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MASS MEDIA FLOW AND DIFFERENTIAL GROWTH IN KNOWLEDGE

BY P. J. TICHENOR, G. A. DONOHUE, AND
C. N. OLIEN

Data from four types of research—news diffusion studies, time trends, a newspaper strike, and a field experiment—are consistent with the general hypothesis that increasing the flow of news on a topic leads to greater acquisition of knowledge about that topic among the more highly educated segments of society. Whether the resulting knowledge gap closes may depend partly on whether the stimulus intensity of mass media publicity is maintained at a high level, or is reduced or eliminated at a point when only the more active persons have gained that knowledge.

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AQUISITION OF KNOWLEDGE about science and other public affairs issues may be viewed as a component of social change consistent with a cumulative change model. According to this perspective, a given increment of change may lead to a chain reaction appearing as an increased rate of acceptance of a pattern of behavior, a belief, a value, or an element of technology in a social system.^{1, 2} Because certain subsystems within any total social system have patterns of behavior and values conducive to change, gaps tend to appear between subgroups already experiencing change and those that are stagnant or slower in initiating change.

The intent of this paper is to examine evidence from prior studies and from a recent field experiment in Minneapolis and St. Paul bearing on the following general hypothesis:

As the infusion of mass media information into a social system increases, segments of the population with higher socioeconomic status tend to acquire this information at a faster rate than the lower status segments, so that the

¹ Wilbert E. Moore, *Social Change*, Englewood Cliffs, N.J., Prentice-Hall, Inc., 1963, pp. 37-38.

² Charles P. and Zena K. Loomis, *Modern Social Theories*, Princeton, N.J., D. Van Nostrand, 1961, p. 589.

gap in knowledge between these segments tends to increase rather than decrease.

This "knowledge gap" hypothesis does not hold that lower status population segments remain completely uninformed (or that the poor in knowledge get poorer in an absolute sense). Instead, the proposition is that growth of knowledge is *relatively* greater among the higher status segments. For this paper, education is assumed to be a valid indicator of socioeconomic status.³

Two other assumptions are important for this analysis. One is that growth of human knowledge may be characterized by either linear or curvilinear trends, but that such growth is irreversible within the timespan under study.^{4, 5} A second assumption is that, for a given topic being studied, a point of diminishing returns from mass media infusion has not been reached, or, if it has been reached, it is possible that it occurs at different levels for different socioeconomic groups. Furthermore, this hypothesis applies primarily to public affairs and science news having more or less general appeal. It would not necessarily apply to more audience-specific topics, such as stock market quotations, society news, sports and lawn and garden care.

PREVIOUS FINDINGS

Although not stated specifically, this knowledge gap hypothesis has been implicit throughout the literature on mass communication effects. Underlying this view is the general finding that education is a powerful correlate of acquisition of knowledge about public affairs and science from mass media.⁶

Increased formal education indicates an expanded and more differentiated life space, including a greater number of reference groups, more interest in and awareness of science and other public issues, more accumulated knowledge of these topics, and more extensive exposure to mass media content in these areas.⁷

³ Albert J. Reiss, Jr., *Occupations and Social Status*, New York, Free Press, 1961, pp. 115-116.

⁴ James S. Coleman, *Introduction to Mathematical Sociology*, New York, Free Press, 1964, p. 492ff.

⁵ Gosta Carlsson, "Change, Growth and Irreversibility," *American Journal of Sociology*, Vol. 73, 1968, pp. 706-714.

⁶ See, for example, Robert C. Davis, *The Public Impact of Science in the Mass Media*, Survey Research Center, University of Michigan, 1958; Wilbur Schramm and Serena Wade, *Knowledge and the Public Mind*, Institute for Communication Research, Stanford University, 1967; and Serena Wade and Wilbur Schramm, "The Mass Media as Sources of Public Affairs, Science, and Health Knowledge," *Public Opinion Quarterly*, Vol. 33, 1969, pp. 197-209.

⁷ Merrill E. Samuelson, R. F. Carter, and Lee Ruggels, "Education, Available Time, and Mass Media Use," *Journalism Quarterly*, Vol. 40, 1963, pp. 491-496.

The "knowledge gap" hypothesis thus seems to suggest itself as a fundamental explanation for the apparent failure of mass publicity to inform the public at large. In analyzing efforts to inform Cincinnati adults about the United Nations, Star and Hughes point out that persons reached by the campaign tended to be the better educated, the younger, and the men, while less educated and older persons virtually ignored the whole thing.⁸ Robinson offers the Newtonian explanation that those who are uninformed remain so unless acted upon by an outside force, while those already informed stay in motion.⁹ Robinson's mechanistic perspective seems to say that people may develop trained capacities or incapacities to react to stimuli from both internal and external sources. Hyman and Sheatsley also appear to accept the notion of trained capacities to learn about public affairs: "as people learn more, their interest increases, and as their interest increases, they are impelled to learn more."¹⁰

Star and Hughes go a step further in specifying the interdependence among education, interest, and exposure, pointing out that highly educated persons reached by the campaign were more likely to be interested and therefore better informed. They concluded that persons reached by the campaign were least in need of it, and the persons missed were the ones the plan tried to reach.¹¹ Key's analysis of the powerful relationship between audience stratification and political news exposure suggests that one principal function of a presidential campaign would be to increase the difference in level of information between persons at educational extremes, since those at the top have higher rates of exposure.¹² In a more general sense, a widening knowledge gap may be occurring in developing nations as a result of the systems for delivering information to people. As Beers states, the pattern of education improvement in modernizing nations may be such that the relative ignorance of a literate villager today is greater than that of his illiterate father.¹³

There are several contributory reasons why the predicted knowledge gap should appear and widen with increasing levels of media

⁸ Shirley Star and Helen M. Hughes, "Report of an Educational Campaign: The Cincinnati Plan for the United Nations," *American Journal of Sociology*, Vol. 55, 1950, pp. 389-397.

⁹ John P. Robinson, "World Affairs and Media Exposure," *Journalism Quarterly*, Vol. 44, Spring 1967, pp. 23-31.

¹⁰ Herbert H. Hyman and Paul B. Sheatsley, "Some Reasons Why Information Campaigns Fail," *Public Opinion Quarterly*, Vol. 11, 1947, pp. 413-423.

¹¹ Star and Hughes, *op. cit.*

¹² V. O. Key, *Public Opinion and American Democracy*, New York, Knopf, 1961, pp. 348-357.

¹³ Howard W. Beers, *Application of Sociology in Development Programs*, New York, Agricultural Development Council, 1963.

input. One factor is *communication skills*. Persons with more formal education would be expected to have the higher reading and comprehension abilities necessary to acquire public affairs or science knowledge.

A second factor is amount of *stored information*, or existing knowledge resulting from prior exposure to the topic through mass media or from formal education itself. Persons who are already better informed are more likely to be aware of a topic when it appears in the mass media and are better prepared to understand it.

A third factor is *relevant social contact*. Education generally indicates a broader sphere of everyday activity, a greater number of reference groups, and more interpersonal contacts, which increase the likelihood of discussing public affairs topics with others. Studies of diffusion among such groups as doctors and farmers tend to show steeper, more accelerated acceptance rates for more active, socially integrated individuals.¹⁴

A fourth factor includes *selective exposure, acceptance, and retention* of information. As Sears and Freedman have pointed out, voluntary exposure is often more closely related to education than to any other set of variables. They contend that what appears to be selective exposure according to attitudes might often more appropriately be called "de facto" selectivity resulting from educational differences.¹⁵ Selective acceptance and retention, however, might be a joint result of attitude and educational differences. A persistent theme in mass media research is the apparent tendency to interpret and recall information in ways congruent with existing beliefs and values.¹⁶

A final factor is the nature of the mass media system that delivers information. Thus far, most science and public affairs news (with the possible recent exceptions of crisis events and space spectaculars) is carried in print media which, traditionally, have been more heavily used by higher-status persons. Print media are geared to the interests and tastes of this higher-status segment and may taper off on reporting many topics when they begin to lose the novel characteristic of "news." Unlike a great deal of contemporary advertising, science and public affairs news ordinarily lacks the constant repetition which facilitates learning and familiarity among lower-status persons.

The knowledge gap hypothesis might be expressed, operationally, in at least two different ways:

¹⁴ Elihu Katz, "The Social Itinerary of Technical Change: Two Studies on the Diffusion of Innovation," *Human Organization*, Vol. 20, No. 2, Summer 1961.

¹⁵ David O. Sears and Jonathan Freedman, "Selective Exposure to Information: A Critical Review," *Public Opinion Quarterly*, Vol. 31, 1967, pp. 194-214.

¹⁶ Joseph Klapper, *The Effects of Mass Communication*, New York, Free Press, 1960, pp. 15-26.

1. *Over time*, acquisition of knowledge of a heavily publicized topic will proceed at a faster rate among better educated persons than among those with less education; and

2. *At a given point in time*, there should be a higher correlation between acquisition of knowledge and education for topics highly publicized in the media than for topics less highly publicized.

One would expect the knowledge gap to be especially prominent when one or more of the contributory factors is operative. Thus, to the extent that communication skills, prior knowledge, social contact, or attitudinal selectivity is engaged, the gap should widen as heavy mass media flow continues.

TIME TREND DATA

Evidence may be taken from both short-term and longer-term studies. Budd, MacLean, and Barnes studied the diffusion over a two-day period of two major news events, the resignation of Nikita Khrushchev and the Walter Jenkins case of 1964. The studies covered the period starting when the events were first announced and continuing for the next day or longer.¹⁷ Although the authors expected socioeconomic differences in knowledge to be *diminished* in such events of major impact, the results were generally consistent with the knowledge gap hypothesis. Respondents with more education learned of the events more rapidly than did those with less education, and a larger proportion of persons with more education were aware of the events two days after they had occurred. Within this timespan, the gap in awareness between socioeconomic groups actually widened.

Another test of the knowledge gap hypothesis would involve data from studies conducted over time, with the same question asked at various intervals. Data on three such topics were gathered by the American Institute of Public Opinion between 1949 and 1965.¹⁸ The topics include earth satellites, man's attempt to reach the moon, and the cigarette-cancer controversy. Each topic received considerable mass media attention during the period under study, and the entire period was one when U. S. mass media in general gave science increasingly heavy coverage.¹⁹ In 1958, managing editors of 240 daily newspapers were asked whether news space given to science, engineering, and medicine had changed in recent years. More than 90 per cent said there had been an increase and nearly two-fifths said the increase

¹⁷ Richard W. Budd, Malcolm S. MacLean Jr., and Arthur M. Barnes, "Regularities in the Diffusion of Two Major News Events," *Journalism Quarterly*, Vol. 43, 1966, pp. 221-230.

¹⁸ Data from AIPO surveys were obtained through the Roper Public Opinion Research Center, Williamstown, Mass.

¹⁹ Hillier Kriehbaum, *Science and the Mass Media*, New York University Press, 1968, p. 65ff.

amounted to at least a doubling of science news space. In a similar study in 1965, nearly half of the editors reported a doubling of science news.²⁰ Furthermore, each specific topic had received heavy media treatment as the result of specific events. The principal event in space research was the 1958 launching of the Sputnik I, followed by the several satellite launchings by both the U. S. and Soviet Russia. The possible link between smoking and cancer first received widespread coverage after the 1954 AMA report on the problem.

For each topic, there was general growth in knowledge or acceptance of the stated belief over time. Correlation coefficients between education and knowledge or belief for each topic and year are shown in Table 1, and the pattern is quite consistent with the hypothesis of an increasing knowledge gap. The two polls on earth satellites are illustrative, with the correlation rising as knowledge increases from 1955 (three years before Sputnik) to 1961 (after the first U. S. manned space flight).

More impressive are results from the four polls asking respondents whether they believed man would reach the moon in the foreseeable future.²¹ Again, as general acceptance of this belief increased, the correlation with education showed a statistically significant increase over each 5- or 6-year period. The increasing gap between educational levels is directly visible in Figure 1.²² Among college-educated persons, belief that man would reach the moon rose from under 20 per cent in 1949 to over 80 per cent 16 years later; among the grade-school educated, this belief grew to only 38 per cent during the same period.

None of these studies measured mass media coverage or exposure directly, and the impact of media information on these patterns must be inferred. It seems quite clear that media publicity is a principal factor here, but it is also possible that far more is involved. The 16-year timespan covers a period of changes in the educational system. The population also changed, with the top educational category including a greater proportion of young persons in 1965 than in 1949. The important point, however, is that the gap does not close in the period studied.

²⁰ Krieghbaum, *op. cit.*

²¹ Specific questions varied slightly. In 1949, 1959, and 1965, respondents were asked whether they expected man to reach the moon within 20 years. In 1954, the question was whether man would reach the moon in the next 50 years. In both these items and those on smoking, "belief" is assumed to reflect increased knowledge.

²² Trend analysis of the data in Figure 1 shows that both linear and quadratic effects are statistically significant beyond the .001 level for all three educational levels. However, the quadratic effect for the college group, for example, accounts for less than .005 additional variance. Thus, it is reasonable to regard these trends as basically linear.

TABLE 1
CORRELATION BETWEEN EDUCATION AND KNOWLEDGE ON THREE TOPICS RECEIVING INCREASED PUBLICITY OVER TIME

Topic	1949	1954	1955	1957	1959	1961	1965	1969	Difference between <i>r</i> 's
Correct identification of earth satellites			.158			.265			$p < .050$
Belief that man will reach moon	.042	.132			.259		.334		1949-54, $p < .020$ 1954-59, $p < .001$ 1959-65, $p < .010$
Belief that cigarettes cause lung cancer		.050		.116 .079				.127	n.s.
Data source:	AIPO 450	AIPO 541, 525	AIPO 544	AIPO 585, 592	AIPO 621	AIPO 652	AIPO 705	AIPO Sept. 1969	

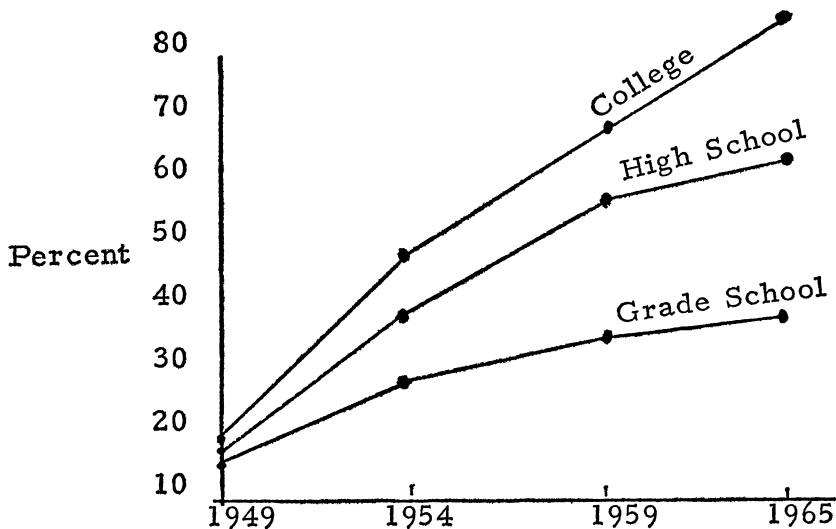


FIGURE 1. PER CENT OF RESPONDENTS IN NATIONAL SURVEYS STATING BELIEF THAT MAN WILL REACH MOON, BY EDUCATION AND YEAR

Belief in the cigarette-cancer link also follows the predicted pattern, although the correlation in the later year remains low. In the 1954-57 period, however, the smoking and cancer issue was held in far more doubt than is true today. Although more recent studies have been conducted on this issue, they involve different samples and measurement techniques and therefore cannot be compared directly with the AIPO data.

A NEWSPAPER STRIKE STUDY

Another possible way to test the knowledge gap hypothesis is to view the effects of withdrawing mass media publicity. In accordance with the hypothesis, we would expect that removing mass media coverage of a topic would reduce the difference in knowledge between educational groups. While such an experiment is difficult to manage, it might be approximated in a newspaper strike situation. Samuelson in 1959 studied knowledge of current public events in a community where the newspapers were on strike, and in a nearby community where the daily newspaper continued to publish as usual.²³ The study was conducted at the end of the first week of the strike, before citizens of the strike community were able to establish a great deal of substitute media behavior. Since withdrawing a newspaper means less mass media attention to news of the day by better-educated per-

²³ Data from a study conducted by Merrill Samuelson for "Some News-Seeking Behavior in a Newspaper Strike," unpublished Ph.D. dissertation, Stanford University, 1960.

sons, the hypothesis is that these persons "lose" proportionately more as a result of the newspaper strike. Thus, there should be less of a knowledge difference between better and less well-educated persons in the strike community than in the other one.

Since the non-strike community sample had only 9 persons with less than a high school education, the analysis here deals only *with the high school* group and the *college* group for each community. As hypothesized, the knowledge difference between educational levels is greater in the non-strike community than in the community where the newspaper had been on strike for the previous week (Table 2, difference of 1.08 *vs.* .44). This interaction, or contrast effect, is statistically significant beyond the .001 level.²⁴ Again, these data do not rule out alternative explanations, such as the possibility that the strike community may have been characterized by a low correlation between education and public affairs knowledge before the strike. Although the two communities are near each other geographically, the non-strike community was smaller, less industrialized, and characterized by a generally higher socioeconomic level. In the absence of data before or after the strike, the interpretation of these data must remain tentative.

TABLE 2

LEVELS OF PUBLIC AFFAIRS KNOWLEDGE FOR PERSONS WITH DIFFERENT EDUCATIONAL BACKGROUNDS, IN A NEWSPAPER STRIKE COMMUNITY AND A NON-STRIKE COMMUNITY, 1959*

<i>Community</i>	<i>High School Education</i>	<i>College Education</i>	<i>Difference</i>
Newspaper strike	4.07 (N = 153)	4.51 (N = 142)	.44
No newspaper strike	4.38 (N = 40)	5.46 (N = 56)	1.08

* Number of items correct in an 11-item test on current events.

THE MINNEAPOLIS-ST. PAUL EXPERIMENT

Although most of the data above are consistent with the knowledge gap hypothesis, the underlying factors are inferred rather than observed. If the general hypothesis is correct, education should be more closely correlated with knowledge gained from a *specific* article dealing with a topic that has been subjected to heavy previous publicity, compared with articles on less publicized topics. Highly educated persons are more likely to have been exposed to a heavily publicized topic in the past; they are already "in motion" on this topic and are easier to move still farther than less educated persons.²⁵

²⁴ The analysis of variance used in making this test is based upon an approximation procedure in which mean squares are adjusted for unequal numbers of cases in the subcells. See Hubert M. Blalock, *Social Statistics*, New York, McGraw-Hill, 1960, p. 264.

²⁵ Robinson, *op. cit.*

A recent field experiment in the Minneapolis-St. Paul metropolitan area provided for a more direct test of this aspect of the hypothesis. Reader understanding was measured for 22 medical and biological research articles and 21 social science articles, all taken from upper midwest metropolitan papers in the summer of 1967 and the winter of 1967-68. These subject areas were analyzed separately, since for medical news, the relationship between education and understanding is frequently curvilinear.^{26, 27} Also, it was essential to use articles in areas varying in amount of previous publicity.²⁸

An area probability sample of 600 persons was selected in the Minneapolis-St. Paul metropolitan area and interviews were conducted in April, 1968. Each respondent was asked to read two different science news articles.²⁹ Each article was presented with the question, "Would you please read through this, as you would any news article?" After the respondent had finished reading, the interviewer took the article back and asked: "What, as you best recall, does this article say?" Interviewers were instructed to use two probes for recall. Slightly more than 94 per cent of the respondents read at least one of the two articles. Each article was read by a maximum of 20 persons. Pairing was arranged so that a given article was administered first in 10 interviews and second in the other 10.

Responses were then analyzed for each *separate statement of content*, defined as a specific assertion with whatever qualifying phrases the person offered as part of that assertion. Sources quoted in the articles were then contacted and asked to judge the accuracy of the statements. Reader *understanding* is defined as the number of statements produced by the reader which were rated above the middle of a 7-point "accuracy rating scale" by the source.

This recall measure is open-ended and may, of course, underestimate ability to *recognize* information in the future. Presumably, however, it measures the person's ability to *verbalize* news article content and therefore the information which the person is able to transmit into the social system.

Publicity level for an article was defined operationally as the number of times during the previous calendar year when an article on the same topic area had appeared on the front page of one of the

²⁶ P. J. Tichenor, "Communication and Knowledge of Science in the Adult Population of the U.S.," unpublished Ph.D. dissertation, Stanford University, 1965.

²⁷ Hillier Kriegbaum, *Science, the News and the Public: A Report of the National Association of Science Writers, Inc.*, New York University Press, 1958, p. 5.

²⁸ The study involved a total of 60 articles. However, those dealing with subjects other than medicine, biology, or social science varied so greatly in topic and so little in level of previous publicity that they were inappropriate for this analysis.

²⁹ Interviews were conducted as part of a Metro-Poll survey conducted by the Minneapolis Star and Tribune Research Division.

four major Twin Cities daily newspapers. The assumption is that front-page treatment constitutes major media publicity. For medicine-biology, "more publicized" meant two front-page mentions or more; for the social sciences, "more publicized" meant four front-page mentions.

FINDINGS

Since responses to a second article read by a person might differ from the first, results were analyzed separately (Table 3.) Also, the news article assignment led to some overlap in subsamples for first and second articles. However, the data for "first article read" in Table 3 represent four independent subsamples, and the same is true for "second article read."

TABLE 3
CORRELATIONS BETWEEN EDUCATION AND UNDERSTANDING OF SCIENCE ARTICLES FOR HIGH AND LOW PUBLICITY TOPICS IN TWO GENERAL AREAS

Area	First Article Read		Second Article Read	
	More Publicized Topics	Less Publicized Topics	More Publicized Topics	Less Publicized Topics
Medicine-biology	$r = .109$ ($N = 84$) <i>n. s.</i>	$r = .032$ ($N = 111$) <i>n. s.</i>	$r = .264$ ($N = 90$) $p < .02$	$r = .165$ ($N = 108$) <i>n. s.</i>
Social sciences	$r = .278$ ($N = 104$) $p < .01$	$r = .228$ ($N = 93$) $p < .05$	$r = .282$ ($N = 91$) $p < .01$	$r = .117$ ($N = 97$) <i>n. s.</i>

The general pattern of correlations between education and understanding in Table 3 is consistent with the hypothesis; in each of the four comparisons, the "more publicized" articles tend to show a higher correlation. For the first article read, the correlations do not differ significantly according to previous publicity. However, for the second article read, the coefficient is significantly greater than zero for subsamples reading about more heavily publicized topics and nonsignificant for the less publicized topics. This pattern holds for both medical-biological and social science articles.

As expected, the observed relationship between education and understanding for more heavily publicized medical-biological topics tended to be curvilinear. That is, the sharpest difference in understanding of more and less publicized topics in this area is at the middle, rather than the highest, educational level. This pattern again illustrates the extremely high interest in medicine and health information among moderately educated persons.

PUBLICITY AND FAMILIARITY

Most of the data, then, tend to be consistent with the "increasing knowledge gap" hypothesis. To the extent that this hypothesis is tenable, it provides some sobering reflections on the "mass" impact of the media. At least for the subjects investigated here, the mass media seem to have a function similar to that of other social institutions: that of reinforcing or increasing existing inequities.

If media widen these gaps, under what conditions do the gaps close? Surely, some ideas eventually are universally shared. While data are not yet available, there is little doubt that the "moon walk" of July, 1969, produced widespread acceptance of the fact that man can reach the lunar surface. But media have limited resources, and the 1969 space spectacular may be an outstanding exception that illustrates a more general rule: media coverage tends to wane before the knowledge gap closes, and this tendency may be especially apparent in science, where a new development or finding renders yesterday's news topics obsolete. Once man went into orbit, earth satellites were virtually ignored by the media. If this is generally the case, the prospects for closing knowledge gaps in broad areas of science and public affairs through the mass media appear dismal. Other mass information delivery systems may be required if lower-status segments of the populations are to avoid falling further behind in relative familiarity with events and discoveries of the day.

This analysis has concentrated to a great extent on *print* aspects of mass publicity and may not apply to learning from television—at least, perhaps, not to the same extent. Since television use tends to be less correlated with education, there is a possibility that television may be a "knowledge leveler" in some areas. Whether TV does in fact have such a leveling function seems to be an urgent matter for further research.

Even as the results of this analysis stand, however, they do not necessarily point to a "failure" of information campaigns, as suggested by Hyman and Sheatsley or Star and Hughes. Creation of greater differentials in knowledge across society is itself a profound social effect, and may be a central factor in future social change. To the extent that more highly educated persons are at the vanguard of social and technological change, their accelerated acquisition of mediated knowledge may be socially functional. At the same time, however, differentials in knowledge may lead to increased tension in the social system; one of the recognized disparities between black and white people, for example, is the relative difference in gaining awareness of new information. A knowledge gap by definition implies a communication gap and a special challenge in resolving social problems.