention of information about an argument or message requires, at a bare minimum, allocation of sufficient attention to allow for decoding and comprehension. In other words, a message must be received before it can be remembered. Further, assuming sufficient allocation of attention to permit comprehension in the first place, retention of information in retrievable form appears to be at least in part a function of the degree to which it has been subjected to active analysis or processing, a process which has been variously referred to as "elaboration coding," "depth processing," or "elaborative rehearsal" (Craik & Lockhart, 1972; Hastie, 1980; Tulving & Madigan, 1970).

In studies reporting positive effects of distraction on persuasion, the first condition for recall must obviously obtain. For a message to have an immediate measurable persuasive impact, initial comprehension at some level is a necessity. However, if distraction inhibits cognitive elaboration, later recall of message information will be inhibited. Findings consistent with this argument were reported by Watts and Holt (1979) and by Insko, Turnbull, and Yandell (1974).

It has been argued that counterarguing, in the persuasion/ distraction paradigm, should be seen as simply one type of cognitive elaboration process. Conditions which allow for greater numbers of counterarguments to be generated should therefore also allow for better performance on other intellectually demanding tasks. Conversely, if distraction promotes persuasion by inhibiting counterarguing, distraction should also affect other complex mental tasks in a like manner. In addition to the evidence relating to recall, there is additional support for this idea.

Insko, et al. (1974) used a thought-listing procedure derived from Osterhouse and Brock (1970) and Greenwald (1967, 1968) to determine the proportion of thoughts generated by subjects in response to a persuasive messages which could be classified as either externally-originated (verbatim or almost verbatim from the message), recipient-modified, or recipient-generated.

Distraction subjects had a significantly and substantially higher proportion of their thoughts categorized as "externally-originated" than had subjects in a no-distraction condition. In other words, subjects under distraction were much more likely to accept or repeat thoughts or statements from the text of the message, without modification, and were relatively less likely to generate original thoughts in response to the persuasive message. Making the seemingly reasonable assumption that it requires less cognitive investment to assimilate or repeat what another has encoded than to develop and encode original ideas, we may take this finding as support for the idea that the distraction effect in persuasion results not so much from a specific impact of distraction on counterarguing per se as from a general impact of distraction on cognitive processing, applied to the specific persuasion situation.

Implications of this for the possible impacts of television on concurrent activities are intriguing. If television acts like the distracter in the Insko, et al. study, material read in the presence of television may be initially more uncritically accepted, but will be less likely to be integrated effectively into long-term memory.

Additional evidence for the generalizability of distraction effects was provided by Tesser (1978), who reported on a number of studies in which distraction was used to inhibit schema-directed thinking in general, not just counterarguing. Impacts of distraction were measured both in terms of thought-listing procedures and with respect to theoretically predicted outcomes of schema-directed thinking.

Finally, in another relevant study, Cacioppo (1979) reported that the same type of physiological manipulation (external manipulation of heart rate) which led to observed differences in amount of counterarguing, also resulted in parallel differences in performance on a reading comprehension task.

Thus, it appears that the same type of distraction which interferes with counterarguing in the persuasion context may also limit performance on other mental tasks which make similar demands on cognitive capacity or specific abilities.

In addition to studies involving effects of distraction on persuasion, which have for the most part indirect implications for general television effects on cognitive processing, there is a substantial body of research examining the impact of distraction on the quality of subjects' performance on a variety of information-processing tasks.

Effects of distraction on task performance

Results of empirical research attempting to directly assess the impacts of distraction on information processing have been mixed. A number of early studies seemed to indicate that distraction could often be overcome with little or no decrement in task performance, if indeed at some cost in effort and stress (e.g., Hovey, 1928; Smith, 1951). On the other hand, a large number of studies have appeared to demonstrate the opposite (e.g., Fendrick, 1937; Henderson, Crews and Barlow, 1945; Hale & Stevenson, 1974; Klein, 1978).

It is helpful in understanding the opposing findings of various experimental studies of distraction effects to consider at least two ways in which these studies have differed from one another. First, distraction has been operationalized differently by different researchers, and second, the sorts of tasks treated as dependent variables in different studies have varied widely.

The distractors used in different studies can be categorized in terms of three general types. First, there are a large number of studies using non-meaningful distracters, or noise. Such distractors include buzzers, bells, industrial equipment noise, street noise, etc. Second, there are a smaller, but still substantial number of studies using what could be called meaningful distracters, usually music or speech. Finally, there are also a number of studies which operationalize distraction in terms of providing a secondary task which must be performed at the same time as a primary criterion task.

Dual-task distracters are mainly of interest to the degree to which they simulate one or another of the mechanisms (arousal, OR, or interference) by which environmental distracters affect performance. Several studies using dual-task distracters have created conditions with which arousal (Hagen, 1967) or attentional shifts (Sanders & Bacon, 1973) were likely mediating factors in observed performance effects. With others, structural

(Mowbray, 1953) or capacity interference (Klein, 1978) would seem to better explain observed effects of treatment.

Most of the empirical studies which show distraction having little or no effect on performance have used some sort of non-meaningful noise as the experimental distracter, but not all noise distraction studies show null effects. Response to noise distraction appears to be a function of the type of primary information processing task in which an individual is engaged. Decrements in performance are most often demonstrated on tasks which are difficult or complex (Boggs & Simon, 1968; Broadbent, 1954), which require continuous processing of information or monitoring unpredictable events (Broadbent, 1958; Vogel-Sprott, 1963), or which require attention to several sources of information (attentional flexibility) (Jerison, 1957). Null or positive noise distraction effects occur with simple tasks requiring speeded performance (Smith, 1951), especially among groups of subjects expected to be low in initial level of arousal (Davies & Davies, 1975). Also, in some cases null findings may have been due to the use, as dependent variables, of overall composite scores on tests for which different sections would be expected, consistent with this generalization, to be differentially affected by noise (e.g., Hovey, 1928).

Overall, the results of studies using noise distracters are explicable in terms of two mechanisms. With relatively continuous high levels of noise, performance appears to be affected mostly through the induction of high levels of physiological arousal (Hockey, 1969). As previously noted, high arousal leads to a performance decrement more quickly for complex tasks than for simple tasks, in large part due to its effect of narrowing attentional focus. High arousal also causes people to work faster, but less accurately.

Intermittent loud noise also acts to increase arousal, but may in addition affect performance by eliciting orientation responses. Orientation responses, or any rapid shifts of attention, impede performance on tasks requiring continuous monitoring for unpredictable stimuli, or requiring prolonged concentration.

In general, research using meaningful distracters has demonstrated stronger negative effects on performance than has research involving noise distraction. Meaningful distraction introduces the possibility that structural or capacity interference will contribute substantially to a performance decrement, in addition to any impacts arising from arousal or attentional shifts. There are two main types of meaningful distracters which have been studied: music, and connected speech.

Two early studies found negative effects of background music on reading performance. Fendrick (1937) found that retention of information from a chapter of a psychology textbook was impaired when students read the chapter while listening to "lively semi-classical" music. Henderson, Crews, and Barlow (1945), in a somewhat more elaborate study, examined the impacts of classical and popular music on Nelson-Denny Reading Test performance. They found no impact of music on the simpler vocabulary section of the test, but a significant decrement in the popular music condition appeared on the paragraph comprehension portion. Classical music had no effect on either set of scores.

Several more recent studies have also demonstrated performance decrements resulting from the presence of background music, using a variety of criterion tasks. Parente (1976) found that scores of subjects on the Stroop Color-Word test were inferior under conditions in which background music was played. Agarwal and Srivatsava (1969) induced a performance decrement in a "substitution task" (details unspecified) by playing music from popular films. Fogelson (1973) found that students scored more poorly on the eighth-grade level Iowa Basic Skills Test when instrumental versions of popular show tunes were played in the background. Etaugh and Michaels (1975) found performance decrements associated with background music among females taking a paragraph comprehension test.

However, null effects of background music were found by Wolf and Weiner (1972) for performance on an arithmetic test, and by Kahneman (1970) on a test of short-term memory. In addition, several studies found positive impacts of background music.

Kaltsounis (1973) found that high-achievement fifth graders did better on three of four measures of nonverbal creativity while listening to rock music. This study was, however, marred by use of a very unusual sample, and the absence of formal tests of statistical significance. To the degree that we are justified in interpreting such results at all, it may be that rock music was effective because it helped create a more informal, relaxed atmosphere, in what would normally be a dry academic setting, and thus stimulated a more creative, informal task set.

Davies, Lang, and Shackleton (1973) presented evidence suggesting a positive impact of background music on performance on a monotonous visual vigilance task. Results were interpreted in terms of positive effects of increased arousal on this type of task. Conversely, Stanton (1975) showed that music may also be used to improve performance by _reducing_ arousal or stress. He found that playing soothing background music prior to or during a test of reading performance significantly increased exam scores of high test-anxiety subjects. Thus, music effects at least in part depend on such features as tempo, beat, and loudness, which influence whether the music is experienced as arousing or soothing.

Although all music may potentially influence performance through impacts on physiological arousal, only music with lyrics should have strong potential to affect performance through structural or capacity interference. In fact, it could be argued that _only_ music associated with lyrics should be considered _meaningful_ distraction, while other sorts of music should be regarded as a sort of patterned noise (admittedly, this argument ignores possible visual associations which may occur for music from films or music videos). The formal properties of such patterned noise determine its effects on the individual's arousal level, while its familiarity and predictability should determine its potential to elicit involuntary attentional shifts.

Thus, music with clear verbal content should be experienced as more distracting, especially with respect to tasks involving linguistic processing. The results of Henderson, et al. (1945), who reported negative effects for popular music on paragraph comprehension, while classical music exerted no apparent impact, are consistent with this argument. Each of the remaining studies cited that reported significant detrimental effects of background music, with the exception of Fendrick (1937), appear to have involved music with lyrics (Parente, 1976; Etaugh and Michaels, 1975; Agarwal and Srivatsava, 1969; Fogelson, 1973, used instrumentals, but these instrumentals were versions of show tunes that were well-known and had verbal content in the original versions: for example, "Hello Dolly").

Of the studies that showed null or positive effects of background music, two that have been noted (Davies, et al., 1973; Stanton, 1975) used music that was purely instrumental. One (Kahneman, 1970) used a version of rock music so speeded up that the words were almost certainly unrecognizable, if the tune itself wasn't. One study (Zimmer & Brachulis-Raymond, 1978) used "popular music" (no other details given), and reported reading comprehension score means which were lower, but nonsignificantly so, in their music condition. Two additional studies purported to show positive effects of rock music, in one case probably as a function of an increase in arousal (Wolf & Weiner, 1972), and in the other case by inducing a particular task set (Kaltsounis, 1973).

Music is not the only meaningful distracter which affects cognitive performance. Several studies have shown the potential of background speech for inducing performance decrements in a variety of information processing tasks. Baker and Madell (1965) found that student reading comprehension scores were lower under conditions in which a tape of a humorous conversation was played in the background. Weinstein (1977) found that playing a recording of radio news items impaired detection of grammatical errors (but not spelling errors) in a proofreading task. Hale and Stevenson (1974) found that playing a tape recorded children's story decreased the performance of school children on a test of visual short-term memory. Kaltsounis (1973) reported that fifth grade children taking a non-verbal creativity test scored lowest on "fluency" (number of responses) when listening to a taped newscast played in the background (out of three experimental conditions and one control condition). Brown and Clarke (1963)found that performance of mentally retarded children on an object naming task was impaired by meaningful auditory distraction (i.e., speaking names of items in random order, as opposed to nonsense syllables or quiet).

Two studies using simple tasks as criterion measures and taped news broadcasts as operationalizations of meaningful distraction reported null effects. Mech, et al. (1953) found no significant effect of a taped news distracter on performance on a routine coding task, while Wolf and Weiner (1972) found no difference between quiet and newscast conditions in the percentage of a set of simple arithmetic problems which were successfully solved by a group of college students.

Supplementary to the experimental results cited are subjective reports of students concerning the potential of various sorts of stimuli to distract them from effective performance at reading and other tasks. Cantrill and Allport (1935) surveyed students on their study habits vis a vis the radio. Forty-four percent of students surveyed reported listening to the radio while studying "frequently" or "always." However, only eight percent reported having the radio on "even when doing very important work," and 68 percent reported believing that their studying was less effective while the radio was on. The contrast in perceived distractability between nonverbal and verbal content was striking. Ninety-Five percent of respondents reported some type of talk-based program as the type of program "that most hinders your studying" (27%-comedy; 28%-drama; 40%-talks). In addition, 65 percent of respondents reported being distracted by verbal announcements between musical numbers.

To summarize, studies of the effects of distraction on cognitive task performance have demonstrated the potential of various types of distracters to interfere with information processing on a variety of types of tasks. Noise distraction affects cognitive performance primarily through increasing arousal. In accordance with the Yerkes-Dodson Law, this means deleterious effects only on tasks which are relatively difficult and complex; performance on simple tasks may be improved by noise distraction. Intermittent noise also affects performance through its potential to elicit rapid shifts of attention, such as the orientation reaction. Intermittent noise is therefore more detrimental to performance on information processing tasks requiring prolonged and uninterrupted attention.

Meaningful distraction may also affect arousal, with all that this implies for intellectual processes. But the distinction between meaningful distraction and noise is important due to two additional mechanisms through which the former often affects task performance: capacity- and structural interference. Overall, distracters which can by classified as "meaningful" have been found to exert more consistently deleterious impacts on cognitive performance than have noise distracters.

Although background television is not totally analogous to any of the distracters which were used in the studies described in this section, it clearly fits more into the category of meaningful distraction. In fact, there are reasons to expect that television should be especially potent in this role.

The television provides meaningful auditory and (either direct or peripheral) visual stimulation. The visual dimension of television may confer additional potency for two reasons. First, it provides a visual focus for attentional shifts characteristic of the orientation reaction. Second, peripheral visual stimuli have been demonstrated to act as potential distracters in their own right (Belmont & Ellis, 1968; Hale & Stevenson, 1974; Turnure, 1970; Vogel-Sprott, 1963; Worland, North-Jones, & Stern, 1973).

The television viewer may often be motivated to engage in dual processing (that is, attending to both the television and a primary task simultaneously). Specific sound and visual patterns are not perfectly predictable or repetitive. Content is usually designed to be arousing and attention-grabbing. Conversation and music-with-lyrics (i.e., advertising jingles) are very common, as are attention-getting sound effects (the latter may also act as a source of meaningful distraction for the television-literate older viewer). Thus, background television should have substantial potential for influencing cognitive processing through each of the mechanisms which have been discussed: by increasing arousal; inducing rapid attentional shifts (OR); or by causing structural- and/or capacity interference.

Research Questions and Hypotheses

The most general research question to arise from this discussion concerns the real nature of impacts of background TV on cognitive processing: In general, does television reduce performance on cognitive tasks performed concurrently with viewing? It may, however, be profitable to pose the general research question in terms of two versions: a strong version and a weak version.

The strong version of the general research question asks: Does television reduce an individual's performance on cognitve tasks under conditions which would otherwise promote optimal performance? In particular, the concern here is with the motivations of the individual as s/he is attempting to perform some mentally demanding task while exposed to the television. If the presence of background television, acting as a distracter, could reduce performance under conditions of relatively high motivation, and without the presence of other distractions, then there would be adequate justification for assuming that similar impacts would occur under all sorts of less optimal conditions which characterize more natural viewing situations.

The strong version of the general research question, then, deals with impacts of background television when the individual regards the TV as a totally unwanted distraction, and attempts to ignore it in so much as this is possible. There are obviously situations in the real world which approximate "strong version" conditions. Since television is a sight and sound medium, an operating television in one room of a house will often provide at least an auditory distraction for a person attempting to read, study, or engage in other activities requiring concentration in another room. It is also possible to conceive of conditions in which a person attempting to engage in high-capacity cognitive processing may not be practically able to leave the room in which the TV is operating.

However, it is also clear that many times people freely choose to read, study, and the like in the presence of television. For them, the task is not merely to "tune out" distracting auditory and visual noise, but to actually watch TV while simultaneously engaging in other activities. In other words, individuals in this situation are attempting to engage in "dual task" information processing, a feat which the literature on cognitive effects of distraction, discussed earlier, would suggest is more difficult than merely performing one task while overcoming extraneous external stimulation. The weaker version of the general research question deals with the impact of background television on cognitive processing in this sort of situation: Does background television reduce an individual's performance on cognitive processing tasks, under conditions in which the individual is motivated to attend at least minimally to the TV content?

The distraction literature, and the theory articulated in the previous section, provide reasons to believe that television should interfere with cognitive processing under either strong or weak version conditions.

Background television would be expected to inhibit cognitive processing even under conditions in which the individual regards the TV as an unwanted distraction because, first, the mechanisms through which background TV was posited to influence cognitive performance -- elicitation of the orientation reaction, induction of physiological arousal beyond optimal levels, capacity interference, and structural interference -- do not necessarily require that one voluntarily appropriate attention to the television. Indeed, the OR is clearly not under any manner of conscious control, while increases in arousal may arise from the expenditure of energy in attempting to tune out external sensory stimuli. To the extent that attempts to overcome distraction expend central processing capacity in excess of the amount gained through increases in arousal, capacity interference is also a plausible mechanism through which deleterious effects on performance may arise under "strong version" conditions. Assuming that the individual is completely successful in tuning out the television stimulus (not necessarily a safe assumption), structural interference may not be a serious problem.

However, even if an individual is able to perform at near optimal levels when background TV is treated as a distraction to be tuned out, he or she may still be affected in more natural viewing situations. Since dividing attention between two information processing tasks is especially difficult and demanding with respect to central processing capacity (Kahneman, 1973), one would expect a far greater problem with capacity interference when the individual is attempting simultaneously to perform non-TV intellectual tasks <u>and</u> watch the television.

Structural interference also becomes potentially a more serious problem, in so much as following the television program requires appropriation of verbal faculties which must also be used in many types of mental tasks which the individual may be performing concurrently with viewing. Therefore, even if individuals are able to effectively overcome background television when they are highly motivated to do so, they may be affected when they attempt to combine viewing and other intellectually demanding activities under other conditions. For the same reasons, if the individual is adversely affected by background television when treating the TV as an unwanted distraction, the effect should be even more detrimental when he or she attempts to simultaneously attend to the TV and other cognitive tasks.

From this, three hypotheses may be suggested:

H(1): Performance on information processing tasks will be less accurate and efficient in the presence of an operating television, even when subjects are motivated to ignore the TV.

H(2): Performance on information processing tasks will be less accurate and efficient in the presence of an operating television when subjects are motivated to attend at least minimally to the TV content.

H(3): Subjects motivated to attend at least minimally to background TV will exhibit a greater decrement in performance on information processing tasks than subjects exposed to background TV who are motivated to ignore the TV.

Habituation to background television

A second research question follows in part from the weak version of the general question: Can viewers learn to effectively "tune out" television, in other words, to overcome its presumably adverse effects on cognitive processing? Involved here are not only the general abilities individuals possess for overcoming unwanted distractions, but also any influence of practice in operating under distracting conditions on one's ability to overcome external distraction.

Human beings do appear to have substantial abilities with respect to overcoming environmental distractions. However, such defense is accomplished in large part through increases in arousal levels. Such increases in arousal can themselves influence performance on difficult or complex tasks by narrowing attentional focus, and by shortening the time to onset of mental fatigue (Broadbent, 1954; Hockey, 1969; Kahneman, 1973).

But perhaps, with habituation, it becomes <u>easier</u> to filter out distracting stimuli. This would imply that less mental effort would be required to overcome a particular type of distraction (whether noise, music, TV or conversation) with practice. Thus, progressively lower amounts of effort-induced arousal would be required to overcome a particular distracter as one's experience in operating in the presence of that type of distraction increased. Lower arousal levels would mean fewer problems associated with high arousal levels in the performance of complex tasks.

Research reported by Culbert and Posner (1960) would seem to lend some credence to this speculation. Culbert and Posner argued that we become accustomed to particular types of noise over time, and that we perceive familiar types of noise as less intrusive and annoying than equally loud noise of a type with which we are not familiar. Two experiments involving habituation to airplane noises of particular frequencies demonstrated that significant increases in tolerance for such noise occurred with repeated exposure. However, Culbert and Posner's study dealt with relative acceptability of certain levels of airplane noise, and not directly with one's ability to perform other tasks in the presence of that noise. Neither was there any direct measure of physiological responses to the noise over time.

Direct evidence relating to habituation or practice effects with respect to overcoming distraction is scarce. The most direct evidence bearing on the question is probably the study by Etaugh and Michaels (1975), in which an interaction was found between performance under conditions of music distraction, and reported frequency of studying to music at home. However, interpretation of the results of this study was confounded by a strong correlation between sex of subject and frequency of studying to music (males studied to music much more often), and by other problems.

In short, the evidence suggesting a learned ability to overcome particular types of distraction is weak; it is even more so when we make the leap from learning to overcome specific distracters (favorite songs, a particular frequency of airplane noise) to overcoming the impacts of a mass medium in general.

Although there is not a great deal of evidence to substantiate habituation effects, it is clear that there is substantial variation between individuals in general distractability (Baker & Madell, 1965a, 1965b; Broadbent, 1954; Browning, 1967; Brown & Clarke, 1963; Fogelson, 1973; Lasky & Tobin, 1973; Williams, 1961). Perhaps those who are less easily distracted differentially choose to read or study with the TV on, because they find it easier than do others to operate effectively under such conditions. If this is the case, there might indeed be a difference between those who habitually read or study in front of the TV and those who do not, but this difference would not reflect habituation to the medium.

The habituation argument based upon Culbert and Posner (1960) would seem to suggest that it is the exposure experience itself which is important; thus, heavier TV viewers should in general show a greater ability to function intellectually in the presence of television. However, the argument that less distractable individuals will be more likely to choose to study or read with the TV on implies that only those whose habit it is to read, study, or perform other difficult intellectual tasks in the presence of background television will show themselves better able to overcome the distracting influence of this medium.

H(4): Individuals who report habitually reading or studying with the TV on will show less of a performance decrement when performing cognitive tasks under TV distraction than will individuals who habitually do not read or study with the TV on.

H(5): Heavy TV viewers will show a greater ability to overcome the distracting effects of background TV on cognitive performance than will light viewers.

If both hypotheses were supported, or if hypothesis 5 alone was supported, the findings would be consistent with the habituation model derived from Culbert and Posner. However, if only hypothesis 4 were supported, results would be more consistent with the notion that less generally distractable people tend differentially to choose to read or study while the TV is on.

TV content types and distraction effects

To this point, discussion of hypothesized impacts of television on concurrent cognitive processing has proceeded as though the actual content of particular programs viewed while attempting to perform other tasks was irrelevant. However, there is no a priori reason for assuming that all types of TV content should be functionally equivalent with respect to their respective potentials to distract. The third research question addresses the relationship of particular types of television content to the impact of background TV on thought processes: What sort of television content represents the most potent distracter, in the sense of reducing performance on other cogntive processing tasks to the highest degree?

At the most basic level, it would seem reasonable to suggest that content which is more interesting and involving should lead to greater decrements in performance than more boring and less involving content, since a more involving program will be more successful at securing attention than a less involving program. From the standpoint of a capacity model of attention and cognition, content which is more involving is more likely to demand a greater proportion of available attentional capacity more of the time. Indeed, Hale and Stevenson (1974) went so far as to suggest that the "general interest value of a stimulus" was a broad mediating factor explaining empirically larger distraction effects for "meaningful" distracters.

Beyond this somewhat obvious expectation, at least three additional properties of TV programs may be related to their relative potencies as distracters. First, programs differ in the degree to which their content is exciting or arousing. Second, programs vary in the extent to which they contain the sort of auditory and visual cues which elicit orientation reactions or otherwise lead to rapid attentional shifts. Third, programs differ in terms of the amount of verbal content that they present, and thus in their potential to induce structural interference with language-based reasoning and rehearsal processes.

Although we may separate these characteristics of TV content analytically, they are not always separable empirically. Content which is physiologically arousing also tends to be content which is interesting and involving, as Zillman (1982, p. 61) has noted:

> Television drama capable of moving the audience emotionally and of producing enjoyment at the affective level relies on and benefits from the involvement of stimuli that induce strong arousal reactions.

According to Zillman (1980), types of television content which are especially arousing include suspenseful drama, hilarious comedy, athletic contests, sex, and violence. However, as Rice, Huston, and Wright (1982) have noted, formal features such as form complexity and perceptual salience also have been shown to induce arousal, and increase attention. Many formal features related to arousal, particularly those related to pacing and complexity, also exhibit the potential to induce rapid attentional shifts (Singer & Singer, 1979; Zillman, 1982).

One characteristic of television content which may be empirically separable from interest-value, arousal-value, etc., is amount of verbal content. This suggests a contrast between TV content which is high in those characteristics which would be expected to influence mental operations through impacts on arousal or momentary shifts of attention, and content which is high in those properties which would be expected to influence mental operations through structural interference with language-based processing. Programming which is high in verbal content, but low in action, would be expected to exert a relatively stronger influence on mental tasks involving linguistic processing; on the other hand, content which is high in physical action, but low in talk should have stronger effects on complex tasks which do not rely heavily on language-based processing.

> H(6): Mental tasks involving linguistic processing or response will be more strongly disrupted by background TV content which is high in verbal content, than by content which is high in physical action, but low in talk.

H(7): Complex mental tasks not relying on linguistic processing or response will be more strongly disrupted by high action/low verbal content than by high verbal/low action content.

Tasks affected by background television

Thus far, the question of what particular types of cognitive processes are most likely to be affected by background television has not been addressed. The preceding discussion implied that in part the answer to this question depends on the particular type of TV content that is present. What is it possible to say more broadly about the sorts of cognitive processing tasks which are more or less likely to be disrupted by background TV?

In a sense, answers to this fourth research question have already been suggested by the earlier theoretical discussion. Each of the mechanisms through which, it was argued, television should disrupt thought processes, suggests some characteristics of tasks which should be impacted.

The orientation reaction (and other types of attentional shifts) should influence intellectual processes by: (1) limiting size and temporal persistence of material in short-term memory; (2) disrupting any ongoing cognitive processing which is occurring at the time attention is shifted; and (3) creating a physiological state which is optimal for perception, rather than thinking. If background TV elicited this sort of reaction with any frequency, impacts would be expected on operations making heavy demands on short-term memory, requiring continuous attention, or involving in-depth cognitive processing.

The capacity interference mechanism suggests that those types of tasks which make the strongest demands on attentional capacity (i.e., are most difficult in the sense of requiring the greatest investment of cognitive effort) are most likely to be affected by background television. Operations which are difficult and complex, which require subvocal rehearsal or active encoding, or which involve the choice and execution of free responses, should be viewed as the strongest candidates for disruption through capacity interference.

The concept of "structural interference" suggests an impact on all information processing making strong demands on the language-processing faculty. Included in this category would be both subvocal reasoning and rehearsal processes, and the processing of reading material.

Finally, arousal as a mechanism mediating TV effects on cognitive processing suggests that such effects may be either beneficial or detrimental depending upon the individual's prior physiological state and the complexity of the information processing task. Consistent with the Yerkes-Dodson law and extant research on arousal effects, high levels of TV-induced arousal should have positive effects on the performance of simple tasks emphasizing speed, and negative impacts on more complex tasks, particularly those requiring mental flexibility or fine perceptual or conceptual discrimination, and on tasks which are demanding in terms of short-term memory.

Included in the group of information-processing tasks for which background TV effects would be expected, then, are tasks which: (1) make strong demands on short-term memory (OR, arousal, or capacity interference effects); (2) require substantial periods of uninterrupted concentration (OR and arousal effects); (3) require making fine perceptual or conceptual discriminations (arousal effect); (4) involve mental flexibility or creativity (arousal and capacity interference); (5) are difficult and complex (capacity interference and arousal); or (6) make heavy demands on the linguistic processing faculty (structural interference).

Two points from this list are somewhat problematic, each for a different reason. The problem with the idea of difficulty and complexity concerns how one may, with some degree of objectivity, evaluate the relative levels of these properties for particular tasks. The idea that short-term memory should be impacted by distraction runs into empirical problems. The latter may reveal themselves to be rooted, however, in the particular way in which STM has been traditionally conceptualized.

Short-term memory.

Let us deal first with the question of possible television impacts on short term memory. Theory would seem to suggest, as has already been noted, that short-term memory should be negatively impacted by background television, in that several of the processes through which distractors appear to influence cognitive performance imply effects on STM. However, results of empirical distraction studies using STM tasks as dependent variables have not been fully consistent with this expectation (Kahneman, 1970). This would suggest that the generalization that distraction restricts short-term memory is in need of some respecification.

The problem may lie with how short-term memory is conceptualized. Most earlier conceptualizations implicitly treated STM in terms of the passive storage of a limited and fixed number of "chunks" of information (e.g. Miller, 1956). The role of active cognitive processing in STM was seen only in the process of "chunking," or organizing the information input. Differences in such "chunking" abilities resulted in individual and developmental differences in STM (Miller, 1956; Simon, 1974).

More recent models of short-term memory (e.g., Baddeley & Hitch, 1974) explicitly regard short-term memory as an active information processing device, rather than a passive storage facility. Psychologists operating under this conceptual framework increasingly use the term "working memory" or "working storage" to focus upon this difference from traditional models of STM. According to one such model:

> The limited capacity working memory system consists of a central "executive" coupled with an "articulatory loop." The executive is responsible for both the control of mental processes and short-term retention, with one strategy for the latter being use of the articulatory loop as a storage device through the process of rehearsal. (Hitch, 1978, p. 303)

According to this conceptualization, maintaining information in working memory requires (to use Kahneman's terminology) attention and effort. Reallocation of capacity to other information processing operations leads to a reduction in capacity available for rehearsal. However, such reallocation does not always cause loss of information from STM; there appears to be at least some spare attentional capacity which allows human beings to maintain the normal 5-7 chunks of information in memory while performing operations on these items or engaging in other tasks. Although, as would be expected, performing operations on material in STM is perceived as more difficult and effortful than merely storing chunks and rehearsing them until called upon to recall, it is only when this spare capacity is exhausted that we may expect to see real memory decrements.

The fact that simple digit recall types of tasks do not require maximal effort or allocation of attentional capacity helps explain why these sorts of measures are not as susceptible to the influence of distraction as tasks which require that operations be performed on the stored information (and thus more closely approach the limits of mental capacity prior to the introduction of the distracter).

In those cases in which passive storage measures of STM have been shown to be disrupted, the orientation response or momentary shifts in attention, rather than capacity interference, have tended to be implicated as the mechanisms responsible (e.g., MacCoby & Hagen, 1965; Woodhead, 1964).

With respect to the impacts of television, the following hypothesis may therefore be made:

> H(8): Tasks involving mental manipulation or other operations on materials in short-term working memory will be more susceptible to disruption by the presence of background television than will be tasks involving only passive short-term storage of information.

Task difficulty and complexity

It has been argued that the degree to which a mental task will be susceptible to disruption by distracters in general and background TV in particular is a function of the difficulty and complexity of the task. The concepts of difficulty and complexity may seem to tap different dimensions of task characteristics. However, there is reason to treat these two ideas in tandem.

In this respect, a broad distinction between types of mental tests, put forth by Hunt (1980), is useful. Hunt distinguished between mental tests which measure specific abilities (or simple information processing operations), and synthetic tests, which require the strategic use of a number of different information processing operations. The former type is partially represented by tests of short-term memory, perceptual speed, and visual closure; the latter by tests of reasoning, verbal comprehension, and the like.

According to Hunt, tests of specific abilities tap the "structural aspect of thought," involving "mechanistic capacities for storing, retrieving, and transforming information." Synthetic tests reflect two additional levels of information processing: the "process" aspect of thought, or the application of mechanistic information processing abilities "in a particular and highly flexible order;" and the "knowledge" aspect, or "coordination between the present situation and the problem-solver's store of previously acquired information" (Hunt, 1980, p. 456). Synthetic tests are more subjectively difficult because they require mental processing at more than one level. In a sense, what is at stake is not merely the doing, but the deciding how to do, and the organization of the doing process.

In other words, tasks are experienced as difficult typically because they present problems concerning how to use one's basic abilities in a strategic manner: In effectively coordinating simple information-processing operations, in applying one's previous problem-solving experience, and so on.

A similar perspective was articulated by Sternberg (1979), who argued that complex information processing tasks can be broken down into simple "component" operations. Task complexity is, then, seen to be a function of the number of different component operations which must be coordinated in the process of solution.

Sternberg used the term "metacomponent" to apply to "processes by which subjects determine what components, representations, and strategies should be applied to various problems," and "which determine the various rates of component executions ... and the probabilities that varous components will be applied at all in a given situation" (1979, p. 226). The contrast between a "metacomponent" and a "component" process is a contrast between "operations that determine how ... problems will be solved," and "operations that actually solve the problems" (Sternberg, 1979, p. 226).

The influence of metacomponents on task performance apparently increases with the amount of information processing required to complete the task (i.e., complexity, in terms of the number of component processes that must be used, and the number of times each must be used). Task difficulty is seen to be in large part a reflection of demands on metacomponents (cf., Reitman, 1965).

Thus, when it is argued that background television should disrupt performance on tasks which are complex and difficult, it is assumed that difficulty is related to requirements for strategic planning, coordination, and regulation of more fundamental information processing functions; the latter requirements in turn result from complexity, conceived in terms of the number of separable information processing tasks which must be coordinated in solution of the overall task. The generalization that background television will affect performance on difficult and complex cognitive tasks can therefore be stated in other terms:

> H(9): Tasks which require the coordination of a number of separate information processing operations will be more severely disrupted by the presence of background television than tasks which require repetitive use of single, simple information processing operations.

Reading

It is possible to suggest several specific types of cognitive tasks with which there is reason to suspect that television, acting as a distracter, may interfere. The reading process is an especially strong candidate for such disruption. Measures of reading abilities have indeed been shown, in a number of studies, to be susceptible to distraction effects (Baker & Madell, 1965a; Etaugh & Michaels, 1975; Fogelson, 1973; Henderson, Crews & Barlow, 1945; Zimmer & Brachulis-Raymond, 1978).

Reading performance may be influenced by background TV through several mechanisms. Structural interference from the processing of verbal content (dialog) is one possibility. Perhaps of equal importance are those processes through which distracters impede performance on complex information-processing tasks in general: capacity interference and arousal. Hunt (1980) specifically cited tests of reading comprehension as examples of "synthetic" information-processing tests, requiring "the orchestration of several different functions." (p. 457). These are precisely the sorts of tasks, as was argued earlier, which ought to be especially susceptible to capacity interference and arousal effects.

Initial comprehension in reading requires active cognitive processing of written material. But such processing is even more essential for the retention of material obtained in reading. For information to be fixed in long-term memory usually requires actively relating it to other ideas and concepts already in LTM storage, or to particular goals and plans (Capella & Folger, 1980; Craik & Lockhart, 1972). Such processing is often referred to as "elaboration" or "elaborative rehearsal," and in large part its function seems to be to fix information in long-term memory in a way that allows for efficient retrieval. As Hayes (1981, p. 85), put it:

> Perhaps the best way to understand elaboration is to think of it as a process that forms connections -- either within the material to be learned, or between the material to be learned and other things we already know. The more connections the material has, the more likely we are to be able to remember it.

External distraction is especially likely to cause capacity interference when the reading process itself is experienced as difficult, or when the content of the reading material is intellectually demanding. Such interference may affect either the degree to which the reader engages in elaborative rehearsal (thus limiting the later accessibility of information in LTM), or the decoding process itself (thereby reducing the speed at which material is learned or preventing comprehension altogether).

High levels of arousal, by limiting cognitive flexibility, would also be expected to result in decrements in reading comprehension. Decoding of written material, and its cognitive elaboration, are just the sorts of complex mental processes likely to be impeded by the cognitive inflexibility and narrowing of attentional focus associated with very high arousal levels.

The orientation reaction also has potential for reducing the efficiency of information acquisition and storage from written text. The rapid redirection of attention may disrupt decoding and comprehension by displacing information in short-term memory. In addition, the OR could interrupt, and thus short-circuit, the processes of elaboration and response, thereby affecting fixation of information from written text into long-term memory, or interfering with critical response.

Problem-solving

Reading comprehension is not the only type of mental task which, due to being complex and difficult, is a prime candidate to experience detrimental effects from the presence of a distracter such as background TV. There are many other types of cognitive tasks which likewise require, to use Hunt's (1980) terminology, "the orchestration of several different functions." We would expect that tests of reasoning, and of complex problem-solving (requiring multiple steps, planning, detection of implicit patterns, etc.) would also be sensitive to environmental influences, and for reasons similar to those which would lead us to predict effects on the reading process.

The ways in which human beings solve various sorts of problems have received considerable attention from psychological researchers in recent years. According to Simon (1978, p. 279), "problem-solving behavior is produced by a small set of elementary information processes organized into strategies or programs." The first step to effective problem-solving involves creating an internal representation of the problem, on which strategic efforts may be based. Later steps include the induction of strategies, evaluation of operators and subgoals, and so on.

The construction of the "problem space" is an active cognitive process engaged in by the problem-solver. As Hayes (1981, p. 6) put it, "When we form a problem representation, we not only add information and delete information, we also interpret information -- that is, we use our knowledge of the language and the world to understand problem information."

The importance of the initial internal representation of a problem to ultimate solution can hardly be overemphasized. As Simon (1978, pp. 276-277) has noted:

> The relative ease of solving a problem will depend on how successful the solver has been in representing critical features of the task environment in his problem space.... Effective problem solving involves extracting information about the structure of the task environment and using that information for highly selective heuristic searches for solutions.

Even in relatively simple problems, in which only a small number of steps are needed for solution, a complete and accurate representation of the problem is important for efficient solution; excessive speed or lack of patience at the stage of problem representation can be costly (see Sternberg, 1979, pp. 226-227). Effective initial problem representation would be expected to be especially strongly affected by distraction-induced arousal, which serves to narrow attentional and cognitive focus, and energize one for action, as opposed to planning.

Capacity interference may also affect problem-solving, which after all involves such effortful activities as "choices, decisions, rehearsal, and the manipulation of stored symbols" (Kahneman, 1973, p. 191). To the extent that a particular problem is a verbal problem, or is represented verbally in whole or in part, structural interference resulting from a distracter containing verbal content may also occur.

Flexibility in recall: Creativity

The presence of a potent distracter, such as an operating TV set, may also influence recall and use of information already stored in long-term memory. Recall of material from long-term memory does involve demands on attentional capacity, although apparently not to the degree required by several other types of tasks (Kahneman, 1973). Probably of greater importance in this respect are the mechanisms of physiological arousal, and the momentary redirection of attention produced by the orientation response.

Efficiency of recall is influenced by the conditions under which information was originally encoded into LTM (Watkins & Tulving, 1975), by the specific cues present at the time recall is elicited, and by the manner in which the information is organized in the structure of long-term memory. Probably the most common type of model of information storage in LTM has been the network representation (cf., Capella & Folger, 1980), although spatially based models have also been suggested (e.g., Woelfel & Saltiel, 1978; Woelfel & Fink, 1980; Kaplowitz & Fink, 1983).

Network representations posit a set of "nodes," representing (typically) words, concepts, or events, along with links between nodes, representing some type of relationship between word, concept, or event nodes and represented visually as line segments linking nodes.

Network models differ in terms of the types of relationships implied by links between nodes (simple association between concepts, hierarchical inclusion, grammatical relations such as "agent" or "object", and so on), and in terms of the range of information posited to reside in the nodes (Contrast, for example, Kintsch, 1974, with Quillian, 1968).

If a particular concept is accessed as a result of some outside or self-generated stimulus, the other nodes to which the concept is attached may also be accessed. Memory nodes may be linked either directly (via a single link) or indirectly (via links to other nodes). Concepts directly linked to a focal concept will be most easily accessed. The greater the number of mediating links between the focal concept and any indirectly linked memory node, the less the likelihood that this node will be accessed, and if it is to be accessed, the greater the amount of time and effort that will be required in order to do so.

Moreover, the image of LTM as a fully interconnected network of links and nodes is probably incorrect, or at least the ability of persons to access information more than a few links away from a focal concept is severly restricted (Collins & Quillian, 1969; Conrad, 1972). Rather, particular concepts would appear to be encoded in several different locations, in relation to several different networks or schema (Tesser, 1978), or with respect (in episodic LTM) to different environmental cues and conditions under which the concepts have been multiply encoded (Tulving & Osler, 1968; Thomson & Tulving, 1970).

Such conditions suggest two ways in which high arousal levels or elicitation of the OR could affect memory search. Extensive memory search (i.e., involving indirectly-linked concepts or reference to multiple schema) is consuming both of time and of effort. If concentration is disrupted by new sensory input demanding immediate attention (as in the OR), then such a recall process could be disrupted. Excessive narrowing of attention characteristic of human information processing under high levels of arousal may also be expected to interfere with the search for more loosely or remotely connected concepts, and should be especially limiting when access to a concept with respect to multiple encodings or schema is called for. Both such operations require the sort of cognitive flexibility which high levels of arousal mitigate against.

Searching LTM for more loosely or remotely connected concepts, and accessing multiple schema with respect to particular concepts, are operations closely related to common conceptions of mental flexibility or creativity (cf., Guilford, 1967, p. 213).

To summarize, it has been suggested that background television would be expected to disrupt, through several different processes, a number of different types of information processing tasks. First, tasks which involve performing operations (other than rehearsal) on information in short-term working memory should be affected. Second, comprehending, actively responding to, and retaining information from written text should be disrupted. Third, deleterious effects should be observable for complex problem-solving and reasoning tasks. Fourth, TV background should disrupt extensive or flexible search of long-term memory (and thus, creative or divergent thinking). Finally, it should also be noted that TV verbal content may exert a negative influence on verbal processing, through induction of structural interference, even when it occurs in tasks of the sort that might not normally be expected to be affected (for example, Weinstein's (1977) grammatical proofreading task). These expectations may be formally stated as specific instances of the first hypothesis:

H(1a): Exposure to background TV will negatively affect concurrent performance in tasks involving linguistic processing.

H(1b): Exposure to background TV will negatively affect concurrent processing of written text: specifically, comprehension, retention, and inference.

H(1c): Exposure to background TV will negatively affect concurrent performance on complex problem-solving or reasoning tasks.

H(1d): Exposure to background TV will negatively affect concurrent performance on tasks involving creativity or divergent thinking.

H(1e): Exposure to background TV will negatively affect the ability to maintain information in short-term memory while operations (other than rehearsal) are being performed on that information.

Figure 1 summarizes the various factors relating to the background television-as-distracter model which have been discussed in this chapter.

Contingent Factors	Disruptive Mechanisms	Aspects of Intellectual Performance Affected	Expectations
TV Content Type —high verbal —high action Task Set —Distraction —Dual Task Habituation	Orientation Reaction Interference —Capacity —Structural Arousal	Working Memory Linguistic Processing Complex Problem-Solving Reading Creativity	1)Dual-task set most disruptive; 2)Complex/difficult tasks affected more; 3)High verbal content has stronger effect on linguistic tasks; 4)High action content has stronger effect on complex nonverbal tasks.

Figure 1
Factors Relating to the Influence of Background Television on Intellectual Performance

Chapter 2

METHODS

Overview

Eighty-four experimental subjects were randomly assigned to control or to one of four treatment conditions. In the treatment conditions, subjects were asked to perform a set of tests in the presence of an operating television set. Control subjects performed the same set of tests in quiet, with the television set off. Treatment conditions differed in terms of (1) the type of TV content to which the subject was exposed, and (2) the task set of the subject, as manipulated through written instructions. The order in which particular tests were given was varied within each group, to equalize impacts of fatigue and detect differences associated with tests previously taken. Following completion of the test battery, each subject completed a questionnaire soliciting background information, as well as information useful in checking the effectiveness of experimental manipulations and in assessing plausible rival explanations for study results. Following completion of the experiment, additional information concerning subjects' academic abilities was obtained from University records.

<u>Experimental Manipulations</u>

It was desired to compare effects of two extremes of TV content: Content high in talk and low in action, versus low talk/high action content. It was deemed of less practical importance to determine effects of exposure to ideal types of television content than to determine effects of exposure to content types actually available to viewers. Therefore, examples of "natural" stimuli were chosen, that is of TV content which appeared on network television, even if such content failed to achieve the purity of ideal types.

Four criteria were applied to select programs to operationalize the "high action" portion of the manipulation of program type. These were: (1) the program selected should be judged as containing a relatively high proportion of action; (2) the program should have an action sequence at its beginning or very near the beginning; (3) the program should be relatively low in verbal content; and (4) the program should be subjectively experienced as relatively arousing. Two criteria were specifically applied to the selection of "high talk" programs: (1) the program should be judged to have a relatively high proportion of time devoted to talk; and (2) the program should have a relatively low proportion of time devoted to physical action. Both high action and high talk programs should be hour long, network programs originally shown in prime-time.

Eleven programs were initially selected on an a priori basis as candidates for becoming high action or high verbal experimental programs. Since it was believed that it would be more difficult to meet the criteria for high action manipulations than for high verbal manipulations, the original eleven programs included seven considered to be high action. These were "V," "Hunter," "Hawaiian Heat," "A-Team," "Matt Huston," "Miami Vice," and "Magnum PI." Episodes of each of these series were videotaped for use in the pretest. Four possible "high verbal" programs were also taped: "Love Boat," "Finder of Lost Loves," "Knots Landing," and "Dynasty."

Pretest subjects were volunteers from a sophomore level communication research methods class. Groups of approximately 10 pretest subjects each viewed two 10-minute segments of a particular videotaped program. At the end of each program segment, each pretest subject filled out an instrument in which s/he (1) indicated his or her level of subjective arousal, using an adjective checklist containing the arousal factor items from MacKay's (1980) stress-arousal checklist (SACL); (2) estimated the amount of action in the program segment using three different types of measures; and (3) estimated the amount of verbal content in the program, also on three different types of measures. In addition, after viewing the second segment of the program, subjects evalutated how interesting, attention-grabbing, and involving the program was, based on both segments.

Table 1
Mean Action, Talk, and Arousal Scores for Pretest Programs

Program	Action Scores %[a]	inch[b]	DME[c]	Talk Scores %	inch	DME	Arousal[d]
V	59(26)	2.6(1.1)	10.7(4)	63(10)	2.7(.5)	10.9(2)	2.92
Hunter	55(16)	2.4(.9)	12.4(3)	56(23)	2.5(.7)	9.3(2)	4.39
Hawaiian Heat	49(16)	2.2(.5)	11.1(3)	73(11)	2.8(.6)	13.6(5)	2.70
A-Team	46(19)	1.8(.7)	13.3(5)	66(7)	2.7(.4)	11.8(5)	3.56
Matt Huston	37(17)	1.6(1.0)	11.5(5)	68(13)	2.7(.7)	11.4(4)	2.39
Miami Vice	35(33)	1.7(1.3)	13.5(12)	75(18)	3.1(.7)	16.2(10)	2.05
Magnum P.I.	29(17)	1.2(.4)	7.7(6)	79(6)	3.1(.5)	14.3(3)	3.54
Love Boat	24(12)	1.3(.5)	6.5(3)	88(12)	3.6(.5)	20.1(6)	4.21
Lost Loves	12(11)	.7(.6)	3.4(2)	87(22)	3.8(.2)	17.5(3)	3.43
Dynasty	12(3)	.6(.4)	6.3(2)	87(6)	3.4(.2)	17.7(3)	3.27
Knots	11(9)	.5(.2)	4.0(1)	90(4)	3.6(.2)	15.5(3)	2.21

[a] Estimated percentage of program devoted to action. Numbers in parentheses indicate mean differences in estimates between different program segments.
[b] Amount of action indicated on scale with "no action" and "extremely high" as anchors. Score indicates mean number of inches from "no action" anchor. Total possible = 4.31.
[c] Direct Magnitude Estimation scale measure of action, in which 0 = no action, and 10 = average amount of action.
[d] Arousal checklist measure. Range from -6 to +8.

Table 1 summarizes the analysis of pretest program data used in selecting the programs to act as experimental manipulations.

As noted earlier, for the action manipulation, it was desired to have programs which were consistently high in action, consistently low in verbal content, and experienced as arousing. The programs appearing to best meet this combination of criteria were "Hunter" and "The A-Team." Two of the programs, "V" and "Hawaiian Heat," also scored high in action content, but were rejected on the basis of other criteria. "V" had two main problems associated with it. First, although having a high overall action score, "V" was not rated as being consistent in amount of action. There was a very large difference in the average Percent Action rating for the two segments. Second, "V" was experienced as relatively unarousing by pretest subjects. "Hawaiian Heat" was rejected because it was relatively high in talk, and was experienced as unarousing.

For the high verbal programs, it was desired to have a set of features opposite those desired for the high action programs. The programs were selected to be consistently high in talk, low in action, and relatively unarousing. The two programs which seemed to best fit these criteria were "Knots Landing" and "Dynasty." "The Love Boat" was rejected as having the highest amount of action content of all the "high verbal" programs, and as being the most arousing.

"Finder of Lost Loves" was similar in action and talk ratings to the two programs selected; it was eliminated due to it being less consistent across program segments in terms of both percentage of time devoted to talk, and percentage of time devoted to action. It was also slightly more arousing than either "Dynasty" or "Knots Landing."

Two programs were selected to act as manipulations of each type of content, rather than a single program for each type, in order to reduce the chances of variation between TV stimuli on dimensions which were not of theoretical interest confounding interpretation of findings (see Bradac, 1983; Jackson & Jacobs, 1983, for discussion of problems associated with use of single messages as operationalizations of communication variables). As Hewes (1983) points out:

> Studies of message effects should contain multiple instantations of every message variable being manipulated. To do otherwise is to confound a particular message, with all its sources of uncontrolled variability, with the independent variable that message is supposed to operationalize. (p. 187)

As expected, the "pure action" ideal was less adequately operationalized than the "pure talk" ideal by the set of programs selected. The programs judged highest in action were judged, on the average, to contain only about 50% action content, while the high talk programs selected were judged to have about 90% verbal content. Conversely, even the purest of the high action programs selected was judged to have characters talking over 50% of the time, while the high-talk programs were estimated to contain only 11-12% action.

Regardless, substantial variation was obtained between these two sets of programs on both action and talk dimensions. Where results show no detectable differences in subject performance according to program type, the conclusion would seem to be justified that, within the range of available prime-time program content, differences between high action and high talk program types do not (at least in the aggregate) make a difference. (It should be noted that, even with only about 50% "action," pretest subjects experienced higher degrees of arousal, as measured, when viewing the action programs which were chosen for use in the experiment than when viewing the chosen high talk programs).

The four programs chosen were edited to remove in-program commercials. Commercials were retained at the beginning and end of each program to maintain the most realistic setting possible. The deletion of internal commercials was due to their potential to interfere with the manipulation of task set.

The task set manipulation was designed to allow assessment of both the strong and weak versions of the first research question. The strong version of the first research question stated: "Does television reduce individuals' performance on cognitive tasks, under conditions which would otherwise promote optimal performance?" The weak version asked: "Does television reduce individuals' performance on cognitive tasks under conditions in which the subject is motivated to attend at least minimally to the TV content while performing such tasks?"

All subjects, except control subjects, received one of two sets of instructions. The first set instructed subjects to "do your best to ignore the television and concentrate completely on the tests." This will be referred to as the "pure distraction" manipulation, since subjects in this condition experienced the television solely as an unwanted external distraction.

The second set of instructions told subjects to "try to do the best you can on the tests, while at the same time keeping an eye on what is occurring on the TV screen." They were also told that they would be given a short quiz on the TV content after completing the rest of the tests. This will be referred to as the "dual-task" set.

The comparison of the performance of control condition subjects to that of "pure distraction" condition subjects constitutes a test of Hypothesis (1). The comparison between control and "dual-task" subjects is a test of Hypothesis (2).

Dependent Measures

Each subject completed seven different tests, chosen to reflect different levels or types of cognitive processing which may be disrupted by background television. The purpose was not just to determine a global effect of television on cognitive processing, but to determine, if possible, the locus of any such effect, and the probable mediating processes (orientation reaction, structural interference, capacity interference, or arousal) through which the effect was produced. Included were two tests of short-term memory (digit span test and mental arithmetic test); a test of grammatical processing speed (sentence verification test); two problem-solving/reasoning tests (Thurstone Letter Series Completion Test and Tower of Hanoi puzzle); a reading comprehension measure (Nelson-Denny Reading Test); and a test of mental flexibility (uses test).

Short-term memory tests

Two different tests were given to assess different aspects of short-term memory. The digit span test is a conventional measure of "passive" short-term memory. In this test, the examiner held up to subjects a series of cards, one after another, on which numbers were printed. Subjects were asked to remember the numbers, in the order given. After a particular number sequence was presented to a subject, the experimenter waited 10 seconds, and asked the subject to repeat back the numbers verbally. If the subject was unable to do so perfectly, s/he was presented with another series of numbers of the same length, and the process was repeated. If a subject failed to remember a number series of a particular length after having been given two chances, the test was concluded. The test began with the experimenter presenting the subject with a four-digit sequence. With each success, the experimenter moved to a series of digits containing one additional digit. The maximum possible was nine digits. Digit span score was defined as the highest number of digits in a sequence that a subject could maintain in short-term memory, and repeat back on demand.

Digit span was regarded as a test of "passive" short-term memory because subjects were merely required to keep a sequence of numbers in memory, but not to do any additional information processing using these numbers. A second test, the mental arithmetic test, went beyond this to be a test of <u>working</u> short-term memory.

In the mental arithmetic test, subjects were required to solve a series of multiplication problems which were presented to them on cards held up by the experimenter. The problems were required to be solved in the subject's head, without writing partial answers or notes on paper. Mental arithmetic is considered a test of working memory because subjects are required not just to keep numbers in memory, but simultaneously to perform arithmetic operations on them. Kahneman (1973) argued that mental arithmetic tasks make strong demands on mental capacity and short-term memory:

> In mental arithmetic, ..., one must keep track of the initial problem, of partial results already obtained, and of the next step. Stopping or slowing even for an instant usually forces one to return to the beginning and start again. (p. 26)

In the mental arithmetic test, subjects were asked to solve five multiplication problems, one at a time. Prior to beginning the actual test, each subject was allowed to practice using five simple (one digit by one digit) multiplication problems presented on cards by the experimenter. The five items used in the actual test were: 3 X 88, 3 X 443, 7 X 333, 14 X 55, 17 X 24. Subjects were instructed to solve each problem as quickly as they could, and to signal the experimenter and give the answer when one was found. If the subject gave a wrong answer, s/he was permitted to try again. Subjects were permitted a maximum of 1 1/2 minutes for completion of each problem.

The experimenter recorded the time taken to complete each problem using a stopwatch. If the time limit was reached without completion of a problem, the subject was given a time score on the problem of 1 1/2 minutes. The experimenter also recorded the number of incorrect responses given by subjects. Two summary measures of overall performace on the mental arithmetic test were constructed from this information: (1) total time taken to solve the five problems, and (2) number of incorrect responses given for the five problems.

Language processing and reading tests

It was argued earlier that background television, particularly its verbal content, would be disruptive to language-based mental processes by creating structural interference. Two tests were used to examine different aspects of this question. Any verbal processing, but especially reading, requires substantial cognitive capacity, and use of a variety of processing abilities. If background television reduces reading performance, this fact would be of obvious social import with respect to education. So, one test involving language processing was a test of reading comprehension.

Permission was obtained to use Form F of the Nelson-Denny Reading Test, paragraph comprehension portion, in this research (copyright 1979, The Riverside Publishing Company). Due to time limitations imposed by the length of programs used for experimental manipulations, it was necessary to use a shortened version of this test. Form F of the Nelson-Denny Reading Test contains eight reading passages and 36 questions. Three of these passages, and the questions associated with them, were chosen for elimination by way of a randomization procedure involving cutting a deck of cards. The remaining test contained one long and four shorter reading passages, with a total of 24 questions. A time limit of 10 minutes was imposed.

The second language processing test was chosen to measure one specific mental process whose disruption could conceivably explain the disruption of more synthetic language-related tasks, such as reading. It was desired in this respect to obtain a test which would measure grammatical or syntactic processing, independent of vocabulary or ability to recall information from long-term memory. Such a test is provided by the "sentence verification task" (Clark & Chase, 1972). In sentence verification tasks, subjects are presented with a sentence, such as "A is followed by B," or "Plus is below star," and are asked to decide whether the sentence is true or false, by evaluating it against a simple picture provided. The speed at which subjects are able to determine the truth or falsity of such sentences depends on the formal linguistic features of the sentence (Carpenter & Just, 1975). Studies of different versions of the sentence verification task have shown that speed of performance on such tasks correlates to a moderate and significant degree with performance on standardized measures of verbal ability (Baddeley, 1968; Lansman, 1978). Consistent with this, the sentence verification test used in this study correlated .43 ($p=.001$) with score on the Nelson-Denny Reading Test.

In the present research, a three-minute paper-and-pencil version of the sentence verification task was used, based upon the test developed by Baddeley (1968). A copy of this test is provided in Appendix A. The test consisted of 64 true and false items. In each item, a statement about the relationship between the letters "A" and "B" was made. Subjects were asked to assess the truth of that statement by comparing it to the spatial relationship between a pair of letters "A" and "B" printed to the right of the statement. The grammatical form of the statements varied in terms of:

(1) whether it used the passive or active voice; (2) whether the verb in the sentence was "follows" or "precedes"; and (3) whether the statement was worded positively or negatively. Thus, statements varied in terms of their grammatical complexity and the consequent grammatical processing demands. The basic score used was the total number of correct answers given before the time limit was up, and could be seen as reflecting the speed at which items were processed.

Complex problem-solving tasks

With the exception of the Nelson-Denny Reading Test, all dependent measures discussed to this point have dealt with simple and limited information processing operations, either short-term memory or basic linguistic processes. The remaining measures were chosen to reflect performance on more complex tasks, requiring strategic use of a number of information processing functions. Hunt (1980) reported on results of a multidimensional scaling study of mental tests, which resulted in an interesting pattern. Tests of specific abilities, such as memory span, perceptual speed, etc. were located at the periphery of MDS space, while complex tasks such as reasoning and verbal comprehension were clustered in the center.

Two well-studied types of problem-solving tasks were used as indicators of complex problem-solving abilities under the different environmental conditions. The first of these was a letter series completion test using 15 Thurstone Letter Series Completion Test items studied by Simon and Kotovsky (1963). In the letter series completion task, the problem-solver is presented with a series of letters, such as qxapxbqxa__, and is asked to provide the next member of the series. According to Greeno's (1978) typology of information processing problems, the letter series completion task is classified as a "problem of inducing structure." For problems of inducing structure, "the main task is to identify the pattern of relations present among the elements" (Greeno, 1978, p. 241). Simon and Kotovsky (1963) also suggest that letter series completion problems make specific demands on short-term memory. According to Lansman, et al. (1982), the Thurstone Letter Series Completion Test is an example of a test which loads strongly on the Cattell/Horn fluid intelligence factor, associated with "the ability to use complex reasoning to deal with problems for which subjects must develop their own strategies" (p. 348). Number of LSC problems solved is used as the measure of performance.

A second problem-solving task used was the Tower of Hanoi puzzle. The Tower of Hanoi was used by Greeno (1978) as an example of a "problem of transformation."

> In a problem of transformation, there is an initial situation and a goal and a set of operations that transforms the initial situation into the goal.... The skills needed for simple problems of transformation involve skill in planning based on a method called means-ends analysis. (Greeno, 1978, p. 241)

In the Tower of Hanoi problem, the individual is presented with a board in which three pegs are embedded. Stacked on one peg is a set of disks of different sizes (with the largest disk at the bottom, and each successive disk smaller than the one below it). The subject is then instructed to move the disks to one of the remaining pegs, with the constraints that (1) only one disk can be moved at a time, and (2) at no time may a larger disk be placed on top of a smaller disk. When solved, the disks are stacked on a different peg in the same order as they were originally. The Tower of Hanoi problem may seem quite simple; however, a version using only five disks has been found to be very difficult for most adults (Simon, 1978). Pretesting of experimental procedures suggested that the five disk problem was actually too difficult for many student subjects to solve in a reasonable length of time, and therefore a four disk version of the problem was used in the experiment.

The Tower of Hanoi problem would seem to actually require more elaborate processing than the preceding test (Letter Series Completion). Whereas the letter series completion problems merely required that subjects apprehend patterns, the Tower of Hanoi problem required several skills in addition to pattern recognition. According to Greeno, transformation problems test both analysis and planning abilities, and require skills in "means-ends analysis." The individual must construct an internal representation that allows for efficient solution to the problem. S/he must be able to define goals and subgoals, evaluate operators which allow movement towards goals and subgoals, and construct plans to achieve goals and subgoals, according to Greeno (1978).

Two measures of performance on the Tower of Hanoi puzzle were used. The time taken by the subject to solve the problem was recorded on a stopwatch. In addition, the number of moves taken to solve the problem was recorded on a hand counter. The latter measure in particular could be seen as an indicator of planning abilities, and the ability to determine subgoals. In order to encourage planning, subjects were given 30 seconds to study the Tower of Hanoi problem, after reading the instructions, before they were instructed to begin. A time limit of four minutes was used for the problem. Subjects who failed to solve the problem in four minutes were given a "time" score of 4:00, but were eliminated from the analysis involving number of moves.

Mental flexibility or creativity

Finally, it was suggested previously that one effect of background television as a distracter should be to disrupt extensive, flexible, memory search, and therfore to inhibit divergent production or creative thinking. A common measure of divergent production involves the listing of as many uses as a subject can think of for a common object (for example, a brick, a coathanger, a newspaper, or a pencil). Some variations of this type of task are Guilford's Utility Test, and Alternate Uses Test (Guilford, 1967), and the Unusual Uses Test from the Torrance Tests of Creative Thinking (Torrance, 1966). Most often, the total number of relevant responses is used as a measure of ideational fluency, while a coding of the number of different categories of uses suggested is taken as a measure of flexibility (Torrance also includes measures of "originality" and "elaboration" in his coding scheme). It would be expected that measures of flexibility would be more strongly related to the presence of background television, especially if that television affected performance through arousal.

In the version of the task employed in the present experiment, subjects were told in the instructions that their task would be "to list as many uses as you can think of for a common object." They were not instructed to think particularly of unusual uses, since the interest was more in spontaneous flexibility (which would, after all, more generally reflect the actual situations to which study findings would hopefully be generalized). An example was provided of possible answers to a question asking for uses of newspapers. The example provided both usual (information-gathering) and unusual uses for the object.

Subjects were given three minutes to come up with as many uses as they could for a tin can. Responses were coded in four different ways. First, all relevant responses were counted. Second, the total number of "unusual" responses, defined as all responses in which the can was not used for the storage or preservation of food, was determined. Third, the total number of responses in which the can was not used as a container for the storage of anything (not just food) was recorded. Finally, the number of different categories of response, using a category scheme from Torrance (1966) was determined. In the analysis, a fifth score, which was a ratio of number of categories to number of relevant responses, was also examined. It was believed that the hypothesized impact of background television on flexibility of attention and memory search would result in a stronger impact on the number of categories, number of non-container uses, and categories/relevant responses measures than on the total number of relevant or uncommon uses.

In summary, seven tests were given to subjects as dependent measures. The digit span and the mental arithmetic tests provided measures of passive short-term memory and working memory respectively. The sentence verification test was used to measure linguistic processing efficiency independent of semantic memory or other aspects of actual reading or comprehension tests. The Nelson-Denny Reading Test (paragraph comprehension section) was used as a broad measure of reading comprehension. Two different types of problem-solving tasks were represented by the letter series completion test and the Tower of Hanoi problem. Finally, the uses of tin cans task provided measures of ideational fluency and cognitive flexibility. The first

Table 2
Correlations Among Dependent Variables

	Digit Span	Mental Arithmetic Time	Mental Arithmetic # Wrong	Letter Series	Sentence Verif	TOH Time
Mental Arith.						
Time	-.30*					
# Wrong	-.26*	.63*				
Letter Series	.39*	-.38*	-.34*			
Sentence Verif.	.43*	-.41*	-.13	.41*		
Tower of Hanoi						
Time	-.01	.40*	.35*	-.15	-.08	
Moves	-.06	.24*	.27*	-.06	.01	.68*
Nelson-Denny	.11	-.18*	-.04	.26*	.43*	.01
Uses Test						
Relevant	.13	.02	.14	.10	.24*	-.14
Uncommon	.14	.03	.14	.07	.23*	-.14
Non-Contain	.20*	-.06	.05	.08	.34*	-.10
Categories	.20*	-.08	.00	.11	.24*	-.10
Categ/Rel	.13	-.18*	-.20*	.07	.03	.07

	TOH Moves	Nelson-Denny	Relevant	Uses Test Uncommon	Non-Cont	Categ
Nelson-Denny	-.10					
Uses Test						
Relevant	.05	-.01				
Uncommon	.06	-.00	.94*			
Non-Contain	.18	.07	.75*	.81*		
Categories	.16	.06	.68*	.73*	.87*	
Categ/Rel	.12	.14	-.45*	-.30*	.08	.29*

* $p \leq .05$

The first three of these tests were tests of specific abilities, while the latter five were synthetic tests in which specific abilities were measured along with what Hunt (1980) referred to as the "process" and "knowledge" aspects of thought (see pp. 73-74).

As might be expected with a series of tests measuring abilities which overlap in some respects, scores on the various tests showed significant intercorrelations. Table 2 presents the correlation matrix of the set of dependent measures.

<u>Subjects</u>

Subjects were 84 students from four sections of Communication 100, an introductory level course in communication. Subjects received extra-credit in their section in exchange for participation in this reserach. All were volunteers. Treatment of subjects, and the method by which they were encouraged to participate, were approved by the University Committee on Use of Human Subjects in Research.

Using a subject pool of college students was appropriate, given that correlational research previously cited (pp. 6-19) indicates that empirical relationships between TV viewing and academic performance are more negative (and stable) for older children and adolescents, and among those who might otherwise be expected to score best on academic achievement measures. College students would therefore seem to be a population for whom the types of TV impacts hypothesized, if they occurred at all, should be present.

Manipulation Checks

A post-test questionnaire was administered which included items designed to measure the effectiveness of the task set manipulation, and to assess subjects' subjective feeling of being distracted by the television. First, subjects were asked to indicate, if they were in treatment conditions, what they recalled their instructions to have been with respect to the TV program shown. Choices were: Ignore the TV; pay some attention to the TV but concentrate on the tests; pay equal attention to the TV and the tests; and pay more attention to the TV than to the tests. Table 3 shows the distribution of responses, by treatment group, to this item. The table shows that all but one of the subjects correctly understood the instructions.

Table 3
How Subjects Understood TV Instructions by Condition

Condition	IgnoreTV[a] N(%)	Some Attn[b] N(%)	Equal Attn[c] N(%)	More Attn N(%)
Distraction				
Verbal	17(100%)	0	0	0
Action	18(100%)	0	0	0
Dual-Task				
Verbal	1(6%)	15(94%)	0	0
Action	0	17(100%)	0	0

[a]This alternative read: "Ignore the TV. Concentrate on the tests."
[b]This alternative read: "Pay some attention to the TV, but concentrate mostly on the tests."
[c]This alternative read: "Pay equal attention to the TV and the tests."

Subjects were also asked what they actually did with respect to the television: Ignore it; pay some attention to it; or pay an equal amount of attention to it and to the tests. Table 4 summarizes subjects' responses to this question. The most striking thing about what is shown in this table is the large percentage of distraction-condition subjects who indicated that they did not follow the instructions they were given. Nearly half the subjects in the two distraction conditions reported paying at least some attention to the TV, even though they understood that they had been instructed to ignore it. In addition, eight of the dual-task subjects reported ignoring the television, in spite of instructions. Most likely the latter inconsistency was not due simply to the perverseness of a subset of dual-task subjects, but rather to their difficulty in following the instructions. One subject volunteered, during verbal debriefing after the session, that he had found himself unable to do the experimental tasks successfully while monitoring the TV, and so had decided to block out the TV in order to do better on the tests.

Table 4
How Subjects Reported Responding to the TV, by Condition

Condition	Ignored TV N(%)	Some Attn. N(%)	Equal Attn. N(%)
Distraction			
Verbal	9(53%)	8(47%)	0
Action	10(56%)	8(44%)	0
Dual-Task			
Verbal	3(19%)	12(75%)	1(6%)
Action	5(29%)	11(65%)	1(6%)

As a third check on the effectiveness of the task set manipulation, all subjects in the television conditions were given a paper-and-pencil quiz on the content of the program they viewed. The test for each program included questions about major plot information, characters and events. The majority of questions required at least some attention to the verbal content of the television program, although some questions also tapped visually-encoded information (e.g., the settings in which particular events or types of events occurred). Copies of the television content quizzes are in Appendix A.

If the task-set manipulation was effective, dual-task condition subjects should have learned more of the TV content than distraction condition subjects, and therefore score better on the program content quizzes. Out of a total of 12 points possible on each quiz, distraction subjects scored an average of 4.1, and dual-task subjects an average of 5.8. The difference between the groups was statistically significant ($t = 2.32$, $p \leq .05$).

As a fourth check on the task-set manipulation, subjects were asked to indicate how much attention they paid to the TV program by placing a check on a line between the extremes of "absolutely no attention" and "very close attention." Scale values were measured in millimeters from the left (no attention) anchor, and had a possible range from 0 to 104. Table 5 shows means for attention paid to the TV on this scale by task set and program type. In spite of the problems of some subjects, particularly in the distraction group, in following the task instructions (Table 4), Table 5 reveals a strong main effect for task set, with dual-task subjects reporting that they paid significantly more attention to the TV than distraction condition subjects. In addition, subjects found the high-verbal programs more attention-grabbing than the high-action programs, particularly in the dual-task condition.

Table 5
Attention Paid to Program by Task-Set Instruction and Program Type

Task Set	High Verbal Programs	High Action Programs
Distraction	22.2	20.7
Dual-Task	44.7	30.0

F/significance of Main Effect for Task Set = 18.5, $p = .000$
F/significance of Main Effect for Program Type = 4.90, $p = .03$
F/significance of Interaction of Task Set and Program Type = 3.20, $p = .08$

Finally, subjects were asked to indicate how subjectively distracting they found the TV program to be while they were doing the tests. Subjects indictated distraction by placing a check on a 104 mm. line between the extreme values of "not at all distracting" and "extremely distracting." Table 6 indicates no significant difference between groups in how subjectively distracting subjects found the TV programs. Since scale values ranged from 0 to 104, the means indicate that subjects in each condition found the programs moderately distracting.

Table 6
Mean Subjective Distraction by Task-Set Instruction and Program Type

Task Set	High Verbal Programs	High Action Programs
Distraction	50.9	43.9
Dual-Task	48.9	49.1

All main effects and interactions nonsignificant

Manipulation of Motivation

Given the intrusive nature of the experimental manipulation, the possibility that demand characteristics would lead to invalid results had to be considered. While effective deception concerning the general nature of the study was probably not feasible, an attempt was made to conceal specific hypotheses and expectations. If we accept that the most plausible mediator of demand characteristics for performance on ability tests is differential levels of motivation to perform well (and thus effort expended), this suggests that a consequent threat to validity may be eliminated (or at least substantially lessened) by acting directly upon this intervening factor.

Typically, studies of distraction effects on performance conducted by cognitive psychologists, such as those discussed in the previous chapter, have likewise involved no serious attempt at deceiving subjects with respect to the general subject of the particular experiment. Instead, the typical approach has been to deal with threats to validity arising from such knowledge by independent manipulation of motivation, usually by rewarding subjects monetarily for good performance. Two approaches to manipulation of motivation to perform well were used in the present study, the first involving control of tangible rewards, and the second involving wording the introduction given to subjects at the beginning to the experiment in a way which was expected to increase motivation and conceal overall expectations of the experimenter.

Paying subjects was not seen to be feasible, so another "commodity" of some value to subjects was substituted. Subjects volunteered to participate in the experiment in exchange for a minimum amount of extra credit in an introductory communication class. Subjects were told that they could double the amount of extra credit earned if they performed better on the tests they would take than another student with whom they would be matched. (In reality, all subjects received the greater amount of extra credit).

The explanation given for the study, which was read by subjects when they first entered the room in which the experiment was conducted, was worded in a manner designed to increase motivation to perform well. The introduction indicated that the researcher was interested in assessing the student's performance on several tests of ability. A key portion of this introduction referred to the ostensible value of the tests that would be given as indicators of one's academic and professional achievement. Part of the general instructions given to subjects in the television conditions read as follows:

> You are about to be given a series of tests. These tests have been found to be very good predictors of professional success. First, these tests measure several different abilities, each of which is relevant to success in a different profession. Second, the ability to perform well while under stress and distraction is a good predictor of ability to handle the kind of stressful and distracting conditions which are typical of many business and professional jobs.

In the control condition, subjects read the same statement, except that "while under stress" replaced "while under stress and distraction."

There was reason, a priori, to believe that this type of statement would act as a potent motivator. In practice, it has been shown that people tend to act as if factors which are merely correlated are in fact causally related (Quattrone & Tversky, 1984). For this reason, we are motivated to try hard on IQ tests (or even on medical tests), which are in fact only diagnostic. If one tries harder on an intelligence test, and therefore scores higher than one would otherwise have scored, this does not make one any more intelligent. Nevertheless, most people do try hard to score well on intelligence tests, and find them somewhat stressful.

For this reason, it would be expected that subjects who were led to believe that the ability to perform well in the experimental tests under particular conditions was diagnostic of future success and present ability would attempt to do well on these tests.

In sum, two approaches were taken concurrently in an attempt to create a high and relatively uniform level of motivation across conditions, in order to reduce the possible influence of demand characteristics. First, a direct reward was offered for good performance. Second, subjects were induced to believe that good performance was diagnostic of future success and present abilities. In addition, it should be noted that the same aspects of the introduction which were included for their effect on motivation levels also served the purpose of concealing the particular hypotheses of the study by (1) focusing on individual differences in abilities to perform well under stress and distraction, and (2) equating the ability to overcome distraction with the probability of future professional success.

Making the latter manipulation more plausible was the fact that subjects were requested to sign a form allowing release by the university of data on prior academic achievement (high school grade point, and standardized test scores). In the general instructions, subjects were reminded of this release form, and it was explained that the reason for asking for this release was that the researchers wished to "see if people who do well on these tests have also done well on various measures of academic performance."

Control Variables

On a posttest questionnaire, measures of several types of control variables were taken. First, there were factors which potentially could enter into plausible rival hypotheses "explaining" obtained differences between conditions, or interacting with condition.

Motivation level

One plausible rival hypothesis which would have the potential to explain group differences if not measured and accounted for in analysis involved the possibility of differences in motivation to perform well between groups. Although a serious attempt was made to assure that a uniform and high level of motivation existed in all groups, it was necessary to determine empirically the extent to which this attempt succeeded, and to the degree that it did not, to control for differential motivation statistically. Two separate items were used to assess level of motivation. The first item asked the subject to indicate how strongly s/he wished to do well on the tests, by placing a check on a line between the two extremes of "didn't care at all" and "cared a great deal." The second item asked subjects to indicate the amount of effort they put into trying to do well on the tests by circling a number from 0 (representing no effort) to 10 (representing the amount of effort the subject would put into taking a final exam). Together, these two items were used to assess the alternative explanation that group differences actually resulted from differences in effort or motivation rather than from the distracting effects of television.

Table 7 shows the means for each experimental condition on the two motivation measures. The overall mean for the 0-10 scale of effort expended in the tests was 7.6, which indicates that subjects believed that they did put considerable effort into the tests. The overall mean for the measure in which the subject indicated by a check on a line between two extremes how strongly s/he wished to do well on the test was 73.9 (out of 104). Oneway ANOVA's for each variable were conducted. Overall F's were nonsignificant for both motivation variables. However, a significant contrast between distraction and dual-task subjects was found for the line-checking measure. As can be seen, this was due to subjects in the dual-task-action condition reporting putting less effort into the tests than all other groups, especially those in the distraction conditions.

Scores on the two measures of motivation were correlated .53 ($p \leq .01$). A composite measure for use in later analyses was created by adding the z-score values for the two items.

Table 7
Means for Measures of Motivation by Experimental Condition

Condition	0-10 Effort Measure Mean	SD	0-104 "Care" Measure Mean	SD
Control	7.3	1.4	73.8	16.4
Distraction				
Verbal	8.1	2.4	78.4	18.5
Action	7.7	1.4	77.1	14.3
Dual-Task				
Verbal	7.8	1.4	75.4	14.8
Action	7.1	1.7	64.6	15.4
F/significance	.94/ns		1.99/ns	
significant contrasts	none		dual-task vs. distraction (.05)	

Fatigue

A second alternative was that subjects became more fatigued in some conditions than in others, and that this affected test performance. This was not strictly a rival hypothesis, since one of the ways in which distraction affects performance is by leading to a more rapid onset of fatigue, as a result of expending effort in trying to block out the distracting stimulus. Nevertheless, it was considered that a measure of fatigue would be useful in assessing whether fatigue acted as an intervening variable, and whether any distracting effect of TV operated through other means.

Subjects were asked to indicate at which point (i.e., which test) they began to get tired (if at all). This enabled the determination, for each test, whether a subject was fatigued at the time s/he took the test. It also allowed for the determination of how far along in the test sequence a subject began to feel fatigued. If background TV led to more rapid onset of fatigue, it might be expected that subjects would begin to feel fatigued earlier in the television conditions. In addition, there were two other fatigue measures. First, there was an item which asked subjects to indicate by placing a check on a 104 mm. line between the extremes of "not tired at all" and "extremely tired" how tired overall he or she got from taking the tests. Second, there was a 0-10 scale item asking the subject to indicate how tired or fatigued he or she felt at that particular moment.

Table 8 presents means for the three fatigue measures by treatment condition. The two measures which were overall indicators of how tired subjects got from taking the tests showed no significant differences among conditions. (These indicators were the line-checking item asking "How tired did you get from doing all these tests," and the 0-10 scale asking how fatigued the subject felt at that moment). Both suggest that subjects were not made very tired from taking the tests. The overall mean for the 0-10 scale of fatigue was a low to moderate 4.2. The overall mean for the 0-104 line-checking item was 41.2.

Interestingly, the measure of the test number at which fatigue began did not act in the same manner, relative to treatment conditions, as the other two fatigue measures. Control group subjects appeared to become fatigued significantly <u>more</u> quickly, contrary to expectations. However, there is reason to believe that this result is deceptive. Subjects who reported being tired before they took any tests were given a score of "0" on the FATNUM measure. When these subjects were removed, the mean of the control group was raised from 4.2 to 4.8, and the overall F for the ANOVA was decreased to 1.82 (ns.). It would appear then that random assignment to conditions failed to achieve equal initial levels of fatigue in all groups.

Table 8
Means of Fatigue Measures by Treatment Condition

Condition	FATIGUE[a] Mean(SD)	TIRESD[b] Mean(SD)	FATNUM[c] Mean(SD)
Control	4.1(2.4)	39.6(28.3)	4.2(2.6)
Distraction			
Verbal	3.9(1.8)	35.6(24.2)	5.8(2.5)
Action	4.1(1.7)	42.9(23.8)	5.4(2.1)
Dual-Task			
Verbal	4.1(2.9)	44.6(26.9)	6.6(1.4)
Action	4.8(2.6)	43.2(25.9)	4.6(2.6)
F/significance	.42/ns	.33/ns	2.86/.03
Significant Contrasts	none	none	C vs. all C vs. Distraction C vs. Dual Task

[a]0-10 measure of fatigue
[b]0-104 line-check measure of fatigue
[c]Test number at which fatigue began

Scores on the 0-10 scale of fatigue and the 0-104 line-checking scale were highly correlated (r = .62). Test number at which fatigue began was correlated with the other two measures to a lesser degree (r = -.35 with both other measures).

As was done with the measures of motivation, a composite score was constructed from the fatigue measures, using z-scores (with the sign of the test-number-at-which-fatigue-began measure reversed). The composite score correlated -.72 with test-number at-which-fatigue-began, and .83 with the other two fatigue measures.

Test order

Related to the fatigue question is the problem of the order in which the seven tests were given to students. Tests which were taken later in the battery may plausibly have been influenced more by the television acting as a distracter than tests taken earlier in the battery, if television affected performance through a more rapid onset of fatigue. Presumably, there was also the possibility that the opposite pattern would occur; that is, subjects might get more accustomed to operating under distracting conditions as the experiment went on, leading to a diminished effect of treatment for the tests appearing later in the test battery.

The position in the test battery (first, second, third, etc.) at which a particular test appeared was varied between subjects, in order to assure that order effects did not confound interpretation of test results. In addition, each test was preceded half the time by one other test, and half the time by a different test, since it was conceivable that the content of an immediately preceding test could affect performance on a subsequent one. The position in which a particular test appeared, and an indicator of which test preceded the particular measure, were recorded for each subject. These items were entered into analyses as control variables.

Gender

Two control variables were included primarily due to interest in possible interactions between them and treatment condition. First, some of the previously cited studies of distraction effects suggested that whether an individual is male or female may be related to ability to overcome distraction; therefore, each subject's gender was recorded and used in analysis.

Habitual television behaviors

It was also desired to examine the question whether one could learn to overcome the distracting effect (if any) of background television through practice. If this was the case, it would be expected that subjects who habitually read or studied with the TV on would do relatively better, in the TV conditions, than those who did not. It would also be expected that habitually heavy viewers, as a consequence of greater experience in performing other activities while the TV was on, would do relatively better, in the distraction conditions, than light viewers.

Subjects were asked to indicate whether they "always or almost always," "usually," "sometimes," or "rarely or never" have a TV on when reading or studying at home or in the dorm. In addition, they were asked to indicate which of three study environments they preferred: "while listening to the TV," "while listening to the radio or to recordings," or "in quiet."

Three sets of items assessed overall television viewing. First, subjects were asked to indicate how many hours of TV they viewed on an average weekday, for each of four time periods. Second, they were asked to indicate how many hours they had viewed in these same time periods the previous day. Third, they were asked to indicate how many days in the previous week they had watched at least one hour of TV in each of five time periods.

From the TV viewing questions, the following items were calculated: (1) number of hours of television viewed the previous day; (2) average number of hours of television viewed on a weekday; and (3) total days during the previous week in which at least one hour of TV was viewed in each of the five time periods, summed. These three measures, not surprisingly, were strongly intercorrelated; a correlation coefficient of .58 was obtained for the relationship between the "hours per day on the average" and the "hours viewed yesterday" measures. The measure of total days in which at least one hour of TV was viewed in each of five time periods was correlated .82 and .61 with the "hours on the average day" and the "hours yesterday" measures respectively. Z-scores were created for each of these overall viewing scores, and the three z-scores were added to create a single index of overall television viewing, which was used in subsequent analyses.

In addition, each subject was asked on the post-test questionnaire whether or not he or she had previously viewed the particular program episode used as an experimental stimulus. A total of four subjects had previously seen the episode to which they were exposed, making it unlikely that familiarity was a factor making any substantial impact on experimental findings.

Previous achievement

A final set of "control" variables were assessed for somewhat different reasons. For each subject for whom they were available, measures of previous academic achievement were obtained from the university. These included Scholastic Aptitude Test verbal, mathematics, and total scores; ACT English, math, and composite scores, university English and mathematics placement test scores, and high school grade point average. These items were assessed in order to allow for the extraction of patterned variation in the dependent variables which is known, a priori, to exist regardless of treatment. When control variables of this type relate strongly, independently of experimental condition, with a dependent variable, their inclusion as controls in an analysis of covariance model serves to remove extraneous within-cell variation, resulting in increased measurement precision (Kim & Kohout, 1975). This within-cell variation would otherwise erroneously be treated as (random) error, much reducing the power of subsequent statistical tests.

All background academic data which were requested on student subjects were not available for all students. SAT scores were available for only about 25-30 percent of subjects, ACT scores for almost 80%, university English and math placement test scores for almost 80%, and high school grade point average for over 90%. Given the initially small sample size, the certainty of its substantial reduction using any other analysis strategy, and the basic redundancy of the information provided in various tests, the following strategy was used.

Three constellations of abilities were measured in the set of background academic data available: (1) reading or English ability; (2) mathematics ability; and (3) general or composite abilities. It seemed reasonable to assume that for each subject, the most reliable and accurate indicator of each ability would be a composite of available scores on the several tests measuring that ability. For example, the best possible indicator of reading ability available would be a composite of the SAT verbal score, the ACT English score, and the university reading placement test score. If one of these was unavailable, then the best indicator would be a composite of the remaining two, and so on.

A composite reading score was constructed in the following manner. First, z-scores were calculated for each reading test. If all tests were available, the reading index was made the average of z-scores for the three tests. If only two tests were available, the reading index was constructed as the average of z-scores for the two available tests. If only one reading test was available, its z-score was used as the reading index. If no specific reading test scores were available, the z-score of the subject's high school grade point average was used (h.s. grade point correlated positively with ACT English test score, and was therefore thought to provide a better estimate than the grand mean of reading ability across all subjects).

Scores for mathematical ability were constructed for each subject in a precisely analogous fashion. The overall ability index was a composite of the SAT total score and the ACT composite score (using z-scores). If neither of these were available, but both university-reading and university-math scores were available, then the general ability measure used was an average of z-scores from the two university placement tests. If both ACT and SAT scores were unavailable and one or both of the university placement test scores were missing, high school grade point average was used (High school grade point was used as the last resort in each of these indices because it was related far more weakly to the dependent variables than any of the other academic achievement measures).

Table 9
Intercorrelations Among Indices of Achievement

	Reading Achievment Index	Math Achievement Index	General Achievement Index
Math Index	.47		
General Index	.79	.71	
High School GPA	.30	.39	.41

Table 10
Correlations of Achievement Indices with Component Measures

Measure	Reading Index	Mathematics Index	General Index	High School GPA
S.A.T.				
Verbal	.87	.53	.80	-.02
Math	.52	.85	.61	.10
Total	.32	.38	.77	.15
A.C.T.				
English	.91	.50	.79	.25
Math	.49	.92	.71	.31
Composite	.82	.68	.93	.19
University Placement				
Reading	.89	.37	.58	.02
Math	.35	.92	.56	.29

Tables 9 and 10 show the intercorrelations between the different constructed achievement indices, and the correlations of these indices with the measures from which they were created. Table 11 gives, for each of the achievement indices, the numbers and percentages of subjects for whom the indices were constructed from different numbers of scores on the original measures.

Table 11
Numbers and Percentages of Subjects with Achievement Indices Constructed from One, Two, or Three Scores on Original Measures

	Reading Achievement	Math Achievement	General Achievement
3-Scores	19(23%)	19(23%)	
2-Scores	43(51%)	47(56%)	20(24%)
1-Score	18(21%)	10(12%)	51(61%)
No Scores	4(5%)[a]	8(10%)	13(15%)[b]

[a] "No-score" subjects for either reading or mathematics were assigned a value equal to the z-score form of high school grade point average.
[b] Of the "no-score" group for general achievement, four subjects had both university placement test scores (reading and math). For these subjects, the mean of the university placement test scores was used for the general achievement index value. For the remaining nine subjects, high school grade point average was used.

Experimental Procedure

Subjects were tested individually. The experimental setting was a small, quiet, carpeted, windowless room normally used for seminars or research in audiology. Subjects were greeted at the door to the room, and then seated in a comfortable chair. Directly in front of the chair was a low round table on which subjects could work. Placed beyond the table approximately seven feet from the subject and at about a 45-degree angle to his or her left, was a TV monitor and VCR. The experimenter sat in a chair approximately 45% to the right of the subject and across the table (see Figure 2).

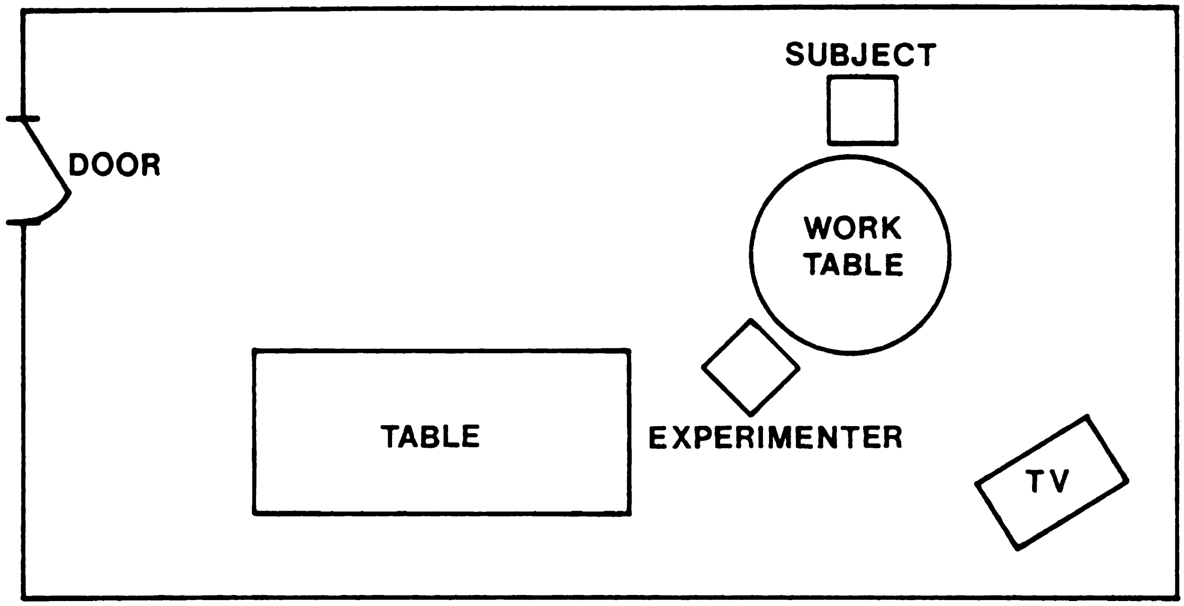

Figure 2
Diagram of Experimental Setting

Once seated at the table, the experimenter (the author, or a senior undergraduate assistant trained and supervised by the author) presented the subject with three forms: A form used to record extra credit the subject was to receive in his or her communication class for participating in the study; a consent form for participation in the study; and a form authorizing the university to release background academic data(SAT and ACT scores, high school grade point average, and university placement test scores). It was made clear that signing the forms was voluntary. Although the case never in fact occurred, any subject who had declined to sign either of the consent forms would have been omitted from the study, but would have received the expected extra credit. Subjects had been informed earlier that they would be asked to sign the two consent forms, when they were being recruited in the Communication 100 sections.

Subjects were randomly assigned to treatment conditions. Within program types, the particular program viewed by a subject was chosen by coin flip.

When subjects had completed and returned the extra credit form, consent form, and release form, they were handed a 2-page set of instructions (Appendix A). The first page was labelled "General Instructions" and informed subjects that they were about to be given a set of tests, indicated that these tests were predictors of professional success, and stated that a subject who scored higher on these tests than another student with whom he or she was paired would get an additional increment of extra credit. The general instructions also indicated that one purpose of the study was to compare performance on these tests with other measures of academic performance, and reminded subjects that they had been asked to sign a release form enabling access to their academic test scores.

The first page of instructions was the same for all subjects with one exception. THe general instructions for the control condition subjects indicated that the ability to do well on these tests under conditions of <u>stress</u> was a good predictor of professional success. For the treatment condition subjects, the instructions referred to the ability to do well under conditions of <u>stress and distraction</u>.

The second page of instructions was entitled "Directions for the Tests." This page contained the overt manipulation of task set (distraction versus dual-task), and was therefore different for control, distraction, and dual-task subjects. The first three paragraphs of these directions were identical in all cases. The first paragraph merely instructed subjects to complete the tests as quickly and accurately as they could, and indicated that both speed and quality would be important in assessing their performance. The second indicated that the tests they were to take would probably be experienced as difficult, and that they should not get discouraged on this account. The third paragraph told subjects to be sure to ask the person administering the tests if they had any difficulty understanding the directions for any test.

The test directions contained an additional paragraph for subjects in the distraction or dual-task treatment conditions. This final paragraph contained the manipulation of task set. The final paragraph of instructions for the distraction-condition subjects read:

> Part of what we are testing is your ability to overcome distracting conditions while demonstrating the skills which are being measured. For this reason, there will be an television operating in the room with you while you are working on these tests. DO YOUR BEST TO IGNORE THE TELEVISION AND CONCENTRATE COMPLETELY ON THE TESTS. YOU ARE BEING EVALUATED SOLELY ON YOUR TEST PERFORMANCE.

For the dual-task subjects, the final paragraph of instructions read:

> Part of what we are testing is your ability to "split" your attention between two different tasks, while performing well on both. For this reason, there will be a television operating in the room with you while you are working on the other tests. Try to do the best you can on the tests, while at the same time keeping an eye on what is occurring on the TV screen. At the end of the testing session, you will be given a short quiz testing how much you remember about the basic plot and characters in the TV program. This will be the final test you will take. TO DO BEST, CONCENTRATE PRIMARILY ON THE TEST YOU ARE TAKING, AND ONLY SECONDARILY ON THE TV PROGRAM.

When subjects had indicated that they had read and understood the two pages of instructions, the actual testing began. Tests were given in different orders to different subjects. There were 14 total alternative test orders, and a particular subject was assigned to one of these orders using a randomization procedure involving cutting a deck of cards and flipping a coin. Subjects were presented with a page of test instructions, followed by the test itself. For each test, subjects were instructed not to begin until the examiner told them to. For treatment condition subjects, the television set was turned on at the time they received the instructions for the first test, and remained on until all tests were completed.

Television programs were presented at a constant amplification for all subjects. Measures were made of sound volume at the position in the experimental room at which subjects were seated. Readings were made on a Bruel & Kjaer

Type 2609 Measuring Amplifier, with condenser microphone. Sound levels ranged from approximately 65db to approximately 80db. The maximum decibel level was thus substantially below the minimum required for deleterious effects of non-meaningful noise (Hockey, 1969; Woodhead, 1964). Differences between experimental and control groups cannot therefore be attributed solely to high sound volumes or to arousal resulting from high noise levels. In fact, the sound volumes experienced by subjects in this study were almost certainly below those often experienced by TV viewers in natural settings.

When a subject had read the instructions for the first test, and indicated this to the experimenter, he or she was asked if the instructions were understood. If the subject replied in the affirmative, s/he was told to begin the test. As soon as one test was completed, the experimenter handed the subject the instructions for the following test.

When all dependent measures had thus been completed, the television was turned off. Treatment condition subjects were given a short quiz on the content of the program that had been on while they were working on the tests, followed by the posttest questionnaire. Control condition subjects were given the posttest questionnaire immediately following the tests. Following completion of the posttest questionnaire, each subject was briefly questionned verbally to determine if they had prior knowledge of details of the tests or the study hypotheses, in which case the intent was to eliminate the subject from the experiment. However, no significant leakage of study details or other invalidating information was obtained in this way.

When the subject had completed the posttest questionnaire and been questionned by the experimenter, he or she was presented with a debriefing form explaining in general terms the purpose of the study, and asking the subject not to discuss its purpose or any of its details with other students. The debriefing form was then returned to the experimenter. The subject was thanked for participating, asked verbally not to repeat any study details to others, and escorted to the door. The entire experimental procedure took between 55 and 75 minutes to complete, depending on the speed with which the individual subject performed the tests and filled out the pre- and post-test forms.

Copies of experimental materials are provided in Appendix A.

Analysis

The main analytical procedure used in testing the hypotheses of the study was Analysis of Covariance. The particular statistical program used was SPSS subprogram MANOVA.

Hypotheses comparing control to distraction and dual-task conditions were examined within a 1 X 5 ANCOVA design, with planned contrasts. Hypotheses involving the relative impacts of distraction versus dual-task conditions, and of high-action versus high-verbal conditions, were assessed using a 2 X 2 factorial design (with the control condition removed).

Prior to performing analysis of covariance, dependent measures were examined to determine the degree to which each met the fundamental assumptions of the statistical method. Since methods utilizing ordinary least squares estimation assume homoscedasticity (equal variances of the dependent variable and residuals at different levels of the independent variable) for unbiased estimation, and normality of residuals for significance testing, each measure was examined for evidence of heteroscedasticity and for substantial deviations from normality. For each measure which significantly failed to meet the assumption of equal variances across conditions, or which showed substantial positive or negative skew (operationally defined in this study as skew in any condition with an absolute value greater than or equal to 1.0), appropriate nonlinear transformations were examined to determine if the variable could be normalized and/or made homoscedastic in this manner.

Transformations of Variables

Eight of the 13 dependent measures presented no problems for analysis, in that they were judged neither significantly heteroscedastic (i.e., not significantly different in variance between conditions) according to either the Bartlett-Box F test or Cochran's C test of homogeneity of variances, nor skewed greater than 1.0. These measures were: score on the digit span test; mental arithmetic number wrong; letter series completion test score; sentence verification test score; Nelson-Denny Reading Test score; uses test (relevant uses); uses test (uncommon uses), and uses test (use categories/relevant uses). These measures were analyzed using their untransformed raw scores.

Five measures failed, to varying degrees, to meet the assumptions of the statistical method. For each of these a search was made for normalizing transformations and/or for transformations which would render the variables in question homoscedastic.

Time spent on mental arithmetic problems was skewed greater than 1.0 in several conditions, and demonstrated heteroscedasticity (Bartlett-Box $F = 2.31$, $p \leq .05$). Transforming the mental arithmetic time score using the natural logrithm of the raw score (Mosteller & Tukey, 1977, Ch. 5) was sufficient to achieve an adequate level of homoscedasticity and reduced skew to acceptable levels. Therefore a LN transform of this dependent measure was used in subsequent analyses.

The other time measure, which was the number of seconds needed to complete the Tower of Hanoi puzzle, was not highly skewed, but was significantly heteroscedastic in its raw form (Bartlett-Box $F = 2.88$, $p = .02$). Again, a logarithmic transformation rendered the data homoscedastic (Bartlett-Box $F = .32$, $p = .86$). The natural logarithm of the raw score was therefore used in analysis of this measure.

The other measure of performance on the Tower of Hanoi puzzle, number of moves needed for solution, was extremely heteroscedastic (Bartlett-Box $F = 11.68$, $p = .000$) and was highly skewed. A simple logarithmic transformation was not sufficient to correct the distribution in this case. However, it was found that a Box-Cox power transformation (Box & Cox, 1964; Bauer & Fink, 1983) using coefficient lambda = (-1) resulted in a measure which was not significantly heteroscedastic (Bartlett-Box $F = 1.17$, $p = .32$), and for which skew was reduced to an acceptable level. The variable thus transformed was used in subsequent analyses.

Two measures from the uses test showed problems with heteroscedasticity or skew. The total number of non-container uses was found in the raw form to be significantly heteroscedastic (Bartlett-Box $F = 2.32$, $p = .05$; Cochrans $C = .38$, $p = .03$). A Box-Cox power transformation with coefficient lambda = .5 was found to render the data homoscedastic, and also to reduce skew. The variable so transformed was used in later analyses.

The number of use categories measure was not significantly heteroscedastic in the raw form, but exhibited a skew of 1.1 in the control condition. A search was made for a transformation that would improve this distribution, but no transformation was found that succeeded in reducing skew without making the variable heteroscedastic. It was decided therefore to retain this variable in its raw form.

Analysis of Covariance

The Analysis of Covariance procedure used a unique sums-of-squares method for estimating the contribution of each independent variable contrast and each covariate. The unique sums of squares method is analogous to simultaneous estimation in multiple regression. With unique sums of squares, the independent contribution of each factor, contrast, or covariate is assessed controlling for contributions of all other factors, contrasts, and covariates in the model. The use of unique sums of squares is necessary in SPSS MANOVA to achieve accurate estimation of specified contrasts whenever such contrasts are not strictly orthogonal.

Use of unique sums of squares estimation creates difficulties in the assessment of the contributions of covariates if these covariates are highly intercorrelated or collinear, since the estimation of the contribution of each covariate is an estimation of its unique contribution, controlling for all other covariates. Therefore, in order to accurately assess whether a particular covariate measure contributed significantly to the dependent variable, and therefore should be retained in the model, preliminary measures had to be taken to assure that highly intercorrelated measures did not essentially cancel out each other's contributions.

One set of covariates in which the collinearity problem was quite striking was the set of achievement indices (reading achievement, mathematical ability, and overall achievement). Intercorrelations among these composite measures ranged from .49 to .79, with smaller but still substantial correlations between these indices and the other academic achievement measure, high school grade point average.

The problem was addressed by entering the three achievement indices, plus high school grade point average, into stepwise multiple regression analyses (SPSS subprogram Regression) predicting each dependent variable. Each achievement measure which was found to be a significant predictor of a given dependent measure, at the .10 level, was retained as a covariate for that measure in the first stage of covariance analysis. Otherwise, the particular achievement measure was dropped from subsequent analyses.

A similar procedure was used to extract for each dependent variable a subset of the remaining, non-achievement-related, covariates which showed some evidence of a relationship with the DV. A stepwise multiple regression analysis was conducted, in this case with the set of conventional control variables (sex, effort measures, fatigue measures) predicting each of the dependent measures.

Again, a .10 level of significance was used, in order not to exclude any control variable which might make a legitimate impact in later analytical stages. It should be noted that this constitutes a conservative procedure with respect to ultimate interpretation of experimental effects.

The TV viewing index was included in initial analyses of covariance for all dependent variables, since Hypothesis 4 required a formal test of the significance of the treatment condition by TV viewing interaction.

For each dependent measure, an initial 1 X 5 analysis of covariance was conducted, with the set of covariates included according to the procedure just outlined. In this stage of the analysis, covariate by treatment interaction terms were included for each covariate. Covariates which contributed proportions of variance which were significant at the .10 level were retained; others were eliminated from further analysis. Significant covariate by treatment interactions were accounted for in the following manner in subsequent stages of analysis.

The finding that an interaction effect exists between a covariate and a factor indicates that the hypothesis that the regression coefficient relating the covariate to the dependent variable is the same across conditions is untenable. For example, in the initial analysis of covariance involving the Nelson-Denny Reading Test, a significant interaction was obtained between the index of prior TV viewing and experimental condition, indicating a significant difference between conditions in the relationship between viewing and Nelson-Denny score.

Under such conditions, it is not appropriate to analyze the control variable in the normal manner as a covariate in the Analysis of Covariance. The solution to this problem is to estimate separate within-cell regression coefficients relating the covariate to the DV for each level of treatment. Thus, for example, the single television viewing index was replaced in the analysis involving the Nelson-Denny Test by five variables, representing variance in viewing within each of the five cells of the ANCOVA model.

In other words, whenever a significant covariate/treatment interaction was obtained, a set of five separate substitute covariates were constructed, one for each condition. Within a particular condition, the covariate in question was allowed to vary normally. Outside the particular condition in question, the variable was set to a constant (the mean of the condition within which it was left free to vary). For the Nelson-Denny analysis, a TV-viewing-within-control-condition variable was constructed, for example, as follows. Using a series of "IF" control statements, the program was instructed to make the within-condition TV score equal to the TV viewing index for all control condition subjects. For all subjects in other conditions, the value of the variable was set to -.15763, the mean of the TV viewing index for control condition subjects. Within-cell variables were constructed in analogous fashion for each of the other conditions, and all five measures entered into the Analysis of Covariance as covariates.

As a result of this procedure, each within-cell covariate exhibited (within-cell) variance within a single cell in the design, no within-cell variance in any other cell, and no between-cell variance. This is mathematically equivalent to the following regression model: $Y = b_1D_1C + b_2D_2C + b_3D_3C + b_4D_4C + b_5D_5C$, where b_i is the within-cell regression coefficient relating covariate (C) to the dependent variable (Y) for condition (i), and Di is a dummy variable with a value of 1 if the treatment condition is equal to (i) and 0 if the treatment condition is not equal to (i). (NOTE: This equation assumes that the covariate has been scaled in mean-deviation form and ignores the intercept). Thus, where significant interactions between covariates and treatment condition were obtained, in subsequent analyses five within-cell variables were used as covariates as a substitute for the original control variable.

Once significant covariates and interactions are extracted, the 1 X 5 covariance analyses were re-run using only these significant covariates and interactions. Obtained ouput included raw means of the dependent variable for each treatment condition, means adjusted for covariates and interactions, tables providing sums of squares and tests of significance for treatment contrasts, and regression coefficients relating covariates, interactions, and treatment contrasts to dependent measures (with associated significance tests). In addition, homogeneity of variance tests and residual plots allowed examination for serious violations of assumptions.

From the 1 X 5 ANCOVA's were obtained estimates of group means adjusted for covariates and interactions, tests of the significance of differences between control and distraction and between control and dual-task conditions (relevant to testing hypotheses 1 and 2), and tests of statistical assumptions.

Following completion of this analysis, a 2 X 2 ANCOVA was conducted for each dependent variable to test the appropriate hypotheses concerning the relative impacts of distraction and dual-task manipulations, and of the high-action versus high-verbal TV content manipulations. The same set of covariates and interactions included in the final 1 X 5 analysis was also used in the 2 X 2 analysis. The 2 X 2 analysis provided separate tests of the significance of main effects of instruction (distraction versus dual-task) and program type, and of the interaction of instruction and program type.

Chapter 3

RESULTS

Before presenting results directly relevant to hypothesized treatment effects, it will be necessary to identify significant covariates for each dependent variable. Table 12 presents standardized regression coefficients, t-values, and significance levels associated with t for each covariate contributing significantly to the prediction of each dependent measure used in the analysis. Where significant interactions between covariates and treatment conditions were found, within-cell regression coefficients are reported, with the overall significance level of the interaction (obtained from a previous stage in the analysis) noted separately.

Measures relating to each of the seven tests used as dependent variables will be discussed separately.

Digit span

Preliminary analysis revealed three covariates which were significant predictors of digit span score in interaction with treatment condition. The first of these was "ABORDER," a dummy variable indicating which of two other tests immediately preceded the digit span test.

Table 12
Significant Covariates and Interactions in 1 X 5 Analysis of Covariance By Dependent Measure

DIGIT SPAN

Covariate	B	t	significance
ABORDER within Control[a]	-.127	-1.22	.227
ABORDER within Distraction-Verbal	.287	2.68	.009
ABORDER within Distraction-Action	-.008	-.08	.938
ABORDER within Dual Task-Verbal	.010	.10	.925
ABORDER within Dual Task-Action	-.426	-4.34	.000
Effort (0-10 scale) within Control[b]	-.208	-1.69	.097
Effort within Distraction-Verbal	.024	.05	.959
Effort within Distraction-Action	.165	1.72	.090
Effort within Dual Task-Verbal	.169	1.62	.111
Effort within Dual Task-Action	.250	1.99	.051
DSFATG within Control[c]	.221	1.92	.059
DSFATG within Distraction-Verbal	-.295	-2.55	.013
DSFATG within Distraction-Action	-.011	-.11	.911
DSFATG within Dual Task-Verbal	-.049	-.52	.604
DSFATG within Dual Task-Action	-.297	-2.29	.026
General Achievement Index	.295	2.94	.005

[a] ABORDER is a dummy variable indicating which of two tests preceded the Digit Span test ("0" = preceded by the Uses Test; "1" = preceded by the Mental Arithmetic Test). Overall interaction effect of ABORDER by Treatment, $F = 6.97$, $p = .000$.

[b] For the overall interaction effect of Effort by Treatment, $F = 2.15$, $p = .091$.

[c] DSFATG is a dummy variable indicating whether or not the subject indicated feeling tired at the time s/he took the test ("0" = not tired; "1" = tired). For the overall interaction effect of DSFATG by Treatment, $F = 2.15$, $p = .051$.

MENTAL ARITHMETIC: TIME TO COMPLETION

Covariate	B	t	significance
Mathematics Achievement Index	-.349	-3.75	.000
Television Viewing Index	-.274	-2.91	.005
Effort Composite	-.182	-1.94	.056
Fatigue Composite	.265	2.87	.006

Table 12 (cont'd)

MENTAL ARITHMETIC: NUMBER OF WRONG ANSWERS

Covariate	B	t	significance
Effort Composite	-.332	-3.08	.003
Test Order (first through seventh)	-.180	-1.67	.099

LETTER SERIES COMPLETION TEST SCORE

Covariate	B	t	significance
General Achievement Index	.554	6.18	.000
Test Order (1-7) within Control[a]	-.182	-1.98	.052
Test Order within Distraction-Verbal	-.025	-.29	.773
Test Order within Distraction-Action	.123	1.35	.181
Test Order within Dual Task-Verbal	-.045	-.51	.613
Test Order within Dual Task-Action	.322	3.77	.000
TV Viewing within Control	.120	1.32	.192
TV Viewing within Distraction-Verbal[b]	-.070	-.82	.417
TV Viewing within Distraction-Action	.132	1.43	.156
TV Viewing within Dual Task-Verbal	.214	2.41	.019
TV Viewing within Dual Task-Action	.058	.68	.499

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[a]For overall interaction of Test Order by Treatment, $F = 6.25$, $p = .001$.
[b]For overall interaction of TV Viewing by Treatment, $F = 2.95$, $p = .032$.

SENTENCE VERIFICATION TEST SCORE

Covariate	B	t	significance
General Achievement Index	.390	3.84	.000
Fatigue (0-104mm scale)	-.229	-2.27	.027

Table 12 (cont'd)

TOWER OF HANOI; TIME TO COMPLETION

Covariate	B	t	significance
Television Viewing Index	-.351	-3.51	.001
ABORDER[a]	-.221	-2.21	.030
THFATG[b]	.306	2.59	.012
Test Order (1-7) within Control[c]	-.161	-1.60	.114
Test Order within Distraction-Verbal	-.083	-.82	.414
Test Order within Distraction-Action	.174	1.73	.087
Test Order within Dual Task-Verbal	-.216	-2.07	.042
Test Order within Dual Task-Action	.013	.12	.903

[a] ABORDER is a dummy variable indicating which of two tests preceded the Tower of Hanoi task ("0" = preceded by the Sentence Verification Test; "1" = preceded by the Nelson Denny Reading Test).

[c] THFATG is a dummy variable indicating whether or not the subject indicated feeling tired at the time s/he took the test ("0" = not tired; "1" = tired).

[c] For the overall interaction of Test Order by Treatment, $F = 2.17$, $p = .086$.

TOWER OF HANOI; NUMBER OF MOVES

Covariate	B	t	significance
General Achievement Index	.363	2.40	.019
Math Achievement Index	-.461	-2.95	.004
Television Viewing Index	-.222	-1.99	.051
Sex of Subject	.370	3.16	.002

NELSON DENNY READING TEST SCORE

Covariate	B	t	significance
Reading Achievement Index	.546	6.21	.000
TV Viewing Index within Control[a]	-.047	-.54	.593
TV Viewing within Distraction-Verbal	.070	.80	.424
TV Viewing within Distraction-Action	-.028	-.32	.751
TV Viewing within Dual Task-Verbal	.011	.13	.897
TV Viewing within Dual Task-Action	.380	4.40	.000
Sex of Subject	-.250	-2.68	.009

[a] For overall interaction of TV Viewing by Treatment, $F = 3.14$, $p = .02$.

Table 12 (cont'd)

RELEVANT USES

Covariate	B	t	significance
General Achievement Index	.217	1.95	.055

UNCOMMON USES

Covariate	B	t	significance
General Achievement Index	.228	2.06	.043

USE CATEGORIES

Covariate	B	t	significance
General Acheivement Index	.389	3.16	.002
ABORDER[a]	.231	2.02	.047
High School Grade Point Average	-.261	-2.15	.035

[a] ABORDER is a dummy variable indicating the test which preceded the Uses Test in the test battery ("0" = preceded by the Nelson-Denny Reading Test; "1" = preceded by the Digit Span test).

NON-CONTAINER USES

Covariate	B	t	significance
Fatigue (0-104mm scale) within control[a]	.110	1.09	.279
Fatigue within Distraction-Verbal	-.236	-2.30	.025
Fatigue within Distraction-Action	-.208	-2.09	.040
Fatigue within Dual Task-Verbal	.020	.20	.839
Fatigue within Dual Task-Action	.024	.24	.811
General Achievement Index	.512	-3.51	.001
Math Achievement Index	-.458	-3.19	.002
Sex of Subject	.229	2.21	.030

[a] For overall interaction of Fatigue with Treatment, $F = 2.16$, $p = .083$.

In the "A" order (coded 0), subjects took the uses test immediately before the measure of digit span. In the "B" order (coded 1), the digit span test was preceded by the mental arithmetic measure.

The form of this interaction can be determined by examining the signs and relative magnitudes of the within-cell regression coefficients relating ABORDER to digit span score. The significant interaction apparently resulted from a difference in order effects depending on whether subjects were in the distraction-verbal condition or the dual task-action condition. Among distraction-verbal subjects, those for whom the Digit Span test was preceded by the mental arithmetic test did significantly better; dual task-action condition subjects, however, did significantly better on the digit span task when it was preceded by the uses test. Which test preceded digit span did not seem to have any influence on performance in the remaining experimental conditions.

The second interaction involved the 0-10 scale measure of effort put into doing the set of tests. The significance of the interaction in this case seems attributable to a difference between the control condition and the treatment conditions. The relationship between professed effort and performance on the digit span test was negative for the control group, and positive or zero for all the TV groups. Putting more effort into taking the tests appeared to be associated with marginally better performance for subjects in the distraction-action, dual task-action, and (perhaps) the dual task-verbal conditions. However, greater effort, as measured by this item, was associated with a somewhat worse level of digit span performance for control condition subjects. (It should be noted, however, that this interaction was significant at the .10 level only).

The third significant interaction involved the indicator of whether or not the subject felt fatigued at the time the digit span test was taken. The within-cell regression coefficients indicate that, in the control condition, subjects who reported being fatigued at the time the test was taken did better than subjects who did not feel fatigued. However, for two of the experimental conditions -- distraction-verbal and dual task-action -- the opposite occurred. Being fatigued was associated with significantly worse performance in these conditions.

Finally, one variable contributed to the prediction of digit span score across conditions: the overall achievement index, which was constructed as a summary of available information about subjects' prior academic performance. Higher scores on this index were associated with higher scores on the digit span test, consistent with the expectation of a positive relationship between short-term memory abilities and academic performance.

Mental Arithmetic

Several of the covariates ended up as significant predictors of scores on the mental arithmetic test. First, for the measure of total time taken to complete the set of mental arithmetic problems, four covariates made significant contributions. Three of these variables entered into negative relationships with mental arithmetic time: the mathematics achievement index, the television viewing index, and the composite index of effort expended in working on the tests. In other words, subjects did better on this measure (took less time) if they had scored higher on previous standardized measures of mathematics achievement, if they were habitually heavier TV viewers, and if they worked harder on the tests.

One covariate was positively related to time taken to complete the mental arithmetic problems: the composite index of fatigue. Thus, the more fatigued the subject felt while taking the tests, the more time taken on the mental arithmetic test. There were no significant interactions between covariates and treatments for this measure.

A second indicator of performance on the mental arithmetic test was the number of incorrect answers given by a subject. Only two covariates made significant contributions to the prediction of scores on this measure. First, there was a negative relationship between number of errors and scores on the effort index, indicating that better performance was associated with the expenditure of more effort. Second, there was a relationship between test score and the position in the test battery at which the mental arithmetic test was taken. The later in the group of tests that the mental arithmetic test occurred for a particular subject, the fewer the number of errors that were made.

Letter Series Completion

Three covariates, two in interaction with treatment condition, were significant predictors of performance on the letter series completion test. First, letter series score was strongly positively associated with subjects' scores on the general achievement index. Second, there was a significant test order-by-treatment interaction, which seems to be due to a contrast between the role of test order in the control condition and its role for subjects exposed to high-action TV content, especially for dual task-action subjects. In the control condition, higher scores were achieved by subjects taking the test at an earlier point in the test battery. For the dual task-action condition in particular, better performance was associated with placement of the test later in the set.

There was also an interaction between TV viewing and treatment condition. However, none of the within-cell regression coefficients relating TV viewing to letter series completion test performance was individually significant, with the exception of that obtained in the dual task-verbal condition. For dual task- verbal subjects, the relationship between habitual TV viewing and performance was positive.

Sentence Verification

Only two significant covariates were obtained for the sentence verification test, and no interaction effects were found. There was a strong positive relationship between scores on the general achievement index and sentence verification test scores. Level of fatigue, as measured by subjects placing a check on a 104mm line between the anchors "not tired at all" and "extremely tired," was negatively associated with sentence verification performance.

Tower of Hanoi

There were two measures of performance on the Tower of Hanoi puzzle: time to completion, and number of moves to completion.

Four covariates made significant contributions to the time to completion measure of performance, one in interaction with treatment condition. First, habitual television viewing was negatively related to the amount of time necessary for a subject to solve the problem. In other words, TV viewing was positively related to performance; heavy viewers took less time.

Also predicting the time measure of Tower of Hanoi performance was the ABORDER variable. As noted earlier, this was a dummy variable indicating which of two alternative tests preceded the criterion in the set of tests. In the case of the Tower of Hanoi, this variable received a score of "0" when the test was preceded by the sentence verification task. A score of "1" was used to indicate that the Tower of Hanoi was preceded by the Nelson-Denny Reading Test. Therefore, the sign of the coefficient relating ABORDER to Tower of Hanoi-time indicates that better scores tended to be obtained when the latter followed the sentence verification Test in the test battery. Since such a relationship did not occur for the other measure of performance on the Tower of Hanoi, it may be suggested that a carryover from the speeded set imposed by the sentence verification test led to greater speed in making moves on the Tower of Hanoi.

Whether or not the subject reported being fatigued also predicted time score on the Tower of Hanoi. Subjects who felt fatigued at the time they did this problem took more time in solving it.

How early or late the Tower of Hanoi occurred in the set of tests was related to time scores in interaction with treatment condition. This interaction appears to be mainly due to differences between the dual task-verbal condition (in which better performance was obtained when the test was given earlier) and the distraction-action condition (in which the opposite relationship obtained).

For the number of moves measure of performance on the Tower of Hanoi puzzle, four variables made significant contributions. There were no interactions. Two different achievement indices predicted performance. First, higher scores on the mathematics achievement index were associated with needing fewer moves to solve the problem (that is, with better performance). On the other hand, the overall achievement index was negatively associated with performance (the higher the score, the more moves needed to solve the puzzle). The latter (rather surprising) relationship may actually be an artifact of partialing, considering the rather large amount of shared variance between mathematics achievement and general achievement. Indeed, the zero-order correlation between the overall achievement index and the Tower of Hanoi moves score is tiny and nonsignificant ($r = .02$, $p = .417$).

The television viewing index was negatively associated with the number of moves measure, indicating that heavier TV viewers tended to do better (i.e., needed fewer moves). This is consistent with results obtained for the other (time to completion) indicator of performance on the Tower of Hanoi.

The significant coefficient relating sex of subject to number of moves indicates (with females dummy-coded as "0" and males as "1") that males tended to do worse on the test than females.

Nelson-Denny Reading Test

Three covariates made significant contributions to the prediction of Nelson-Denny Reading Test scores, one of them in interaction with treatment. The reading achievement index was, not surprisingly, strongly and positively related to Nelson-Denny test score. Sex of subject was also a significant predictor, with females doing better than males.

There was a significant interaction between the television viewing index and treatment condition. Within-cell regression coefficients were negative, but nonsigificant, in the control and distration-action conditions; nonsignificant positive coefficients were obtained in the distraction-verbal and dual task-verbal conditions. However, there was a strong and highly significant positive relationship between prior viewing and Nelson-Denny score for dual task-action condition subjects.

Uses Test

There were several different measures used to evaluate performance on the uses test. For two of these measures, number of relevant uses, and number of uncommon uses, the only significant covariate was the overall achievement index. Prior achievement was positively related to number of relevant and uncommon uses suggested by subjects.

As a third measure of performance on the uses test, the number of distinct categories of use suggested by subjects were noted. For this measure, as for the two previously discussed, the overall achievement index made a significant contribution. However, so did two additional covariates: ABORDER and high school grade point average.

First, the negative coefficient relating high school G.P.A. to the number-of-use-categories measure appears to be a result of partialing for overall achievement. Although high school G.P.A. is negatively related to a significant degree to score on the use categories measure when controlling for overall achievement, the zero-order correlation relating it to this measure is a miniscule -.07 ($p = .28$).

Performance appeared to depend in part on which test preceded the uses test in the test battery. Subjects for whom the uses test followed the digit span test tended to do better than subjects for whom it followed the Nelson-Denny Reading test.

Recall that in the uses test, the stimulus object for which subjects were asked to suggest uses was a tin can. Since the most common use of a tin can is as a container, the number of uses suggested in which the can was given some alternative function was also assessed as a creativity measure. The number of non-container uses suggested was significantly predicted by overall achievement, mathematics achievement, sex of subject, and fatigue, the latter in interaction with treatment condition.

Consistent with its relationship to the other measures of performance on the uses test, score on the general achievement index was positively associated with the number of non-container uses generated. Mathematics achievement was negatively associated with performance, when controlling with general overall achievement. Once again, this would appear to be an artifact of partialing, with a zero-order correlation between the mathematics achievement index and non-container uses a small and nonsignificant .02 ($p = .432$).

The coefficient relating sex of subject to number of non-container uses indicates that females suggested more such uses on the average than males.

Overall level of fatigue, measured on the dual-anchor (0=104mm) scale measure, interacted significantly with treatment condition in predicting performance on this measure. In the two pure distraction conditions, level of fatigue was negatively and significantly related to number of non-container uses. Positive, but nonsignificant, correlations were obtained for control and dual task condition subjects.

Finally, for the measure using the ratio of use categories to relevant uses, there were no significant covariates.

Treatment Effects and Tests of Hypotheses

Hypotheses (1) and (2) referred to the effects of background television on information processing performance in general. Hypothesis (1) states that "performance on information processing tasks will be less accurate and efficient in the presence of an operating television, even when subjects are motivated to ignore the TV." Hypothesis (2), representing the weaker version of the TV-distraction hypothesis, states "performance on information processing tasks will be less accurate and efficient in the presence of an operating television when subjects are motivated to attend at least minimally to the TV content." In the context of the 1 X 5 Analysis of Covariance design, the contrast between control and pure distraction conditions constitutes, for each dependent measure, a test of Hypothesis (1). The contrast between control and dual task conditions constitutes, for each task, a test of Hypothesis (2).

Table 13 shows the means of each dependent variable, adjusted for the influence of significant covariates, for each experimental condition in the 1 X 5 Analysis of Covariance, and gives F statistic values and probabilities for contrasts of control with distraction and dual task conditions.

Table 13
Adjusted Means of Dependent Variables by Treatment Condition, and Significance of Planned Contrasts

Dependent Variable

Conditions/ Contrasts	Digit Span	Mental Arithmetic Time	Mental Arithmetic Wrong	Letter Series	Sentence Verif
Control	7.32	128.37	2.51	10.25	27.67
Distr/Verbal	7.53	136.23	2.94	9.71	26.39
Distr/Action	6.94	138.69	3.65	9.72	29.16
DT/Verbal	7.10	137.46	2.42	9.88	24.65
DT/Action	7.10	121.66	2.43	9.84	28.78
F(C vs. Distr)	.08	.26	1.42	.76	.00
prob. of F	.775	.611	.237	.390	.975
F(C vs. DT)	.52	.00	.02	.39	.09
prob. of F	.474	.957	.894	.540	.765

Conditions/ Contrasts	Tower of Hanoi Time	Tower of Hanoi Moves	Nelson-Denny	Uses Test Relevant	Uses Test Uncommon
Control	61.44	18.72	14.91	10.13	9.74
Distr/Verbal	86.49	20.00	13.70	10.04	9.67
Distr/Action	105.31	26.67	14.72	10.84	9.88
DT/Verbal	112.49	24.11	11.85	7.90	7.47
DT/Action	72.94	23.27	12.65	9.70	8.98
F(C vs. Distr)	6.11	5.28	.47	.10	.00
prob. of F	.016	.025	.493	.760	.977
F(C vs. DT)	4.66	5.61	6.93	1.80	1.95
prob. of F	.034	.021	.010	.167	.167

Table 13 (cont'd)

Dependent Variable

Conditions/ Contrasts	Uses Test Categories	Non-Cont	Cat/Rel
Control	7.46	6.95	.743
Distr/Verbal	7.58	6.64	.753
Distr/Action	6.27	6.50	.591
DT/Verbal	5.74	5.22	.775
DT/Action	6.33	5.75	.703
F(C vs. Distr)	.70	.20	1.79
prob. of F	.405	.659	.185
F(C vs. DT)	4.74	3.02	.00
prob of F	.033	.087	.947

Table 13 does not reveal a consistent negative effect of background television across the set of tasks. However, significant results were obtained for a subset of information processing measures.

No significant differences between control and television conditions were found on four of the tests: Digit span, mental arithmetic, letter series completion, and sentence verification (no effect was hypothesized for the digit span measure). Significant contrasts consistent with Hypothesis (1) were obtained for one test: the Tower of Hanoi puzzle. Contrasts between control and dual task television conditions were found for measures of performance on three tests: the Tower of Hanoi, the Nelson-Denny Reading Test, and the uses test.

As noted earlier, two different measures were used to assess performance on the Tower of Hanoi puzzle: time to solution, and number of moves to solution. On both measures, pure distraction and dual task TV groups each did significantly worse than the no-TV control group. Table 13 shows that on the average, distraction and dual task condition subjects took substantially longer to complete the task than control subjects, and required a greater number of moves to do so.

For the Nelson-Denny Reading Test, the highest adjusted mean occurred in the control condition. However, the differences between the control condition mean and the means obtained for the pure distraction conditions are trivial and not statistically significant. There was, nonetheless, a significant difference between the performance of control and dual task subjects, in favor of the former.

For the first two measures of performance on the uses test, number of relevant uses, and number of uncommon uses, no significant differences were obtained between control and television subjects, although the direction of the difference between control and dual-task conditions is consistent with measures on this test which do differentiate. The former measure was simply a count of all uses suggested for tin cans that made any sense whatsoever, while the latter was a count of all such uses, excluding the use of the cans for storing or preserving food. In the context of the way in which these sorts of measures have been used previously (e.g., Torrance, 1966), they may be regarded as measures of "ideational fluency."

Probably more concurrent with common conceptions of the meanings of the terms "creativity" or "flexibility" were the Uses Test measure involving number of different categories of use, and the measure of the number of different uses in which the can served a role other than that of container. For each of these measures, there was still no significant difference between control and pure distraction TV subjects. However, subjects in the control condition suggested a significantly greater number of use categories than dual task subjects. A similar relationship for the measure of non-container uses achieved significance only at the .10 level. Finally, differences between control and distraction conditions, and between control and dual-task conditions for number of categories taken as a proportion of number of relevant uses were not significant.

In sum, while the results reported in Table 13 provide insufficient support for either Hypothesis (1) or Hypothesis (2) as general propositions, their predictions are supported for a subset of dependent variables. The evidence is stronger with respect to Hypothesis (2), whose prediction was consistent with findings for the Tower of Hanoi, the Nelson-Denny Reading Test, and at least one (perhaps 2) of the uses test measures.

Sub-hypotheses (1a) through (1e) identified separate types of tasks for which it was predicted that background television would negatively influence performance. Hypotheses (8) and (9) went further, in identifying which of the types of information processing tasks identified in subhypotheses (1a)-(1e) should be more strongly affected by background TV acting as a distracter.

Hypothesis (1a) stated that "exposure to background TV will negatively affect concurrent performance in tasks involving linguistic processing." The focus of this hypothesis was on the possible impact of background TV content in inhibiting the grammatical manipulation of symbols in the language system. The test which most directly assessed such processing was the sentence verification test, for which no significant treatment effects were obtained. A significant control versus dual-task condition contrast was obtained for a second measure, the Nelson-Denny Reading Test, which also clearly required grammatical processing; however, performance on the latter is more clearly relevant to testing a different hypothesis (1b). The fact that the purer measure of grammatical processing speed was not apparently affected suggests that the background TV content was not probably affecting language processing directly at the level of syntax.

Hypothesis (1b) stated that "exposure to background TV will negatively affect concurrent processing of written text." The Nelson-Denny Reading Test, as a specific test of reading comprehension, was the most relevant measure for assessing this prediction. This being the case, Hypothesis

(1b) would appear to have received support only under weak version conditions, that is, when the individual was motivated to attend to some degree to the television.

Hypothesis (1c) stated that "exposure to background TV will negatively affect performance on complex problem-solving or reasoning tasks." Two tests were included in the test battery specifically to assess complex problem-solving or reasoning performance: the letter series completion test and the Tower of Hanoi. Of these, it was argued earlier, the more complex and demanding would appear to be the Tower of Hanoi puzzle. For the Tower of Hanoi, Hypothesis (1c) was supported with respect to both distraction and dual task television conditions. For the letter series completion test, however, the control condition mean was only nonsignificantly higher than that of the treatment groups. Hypothesis (1c) thus receives partial support.

Hypothesis (1d) states that "exposure to background TV will negatively affect concurrent performance on tasks involving creativity, divergent thinking, or flexible memory search." The task most relevant to this hypothesis was the uses test. As can be seen in Table 13, uses test measures reflecting ideational fluency, or the gross number of uses (relevant uses, uncommon uses), exhibited non-significant differences between conditions. However, the measures reflecting more strongly the idea of flexibility or creativity (use categories, non-container uses) appeared to be affected by background TV in the predicted manner, although only with respect to the dual task treatment. Hypothesis (1d) thus also appears to be partially supported.

Hypothesis (1e) states that "exposure to background TV will negatively affect the ability to maintain information in short term memory while operations (other than rehearsal) are being performed on that information." The direct test of this hypothesis involved performance on the mental arithmetic test. In this test, subjects were required to perform arithmetic operations on numbers in short term memory. Hypothesis (1e) was not supported. There were no significant differences in performance between conditions either on the mental arithmetic test, or on the digit span measure of passive short term storage.

Related to Hypothesis (1e) was Hypothesis (8) which predicted that tasks involving mental manipulation of materials in short term memory would be affected more by television than tasks which required merely that materials be maintained (in the form input) in short term memory. Since so significant differences were obtained for either short term memory measure (mental arithmetic or digit span), Hypothesis (8) likewise failed to be supported.

Hypothesis (9) formalized the expectation that tasks requiring the flexible coordination of separate information-processing operations would be more strongly disrupted than tasks relying on any single type of simple operation. The results presented in Table 13 would appear to be generally consistent with this prediction. Tests of single simple information processing operations, using the criteria discussed in Chapter 2, would include both short term memory tests and the sentence verification test (basically a test of linguistic processing speed). For none of these three tests were any significant treatment effects obtained.

The remaining tests, to varying degrees, could be seen to require coordination of various types of discrete information processing operations; they are certainly more complex than the aforementioned three tasks. For three of these four, significant effects of background television on performance were obtained. For the remaining measure, the letter series completion test, group means, although showing a pattern consistent with expectations, failed to differ to a significant degree.

<u>Effects of Task Set Instruction and Program Type</u>

Hypotheses (3), (6), and (7) deal with predicted differences among treatment conditions. Hypothesis (3) formalized the expectation that subjects in the dual task conditions would be more strongly affected by the TV distracter than subjects instructed to ignore the television completely. Hypotheses (6) and (7) dealt with which sorts of tasks were expected to be more strongly affected by high-verbal and high-action TV content

respectively. These three hypotheses may be assessed by examining the results of the
2 X 2 Analysis of Covariance, shown in Table 14.

The test of Hypothesis (3) is the statistical test of significance of the main effect of instruction in the 2 X 2 ANCOVA. Main effects of Instruction in the predicted direction which were significant at the .05 level were found for the Nelson-Denny Reading Test, and for the measure of total relevant uses in the uses test. It should be recalled that the latter indicator would be regarded, consistent with previous usage, as a measure of ideational fluency (as opposed, say, to the use categories measure, which is regarded as an indicator of flexibility or creativity). Main effects of instruction, in the predicted direction, were significant at the less conservative .10 level for two other uses test measures: number of uncommon uses, and number of use categories, although in the latter case an interaction between TV content type and instruction confounds interpretation.

On the other hand, a main effect of instruction for the mental arithmetic number of incorrect responses measure, significant at the .10 level, ran in a direction opposite to that which was hypothesized. This was apparently due to subjects in the distraction-action condition doing substantially worse than any of the other groups.

Hypothesis (6) argued that "mental tasks involving linguistic processing or response will be more strongly disrupted by background TV content which is high in verbal content, than by content which is high in physical action but low in talk." The tests in this set which most clearly rely on "linguistic processing or response" are the sentence verification test and the Nelson-Denny Reading Test, although it might be argued that the uses test also falls in this category. The status of the last is ambiguous because, although obviously requiring language use in the generation of responses, it is primarily a test of cognitive flexibility, and therefore theoretically susceptible primarily to impacts of arousal.

For the both the sentence verification test and the Nelson-Denny Test, sample means in the high-verbal TV conditions are indeed lower than sample means for the high-action groups. However, these differences are not great enough in either case to attain statistical significance. Therefore, it cannot be determined whether an actual impact has occurred which is too small to be detected in a sample of this size, or that the obtained mean differences were simply the result of sampling error.

Table 14
Adjusted Means, Main Effects of Task Set Instruction and Program Type, and Interaction of Task Set and Program Type in 2 X 2 ANCOVA

Dependent Variable

Conditions/ Effects	Digit Span	Mental Arithmetic Time	Mental Arithmetic Wrong	Letter Series	Sentence Verif
Distr/Verbal	7.49	134.86	2.99	9.55	25.84
Distr/Action	6.91	139.19	3.71	9.57	28.77
DT/Verbal	7.05	139.92	2.37	9.73	24.17
DT/Action	7.08	127.17	2.32	9.69	28.47
Main Effects					
F-Instruction	.28	.06	3.26	.10	.16
prob. of F	.599	.800	.076	.750	.688
F-Program Type	1.16	.08	.37	.00	2.17
prob. of F	.286	.770	.543	.987	.146
F-Interaction	1.14	.35	.49	.00	.08
prob. of F	.238	.560	.487	.951	.780

Conditions/ Effects	Tower of Hanoi Time	Tower of Hanoi Moves	Nelson-Denny	Uses Test Relevant	Uses Test Uncommon
Distr/Verbal	85.63	20.04	13.62	9.98	9.60
Distr/Action	104.21	26.90	14.63	10.79	9.82
DT/Verbal	111.10	24.17	11.78	7.84	7.40
DT/Action	72.72	22.49	12.55	9.65	8.92
Main Effects					
F-Instruction	.11	.03	5.90	4.06	2.96
prob. of F	.737	.860	.018	.048	.091
F-Program Type	.59	1.84	1.18	2.55	.91
prob. of F	.445	.180	.283	.115	.343
F-Interaction	4.40	4.96	.02	.38	.53
prob. of F	.040	.030	.881	.541	.469

Table 14 (cont'd)

Dependent Variable

Conditions/ Effects	Uses Test Categories	Non-Cont	Cat/Rel
Distr/Verbal	7.55	6.66	.753
Distr/Action	6.31	6.55	.591
DT/Verbal	5.72	5.25	.775
DT/Action	6.30	5.75	.703
Main Effects			
F-Instruction	2.84	2.54	2.28
prob. of F	.097	.117	.136
F-Program Type	.37	.09	6.99
prob. of F	.543	.770	.010
F-Interaction	2.85	.21	1.04
prob. of F	.097	.651	.311

A similar result obtains for the uses test measures of relevant and uncommon uses. However, the patterns of means for the two uses test measures of flexibility (use categories and non-container uses) were not consistent with this hypothesis. The only significant result was obtained for the measure of use categories as a proportion of relevant uses. In this case a highly significant main effect of type of TV content was obtained, but the direction of this effect was consistent with the arousal mechanism, not with disruption of linguistic processing. Subjects in the high-action content conditions, particularly the pure distraction subjects, did significantly worse on this measure than subjects in the high-verbal conditions.

In sum, there is insufficient evidence to lend support to Hypothesis (6). For the two measures which most clearly met the conditions of the hypothesis (i.e., relied most strongly and exclusively on verbal processing), no significant differences were obtained. The results therefore fail to provide support for the notion that, at least within the range of content variation reflected in these experimental treatments, TV content with high levels of verbal content especially disrupts viewers' linguistic processing.

Hypothesis (7) states that "complex mental tasks not involving linguistic processing or response will be more strongly disrupted by high-action/low-verbal content than by high-verbal/low-action content. The most unambiguous example of such a task is the Tower of Hanoi puzzle, a complex nonverbal puzzle. While there is no main effect of program type for either measure of performance on the Tower of Hanoi, there is an interesting interaction of instruction with program type.

For example, on the time-to-completion measure, a lower sample mean was obtained in the distraction condition for the group exposed to the high-verbal programs, consistent with expectations (a lower time score represents better performance), although this difference did not achieve statistical significance ($t = 1.01$, $p = .316$). For dual task condition subjects, those exposed to the high-action content did significantly better than subjects watching high-verbal programs ($t = -2.13$, $p = .036$). This was contrary to expectations.

For the number of moves measure of performance on the Tower of Hanoi task, the pattern of means was similar. However, for this indicator, only the difference between verbal and action conditions among the pure distraction subjects was significant ($t = 2.63$, $p = .010$). There was therefore evidently something going on which was more complex than what would be expected based on Hypothesis (7). This hypothesis does not therefore appear to be supported.

Hypotheses (4) and (5) dealt with the possible impact of prior media habits on the relationship between background TV and cognitive processing. Hypothesis (4) predicted that subjects who were more experienced in reading or studying in front of the television would be better able to overcome the distracting effects of background TV; therefore, they would do relatively better in the various TV conditions than subjects who did not habitually read or study with the television on. Hypothesis (5) posited an habituation effect of exposure per se. It simply predicted that heavy television viewers would be better able to overcome the distracting effects of background TV than lighter viewers. Heavier viewers should therefore do relatively better in the four treatment conditions.

As it turned out, Hypothesis (4) could not be tested in this experiment, since only one subject out of the whole sample admitted to habitually studying or reading with the television on. Therefore, let us proceed to assess the predictions implied by Hypothesis (5).

If habitually heavier TV viewers were able, as hypothesized, to more easily overcome television distraction, an interaction effect of TV viewing with experimental condition should be detected in the 1 X 5 Analysis of Covariance for each dependent measure (or at least for all criterion measures for which significant effects of TV distraction were obtained). The test of the significance of covariate by treatment interactions in the Analysis of Covariance model is equivalent to a test of the hypothesis that the within-cell regression coefficients relating the covariate to the criterion are equal across conditions. Such interactions were significant only for measures of performance on two of the seven tasks: the letter series completion test ($F = 2.95$, $p = .032$), and the Nelson-Denny Reading Test($F = 3.14$, $p = .020$).

The finding of a significant interaction is not in itself sufficient to support the hypothesis. It is also necessary to determine if the differences between cells in the relationship between habitual viewing and performance are consistent in direction with what would be expected if

Hypothesis (5) were true. This information (originally from Table 12) is provided in Table 15, which shows within-cell regression coefficients relating the television viewing index to scores on the Nelson-Denny Reading Test and the letter series completion test.

Table 15
Within-Cell Regression Coefficients for Television Viewing Predicting Letter Series Completion and Nelson-Denny Reading Test Scores

Conditions	Letter Series Completion Test	Nelson-Denny Reading Test
Control	.120	-.047
Distraction		
Verbal	-.070	.070
Action	.132	-.028
Dual-Task		
Verbal	.214*	.011
Action	.058	.380*

*$p \leq .05$

If heavy habitual viewing led to a greater ability to overcome the distracting influence of background television, the within-cell regression coefficients relating TV viewing to performance should be positive in the four TV conditions and negative or null in the control condition. In neither case in which a significant interaction was detected did such a pattern emerge.

Heavy viewers did appear to do relatively better on the letter series completion test in the dual task-verbal condition, but the same was not true of the other TV-viewing conditions. The coefficient relating TV viewing to Letter Series task performance was also positive (but nonsignificant) in the control condition. For the Nelson-Denny Reading Test, prior TV viewing was related to performance in the predicted manner for subjects in the dual task-action condition, but not for the other experimental groups. Examination of the within-cell regression coefficients for these two dependent variables does not suggest overall that heavy viewers were relatively immunized to the effects of background television.

Within-cell correlation coefficients relating TV viewing to each dependent measure were also examined for any evidence that background TV affected heavy viewers any less than light viewers. Table 16 presents the within-cell correlations between prior viewing and scores on criterion measures. What is important with respect to evaluating these within-cell correlations is to discern any pattern whereby the relationship between viewing and performance differed between the control condition and the set of treatment conditions. Consistent with Hypothesis (5) would be any consistent pattern in which the performance of heavy viewers was relatively better in the four TV conditions, in comparison to the control condition.

Examination of these correlation coefficients reveals no general pattern conforming to the expectations induced by Hypothesis (5).

On the digit span test, there was a negative correlation of borderline significance relating TV viewing to performance in the control condition. Correlations of similar magnitude but opposite direction were found for the two pure distraction conditions. However, coefficients very close to zero were obtained in the two dual task conditions on this measure, so the overall pattern cannot be said to correspond very well to expectations.

Heavier TV viewers tended to do better on the two mental arithmetic test measures in the control and television groups alike. For example, the mean correlation between TV viewing and mental arithmetic-time across the four treatment conditions was -.373, while the coefficient in the control condition was -.302. The mean experimental-condition correlation on the number of incorrect responses measure was -.215, less than the -.304 correlation found in the control condition. (Interestingly, this would seem to run counter to the popular notion that habitual TV viewing lowers attention span). A similar result was obtained for the letter series completion test.

An interesting pattern of correlations appeared for the sentence verification test. Coefficients between .30 and .35 were obtained in the two high-action TV content conditions, with TV viewing related negatively in the same range to performance for the control group. A relationship with type of program content is suggested, since correlations coefficients very close to zero were obtained in the two treatment conditions which used high-verbal content. Of course, the absence of statistical significance (possibly due to low power resulting from the small size of sub-samples) renders this comparison merely suggestive.

Table 16
Within-Cell Correlations of Television Viewing with Test Scores

		Distraction		Dual Task	
	Control	Verbal	Action	Verbal	Action
Digit Span	-.362*	.368*	.296	.080	-.004
Mental Arithmetic Time	-.302	-.363*	-.561**	-.057	-.509**
Mental Arithmetic Wrong	-.304	-.211	-.485**	.031	-.194
Letter Series Completion	.396*	-.058	.544**	.358*	.058
Sentence Verification	-.340	-.072	.338*	-.019	.311
Tower of Hanoi Time	-.187	-.264	-.598**	-.255	-.436**
Tower of Hanoi Moves	.424*	-.126	-.433**	.022	-.444**
Nelson-Denny Test	-.382*	.107	.125	-.292	.593**
Uses Test: Relevant	.091	-.097	.265	.338*	-.285
Uses Test: Uncommon	.103	-.069	.032	.374*	-.409*
Uses Test: Non-Container	.086	.022	-.025	.305	-.314
Uses Test: Categories	.289	.040	.080	.203	-.258
Uses Test: Categ/Relevant	.235	.241	-.157	-.260	.040

*significant at .10 level.
**significant at .05 level.

A similar pattern was obtained on the Tower of Hanoi puzzle. For both measures of task performance (time to completion and number of moves), heavier TV viewing was associated with significantly better performance, but only in the distraction-action and dual task-action conditions. In the control condition, for the number of moves measure only, prior viewing was associated with worse task performance.

For the Nelson-Denny Test, the correlation coefficients not surprisingly yield a pattern consistent with that already discussed with respect to the within-cell regression coefficients. Heavier viewers appear to have done worse in the control condition, and better in the dual task-action condition. However, the relationship between viewing and test score was nonsignificant and inconsistent with respect to direction for the remaining three treatment conditions.

Neither is any pattern consistent with Hypothesis (5) discernible for any uses test measure. Heavy TV viewers in the dual task-action condition seemed to do relatively worse on the various measures of performance, while heavy TV viewers in the dual task-verbal group did relatively better. Again, significance levels are not sufficient to make generalizations.

To achieve more of an overall picture of the relationship between TV viewing and test performance across tests, weighted averages of correlations within conditions were calculated. In calculating these mean correlations, particular measures were weighted such that each separate test received the same weight, regardless of the number of individual measures associated with the test (i.e., the uses test and the Nelson-Denny test were given the same weight in the calculations, in spite of the fact that performance on the former was assessed on four scores, and only one score was obtained for the latter). Signs of correlations were also adjusted so that a negative sign was always associated with heavy TV viewers performing more poorly, and a positive sign with heavy TV viewers performing better. The results of these calculations are reported in Table 17.

Table 17
Weighted Average Within-Cell Correlations Between Test Performance and TV Viewing[a]

	Control	Distraction Verbal	Distraction Action	Dual Task Verbal	Dual Task Action
Test Performance/TV	-.052	.114	.274	.080	.205

[a] In computing average correlations, the scores for the use categories/relevant uses measure were omitted. The fact that this measure was a ratio of two other measures used in the computations was considered to be confounding.

Although Table 17 shows heavy viewers in the sample doing slightly better than light viewers in the two action content TV conditions, none of these coefficients would approach statistical significance for samples the size of each within-group condition. In other words, the small differences shown in Table 17 could easily be due to failure of randomization to achieve groups of sufficient similarity.

In sum, neither the examination of interaction effects in the Analysis of Covariance, nor the within-cell correlations between prior viewing and test performance, suggest general habituation effects of television viewing. Although the data do not rule out modest degrees of habituation relating to specific tasks, they do not support a general immunization to distraction effects such as suggested by Hypothesis (5).

Summary

Of six tests for which performance was hypothesized to be affected by background television, significant effects in the expected direction were obtained for three: The Nelson-Denny Reading Test, the uses test measures of use categories and non-container uses, and the Tower of Hanoi puzzle. For the Nelson-Denny and uses tests, television impacts only appeared in conditions in which subjects were instructed to pay some degree of attention to the television. However, performance was substantially worse in all television conditions for the Tower of Hanoi. Moreover, on the latter measure, there was no significant difference in performance between "dual-task" and "pure distraction" subjects.

Partial support is thus obtained for hypothesized television distraction effects on processing of written text, divergent production, and complex problem-solving. No effects of background TV were found for measures of short-term memory or linguistic processing speed. Predicted main effects for type of television content (verbal versus action) were not obtained, although some interaction effects of content with task set were found. Analysis failed to support the prediction that habitually heavier TV viewers, by becoming acclimated to operating under background TV conditions, would prove relatively better able to perform under conditions of television distraction.

Chapter 4

DISCUSSION

The purpose of this study was to propose a process which could account for the observed relationships between television viewing and intellectual ability and achievement, and to test the plausibility of this process experimentally. The study actually conducted to examine this process was complex, both with respect to design and with respect to the results obtained. It was intended not just to determine _if_ background television had any impact on information processing abilities, but to provide information concerning _how_ such impacts occurred, and what sort of information processing abilities were therefore affected. The study also attempted to assess the _conditions under which_ TV exposure might affect cognitive processing: In this respect, the influence of variables relating both to program content and to orientation toward the television were taken into account.

Seven different information processing tasks were set before experimental subjects in five different conditions. Tasks included tests of short-term memory, grammatical decoding abilities, reading, complex problem solving, and flexible memory search. Four television viewing conditions varied according to attitude induced toward the television stimulus, and nature of program content. In addition a set of control variables was included in an Analysis of Covariance design.

It will be useful, due to the complexity of the study and its findings, to discuss the latter in an organized fashion: First, to discuss the main findings with respect to treatment effects; second, to draw conclusions about mediating processes which may help to explain the quantitative results; third, to answer other questions posed in the course of the study; fourth, to discuss weaknesses in the methods employed, and how they affect interpretations of findings; and fifth, to suggest implications of the findings and directions for further research.

Treatment Effects

Before proceeding to interpret the evidence relating to the specific questions this study attempted to answer, one caveat should be noted. Although the seven tests which were used as dependent measures in the experiment differed in many respects from one another, they by no means can be regarded as a representative sample of all possible tests or dimensions of intellectual performance. Because of the absence of representativeness in this respect, overall judgments about the impacts of background television on mental processing in general cannot result from simply averaging differences between treatment groups across tests.

While the tests chosen for inclusion in this study were not picked to be representative of all information processing tasks, neither were they chosen abritrarily. Each of these tests was selected for a reason, to represent a particular type of task which may be disrupted by background television, and in order to help locate the locus of any impacts actually found. It is most appropriate to treat these tests individually, and then to attempt to assess the common characteristics of those tests which seemed to respond to treatments in a common manner.

The first and most basic goal of this research was to determine *if* concurrent viewing of television had any discernable effect on intellectual performance.

Performance on six of seven tests was predicted, on the basis of different hypothesized mechanisms, to be negatively affected by the presence of background television. Significant differences between scores of subjects working in quiet and subjects working in the presence of television were obtained for measures involving three of these tests. For two of the three, a significant performance decrement only occurred under conditions in which subjects were (artificially) motivated to appropriate some degree of attention to the TV content, while for the third test, significantly poorer performance was observed even when subjects were instructed to ignore the television entirely.

What did these findings imply about the types of information processing tasks which would tend to be affected by the presence of background television? While this is somewhat difficult to answer simply, since tests may be grouped in various ways according to different types of characteristics, it is possible to draw some tentative conclusions from an examination of apparent similarities between tasks which were negatively impacted, and by noting differences between that set of tasks and those for which no effects of background television could be detected.

The tasks for which significant treatment effects were found were: the Tower of Hanoi puzzle; the Nelson-Denny reading test; and the uses test. The tasks for which there were no significant differences between control and television conditions were: digit span (no effect was originally hypothesized for this measure); mental arithmetic; sentence verification; and letter series completion.

One rather striking similarity among the tests included in the former set is that they were all tasks of the sort that Hunt (1980) has referred to as "synthetic," in reference to requiring the creative orchestration of a number of different information processing abilities. Of the tests for which no significant impacts were obtained, only one fell at least nominally into this category: the letter series completion task. (All experimental group means on the LSC test were indeed below the mean for the control group, but the difference was not significant.)

There was also a second way in which the tasks which were affected by background television would appear to differ from those on which it had no significant impact. The tests which were unaffected each consisted of a series of relatively short, self-contained, problems, while those for which background TV exerted a deleterious influence tended to demand fairly prolonged concentration on particular tasks. The Tower of Hanoi was a single problem. The Nelson-Denny test, while consisting of a fairly large set of items, required prolonged periods of concentration on reading passages prior to answering these questions. The uses test was essentially a single problem.

Contrast this with the types of tasks which did not appear to be affected by television. Each digit span problem required that subjects read a series of numbers, hold the series in memory for ten seconds, and repeat it back to the researcher. Each successive series was independent and unrelated (in terms of solution) to the preceding problem. Similarly, the mental arithmetic test was a series of simple arithmetic problems, each again short and self-contained. In the sentence verification test, subjects were required to answer as many (independent and self-contained) true-false questions as possible in three minutes. The letter series completion test required subjects to solve as many of 15 completion problems as possible in a limited time period. In this test again, each short problem was unrelated, except in its basic form, to any other.

None of the tasks which failed to be affected by concurrent TV viewing required prolonged concentration on a particular information processing problem, so perhaps the requirement of prolonged concentration is the unifying element here. Each of the tasks which were affected by background TV required such prolonged concentration to some degree. The particular task which can be regarded as the most nearly a unitary task, in the sense of requiring attention to a single problem, is the Tower of Hanoi: the test for which by far the strongest impacts were found.

If it is important to determine the salient differences between those tests which were impacted by television and those which seemed impervious to this type of distraction, it is also important to attempt to assess why one member of the former set of tests was so much more strongly affected than the other two. By far the strongest impacts were obtained for performance on the Tower of Hanoi puzzle, the only task for which significant distraction effects were found even when subjects were instructed to totally ignore the television.

Two different measures were used to assess performance on the Tower of Hanoi task: time to solution, and number of moves to solution. In the original metric, distraction subjects took 28% more moves and 56% more time on the average to solve the Tower of Hanoi puzzle than did control subjects. In contrast, scores on the Nelson-Denny reading test were on the average approximately 5 percent lower in the distraction condition, and 18 percent lower when subjects were instructed to attend minimally to the television, compared to the no-television control group. For the uses test measure of number of use categories, the pure distraction subjects scored on the average 7 percent lower than control subjects, while dual task TV distraction subjects provided an average of 19 percent fewer uses. Similar differences were obtained for non-container uses.

Why were results for the Tower of Hanoi puzzle so much more dramatic than those for any of the other tests for which significant differences were also obtained? What characteristics distinguish this particular task from all others in the test battery, and most importantly, what might these differences suggest about the manner in which background TV may affect cognitive processing?

Three plausible reasons why performance on the Tower of Hanoi should be most strongly affected by concurrent TV exposure can be inferred from ways in which this test differed from others used in the experiment. First, the stronger effect may have to do with the level of difficulty and complexity of the task. There is some reason at least to believe that the Tower of Hanoi was the most difficult of the tests used in the experiment. In fact, as was noted in earlier discussion of this test, it had originally been planned to use a version with 5 disks but, because the 5-disk version was too difficult for many students to complete in a reasonable amount of time, a 4-disk Tower of Hanoi actually had to be used. On a somewhat more subjective level, the Tower of Hanoi was the only test about whose difficulty a substantial number of subjects spontaneously commented.

A second possibility has to do with the special demands made by this task in particular on planning abilities involved in what Greeno called "means-ends analysis" (see pp. 103-105). It may be argued that strategic planning and skill at problem-representation is more important to the Tower of Hanoi problem than to any other test in the test battery.

There is an additional reason for believing that the Tower of Hanoi might have tested planning and problem-representation abilities to greater extent than other tests in the battery. The Tower of Hanoi was one task in which time was <u>specifically set aside</u> for subjects to plan, to study the problem before attempting solution. Considering that tests were speeded in general in this battery, and subjects were aware that they were being evaluated at least partially on speed, planning may have been artificially, if inadvertantly, inhibited for the other tests. If distraction of the type represented by background television affects performance by influencing what Sternberg (1979) called "metacomponents" (see pp.77-79), particularly by inhibiting planning and reducing time spent in preparing to solve a problem, we would expect this sort of influence to show up most strongly in a test which first, requires preparation and planning to solve, and second, where such planning and preparation is not externally inhibited already by other influences.

A third possibility has to do with the degree to which each test was familiar. Most of the tests used in the experiment asked subjects to perform tasks which were at least somewhat familiar to anyone who has gone through public or parochial school systems in the U.S. The format and content of most if not all of the tests, except for the Tower of Hanoi, was the sort that one is exposed to in elementary and high school in tests of achievement and intelligence. Therefore, it is possible to apply pre-established strategies to their performance. The Tower of Hanoi, not being the sort of problem which is common in standardized IQ and achievement tests, would require that a subject develop an original mental representation of it and devise a strategy for its solution essentially from the whole cloth. This is one reason why, presumably, subjects found the Tower to be so subjectively difficult. As George Miller (1967) has noted:

> If a new task meshes well with what we have previously learned, our earlier learning can be transferred with profit to the novel situation. If not, the task is much harder to master. (p. 3)

Of course, one may make other, methodological, suggestions about the cause of the difference in the way in which background TV affected the Tower of Hanoi, compared to other tests. The measures used for the Tower of Hanoi puzzle did allow for superior precision in evaluating performance, compared to, for instance, letter series completion score, or number of use categories, each of which had a relatively narrow range of possible values.

However, greater measurement precision cannot be the whole answer, since other tasks also had relatively sensitive measures (i.e., mental arithmetic, sentence verification, Nelson-Denny test), but none showed impacts of the magnitude obtained with the Tower of Hanoi.

Furthermore, when comparing results for the Tower of Hanoi with results for the other two variables for which significant differences were obtained -- Nelson-Denny and Uses Test -- we find not just differences in <u>magnitude</u> of effect (which could be conceivably attributed to lesser reliability for the latter measures), but differences in the <u>basic pattern</u> of group means. In the Nelson-Denny and the uses test, group means were substantially lower in the dual task condition, relative to the pure distraction condition, and only the former group's scores differed significantly from those of the control group. However, with the Tower of Hanoi, a significant impact of background television appeared in the pure distraction condition, and there was no significant difference between means of pure distraction and dual task subjects (in fact, the means of the former groups were nonsignificantly better than those of the latter). This suggests that there is a real difference between the way in which background television affected performance on the Tower of Hanoi task, and the way in which it related to the other two tests for which significant differences were obtained.

Of course, one quite obvious difference between the Tower of Hanoi and the other tests used in this experiment is that the former was a non-verbal (spatial) problem-solving test. That the task most dramatically affected by background television was nonverbal is interesting, and to some degree at odds with prior expectations. It was speculated at the outset of the study that a major (perhaps <u>the</u> major) way in which background television would affect performance would be through structural interference with verbal processing. Yet the results illustrate that negative impacts can occur when there is no necessity for verbal processing. In addition, the null result for the sentence verification test demonstrates that merely having a task involve the linguistic faculty is insufficient in itself to enable disruption by background TV.

It may be argued that it is of equal importance in determining the probable locus of effects on cognitive processing to identify levels or operations that are <u>not</u> affected by background television. The finding that simple grammatical processing is not apparently affected is important in this respect. In addition, null results for the two measures of short-term memory lessen the plausibility of background TV impacts on this aspect of information processing.

The contrast between the letter series completion test (for which no significant treatment effects were found) and the Tower of Hanoi is also suggestive with respect to the levels at which effects on cognitive performance may occur. While the letter series completion test involved essentially only skills in pattern recognition, the Tower of Hanoi added to the necessity of pattern recognition the set of skills required for means-ends analysis: In other words, the ability to construct an original mental representation of a problem, and to plan a series of operations leading to its solution. This may suggest that simple pattern recognition operations are not easily disrupted by distractors such as television, compared with more taxing mental operations, particularly those involving planning skills.

Mechanisms Explaining TV Distraction Effects

This brings us to the question of what processes are implicated, or fail to be implicated, in the relationship of background TV to cognitive performance. Four mechanisms were originally posited through which background television could conceivably affect intellectual performance:

elicitation of the orientation reaction; structural interference; capacity interference; and arousal.

The design and measures used in the experiment do not permit us to draw hard-and-fast conclusions about the underlying process through which differences between experimental groups were obtained on the various tests. Since each test was susceptible to some degree to more than one mechanism, disentangling underlying processes is a less than straightforward proposition.

This caveat being noted, it is yet possible to suggest two mechanisms which appear most plausible, given the pattern of results across tests: arousal and capacity interference.

If classical arousal effects were present, we would expect speeded performance on simple tasks, and performance decrements on complex tasks and on tests involving mental flexibility. This pattern is generally upheld insomuch as the tasks for which performance decrements were measured were those which were more difficult and complex (Tower of Hanoi, and Nelson-Denny), or which measured creativity/flexibility (uses test). On the other hand, TV did not measurably <u>improve</u> performance on any of the simple information processing tasks.

It may be that positive arousal effects for the simple tasks were offset to some degree by influences in the other direction, acting through other mechanisms. The pattern of means actually obtained for the sentence verification test is interesting in this respect. Although the overall differences were non-significant, it is interesting that group means in both high-action TV content conditions (which would also presumably be the most arousing conditions), were higher than the control group mean, while the means for the two high-verbal content conditions were marginally lower than the control group. While this pattern could be the result of random error, it could also have arisen if effects of arousal (making one work faster on simpler problems) were being offset by structural interference effects (with the relative importance of the two mechanisms affected both by how arousing the content was, and by how much verbal content it contained).

However, it would be ignoring some of the findings to posit arousal as <u>the</u> cause of lower performance in television viewing conditions. For one thing, if this were the case one would expect to find consistently stronger effects on subjects exposed to high-action TV content. Yet there was only a single significant main effect for program type, involving the uses test measure of use categories as a proportion of all uses. Moreover, this finding cannot be attributed merely to a lack of power resulting from a small sample size, because the actual magnitudes of sample means failed to form a pattern consistent with this expectation.

A secondary effect of any high levels of arousal induced by experimental treatments should have been (if one can rely on previous research) a more rapid onset of fatigue. It would follow that greater differences between experimental and control conditions would occur with tests appearing later in the test battery. In terms of the analysis which was conducted, this would imply an interaction effect, for each dependent measure, between test order and treatment. In addition, arousal effects would imply higher levels of reported fatigue among subjects in experimental conditions.

Results were not generally consistent with the former prediction. Interaction effects involving position in the test battery were obtained for two of the measures, the letter series completion test, and the Tower of Hanoi time measure. However, the pattern of within-cell regression coefficients (see Table 12) was in neither instance in accord with expectations. (In fact, the pattern obtained for the letter series completion test was almost the opposite of what would be hypothesized).

A methodological oversight makes more difficult the assessment of the latter prediction, that higher levels of fatigue would be induced among subjects in TV conditions than among control-condition subjects. This oversight was in not taking a pre-test measure of fatigue. The pattern of post-test measures suggested that initial levels of fatigue were not actually the same across groups (see pp. 121-124). This makes it very hard to determine the independent influence of treatment in this respect. (The fact that initial levels of fatigue differed does not constitute a plausible rival hypothesis explaining experimental findings, because of the use of fatigue measures as control variables in the Analysis of Covariance).

Fatigue did appear to be associated with performance on several of the tests (Table 12). If it indeed had acted as an intervening variable linking treatment-induced arousal level and cognitive performance, the inclusion of fatigue as a control might have actually served to mask treatment effects. Therefore, data were re-analyzed for those dependent measures for which fatigue was a significant predictor and had been included as a control in the original Analysis of Covariance. The new ANCOVA's run for these variables, with fatigue removed, yielded no significant changes in findings (see Appendix B). This provides additional evidence that level of fatigue did not, in fact, act as an intervening variable.

An additional reason for questionning the plausibility of arousal, as least as the exclusive explanation for the obtained results, was the absence of any impact of experimental treatment on the measures of short-term memory. As noted previously, high levels of arousal have been shown experimentally to negatively impact short-term memory. Therefore, at least some impact on the digit span and/or mental arithmetic tests would be suggested if arousal was the most important mechanism in operation in this experiment.

Structural interference with linguistic processing was a second process through which background television was hypothesized to interfere with cognitive processing. Since the ability to process information using the language faculty appears to be limited to a single channel (that is, two verbal messages cannot be interpreted or created simultaneously), it was suggested that attending to verbal television content would disrupt performance on language-based cognitive tasks.

Clearly, the strong treatment effect found on the Tower of Hanoi spatial processing problem runs contrary to the notion that structural interference is the most important mechanism through which TV impacts cognition. However, this does not rule out the possibility that structural interference occurred for other tests.

If structural interference were a major contributor to effects, several findings would be expected. First, tasks making heavy demands on language abilities would be expected to be impacted negatively by concurrent viewing. Second, for these same tests, heavily verbal content would be expected to exert a more deleterious effect than TV content high in action, but low in verbosity.

Treatment effects were in fact found for only one of the two tests which were heavily loaded on linguistic processing. While the synthetic reading test (Nelson-Denny) was impacted by concurrent viewing, no effects attributable to treatment were found for the sentence verification test, a measure of syntactic processing speed. While means for high verbal TV content conditions were lower in all cases for these two tests than the means for the high action content conditions, the respective contrasts did not achieve statistical significance.

These results are not sufficient to "prove" the null hypothesis with respect to structural interference, but they certainly do not provide evidence of any substantial effect attributable to this mechanism. It may be that verbal program content is relatively easy to tune out for most people of college age, and thus the "single channel" is easily appropriated for primary task performance when the individual is so motivated. It may also be that the difference in amount of verbal content between the high-action and high-talk programs used in the experiment was insufficient (recall that even the "high-action" programs used contained over 50% talk).

The absence of apparent TV impacts on sentence verification test performance would be consistent with the null hypothesis with respect to structural interference, but could also have resulted if either: (1) as noted earlier, interference effects were substantially offset by positive impacts of arousal on speed of task performance; (2) the locus of structural interference effects is not on processing at the syntactic level as much as at the semantic level, involving word recognition and interpretation.

Finally a possibly key difference between the sentence verification test, for which television impacts did not occur, and the Nelson-Denny test, on which background TV did have an apparent effect, may have to do with the continuity of attention to verbal processing required by each test. A series of short, independent sentences may provide a greater opportunity for rapid switching back and forth between the verbal content on the test and the verbal content of the television program, making relatively efficient use of the single verbal processing channel.

In contrast, reading an extended passage of connected discourse requires that earlier phrases and sentences in the reading passage (at least their semantic interpretations) be kept in memory, as each sentence in a paragraph of connected discourse builds upon information contained in preceding sentences. Thus, switching back and forth between reading and processing verbal TV content would be less efficient and more potentially disruptive.

In sum, the data provided little substantive evidence to suggest that structural interference was a mechanism leading to performance decrements in this experiment. However, it would be wise to remain cautious in interpreting this as a general "disproof" of the idea that background television may cause structural interference with verbal processing.

Capacity interference is, along with arousal, probably the most likely process of those suggested at the onset to explain the obtained pattern of results. Capacity interference refers to the idea that central processing capacity is limited, and that increases in demands on attention may result in a decrease in capacity available for primary task performance, inducing a performance decrement.

Measurable capacity interference effects should only occur when a secondary task or environmental condition is extremely distracting, or when a primary task is already highly demanding of cognitive capacity.

This suggests that capacity interference from TV would likely influence performance only for tasks which are difficult and complex to begin with. This is borne out for the most part in the pattern of results obtained in the experiment. Those tests which were more demanding of complex mental processing tended to be those tests for which treatment effects were found. Those tests which plausibly could be carried out with cognitive capacity to spare for other tasks generally were not affected by treatments.

One sign that the limits of available capacity are being reached is a narrowing of attention, and a decrease in flexibility. The two tests for which cognitive flexibility was most important for performance were the uses test and the Tower of Hanoi, both of which were impacted by background television in this experiment.

The similarity between this expectation and the expectations arising from consideration of arousal as a mechanism is not coincidental, since increases in demands on cognitive capacity produce increases in levels of physiological arousal (what Kahneman, 1973, termed "effort-induced arousal").

There is, unfortunately, not a lot of information available from the data to bear directly on the proposition that the orientation reaction (i.e. the rapid and involuntary redirection of attention to an unexpected or significant sensory stimulus) had a role in the obtained results. Were physiological measures used, or even perhaps a videotape of subject behaviors during the experiment, a better assessment could be made. As it was, there were no effects which could be unambiguously attributed to an orienting response.

Conversely, one expectation which would follow from consideration of the orientation response as a mechanism leading to performance decrements would be that greater TV impacts should be found in the high-action content conditions (which would have more of the sort of content likely to elicit the OR). This expectation was not in general borne out. With respect to these results, the OR does not appear to add much explanatory power to the previously-discussed mechanisms of capacity interference and arousal.

Other Questions

One hypothesis of the study posited a significant role of motivational state as a contingent factor affecting the relationship between TV viewing as a secondary activity and cognitive performance. If impacts of concurrent TV viewing on cognitive processing could be detected, would they depend on the individual voluntarily appropriating some portion of his/her attention to the television, or would they occur even when the TV was regarded as a purely extraneous distraction?

Subjects were expected to do significantly worse (with respect to tests for which TV impacts were found) when motivated to attend at least minimally to the television. This was expected to be true even if distraction alone was sufficient to lead to a significant performance decrement relative to the control group.

For the Nelson-Denny and uses tests, significant impacts were found only when subjects were instructed to assume a dual-task set. However, with the Tower of Hanoi puzzle (in which the largest magnitude of effect was obtained) the performance of the dual task subjects did not differ significantly from that of the subjects instructed to attempt to ignore the television. Whether this difference (between the Tower of Hanoi puzzle and the Nelson-Denny and uses tests) was a result of a difference in the manner in which the background television acted upon each task, or indicates a type of "threshold effect" of distraction for each particular task, cannot be determined from the data at hand.

The question of the relationship of program type to background TV effects is somewhat less interesting, simply because there were fewer significant impacts of program type, and most of those reflected interactions between program type and instruction.

It was predicted that tests which relied heavily on verbal faculties would be more strongly affected by TV content which was more heavily verbal. As was noted previously, the patterns of means for the two tests which most unambiguously measured linguistic processing -- the sentence verification test, and the Nelson-Denny reading test -- were consistent with this expectation, but the magnitudes of differences between verbal and action content groups were small, disappointing, and nonsignificant.

The remaining research question concerned the possibility that individuals may, through practice or high amounts of exposure, become acclimated to background TV, and thereby develop abilities to overcome its effects on cognitive performance. Results relevant to this speculation were inconclusive. Statistical tests of the significance of the TV-viewing/treatment interaction in the Analysis of Covariance design failed on the whole to establish significant differences in the relationship between previous TV viewing and performance based on whether subjects were in control or treatment conditions.

On the other hand, examination of the within-cell correlations between viewing and test performance revealed apparent differences between conditions which were consistent, for at least some tests, with the hypothesis that heavier exposure confers a degree of protection from TV-distraction effects.

Differences between control and television conditions appeared to be at least partially consistent with expectations for the Digit Span Test, the Sentence Verification Test, the Tower of Hanoi puzzle, and the Nelson-Denny Reading Test (in the latter, the correlation between habitual viewing and performance in the dual task-action condition must however be considered anomalous).

The general absence of statistical significance with respect to either differences between cells in the ANCOVA design or (most of) the individual within-cell correlations makes it impossible to conclude that any relationship actually obtains between habitual TV viewing and susceptibility to TV distraction. However, the small size of the within-cell sub-samples, and the consequent necessity that any effect be quite large in order to achieve statistical significance, suggest that it would be unwise to treat the hypothesis of habituation effects as conclusively disproven.

Methodological Considerations

The study had a number of weaknesses in design and measurement, some of which were the unavoidable result of the type of tradeoffs which must be made in designing any study. Other weaknesses resulted from the sort of errors in planning which are unfortunately only obvious in hindsight. Several methodological weaknesses and tradeoffs have implications for the interpretation of findings.

Discussion of the question of habituation effects in the previous section has drawn attention to a feature of the study which has broader implications for interpretation of findings. This is the relatively small size of the sample on which judgments about the impact of background TV on cognition must be made. The relatively small size of subsamples for each condition is an obvious problem with respect to significance testing, in that it reduces the power of such tests below desirable levels. Such lowering of power simply means that impacts have to be large in order to achieve statistical significance. A small, but real, effect will be interpreted as nonexistent.

For example, for a correlation to achieve statistical significance using the whole sample, an r = approximately .18 is necessary. The Williams, et al. meta-analysis (see pp. 7-12) estimated an average TV viewing/academic achievement correlation in the range of .13-.14 (absolute magnitude) for those social categories which tended to be more highly impacted. The power of statistical tests of within-cell correlations is even lower. With the sizes of sub-samples used in this study, within-cell correlations must achieve magnitudes of approximately .40 to meet requirements for statistical significance at the .05 level.

The relatively small sample size is a weakness, but one which was the result of a conscious trade-off in planning the study. In order to be able to give each subject a series of different cognitive processing measures, including those which measured performance on some rather time consuming tasks, as well as to measure a host of covariates and threats to validity, it was necessary that each subject be (1) tested individually, and (2) take on the average over an hour to complete his or her part in the experiment. Considering practical limitations on the study, equipment and room scheduling constraints, and so on, the decision to employ a design in which it would take over an hour to run each individual subject implied that a very large sample size would be impractical. The tradeoff therefore was statistical power for breadth in measurement.

The ability of statistical tests to distinguish whether smaller mean differences were due to treatments or various sources of random error would have been especially helpful with respect to measures such as the letter series completion test, the sentence verification test, and the uses test measures of relevant and uncommon uses. In each of these cases the patterns of means obtained would be interpretable within the theoretical framework of this research. However, there is simply no way to extrapolate whether apparent impacts of similar magnitude would be obtained if larger samples were used, and therefore the conservative and proper course for this particular study is not to interpret these differences as representing anything real. The problem is substantially greater, as was noted earlier, with respect to evaluating the role of prior viewing habits in the background TV/cognitive performance relationship.

Of course, one method for improving the likelihood of detecting small impacts is to employ a within-subjects design. Quite aside from the implications of such a design for the amount of time taken by each subject to complete the experiment, one of the measures used in the study (the Tower of Hanoi) could not have been used in such a design. However, a within-subjects design would be appropriate for studies focusing on a particular type of repeatable task (for example, sentence verification, or two versions of the letter series completion test), and would have additional advantages (i.e., allowing one to detect more easily whether background TV has different impacts for different individuals).

Two decisions concerning the nature of the experimental stimuli used in the experiment also have implications for the interpretation of findings. First, commercials were removed from the programs used in treatment conditions. This was necessary to avoid confounding influences of program type, and more importantly, to maintain differences between dual-task and pure distraction subjects uniformly across tasks. However, it is at least plausible that leaving the commercials out affected the results of the study.

It may very well be that the distracting potential of the TV stimuli used was reduced by extracting the commercials. First, commercials provide a break, sometimes abrupt and sometimes anticipated, in the program. Such dramatic breaks could conceivably be an important influence by eliciting orientation reactions. Moreover, the content of commercials is often specifically designed to grab attention involuntarily. After all, viewers are not generally intrinsically motivated to attend to commercials, so one of the practical tasks of the advertiser is to obtain that attention. The program itself, on the other hand, does not have to gain a uniformly high level of attention on its own merits in order to be successful.

Many commercials include the sort of features which induce arousal (rapid cuts, loudness, action, etc.). Jingles and conventional verbal content are also common. Moreover, it is likely that a great deal of reading or studying that takes place in front of the TV by heavy viewers is liable to take place preferentially during times when commercials are being shown. It is plausible that leaving the commercials out not only led to an under-estimation of TV impacts, but also reduced substantially the realism of the experimental treatment, to the degree to which it resulted in a failure to adequately simulate the nature of the concurrent viewing/reading/studying situation which occurs in the home. However, this weakness must be regarded as the a necessary evil, in that it results from a conscious tradeoff without which the assessment of the impact of task set and program type would have been more problematic.

In addition to methodological considerations relating directly to design, it is important to note limitations relating to measurement of dependent variables in this study. Most of these result indirectly from design decisions.

The most basic problem concerning adequacy of dependent measures may have had to do with the general emphasis on speed of performance. On the one hand, this emphasis would seem to have at least superficial justification at the theoretical level. The concept of "efficiency" can easily be interpreted in terms of the most product in the least time. But there is a point at which analogies to industrial production break down. If the work of Robert Sternberg (previously cited) provides any indication, one's speed in the completion of particular, well-defined, information processing operations is only one factor, and not the major factor, in one's ability to solve complex problems. In fact, acting with speed may be inversely related to quality of performance on many types of problems.

This is not to say that speed, in terms of time to successful completion, should be regarded as an invalid measure of cognitive performance. Rather, the problem in this present context is twofold: first, the overt nature of measures of speed in the experiment probably put pressure on subjects to begin <u>doing</u> tasks immediately, and discouraged planning and reflective thinking. It is revealing that, as was noted previously, the test for which the strongest impacts of background television were found was the single test of complex problem solving for which time was specifically set aside in the experimental procedure for planning. Second, the shortness of the actual time limits used for a number of tests may have rewarded problem-solving strategies which emphasized speed. Thus, the general speeded nature of the tests used to measure cognitive performance may not be an insignificant weakness, and must be regarded as a potential source of bias.

In this context, it should be noted that the strict time limits used for the tests resulted from a practical tradeoff; if all the tests were to be included in the battery (with the practical limitation that all could be administered in the approximately 45 minutes it took to complete one of the experimental programs) rigid time limits were a necessity.

In considering the various mechanisms through which TV viewing was hypothesized to influence cognitive processing, the one which relates most directly to speed is clearly arousal. The higher the level of physiological arousal, the more rapidly one tends to work. Thus, tests which emphasize speed will tend to be positively related to arousal level. With respect to this battery of tests, this means that the influence of arousal as a mechanism affecting performance, especially its positive impacts, may have been overestimated.

In some of the tests used, speed was either considered desirable, or was irrelevant (i.e., digit span, mental arithmetic, sentence verification, and possibly also letter series completion). In one test, the Tower of Hanoi, the emphasis on speed of performance was offset by providing planning time. But for two tests, reductions in time limits could conceivably have distorted results.

The Nelson-Denny reading test and the uses test both were administered with time limits shorter than those normally used. With respect to the latter, one could easily argue that a test which intended to measure the limits of creativity (in terms of the number of different cognitive schema one could access concerning a particular object) ought to be highly susceptible to time pressures. A person in a more highly aroused state would be expected to come up with uses more quickly, but to come up with fewer genuinely different or original uses, especially over a longer period. A less aroused individual would be expected to work more slowly, but to access more different cognitive schema and therefore to come up with more categories of uses and more total uses over time. Thus, It is quite possible then that highly restrictive time limits mitigated against significant findings with respect to this measure.

Speededness may have impacted the Nelson-Denny reading test in a similar manner. Arousal impacts on speed of work and narrowing of attention would be expected to impact positively on a highly speeded reading test involving the comprehension of objective information. The fact that such impacts may also reduce elaboration or depth processing (Craik and Lockhart, 1972), thus having substantial implications with respect to reading in its practical, day-to-day context, would have much less relevance to performance as measured on such a test.

This of course brings us to a weakness of the Nelson-Denny test itself as a measure of reading performance in the present context. This test is not particularly good at measuring elaboration upon, or retention of, information from a reading passage. First, the test has a multiple choice format, and therefore, to the degree to which it can be said to measure memory of written material at all, it measures recognition rather than recall memory. Second, each reading passage is available for the student to return to if s/he does not retain the specific information required to answer a particular question. Although the Nelson-Denny test is not completely irrelevant to the measurement of retention (it is certainly quicker to answer a question if one does not have to go back to the reading passage to do so), it cannot, in retrospect, be said to have provided an optimal reading measure, considering the processes through which TV was expected to impact reading performance. The overt speed factor may have artificially inhibited elaboration and reflection (or worse yet, penalized them), while the question format failed to measure the desirable consequences of elaboration: recall of content, and ability to apply it to new contexts.

The absence of a good test of retention of reading material was a major weakness of the study, regardless of the fact that significant results were obtained for the measure of synthetic reading ability actually used. Future research of this type could and should include measures which (1) do not demand highly speeded reading, and (2) employ delayed measures of retention of, and ability to apply, the content read.

A final methodological cause for concern needs to be addressed, before proceding to the broader implications of the experimental findings. This concerns the efficacy of the manipulation of task set. As one experimental manipulation, subjects were instructed to either ignore the TV entirely as they did their work (pure distraction condition) or to concentrate on their work while keeping track of what was going on in the TV program (dual task set). A post-test manipulation check indicated that subjects correctly understood their instructions (Table 3), but a nontrivial proportion of subjects reported not acting in accordance with them (Table 4). The question is how should this difference by interpreted?

This question is problematic because the post-test questionnaire asked subjects what they actually did, rather than what they _tried_ to do with respect to the TV. When approximately 45 percent of subjects in the pure distraction conditions reported paying at least some attention to the TV, did this indicate a capricious resistance to following instructions, or a lack of ability to "tune out" the distracting television stimulus? If the latter was in fact the case, it would indicate that a substantial proportion of people in the population from which the sample of experimental subjects were drawn could not by force of will alone ignore an operating television in the same room with them. The fact that a much smaller percentage of dual task condition subjects reported failing to follow task set instructions suggests that this latter interpretation may be the more plausible, but this is by no means certain.

It seemed necessary, therefore, to attempt to assess how this problem might, in its worst possible interpretation, potentially affect basic study findings. In order to provide such a check, the Analysis of

Covariance for each dependent measure was re-computed with subjects self-reported behavior toward the TV substituted for the assigned task-set condition.

Results of this analysis (provided in Appendix B) showed no really major differences from the findings already reported. The only meaningful differences were: (1) for one of the two measures of performance on the Tower of Hanoi puzzle, the significance of the contrast between control and distraction conditions was reduced to a borderline ($p = .06$) level; (2) the significance of the contrast between control and dual-task conditions for the uses test measure of non-container uses was improved from $p = .087$ to $p = .032$. (In neither case did this actually represent a major change in the means of the respective groups).

Implications

It is well documented that a number of activities which can be intellectually stimulating, or which require substantial cognitive investment for optimal results, are in many households conducted at least some of the time in the presence of an operating television. Three such activities which come to mind most readily are certain kinds of homework or study on the part of students, reading on the part of older children, adolescents, or adults, and conversation on the part of all members of a household. The results of this study, to the extent to which they are generalizable, suggest the potential for television to have deleterious effects at the cognitive level on these sorts of activities.

The results also suggest that the activities which stand to be affected are those which are by themselves highly demanding of cognitive capacity, involve planning abilities, creation of new problem-solving strategies, or flexible application of strategies already known. On the other hand, activities involving routinized problem-solving, even when demanding in terms of short-term memory requirements, do not appear to be negatively impacted by concurrent TV viewing.

While the results suggest that background television affects cognition more strongly when the individual is consciously paying attention to a program, negative impacts were not restricted to such conditions. This implies a potential for detrimental effects even when one is involuntarily exposed.

It should be noted that the mechanism proposed and tested here did not imply differences in direct TV effects based on the demographic characteristics of individuals. The experimental evidence is consistent with this, in that no significant differences were found between males and females, high achievers and low achievers, etc., in the manner in which background TV covaried with performance. Differences between demographic groups found in earlier correlational research may be due to different behaviors toward the TV in the home, differing demands of the school situation, and differences in the degree to which positive impacts (direct learning and enrichment) balance out harmful effects.

Although this study is only a first step toward precisely determining how television impacts concurrent cognitive activities, its results suggest that viewing as a secondary activity does have the potential to interfere with at least some types of mentally demanding activities. The heavy viewing, heavy readers who were found in the National Assessment of Educational Progress to constitute such a backward group may indeed be reading more, but learning less (or, alternatively, reading more slowly and getting less done), compared to moderate readers who set aside quiet time for this activity.[2] In addition, if children and adolescents who attempt difficult homework assignments in front of the TV thereby make their tasks that much more difficult, the direct negative effects on learning may be compounded by the creation of frustation, affecting an individual's attitude toward school and his or her overall intellectual self-concept.

Even if the direct impact of television on intellectual performance relates only to the effect of viewing on temporally concurrent activities, this does not mean that the longer-term, indirect effects are insubstantial.

If thinking, problem-solving, and specific cognitive skills require practice in order to be maintained or used effectively, then to the extent to which the television experience interferes with this practice, abilities not already developed may fail to be realized, and abilities already developed may atrophy. Thus, short-term impacts of background television on cognitive processing may have substantial implications for abilities developed and sustained in the long term.

Even a small, consistent impact of background television on the quality of one's intellectual experiences could account for correlational findings linking heavy viewing to lower scores on measures of intellectual ability and achievement. In fact, the actual magnitudes of effects found in several cases were certainly not trivial.

To the extent to which these results hold up in future research, they would suggest that parents concerned with their children's intellectual development and school achievement should see to it that the use of television concurrently with reading or homework is restricted. It would appear that intellectually demanding activities are best conducted in quiet, or in the presence of less intrusive sensory stimulation.

However, beyond the suggestion that television-free time should be created, there are few other direct implications from the present study which would serve to guide parental behavior. It was hoped that at least some suggestions could be made concerning types of programs that would be more or less disruptive, but the findings justify no such implications.

If results suggest that combining television viewing with intellectual activities is harmful, they do not by themselves suggest any harmful effects of reasonable amounts of viewing as a primary entertainment activity. The model of the effects of television viewing on intellect which was proposed and partially tested in fact admits the possibility that some positive impacts may arise from the activity of viewing, especially for younger children and those otherwise deprived. This factor suggests that heavy television exposure should exert a relatively more benign aggregate influence on the otherwise disadvantaged, for whom distraction effects may be balanced off to a greater degree by positive influences in terms of learning and general mental stimulation. This model, then, would tend to suggest an overall social impact of narrowing the intellectual gap between various groups of heavy viewers, a consequence consistent with cultivation theory models of TV effects at the sociological level. This would imply that the variance in academic achievement among heavy viewers should tend to be lower than the variance for moderate or light viewers, which is, in fact, consistent with findings reported by Morgan and Gross (1982), and Fetler (1984).

The lack of any discernable relationship between the necessity for utilization of language skills in a particular test and the probability that background television would have a detrimental impact was surprising, considering the correlational research findings suggesting that TV viewing was most strongly associated with scores in reading achievement. The correlational findings may be an artifact of partialling for IQ, where the form of IQ test items parallelled that of math or science test items more closely than they matched the form of reading comprehension test items. In at least some of the extant research (see Williams, et al. 1982; Fetler, 1984), relationships without IQ partialling were of similar magnitudes for reading and other types of achievement. Of course, this explanation for the discrepancy between experimental and survey results is speculative. However, the clear implication of this research is that disruption of cognitive processing by background television is not restricted to verbal processing.

If this study succeeded in demonstrating negative impacts from secondary exposure to naturalistic television content on some primary information processing activities, it only made a start toward answering several other questions related to this finding. First, the process or processes through which measured impacts occurred was not conclusively identified. To begin to link psycho-physiological effects of TV exposure to discernable cognitive or behavioral effects will probably require experimental designs in which physiological state measures are added to measures of information processing outcome. In addition, specific types of test contrasts could be designed to test the relative plausibility of two contrasting mechanisms. Third, videotaping subject behavior during an experiment similar to this one would add information relevant to the determination of process.

It is also important to determine whether negative impacts of background television on intellectual functionning are universal, or dependent upon the characteristics of individuals. Although the use of control variables in a between-subjects design allows for some level of inference, by far the more sensitive type of study would use a within-subjects design, with the same individuals being observed functionning under various environmental conditions. Such a design would also have the potential for demonstrating acclimatization effects; by being repeatedly required to function under conditions of television background, can individuals improve their abilities to perform under such distraction?

Work remains to be done to further define the types of intellectual tasks and operations which fare more poorly in the presence of television. Although seven different tests may initially seem to be ample, it is clear that several areas were left inadequately sampled. Most striking is the absence of a test of long-term learning from reading material, important due to the fact that this is what much homework or studying involves, especially for older age groups. Perhaps of equal importance, at least with respect to older adolsecents and adults, is the question of the possible effects of TV-as-background on critical processing of written material. Research on the persuasion-distraction paradigm would imply that material read under such distracting conditions would be accepted more uncritically than the same material read under conditions more optimal for elaborative processing.

Other types of homework (i.e., much math homework) aim at giving one practice at using particular problem-solving strategies, which can then be used to solve other problems in the future. Does one's retention, or ability to apply, strategies learned in such a context decrease if the practice is conducted in the presence of the TV? Does even one's ability to detect patterns in the solution of similar problems depend upon the presence or absence of background stimulation? Such questions provide ample seed for subsequent research.

It is traditional to end a research study, particularly a thesis or dissertation, with a call for further research. In the present circumstance, such a call is not as gratuitous as is often the case. This is because the research reported here did, I believe, break some new ground in terms both of theory and the type of evidence obtained in testing it. For this reason, there remains a great deal to do, and many possible directions to pursue. Many of the questions that remain to be answered I have discussed more or less in detail; others are so obvious that little time need be spent on them: In particular, the obvious requirement to get information from other population segments if this paradigm is to be generally applied. Also in this category would fall attempts to more closely match different viewing situations and styles, especially with respect to the role of commercials. The findings from this study do suggest that these and other such efforts would be worthwhile to make.

FOOTNOTES

1. This is not to deny that it may be useful to examine TV/achievement correlations within sub-groups defined by IQ (cf., Morgan & Gross, 1980). Rather, it is to counsel caution in the use of IQ as a control, especially with respect to using partial correlations, and in interpreting results when IQ controls are used.

2. In fact, the backwardness of the heavy viewing/heavy reading subgroup in the NAEP study would suggest that more is involved in terms of the detrimental impact of TV than merely taking longer to accomplish the same amount of learning. If reading, etc. was merely slowed, the heavy TV/heavy reading subgroup would be expected exhibit a level of performance similar to the low TV/moderate reading group, whereas they in fact do much worse. Moreover, at least some of the experimental findings suggest that task performance is affected not just in terms of time, but in terms of quality of solution. Witness, for example, the difference among subjects who successfully solved the Tower of Hanoi puzzle. No-TV control subjects required significantly fewer moves than subjects in the background television conditions, indicating greater success at evaluating the requirements

of the problem cognitively, greater use of planning capacities, and so on.

APPENDICES

Appendix A

Experimental Materials

DEPARTMENTAL RESEARCH CONSENT FORM

With regard to my participation in research:

1. I understand the procedures by which participation will count for some form of extra credit in the Communication class listed below.

2. I understand that participation in this research project is not a requirement in any Communication class.

3. I understand that any credit I may earn via participation in research is not transferable to another class or another term.

4. I understand that my participation in a study does not guarantee any beneficial results to me other than credit for participation.

5. I understand that there may be deception involved in research for which I have volunteered to participate. I further understand that I have the right to have any study in which I participate explained to me to my satisfaction after I have participated.

7. I understand that I have the right to withdraw from any study at any time without penalty. A decision to withdraw from the study will <u>not</u> adversely affect my course grade in any Communication course.

8. I understand that the results of a given study will be treated in strict confidence with regard to the data on any given participant. Within this restriction, I understand that the results will be made available to me at my request.

9. I understand that the data I provide a researcher as a result of my participation in a given study may be used by other social scientists for secondary analysis. Again, data will be treated with the strictest confidence.

10. I understand that should I have any questions, problems, complaints, or if I desire further information, I have the right to contact the Research Coordinator in the Department of Communication.

Given these understandings, I have freely consented to participate in scientific research being conducted during this term in the Department of Communication.

Signed____________________________

Date____________________________

Name (print)____________________________

Student Number____________________________

Class____________________________

Section____________________________

Term and Year____________________________

CONSENT FORM FOR ACCESS TO UNIVERSITY RECORDS

I consent to allow the researchers in the research project in which I am participating on this date in the Department of Communication to obtain from the University records of: (1) my high school grade point average; (2) my ACT and/or SAT test scores; and (3) my M.S.U. placement test scores (taken during new student orientation).

I understand that this information will be treated in strict confidence with regard to the data on myself or any other individual participant, and will be used solely for purposes of scientific research. In keeping with this, I understand that the researchers will record this information in a way that will not allow particular scores to be identified as belonging to me or any other individual participant.

I understand that I can withdraw from this research at any time, and that I can withdraw this consent at any time prior to the actual receipt and recording of this data from the University.

Signed________________________________

Date__________________________________

Name (print)___________________________

Student Number_________________________

GENERAL INSTRUCTIONS

You are about to be given a set of tests. These tests have been found to be very good predictors of professional success. First, these tests measure several different abilities, each of which is relevant to success in a different profession. Second, the ability to perform well while under stress is a good predictor of your ability to handle the kind of stressful conditions which are typical of many business and prfessional jobs. Hence, we will have you take these tests while under the stress of knowing that your performance will determine the amount of extra-cardit you will receive for participating.

In this study, we will also see if people who do well on these tests, have also done well on various measures of academic performance. Therefore, we are asking you to permit us to obtain your scores on the SAT and/or ACT, your high school grade point average, and your scores on the MSU placement exams you took when your first entered the University. IF YOU HAVE NOT ALREADY SIGNED THIS RELEASE FORM, BE SURE TO INFORM THE PERSON WHO IS ADMINISTERING THE TESTS.

The amount of extra credit you will receive for participating in this study will depend on how well you have done on these tests. You will be paired with someone who is taking these tests at another time. If you score less than this other person, you will receive extra credit of .05. If you score more than the person you are paired with, you will receive .10 extra-credit.

DIRECTIONS FOR THE TESTS:

Complete each test as quickly and accurately as you can. Before each test you will be told exactly what is expected of you. However, you should keep in mind that speed as well as quality is important in most of these tests.

Do not get discouraged if you have difficulty with some of these tests. They are intended to be difficult, and the time available is intended to be short.

If you do not understand the instructions for a particular test, be sure to ask the person who is administering the test to explain the directions. No questions about a particular test will be answered after you have begun to take the test.

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d

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Do not get discouraged if you have difficulty with some of these tests. They are intended to be difficult, and the time available is intended to be short.

If you do not understand the instructions for a particular test, be sure to ask the person who is administering the test to explain the directions. No questions about a particular test will be answered after you have begun to take the test.

Part of what we are testing is your ability to overcome distracting conditions while demonstrating the skills which are being measured. For this reason, there will be a television operating in the room with you while you are working on these tests. DO YOUR BEST TO IGNORE THE TELEVISION AND CONCENTRATE COMPLETELY ON THE TESTS. YOU ARE BEING EVALUATED SOLELY ON YOUR TEST PERFORMANCE.

GENERAL INSTRUCTIONS

You are about to be given a set of tests. These tests have been found to be very good predictors of professional success. First, these tests measure several different abilities, each of which is relevant to success in a different profession. Second, the ability ot perform well while under stress and distraction is a good predictor of your ability to handle the kind of stressful and distracting conditions which are typical of many business and professional jobs. Hence, we will have you take these tests while under the stress of knowing that your performance will determine the amount of extra-credit you will receive for participating, and while having to deal with the distraction of a TV program.

In this study we will also see if people who do well on these tests, have also done well on various measures of academic performance. Therefore, we are asking you to permit us to obtain your scores on the SAT and/or ACT, your high school grade point average, and your scores on the MSU placement exams you took when you first entered the University. IF YOU HAVE NOT ALREADY SIGNED THIS RELEASE FORM, BE SURE TO INFORM THE PERSON WHO IS ADMINISTERING THE TESTS.

The amount of extra credit you will receive for participating in this study will depend on how well you have done on these tests. You will be paired with someone who is taking these tests at another time. If you score less than this other person, you will receive extra credit of .05. If you score more than the person you are paired with, you will receive .10 extra-credit.

d

DIRECTIONS FOR THE TESTS:

Complete each test as quickly and accurately as you can. Before each test you will be told exactly what is expected of you. However, you should keep in mind that speed as well as quality is important in most of these tests.

Do not get discouraged if you have difficulty with some of these tests. They are intended to be difficult, and the time available is intended to be short.

If you do not understand the instructions for a particular test, be sure to ask the person who is administering the test to explain the directions. No questions about a particular test will be answered after you have begun to take the test.

Part of what we are testing is your ability to "split" your attention between two different tasks, while performing well on both. For this reason, there will be a television operating in the room with you while you are working on the other tests. Try to do the best you can on the tests, while at the same time keeping an eye on what is occurring on the TV screen. At the end of the testing session, you will be given a short quiz testing how much you remember about the basic plot and characters in the TV program. This will be the final test.you will take. TO DO BEST, CONCENTRATE PRIMARILY ON THE TEST YOU ARE TAKING, AND ONLY SECONDARILY ON THE TV PROGRAM.

DIGIT SPAN TEST

Student #______________

DIRECTIONS: In this test your task is to remember numbers which the researcher will show to you. The researcher will hold up to your view a series of cards (one after the other). Each card will show a digit between 1 and 9.

After you have been shown 3 cards, you will have to remember the numbers (in the correct order) for several seconds, until the experimenter signals you. When the experimenter tells you to "GO", repeat back the numbers that were shown to you, in the correct order (first to last), and write these numbers on this sheet below.

If you make a mistake on your first try, you will be given a second chance with a new set of numbers.

If you correctly remember 3 numbers, you will be asked to remember 4 numbers the next time. Then 5 numbers, 6 numbers, and so on until you fail to remember the numbers on two successive tries.

Any questions? If not, signal the experimenter that you are ready to begin.

DIGIT SPAN TEST ANSWERS

3-DIGIT PROGLEM ____ ____ ____
1st 2nd 3rd

second chance ____ ____ ____
1st 2nd 3rd

4-DIGIT PROBLEM ____ ____ ____ ____
1st 2nd 3rd 4th

second chance ____ ____ ____ ____
1st 2nd 3rd 4th

5-DIGIT PROBLEM ____ ____ ____ ____ ____
1st 2nd 3rd 4th 5th

second chance ____ ____ ____ ____ ____
1st 2nd 3rd 4th 5th

6-DIGIT PROBLEM ____ ____ ____ ____ ____ ____
1st 2nd 3rd 4th 5th 6th

second chance ____ ____ ____ ____ ____ ____
1st 2nd 3rd 4th 5th 6th

7-DIGIT PROBLEM ____ ____ ____ ____ ____ ____ ____
1st 2nd 3rd 4th 5th 6th 7th

second chance ____ ____ ____ ____ ____ ____ ____
1st 2nd 3rd 4th 5th 6th 7th

8-DIGIT PROBLEM ____ ____ ____ ____ ____ ____ ____ ____
1st 2nd 3rd 4th 5th 6th 7th 8th

second chance ____ ____ ____ ____ ____ ____ ____ ____
1st 2nd 3rd 4th 5th 6th 7th 8th

ARITHMETIC TEST Student #______________

DIRECTIONS: In this test, you will be shown a series of multiplication problems. You will be asked to solve each problem in your head without writing anything down.

The experimenter will show you a card with a multiplication problem printed on it. You should begin to try to solve the problem immediately. Do not write anything down while you are trying to solve the problem. When you think you have the answer to the problem, signal the experimenter by raising your hand. Then, state the answer out loud, and write it down in the space provided at the bottom of the page.

If your answer is wrong, you will be given another chance to solve the problem. However, you will be allowed a total of only 1½ minutes to solve each problem correctly.

Before we begin, here are a few simple practice problems to get you used to the procedure. Use the space below for your practice answers. READY?

ANSWERS TO PRACTICE QUESTIONS

PRACTICE QU. 1__________ PRACTICE QU. 4__________

PRACTICE QU. 2__________ PRACTICE QU. 5__________

PRACTICE QU. 3__________

Now you are ready to begin the actual problem set. Keep in mind that you are being evaluated on <u>whether or not</u> you come up with the correct answer to a problem, AND <u>how long it takes</u> you to come up with the correct answer.

When you are ready to go, signal the experimenter.

ANSWERS TO TEST QUESTIONS

QUESTION 1______________ second try______________

QUESTION 2______________ second try______________

QUESTION 3______________ second try______________

QUESTION 4______________ second try______________

TEST M: SENTENCE VERIFICATION TEST Form a

DIRECTIONS: In this test, you are to read the sentence and determine whether what it says is true or false. Each sentence will make a statement about the relative positions of a letter "A" and a letter "B", which are shown directly to the right of the sentence. Decide whether the sentence makes a truthful or a false statement about the positions of A and B. Check the T or F space to the left of the sentence.

EXAMPLE:

A. T___ F___ "A" precedes "B" AB

B. T___ F___ "B" is followed by "A" AB

In example A, the "A" comes before the "B", as the sentence declares. You should put a check beside T.

In example B, the "B" follows the "A", which is the opposite of what the sentence declares. You should put a check beside F.

DO NOT TURN TO THE NEXT PAGE UNTIL TOLD TO DO SO BY THE EXPERIMENTER.

YOU WILL HAVE THREE MINUTES TO ANSWER AS MANY QUESTIONS AS YOU CAN. YOU WILL BE EVALUATED ON THE TOTAL NUMBER OF CORRECT RESPONSES YOU MAKE.

THIS TEST IS MORE THAN A PAGE LONG. DO NOT STOP AT THE END OF THE FIRST PAGE. KEEP GOING UNTIL YOU EITHER COMPLETE THE ENTIRE TEST OR THE EXPERIMENTER SIGNALS YOU TO STOP.

WHEN THE EXPERIMENTER TELLS YOU TO BEGIN, TURN THE PAGE AND START ANSWERING QUESTI

1.	T_____	F_____	A is not preceded by B	AB
2.	T_____	F_____	A follows B	AB
3.	T_____	F_____	B does not follow A	AB
4.	T_____	F_____	A is not preceded by B	BA
5.	T_____	F_____	B precedes A	BA
6.	T_____	F_____	B is followed by A	AB
7.	T_____	F_____	A is preceded by B	BA
8.	T_____	F_____	A follows B	BA
9.	T_____	F_____	A does not follow B	BA
10.	T_____	F_____	B precedes A	AB
11.	T_____	F_____	B is not followed by A	BA
12.	T_____	F_____	A is not followed by B	AB
13.	T_____	F_____	B does not precede A	BA
14.	T_____	F_____	A does not precede B	BA
15.	T_____	F_____	B does not follow A	BA
16.	T_____	F_____	B is followed by A	BA
17.	T_____	F_____	B does not precede A	AB
18	T_____	F_____	B follows A	AB
19	T_____	F_____	A is preceded by B	AB
20.	T_____	F_____	B is not preceded by A	AB
21.	T_____	F_____	B is not preceded by A	BA
22.	T_____	F_____	A does not follow B	AB
23.	T_____	F_____	A is not followed by B	BA
24.	T_____	F_____	A is followed by B	BA
25.	T_____	F_____	B is preceded by A	AB

26.	T_____	F_____	A does not precede B	AB
27.	T_____	F_____	B is not followed by A	AB
28.	T_____	F_____	A precedes B	BA
29.	T_____	F_____	B is preceded by A	BA
30.	T_____	F_____	A precedes B	AB
31.	T_____	F_____	B follows A	BA
32.	T_____	F_____	A is followed by B	AB
33.	T_____	F_____	A precedes B	AB
34.	T_____	F_____	B is not preceded by A	AB
35.	T_____	F_____	B does not precede A	BA
36.	T_____	F_____	B is not preceded by A	BA
37.	T_____	F_____	B does not follow A	BA
38.	T_____	F_____	B does not follow A	AB
39.	T_____	F_____	B precedes A	AB
40.	T_____	F_____	A is not followed by B	BA
41.	T_____	F_____	B is preceded by A	AB
42.	T_____	F_____	A does not follow B	BA
43.	T_____	F_____	A is not preceded by B	AB
44.	T_____	F_____	A is preceded by B	AB
45.	T_____	F_____	A is preceded by B	BA
46.	T_____	F_____	A is not followed by B	AB
47.	T_____	F_____	A is not preceded by B	BA
48.	T_____	F_____	A is followed by B	BA

49.	T_____	F_____	B does not precede A	AB
50.	T_____	F_____	A precedes B	BA
51.	T_____	F_____	A does not precede B	BA
52.	T_____	F_____	A does not follow B	AB
53.	T_____	F_____	B is not followed by A	AB
54.	T_____	F_____	A is followed by B	AB
55.	T_____	F_____	A follows B	BA
56.	T_____	F_____	A follows B	AB
57.	T_____	F_____	A does not precede B	AB
58.	T_____	F_____	B is preceded by A	BA
59.	T_____	F_____	B precedes A	BA
60.	T_____	F_____	B is followed by A	BA
61.	T_____	F_____	B is followed by A	AB
62.	T_____	F_____	B follows A	BA
63.	T_____	F_____	B is not followed by A	BA
64.	T_____	F_____	B follows A	AB

TEST Z: SERIES COMPLETION ABILITIES Student #______________

DIRECTIONS:

In this test, your task is to write the correct letter in the blank.

Read the row of letters below:

A. abababab__

the next letter in the series would be a.

Write the letter a in the blank.

Now read the next row of letters and decide what the next letter should be. Write that letter in the blank.

B. cadaeafa__

You should have written the letter g.

Now read the series of letters below and fill in each blank with a letter.

C. aabbccdd__

D. abxcdxefxghx__

E. axbyaxbyaxb__

F. rsrtrurvr__

G. abcdabceabcfabc__

The answers to these problems are given at the bottom of the page.

YOU ARE NOW READY TO TAKE THE TEST ITSELF.

DO NOT TURN TO THE NEXT PAGE UNTIL THE EXAMINER TELLS YOU TO DO SO.

YOU WILL HAVE A MAXIMUM OF SIX MINUTES TO COMPLETE THE PROBLEMS ON THE FOLLOWING PAGE. YOU WILL BE EVALUATED ON BOTH SPEED AND NUMBER OF CORRECT ANSWERS.

BE SURE TO SIGNAL THE EXAMINER IF YOU COMPLETE ALL THE PROBLEMS BEFORE THE TIME LIMIT IS UP.

C. e D. i E. y F. w G. g

SERIES COMPLETION TEST

FOR EACH OF THE LISTS OF LETTERS BELOW, WRITE THE CORRECT LETTER IN THE BLANK. You will have six minutes to complete the test. Begin immediately.

1. cdcdcd__
2. aaabbbcccdd__
3. atbataatbat__
4. abmcdmefmghm__
5. qxapxbqxa__
6. mabmbcmcdm__
7. abyabxabwab__
8. urtustuttu__
9. rscdstdetuef__
10. npaoqapraqsa__
11. jkqrklrslmst__
12. pononmnmlmlk__
13. defgefghfghi__
14. aduacuaeuabuafua__
15. wxaxybyzczadab__

IF YOU FINISH THE TEST BEFORE THE SIX MINUTES IS UP, SIGNAL THE EXAMINER THAT YOU HAVE COMPLETED IT.

TOWER OF HANOI PUZZLE

DIRECTIONS: You will notice in front of you an apparatus consisting of three upright pegs. A set of colored circles of different sizes is sitting on one of the end pegs. Your task is to move this stack of circles from the end peg to the center peg.

There are 2 rules: (1) you can only move 1 colored circle at a time, and;
(2) A larger circle may NEVER be placed on top of a smaller circle, even for a moment.

You may move any circle as many times as you find necessary, as long as Rules (1) and (2) are followed.

SCORING: Both the <u>speed</u> at which you complete this task and the <u>number of moves</u> you require to do so will be scored. There will be a time limit of 4 minutes enforced. If you have not completed the Tower by that time, your score will be based on the number of circles you have stacked in their correct positions on the center peg.

ANY QUESTIONS? IF NOT, SIGNAL THE EXPERIMENTER THAT YOU ARE READY TO BEGIN.

USES TEST Student #________________

DIRECTIONS: In this test you will be asked to list as many uses as you can think of for a common object.

Write as rapidly as you can. Give all the uses you can think of. Your answers do not have to be complete sentences. You may use short phrases.

There will be numbered lines on which to write your answers. Use one line for each answer. When the signal is given, turn the page over, read the name of the object, then list <u>all</u> the uses of the object that you can think of.

For example, if you were asked to suggest uses for a NEWSPAPER, you might think to write down some of the following uses:

a. find a job (want ads)

b. start a fire

c. wrap garbage

d. learn how to get Tiger tickets for opening day

e. swat flies

f. stuffing to pack boxes

g. line drawers or shelves

DO NOT TURN OVER THE PAGE UNTIL THE EXAMINER TELLS YOU TO DO SO.

You will be given 3 minutes to complete this test. No questions will be answered after the test begins. When you are told to turn over the page, do so and begin the test immediately.

USES TEST

List as many uses as you can think of for a tin can (or cans).
Write each use on a separate line.

Example: preserve food

1____

2____

3____

4____

5____

6____

7____

8____

9____

10_______________________________________

11_______________________________________

12_______________________________________

13_______________________________________

14_______________________________________

15_______________________________________

16_______________________________________

17_______________________________________

18_______________________________________

19_______________________________________

20_______________________________________

21_______________________________________

22_______________________________________

23_______________________________________

24_______________________________________

25_______________________________________

"WHAT DO YOU REMEMBER ABOUT THE TV PROGRAM" TEST

This test is to see how much you were able to learn about the TV program that was shown in the background while you were taking the other tests.

DIRECTIONS: DO NOT WRITE ANYTHING ON THE TEST ITSELF. Use the paper provided to answer the short answer question (QU. 1), and the machine scoring sheet to answer the multiple choice questions (starting with QU 2).

Before you start, be sure to put your name and the program you watched on BOTH answer sheets (not the test booklet).

DT

"WHAT DO YOU REMEMBER ABOUT THE TV PROGRAM" QUIZ

Sometimes we pick up information about what is going on around us, even when we are paying attention to something else. This quiz is to see how much you may have learned about the TV program that was shown in the background while you were taking the tests.

DIRECTIONS: DO NOT WRITE ANYTHING ON THE TEST ITSELF. Use the paper provided to answer the short answer question (Qu. 1), and the machine scoring sheet to answer the multiple choice questions (starting with QU. 2).

Before you start, be sure to put your name and the program you watched on BOTH answer sheets (not on the test booklet).

DYNASTY

1. The program dealt with three big problems being faced by members of the Carrington clan. What were these problems?

   1)

   2)

   3)

2. Dominique Devereaux agreed to perform:

   a. in Las Vegas, at a casino.
   b. in a small Denver nightclub.
   c. in Europe, on a 5-nation tour.
   d. on stage in Los Angeles.

3. The character "Mark Jennings" was important in this episode. This is because:

   a) he had been murdered
   b) he had been kidnapped
   c) he agreed to loan Blake Carrington money
   d) he agreed to look after Mrs. Colby's business while she was on trial

4. In this episode, Alexis:

   a. plotted to steal Blake Carrington from Crystal.
   b. began a secret affair with Brady.
   c. fired her lawyer.
   d. loaned money to Blake Carrington.
   e. filed suit against Dominique Devereaux.

5. Crystal:

   a. sold her furs and jewelry.
   b. found out about Blake's affair with Miss Devereax.
   c. gave the money in her trust fund to Blake.
   d. convinced Alexis to loan money to Blake.

6. Alexis is accussed of:

   a. blackmail
   b. tax fraud
   c. kidnapping
   d. murder
   e. adultery

7. Brady and Miss Devereaux argue in one segment of this program. What did they argue about?

   a. Miss Devereaux was angry because Brady invested her money unwisely.
   b. Brady was angry because he suspected Miss Devereaux of having an affair.
   c. Brady was angry because Miss Devereaux passed up an opportunity to perform in Las Vegas.
   d. Miss Devereaux was angry because Brady destroyed her opportunity to perform in Las Vegas.

8. Dominique Devereaux seems to have something against:

   a. Fallon
   b. Blake Carrington
   c. Alexis
   d. Brady
   e. Jeff

9. What piece of evidence links Alexis to a crime?

   a. a letter
   b. a gun
   c. fingerprints
   d. a check

10. Danny was kidnapped by:

   a. Mark Jennings
   b. Alexis
   c. Jeff
   d. his mother
   e. Miss Devereaux

THE A TEAM

1. Name and describe three crimes which were committed in this episode by the main "bad guy" or his henchmen.

   Crime 1:

   Crime 2:

   Crime 3:

2. The occupation of the main "bad guy" in this episode was:

   a. professional gambler
   b. mine boss
   c. saloon operator
   d. sheriff

3. He cheated at cards by using:

   a. a lighter
   b. a deck of marked cards
   c. signals from observers seated so as to be able to see his opponents' cards
   d. a series of mirrors on the walls of the saloon

4. His main source of extra income seemed to be:

   a. embezzling the company payroll
   b. diverting gold from company mines into his own pocket
   c. running an illegal gambling operation
   d. providing slaves to work in an underground arms factory
   e. smuggling cocaine into the U.S.

5. He did business with another group of bad guys, who intended to:

   a. blow up the country's presidential palace.
   b. make a big dope shipment to New York.
   c. shoot down an American airliner.
   d. take hostages and hold them for ransom.
   e. sell U.S. defense secrets to the Russians.

6. The woman who played the biggest role in this story was:

   a. a representative of the dope smugglers.
   b. an investigator for the mining company.
   c. a C.I.A. agent who became local contact person for the A-Team.
   d. a private individual, trying to get information on the death of her brother.
   e. a spy for the bad guys, used to keep an eye on the A-Team.

7. Mr. T. was almost killed while patrolling the town. What almost killed him?

   a. an out-of-control automobile
   b. a bomb
   c. a forklift vehicle
   d. a shotgun
   e. a falling rock

8. The A-Team was captured and confined:

    a. in the town jail.
    b. in an old mine shaft.
    c. in cages, in the jungle.
    d. by the secret police.

9. Who was knocked cold by a member of the A-Team, after breaking into someone's trailer?

    a. the bad guy
    b. Mr. T
    c. a common burglar
    d. a girl

10. When we first see the A-Team in River City, Mr. T is:

    a. at the hamburger stand.
    b. in the town bar.
    c. patrolling the streets of River City.
    d. in a jail cell.
    e. outside a mine shaft.

HUNTER

1. Three attempts were made on Hunter's life while he was in jail. Name the locations in which each attempt was made:

   Attempt 1:

   Attempt 2:

   Attempt 3:

2. Hunter was in jail because he was accussed of:

   a. corruption
   b. murder
   c. dope dealing
   d. assault
   e. rape

3. The first scene in this story was of:

   a. an ambulance coming to the aid of a school kid
   b. a car chase involving Hunter chasing a dope dealer
   c. a fight between Hunter and a dope dealer
   d. an argument between Hunter and the police chief

4. There were several people killed in this episode. Who was the first to die?

   a. a dope dealer
   b. a prostitute
   c. a jail inmate
   d. a school kid

5. Hunter got into a fight with the character "Oscar Gatlin" (a bald headed criminal)

   a. in a restaurant
   b. in the jail hallway
   c. in a warehouse
   d. in the jail lunchroom

6. McCall poured wine:

   a. over Gatlin's head
   b. into Archie's face
   c. into Hunter's glass
   d. onto Gil's pants
   e. onto the police chief's desk

7. A burglar broke into Hunter's apartment:

   a. while Hunter was asleep in front of his TV set.
   b. while Hunter was out with McCall.
   c. while Hunter was out fixing a woman's car.
   d. while Hunter was locked up in jail.

8. Who was responsible for setting up Hunter to be arrested?

   a. Oscar Gatlin
   b. "the Hammer"
   c. Gil Glascow
   d. a prostitute
   e. McCall

9. What piece of evidence linked Hunter to the crime he was in jail for?

   a. his fingerprints
   b. a "witness"
   c. his car
   d. his gun

10. Why was Hunter eventually released from jail?

   a. because Gil captured the hit man, who confessed.
   b. because Gil and McCall captured a dope dealer, who confessed.
   c. because Hunter beat the hell out of Oscar Gatlin, who then confessed.
   d. because McCall tracked down a girl, who confessed.
   e. because McCall found another judge, who was willing to set bail for Hunter.

KNOTS LANDING

1. Identify three personal or marital problems which different characters had to cope with in this episode.

   Person (However you can identify) Problem

2. Greg Sumner was running for:

   a. Governor of California
   b. U.S. Senator
   c. the 203rd Congressional District Seat
   d. Mayor of Los Angeles

3. Sumner was hurt in the election campaign by the revelation that he:

   a. had killed a man.
   b. had had a nervous breakdown.
   c. had fathered an illegitimate child.
   d. was guilty of tax fraud.

4. Sumner's opponent Caufield was hurt in the election campaign by the revelation that he:

   a. was guilty of tax fraud.
   b. was an associate of J.R. Ewing.
   c. had fathered an illegitimate child.
   d. had had a nervous breakdown.
   e. had killed a man.

5. Sumner's wife:

   a. begged him to withdraw from the race.
   b. began an affair with Matt Mackenzie.
   c. publically endorsed Sumner's opponent.
   d. tried to get Karen to divorce her husband.

6. Valine was pregnant with ____________ child.

   a. Caufield's
   b. Sumner's
   c. Matt MacKenzie's
   d. Gary Ewing's
   e. Ben Gibson's

7. Which character disappeared for part of the program?

    a. Valine
    b. P.K. Kelly
    c. Sumner
    d. Caufield
    e. Abby

8. Karen wants to divorce Matt because:

    a. she found out that Valine was carrying Matt's child.
    b. she wanted to spare him the hurt of watching her die.
    c. she is really in love with Joshua.
    d. she found out that she was pregnant by Sumner.

9. Gary Ewing didn't want to expand the Lotus Point development because of problems with:

    a. construction costs
    b. excessively high taxes
    c. zoning regulations
    d. problems getting enough water

10. Who did Valine ask to help with the birth of her child?

    a. Gary Ewing
    b. Abby Ewing
    c. Greg Sumner
    d. Matt MacKenzie
    e. P.K. Kelly

DEBRIEFING FORM

Thank you for helping us with our research. We would like to take a few minutes to tell you about the study in which you have just participated.

The general purpose of this study was to determine the impact of the sort of "meaningful" distraction which is provided by an operating television, on the mental abilities measured by the different tests you took. Each test was used to measure a different mental ability. The tests were intended to be difficult. Each test used a reduced time limit. For example, the Series Completion Test usually is given with an 8 or 10 minute limit; you were only given six minutes.

In the general instructions you were told that the ability to perform well in these tests while you were under stress or distraction would predict your future success. This was stating things a little too strongly. In fact, we don't know the degree to which these particular tests predict professional success. However, at least one prior scientific study indicates that the abilitiy to perform well under distracting conditions can distinguish between "high achievers" and "under-achievers."

In the general instructions, you were also told that the amount of extra credit you would receive would depend on your performance on the tests. In actual fact, we will be giving everyone the higher amount of extra credit, regardless of their performance. The reason you were told that your extra credit depended on how well you did was that we needed to make very sure that everyone tried as hard as they could on the tests. The only way we could do this was to make it seem that there would be a reward for doing so.

It is very important that students do not know exactly what we are studying, or the details of how we are doing it, at the time they take these tests. If they did know these things, it could affect the results of the tests and invalidate the entire study. Because of this, we would like to ask you to agree not to talk to other students about the purpose of the study, or give out any details about the study until it is completed (about the end of this term). Can we count on you to do this?

Again, thank you for your participation. If you would like to find out about the results of this research, the examiner will give you the name and number of someone you can call (about the middle of next term), who will be happy to discuss the findings with you.

POST TEST QUESTIONNAIRE A

Before you go, we would like you to take a little more time to answer some questions about your test experience. We appreciate your help in doing a good job on this part of the study.

PART 1: Please answer the following questions by putting a mark on the line between the two extreme answers presented. You may place your mark anywhere on the line. The closer your opinion is to one extreme or the other, the closer you should place your mark to that end of the line.

1. How much attention did you pay (voluntarily or involuntarily) to the TV program that was on while you were doing the tests?

   Absolutely NO Attention /_____/_____/_____/_____/_____/_____/ Very Close Attention

2. How distracting did you find the TV, when you were trying to concentrate on the tests?

   Not at all Distracting /____/____/____/____/____/____/____/ Extremely Distracting

3. How strongly did you wish to do well on these tests?

   Didn't care at all /___/___/___/___/___/___/___/___/ Cared a great deal

4. How tired did you get from doing all these tests?

   Not tired at all /__/__/__/__/__/__/__/__/__/ Extremely tired

PART 2: Please answer the following questions by circling a number between zero and ten. Zero will always represent none or almost none of the quality you are being questioned about. Ten will always represent a very large amount of that same quality.

1. We would like you to first rate the amount of effort you put into trying to do well on the tests you were given. Think of a score of "0" as representing the least possible effort, and a score of "10" the amount of effort you would put into trying to do well on final exam in one of your classes.

   AMOUNT OF EFFORT: 0 1 2 3 4 5 6 7 8 9 10
   (circle a number) none ... amount on a final exam

2. Next, please rate how tired or fatigued you feel now, after completing the tests. Think of "0" as representing how tired you might feel a half hour after awakening from a good night's sleep, and "10" as representing how tired you might feel after staying up all night studying for an exam.

AMOUNT OF FATIGUE:		0 1 2 3 4 5 6 7 8 9 10	
(circle a number)	after good night's sleep		after staying up all night studying

PART 3: Please answer the following questions:

1. Which of the following best describes the instructions you were given, as you understood them? (Check the best answer)

   ( ) Ignore the TV. Concentrate on the tests.

   ( ) Pay some attention to the TV, but concentrate mostly on the tests.

   ( ) Pay equal attention to the TV and the tests.

   ( ) Pay more attention to the TV than to the tests.

2. Which of the following best describes what you actually did when you were doing the tests?

   ( ) Ignored the TV. Concentrated on the tests only.

   ( ) Paid some attention to the TV, but concentrated mostly on the tests.

   ( ) Paid an equal amount of attention to the TV and the tests.

   ( ) Paid more attention to the TV than to the tests.

3. On which of the following tests were you working when you first felt yourself beginning to get tireq? (Check one answer).

   ( ) Digit span (recalling lists of numbers)

   ( ) Mental arithemetic (25 x 57 = ?)

   ( ) Letter series (ABCBCDCD_)

   ( ) Tower of Hanoi (moving disks)

   ( ) Paragraph comprehension

   ( ) Uses of tin cans

   ( ) Sentence verification ("A precedes B.")

   ( ) I never got tired during this experiment.

   ( ) I was tired before I ever began this experiment.

4. How often do you normally view the TV series from which the program you were shown was taken? (Check one answer)

( ) Regularly

( ) Fairly often

( ) Rarely or never

5. Have you previously seen this particular episode of the program?

( ) Yes

( ) No

( ) Not sure

PART 4: Please answer the following questions.

1. Think about your television viewing on an <u>average weekday</u> (not a day on which you have a night class). On the average, how many hours of TV do you watch:

(a) before 12 noon? _____hours

(b) between 12 noon and 6 p.m.? _____hours

(c) between 6 p.m. and 10 p.m.? _____hours

(d) later than 10 p.m.? _____hours

2. Think of what you did during the day <u>yesterday</u>. Yesterday, how many hours of TV did you watch:

(a) before 12 noon? _____hours

(b) between 12 noon and 6 p.m.? _____hours

(c) between 6 p.m. and 10. p.m.? _____hours

(d) later than 10 p.m.? _____hours

3. How many days last week did you watch at least one hour of TV before 12 noon?

DAYS: 0 1 2 3 4 5 6 7

4. How many days last week did you watch at least one hour of TV between 12 noon and 6 p.m.?

DAYS: 0 1 2 3 4 5 6 7

5. How many days last week did you watch at least one hour of TV between 6 p.m. and 8 p.m.?

DAYS: 0 1 2 3 4 5 6 7

6. How many days last week did you watch at least one hour of TV between 8 p.m. and 11 p.m.?

DAYS: 0 1 2 3 4 5 6 7

7. How many days last week did you watch at least one hour of TV after 11 p.m.?

DAYS: 0 1 2 3 4 5 6 7

COMPLETE THE FOLLOWING SENTENCES BY PUTTING A CHECK BESIDE THE BEST ANSWER:

8. "When I am reading or studying at home or in the dorm, I ....

( ) always or almost always have a TV on where I can see or listen to it."

( ) usually have a TV on where I can see or listen to it."

( ) sometimes have a TV on where I can see or listen to it."

( ) rarely or never have a TV on where I can see or listen to it."

9. "I prefer to do my studying ...

( ) while listening to the TV."

( ) while listening to the radio or to recordings."

( ) in quiet."

POST TEST QUESTIONNAIRE B

Before you go, we would like you to take a little more time to answer some questions about your test experience. We appreciate your help in doing a good job on this part of the study.

PART 1: Please answer the following questions by putting a mark on the line between the two extreme answers presented. You may place your mark anywhere on the line. The closer your opinion is to one extreme or the other, the closer you should place your mark to that end of the line.

1. How strongly did you wish to do well on these tests?

Didn't care at all /___/___/___/___/___/___/___/___/ Cared a great deal

2. How tired did you get from doing all these tests?

Not tired at all /___/___/___/___/___/___/___/___/___/ Extremely tired

PART 2: Please answer the following questions by circling a number between zero and ten. Zero will always represent none or almost none of the quality you are being questioned about. Ten will always represent a very large amount of that same quality.

1. We would like you to first rate the amount of effort you put into trying to do well on the tests you were given. Think of a score of "0" as representing the least possible effort, and a score of "10" the amount of effort you would put into trying to do well on final exam in one of your classes.

AMOUNT OF EFFORT: 0 1 2 3 4 5 6 7 8 9 10
(circle a number) none ... amount on a final exam

2. Next, please rate how tired or fatigued you feel now, after completion of the tests. Think of "0" as representing how tired you might feel a half-hour after awakening from a good night's sleep, and "10" as representing how tired you might feel after staying up all night studying for an exam.

AMOUNT OF FATIGUE: 0 1 2 3 4 5 6 7 8 9 10
(circle a number) after good night's sleep ... after staying up all night studying

3. 'n which of the following tests were you working when you first felt yourself beginning to get tireq? (Check one answer).

   ( ) Digit span (recalling lists of numbers)

   ( ) Mental arithemetic (25 x 57 = ?)

   ( ) Letter series (ABCbCDCD_)

   ( ) Tower of Hanoi (moving disks)

   ( ) Paragraph comprehension

   ( ) Uses of tin cans

   ( ) Sentence verification ("A precedes B.")

   ( ) I never got tired during this experiment.

   ( ) I was tired before I ever began this experiment.

PART 3: Please answer the following questions.

1. Think about your television viewing on an <u>average</u> <u>weekday</u> (not a day on which you have a night class). On the average, how many hours of TV do you watch:

   (a) before 12 noon? _____hours

   (b) between 12 noon and 6 p.m.? _____hours

   (c) between 6 p.m. and 10 p.m.? _____hours

   (d) later than 10 p.m.? _____hours

2. Think of what you did during the day <u>yesterday</u>. Yesterday, how many hours of TV did you watch:

   (a) before 12 noon? _____hours

   (b) between 12 noon and 6 p.m.? _____hours

   (c) between 6 p.m. and 10. p.m.? _____hours

   (d) later than 10 p.m.? _____hours

3. How many days last week did you watch at least one hour of TV before 12 noon?

   DAYS: 0 1 2 3 4 5 6 7

4. How many days last week did you watch at least one hour of TV between 12 noon and 6 p.m.?

   DAYS: 0 1 2 3 4 5 6 7

5. How many days last week did you watch at least one hour of TV between 6 p.m. and 8 p.m.?

   DAYS: 0 1 2 3 4 5 6 7

6. How many days last week did you watch at least one hour of TV between 8 p.m. and 11 p.m.?

DAYS: 0 1 2 3 4 5 6 7

7. How many days last week did you watch at least one hour of TV after 11 p.m.?

DAYS: 0 1 2 3 4 5 6 7

COMPLETE THE FOLLOWING SENTENCES BY PUTTING A CHECK BESIDE THE BEST ANSWER:

8. "When I am reading or studying at home or in the dorm, I ....

( ) always or almost always have a TV on where I can see or listen to it."

( ) usually have a TV on where I can see or listen to it."

( ) sometimes have a TV on where I can see or listen to it."

( ) rarely or never have a TV on where I can see or listen to it."

9. "I prefer to do my studying ....

( ) while listening to the TV."

( ) while listening to the radio or to recordings."

( ) in quiet."

EXPERIMENTAL PRETEST FORM Z: MOOD ADJECTIVE CHECK LIST

NAME________________________________ STUDENT #______________

PROGRAM NAME________________________________ SEGMENT: 1___ 2___

DIRECTIONS: Below you will find a list of adjectives describing ways a person may feel. FOR EACH ADJECTIVE, circle the response which indicates how well this adjective describes how you feel at this moment.

ADJECTIVE	DEFINITELY FEEL	FEEL SLIGHTLY	CANNOT DECIDE	DEFINITELY DO NOT FEEL
LIVELY	++	+	?	--
DULL	++	+	?	--
STIMULATED	++	+	?	--
ENERGETIC	++	+	?	--
PASSIVE	++	+	?	--
TIRED	++	+	?	--
AROUSED	++	+	?	--
ALERT	++	+	?	--
SLUGGISH	++	+	?	--
DROWSY	++	+	?	--
ACTIVE	++	+	?	--
VIGOROUS	++	+	?	--
SLEEPY	++	+	?	--
ACTIVATED	++	+	?	--

EXPERIMENTAL PRETEST FORM A: PROGRAM SEGMENT EVALUATION

NAME________________________________ STUDENT #____________________

PROGRAM NAME______________________ PROGRAM SEGMENT: 1___ 2___

We would like you to rate the program you are viewing on several qualities. The first of these is PHYSICAL ACTION. Physical action is just what you might think it is: things like car chases, fights, and other things which might be exciting.

1. First, we would like you to estimate the percentage of the program time, for the program you just viewed, that was devoted to action. If there was no action in this part of the program, give a score of "0" percent. If the whole segment was action, give a score of "100" percent. If it was somewhere in between, give a number between 0 and 100 which best represetts the amount of action in the part of the program you just watched.

   % PROGRAM TIME DEVOTED TO ACTION: ________percent

2. Now we'd like you to estimate the amount of action in this program part on another sort of measurement scale. For this scale, place a mark on the line below indicating the amount of action in the program part.

   ACTION: /____/
   No action at all — Extremely high om action

3. Finally, we'd like you to compare the amount of action in this program segment with the average amount of action on prime-time network TV program segments of the same length.

   Call the amount of action in the average program segment a "10." That is, the average segment has 10 units of action. A segment that has no action is scored a "0" in action units.

   If you think this program segment has exactly half as much action as the average program segment of its length, you should give it a score of "5". If this program segment has twice as much action as the average program segment of its length, you should give it a score of "20". And so on.

   How many action units would you say this program segment had? Use any number you think is most accurate. THERE IS NO UPPER LIMIT.

   AMOUNT OF ACTION: ____________ action-units, where 0 = no action, and 10 = the average amount of action.

EXPERIMENTAL PRETEST FORM B: PROGRAM SEGMENT EVALUATION 2

NAME______________________________ STUDENT #_______________

PROGRAM NAME______________________________ PROGRAM SEGMENT: 1___ 2___

The second quality on which we would like you to rate this program segment is "talk". This means, simply, how much of the program time do characters spend conversing? How much talking is going on?

1. Just like you did for "action," we would like you to estimate the percentage of time people in this program segment are talking. Again, your estimate should be a number between 0 (no talking) and 100 (talking all the time). DON'T assume that your "talking" percentage has to add to 100 with your "action" percentage. People can be talking during action sequences, and a program can be low in both action and talk.

   % PROGRAM TIME DEVOTED TO TALK: __________percent

2. Now we would like you to rate the amount of talk in this program segment on a second sort of rating scale, just as you did for "action." Simply place a mark at the point on the line that you think best represents the amount of talk in this program segment:

   TALK: /____/

   No talk at all | Talking all the time

3. Finally, we'd like you to compare the amount of talk in this program segment to the average amount of talk in the average prime-time TV program segment of this length. Again, let "0" represent no talk at all, and "10" represent the amount of talk that occurs in the average program segment of this length. How much talk would you say has occurred in this program part? Use any number you think is best. THERE IS NO UPPER LIMIT.

   AMOUNT OF TALK: __________ talk-units, where 0 = no talk and 10 = the average amount of talk.

EXPERIMENTAL PRETEST FORM Z: MOOD ADJECTIVE CHECK LIST

NAME_____________________________ STUDENT #___________

PROGRAM NAME_____________________________ SEGMENT: 1___ 2___

DIRECTIONS: Below you will find a list of adjectives describing ways a person may feel. FOR EACH ADJECTIVE, circle the response which indicates how well this adjective describes how you feel at this moment.

ADJECTIVE	DEFINITELY FEEL	FEEL SLIGHTLY	CANNOT DECIDE	DEFINITELY DO NOT FEEL
LIVELY	++	+	?	--
DULL	++	+	?	--
STIMULATED	++	+	?	--
ENERGETIC	++	+	?	--
PASSIVE	++	+	?	--
TIRED	++	+	?	--
AROUSED	++	+	?	--
ALERT	++	+	?	--
SLUGGISH	++	+	?	--
DROWSY	++	+	?	--
ACTIVE	++	+	?	--
VIGOROUS	++	+	?	--
SLEEPY	++	+	?	--
ACTIVATED	++	+	?	--

EXPERIMENTAL PRETEST FORM A: PROGRAM SEGMENT EVALUATION

NAME______________________________ STUDENT #__________________

PROGRAM NAME____________________ PROGRAM SEGMENT: 1___ 2___

We would like you to rate the program you are viewing on several qualities. The first of these is PHYSICAL ACTION. Physical action is just what you might think it is: things like car chases, fights, and other things which might be exciting.

1. First, we would like you to estimate the percentage of the program time, for the program you just viewed, that was devoted to action. If there was no action in this part of the program, give a score of "0" percent. If the whole segment was action, give a score of "100" percent. If it was somewhere in between, give a number between 0 and 100 which best represetts the amount of action in the part of the program you just watched.

   % PROGRAM TIME DEVOTED TO ACTION: ________percent

2. Now we'd like you to estimate the amount of action in this program part on another sort of measurement scale. For this scale, place a mark on the line below indicating the amount of action in the program part.

   ACTION: /____/
   No action at all — Extremely high om action

3. Finally, we'd like you to compare the amount of action in this program segment with the average amount of action on prime-time network TV program segments of the same length.

   Call the amount of action in the average program segment a "10." That is, the average segment has 10 units of action. A segment that has no action is scored a "0" in action units.

   If you think this program segment has exactly half as much action as the average program segment of its length, you should give it a score of "5". If this program segment has twice as much action as the average program segment of its length, you should give it a score of "20". And so on.

   How many action units would you say this program segment had? Use any number you think is most accurate. THERE IS NO UPPER LIMIT.

   AMOUNT OF ACTION: ____________ action-units, where 0 = no action, and 10 = the average amount of action.

EXPERIMENTAL PRETEST FORM B: PROGRAM SEGMENT EVALUATION 2

NAME______________________________ STUDENT #______________

PROGRAM NAME___________________________ PROGRAM SEGMENT: 1___ 2___

The second quality on which we would like you to rate this program segment is "talk". This means, simply, how much of the program time do characters spend conversing? How much talking is going on?

1. Just like you did for "action," we would like you to estimate the percentage of time people in this program segment are talking. Again, your estimate should be a number between 0 (no talking) and 100 (talking all the time). DON'T assume that your "talking" percentage has to add to 100 with your "action" percentage. People can be talking during action sequences, and a program can be low in both action and talk.

   % PROGRAM TIME DEVOTED TO TALK: __________percent

2. Now we would like you to rate the amount of talk in this program segment on a second sort of rating scale, just as you did for "action." Simply place a mark at the point on the line that you think best represents the amount of talk in this program segment:

   TALK: /____/

   No talk at all — Talking all the time

3. Finally, we'd like you to compare the amount of talk in this program segment to the average amount of talk in the average prime-time TV program segment of this length. Again, let "0" represent no talk at all, and "10" represent the amount of talk that occurs in the average program segment of this length. How much talk would you say has occurred in this program part? Use any number you think is best. THERE IS NO UPPER LIMIT.

   AMOUNT OF TALK: __________ talk-units, where 0 = no talk and 10 = the average amount of talk.

EXPERIMENTAL PRETEST FORM C: GENERAL EVALUATION

Name________________________ Student #____________

PROGRAM NAME________________________

1. How interesting did you find this program? Place a mark on the line below to indicate your level of interest in this program:

INTEREST: /________________________/

Not interesting at all — Extremely Interesting

2. How well did this program do at holding your attention? Place a mark on the line below to indicate how well the program kept your attention:

ATTENTION: /________________________/

Not attention-grabbing at all — Very attention grabbing

3. How involving do you think this program was? Place a mark on the line below to indicate how well the program itself did at keeping you involved in the story or action.

INVOLVING: /________________________/

Not involving at all — Extremely involving

4. Now we would like you to compare this program to the average prime-time program. If a program is totally boring, it should get a score of "0" on interest value. If it is just as interesting as the average prime-time program, it should receive a score of "10." You can use any number above or below 10 to indicate how comparatively interesting this program was. THERE IS NO UPPER LIMIT ON THE SCORE YOU CAN GIVE.

INTEREST VALUE: __________units, where 0 = no interest value at all, and
10 = average amount of interest value

5. Now we would like you to make the same sort of comparison for how attention-grabbing the program was. If the program was not attention-grabbing at all, give it a "0". If it was just as attention-grabbing as the average show, give it a "10." Otherwise, give it any number which best represents how attention-grabbing the show was. Remember, THERE IS NO UPPER LIMIT TO THE SCORE YOU CAN GIVE.

ATTENTION-GRABBING: __________ units, where 0 = not at all, and
10 = about as attention-grabbing as the average show

6. Finally, we would like you to rate how relatively involving this program was. Again, "0" represents not involving at all, "10" represents about as involving as the average program, and you are permitted to use any number, above or below 10, to indicate how involving you found the show to be.

INVOLVING: __________ units, where 0 = not at all involving, and
10 = about as involving as the average