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Federal Communications Commission
Office of the Secretary

BEFORE THE

Federal Communications Commission

WASHINGTON, D.C. 20554

In the Matter of	)	
	)	
	)	MM Docket No. 87-268
Advanced Television Systems and	)	RM-5811
Their Impact on the Existing	)	
Television Broadcast Service	)	

To: The Commission

MOTION TO FILE SUPPLEMENTAL INFORMATION

1. The Land Mobile Communications Council ("LMCC") hereby respectfully submits this Motion to File Supplemental Information, pursuant to Section 1.45(c) of the Rules and Regulations of the Federal Communications Commission ("Commission"), requesting the Commission to accept the attached study by the Massachusetts Institute of Technology (MIT), entitled "The Mass Audience Looks at HDTV: An Early Experiment." The MIT study was presented at the Annual Convention of the National Association of Broadcasters on April 11, 1988, and was not previously available to LMCC during the scheduled pleading cycle in this proceeding.

0+11

2. LMCC has participated extensively in every stage of this proceeding by submitting Comments and Reply Comments, urging the Commission to move forward in its long-standing proposal to permit further UHF-TV/Land Mobile sharing in eight major metropolitan areas.[1]

3. The MIT study randomly sampled 613 mass audience respondents and 31 broadcasting professionals and engineers to compare National Television System Committee (NTSC) standard broadcast to High Definition Television (HDTV). The research was designed to address: 1) visual discrimination (can viewers see any difference between alternative systems), 2) viewer preference (if a difference is seen, how important is it subjectively to the viewer), and 3) viewer behavior (are expressed preferences strong enough to lead to changed viewing behavior or possibly a purchase decision).

4. The MIT study shows that the viewer preferences for HDTV or NTSC are small, subtle and highly dependent on the distance from the screen, the nature of the programming and other conditions of viewing. In addition, the MIT data dramatically supports the prediction that the further viewers sit

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1/ See Notice of Proposed Rule Making, General Docket No. 85-172, 50 Fed. Reg. 25587 (June 20, 1985).

from the television receivers, the less able they are to discriminate between NTSC and HDTV. Ironically, the normal viewing distance in the great majority of American homes is approximately 3 meters, where, according to the MIT study, HDTV differences at that distance are almost imperceptible.

5. Finally, according to MIT, these findings contradict the accepted wisdom evolving from press releases, informal and non-systematic tests, and subjective analyses by video professionals that HDTV "knocks the socks off" everyone who sees it, represents an entirely new medium for storing, transmitting and displaying moving images, and will replace older media just as color TV replaced black and white. See MIT Study at 10. In fact, as shown by the MIT study, the differences between HDTV and NTSC are miniscule.

6. LMCC urges the Commission to accept and consider the MIT study as a valuable source of new, unbiased information regarding the relative importance of HDTV as compared to the well documented urgent necessity for increased UHF-TV/Land Mobile sharing. In light of these findings and all of the other justifications previously submitted, LMCC urges the Commission to move forward in this proceeding, as no further delay in implementation of the Commission's proposals in this proceeding is warranted.

WHEREFORE, THE PREMISES CONSIDERED, the Land Mobile Communications Council respectfully requests the Commission to accept the attached supplemental MIT study.

Respectfully submitted,

By: John B. Richards

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Dated: May 5, 1988

THE MASS AUDIENCE LOOKS AT HDTV: AN EARLY EXPERIMENT

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The Media Laboratory
Massachusetts Institute of Technology

Audience Views on HDTV: Early Findings
Research Panel
National Association of Broadcasters
Annual Convention
Las Vegas, Nevada
April 11, 1988

In the early days of broadcast radio, the newspaper industry found itself in an awkward and uneasy position. Newspaper publishers were nervous about this new technology, a wireless music box which could broadcast news. A number of them flatly refused to print the radio program schedule for fear it would lend aid and comfort to the enemy. The AP was originally forbidden to allow its news copy to be used by broadcasters.

It is a fascinating and predictable stage in technological history. A new medium appears on the horizon. The established media squint at it, frown and think for a while. Should they shoot at it or make friends with it?

The newspapers discovered that printing radio schedules increased reader interest and sold more newspapers. Publishers invested in and made a lot of money from the radio business. They made friends.

Well, as we enter the 1990s, we find that the American television broadcasting industry has just finished shooting at, negotiating with, and finally making friends with the VCR and the cable industry. Now a new technology gallops over the horizon. Now what? HDTV.

There is squinting. There is frowning. Friend or foe?

One scenario has it that our colleagues from Japan introduce HDTV videodisc players and VCRs in 1990 or 1991. There will be new sets to go with these recorders that display beautiful wide-screen pictures, motion-picture quality or better. High tech yuppie consumers buy them at first. HDTV catches on like designer jeans. Broadcasters, stuck with the old technology, simply cannot compete and lose out to the higher quality competitor, hanging on to fewer viewers every year. Then, new satellite, optical fiber and cable TV systems broadcast HDTV 24 hours a day. It is a disaster for television broadcasters, helpless to compete. Imagine being a black and white station that couldn't upgrade to color while competitors did. Imagine only selling vinyl records when CDs take over the market. Imagine being in the telegraph business while the nation is wired for the telephone. Were this the situation, it would be time to pass out the rifles and call the lawyers.

Well, this is not the situation. HDTV is here. It will be part of the future of television. The scenario I have recounted, however, is inappropriate, unrealistic, and fundamentally misleading. I mention it, as most others do, to get your attention. Now that I trust I have your attention, let's take a closer look at what HDTV is, and how the consumer of the future is likely to respond to it.

HDTV turns out to be, not a single technology, but a series of technologies which can be combined together in various ways to enhance the quality of the displayed picture. Our associates at NHK in Japan have been working very hard over the last two decades and have refined one particular version of HDTV. Their work paid off, the pictures look great. In casual speech this specific 1125 line, non-compatible format, is sometimes equated with HDTV in general. But it is only one format among many. I understand there are 14 different formats currently being considered by the FCC's advisory committee on Advanced Television Systems. Some are called EDTV, for enhanced definition TV, presumably an improvement, but technically short of this imaginary line for "true HDTV." Some of the new systems like NBC's ACTV or MIT's MITV-RC are compatible with existing receivers and could be broadcast by any existing station which might choose to. Others are non-compatible but fit in a standard 6 MHz channel. Others, like the NHK system, require additional spectrum or entirely new media of transmission.

The purpose of this paper is to report on an early experiment conducted in a shopping mall near MIT. We have heard statements from colleagues to the effect that HDTV is not like film, or like TV, it is an entirely new medium. Some have said that after watching HDTV they could never go back to watching ordinary TV. It is difficult to say whether views like this from video professionals will be shared by the public at large. Test patterns in a laboratory under ideal viewing conditions may not provide a good measure of how HDTV will evolve in the real world.

I will have time today to describe our research only briefly and to provide a few central findings. I hasten to add that no single study, using one set of equipment, a small selection of content, in one geographic area, could possibly provide any definitive answers. A great deal of audience research as well as technical research needs to be done to understand this complex phenomenon of HDTV. But the bottom line from this early study is clear. In our study, as best we could design it, the mass audience in comparing standard broadcast NTSC to HDTV found the difference to be a subtle one, highly dependent on the distance from screen, the nature of the programming and other conditions of viewing.

The Study Design

This research was conducted by the Advanced Television Research Program, part of MIT's Media Laboratory. Our group is supported by the Center for Advanced Television Study (CATS), an industry consortium of broadcasters and equipment manufacturers. The study would not have been possible without additional help from HBO, one of the founding members of CATS.

Viewers were recruited to participate in a 30-minute study at the MIT Audience Research Facility, Liberty Tree Mall, Danvers Massachusetts. The study was conducted in early December, 1987. Subjects were randomly assigned to different conditions. Some watched on NTSC sets, some were

assigned to HDTV sets. Thus we could compare the evaluations of these two randomly assigned groups. This was called the Single Stimulus Test. It is a classic form of experimental research design. It was followed by an explicit comparison of two sets side-by-side. One was HDTV, one was NTSC each playing the same programing. We asked our viewers a variety of questions about program interest and screen quality. This second element of the study was called the Double Stimulus Test. Viewers were not told about technology or HDTV when they were recruited. We simply offered to give them a $5 gift certificate in return for their opinions about a few short clips of television programming. Viewing was in groups of 5 to 20 respondents. Subjects are also asked to fill out a background questionnaire asking about their demographics, television behavior and programming preferences, their current television set and other high tech equipment around the house.

The respondents were quota sampled by age and sex to match the census data for Essex County, Massachusetts. In addition to mall recruitment, we supplemented the sample with telephone recruitment using phone numbers randomly selected from the Danvers area. 613 mass audience respondents completed the procedures and questionnaires. We completed an additional 31 questionnaires with broadcasting professionals and engineers. This expert sample consisted of advanced engineering graduate students working in the areas of video and signal processing at MIT, CATS sponsor representatives and Boston area video professionals. The study used six program clips and a still image. The clips were edited in HDTV (from either film or video) and downconverted to NTSC at 1125 Productions with the exception of the football clip which was parallel shot. The clips are as follows:

Carly Simon "Anticipation" 3 minutes, 7 seconds, a daytime outdoor concert performance filmed on Martha's Vineyard as an HBO special. Carly and the band provide an animated performance on a special stage set up near the waterfront as the crowd cheers and sea gulls fly by. The wind noises were such that the music had to be redubbed in a studio after the performance and edited in with the crowd noises. The editing and synchonization are excellent. But the film is quite grainy, generating a very distinctly "film" look. It may have been shot in 35mm but it looks more like 16mm.

Olympics, 2 minutes, a series of crowd scenes and pageantry from the 1984 Olympics in Los Angeles. The video footage was shot by NHK and emphasizes long shots of the main stadium, the Olympic torch being lit and synchronized dancing with literally thousands of dancers nearly filling the floor of the stadium. All the shots in this clip are in broad daylight and no actual sporting events are included.

Football, 2 minutes, video footage from the second quarter of the Jets-Bengals game, the Meadowlands, November 29, 1987 shot in parallel NTSC and HDTV especially for this study by 1125 Productions. The footage includes a goal-line dive and score by the Jets, a pass play touchdown by the Bengals and some crowd footage. It was a day game, but it was dark and rainy and the house lights were on. The crowd was enthusiastic

despite the weather and a so-so season for the Jets. The audio feed was supplied by NBC. The cameras were manually operated in parallel. Given human limitations it was not possible to follow the ball or frame each play identically. The clips selected provide close approximations. In the first plays, the NTSC is a slightly tighter shot, in the later plays the HDTV provides a slightly tighter shot. The NTSC footage was slightly out of color balance toward green and had crushed blacks, so it was not ideal footage. But at the time the study was conducted, it was the only parallel footage available.

Long Gone, 48 seconds, comedy-drama, film-based footage from an HBO movie about a luckless and untalented minor league baseball team. The clip follows a series of humorous errors on the field, as the home team falls further behind, and the coach shows more interest in a blonde spectator than the game.

Mandela, 2 minutes and 3 seconds, heavy drama, film-based footage from an HBO film on the life of Nelson Mandela. The clip follows Mandela's wife as she passes through a crowd and enters the courtroom to hear her husband's eloquent defense of his beliefs and ideals. Most of the scenes are close-ups of Mandela speaking from the dock and close reaction shots of the judge and spectators.

Lions of Africa, 1 minute and 30 seconds, action-drama, film-based footage from another HBO film. The scene opens when a crowd of African villagers and a witchdoctor, in colorful ceremonial dress approach a visiting white medical doctor. There is strange dancing and the beating of drums as the medical doctor looks puzzled and wonders what is expected of her by her local counterpart. The witchdoctor waves his arms wildly and takes her stethoscope and glasses. Another visitor explains, he must do this to ward off evil spirits.

Still Image, displayed for 3 minutes, the left of the screen is a panoramic shot of a church and village in Austria taken from a travelogue sequence prepared by 1125 Productions. The details of the buildings and foliage and the rich colors allow for a critical comparison. The right half of the screen contains a standard black and white test chart with labeled gradation patterns so viewers can, if they are inclined, actually determine the horizontal and vertical resolution in terms of lines per inch.

Technical Set-Up

NTSC Equipment: Sony 2000 1-inch VTR
Sony BVM 1910 Monitor
Sony 25XBR Monitor

HDTV Equipment: Sony HDV 1000 VTR
Sony HDM 1820 Monitor
Sony HDM 2820 Monitor

Audio: Yamaha M40/C40 Power Amplifier
ADS L880 High Fidelity Speakers

The video playback equipment and associated time base corrector units were kept out of sight in a control room. Identical NTSC and HDTV master tapes were mounted on the respective machines. The NTSC and HDTV VTRs were synchronized by slaving the NTSC VTR to the HDTV VTR. The operator would queue up and play the appropriate segment in response to an electronic signal from the supervising experimenter in the viewing room. For the single-set tests, the experimenter simply hid one of the two sets before the subjects arrived following the prearranged schedule. The audio was consistent for all tests, a stereo feed from the HDTV VTR through a pair of speakers located just behind the monitors. The audio level averaged 80 dB at one meter, peaking at about 90 dB for crowd noises or louder musical passages.

The monitors were color corrected and adjusted at least once a day and after monitors were moved. The sweeps of the monitors were adjusted so that in each case the vertical height of the comparable monitors was equal. The 18" monitors had identical phosphors and nearly identical electronics so the color and brightness match was ideal. No broadcast quality NTSC monitor over 19" is available, so the best available substitute, the 25 XBR was adjusted to match the HDTV monitor as closely as possible using a Minolta color analyzer.

Subjects were randomly assigned to seats as follows:

Row	Distance	Approx. Picture Heights, 18" sets	Approx. Picture Heights, 28" sets
1	1 meter	3	2
2	2 meters	7	5
3	3 meters	10	7

Principal Findings

There are three fundamental levels of subjective response to advanced television systems which our research is designed to address. 1) visual discrimination (can viewers see any difference between alternative systems), 2) viewer preference (if a difference is seen, how important is it subjectively to the viewer), and 3) viewer behavior (are expressed preferences strong enough to lead to changed viewing behavior or possibly a purchase decision.) Our initial study indicates 1) yes, viewers can see the difference, 2) yes, overall they prefer HDTV, but 3) the differences are small, subtle and subject to dramatic shifts as a result of slight changes in viewing condition. Thus it is not clear that subjective responses, as best we can measure them with current equipment, are significantly distinct to lead to changed viewing behavior.

The preference for HDTV among mass audience respondents is highly conditional and context dependent. Under a number of conditions viewers express a distinct preference for NTSC over HDTV.

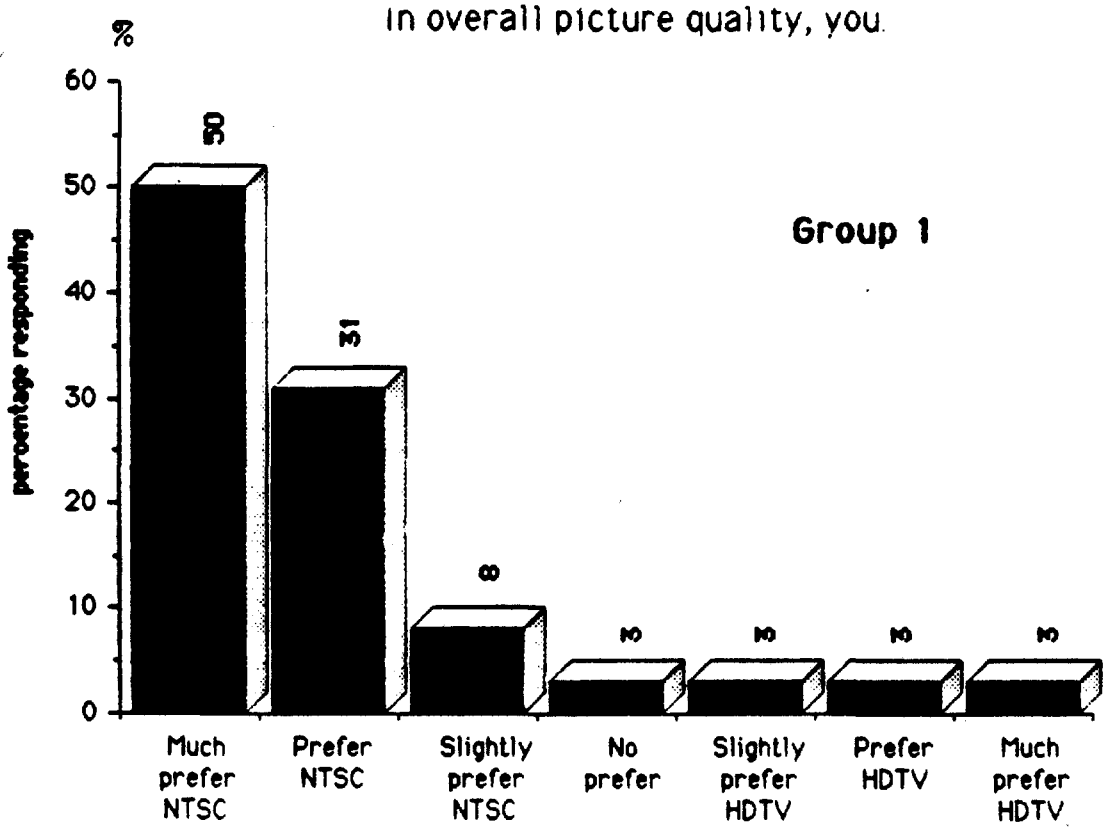
To illustrate the highly conditional character of preferences among video systems, one might review two extreme cases. In the first case, Group One, viewers are watching the football footage on a pair of 18-inch monitors (HDTV and NTSC) from a distance of three meters. The content, set size, and viewing distance are not ideal for showing HDTV to its best advantage, and indeed we find that fully 89% of the viewers prefer the NTSC set over the HDTV set. In a second case, Group Two, viewers are watching the Olympics clip on 28" monitors from a distance of one meter. These are ideal conditions and fully 95% of the viewers express a preference for the HDTV monitor. These results are summarized in Figure 1.

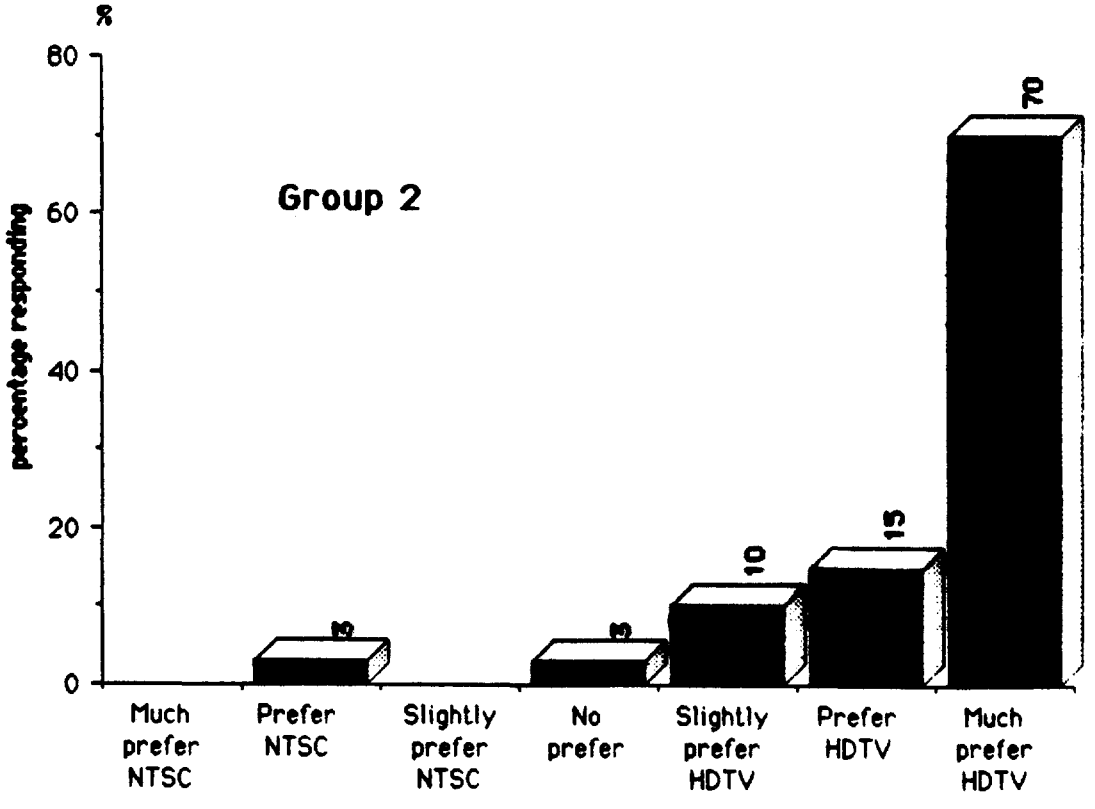
What is the pattern of preference between NTSC and HDTV viewing identical material on the two systems side-by-side? Our results for the Dual Stimulus Test reveal a preference for HDTV, but not a dramatic one. The data summarized across all conditions indicate that 62% of the mass audience subjects prefer HDTV, the remainder express no preference or prefer NTSC. The distribution of responses is summarized in Figure 2.

Figure 1

Highly Conditional Patterns of Preference

In overall picture quality, you





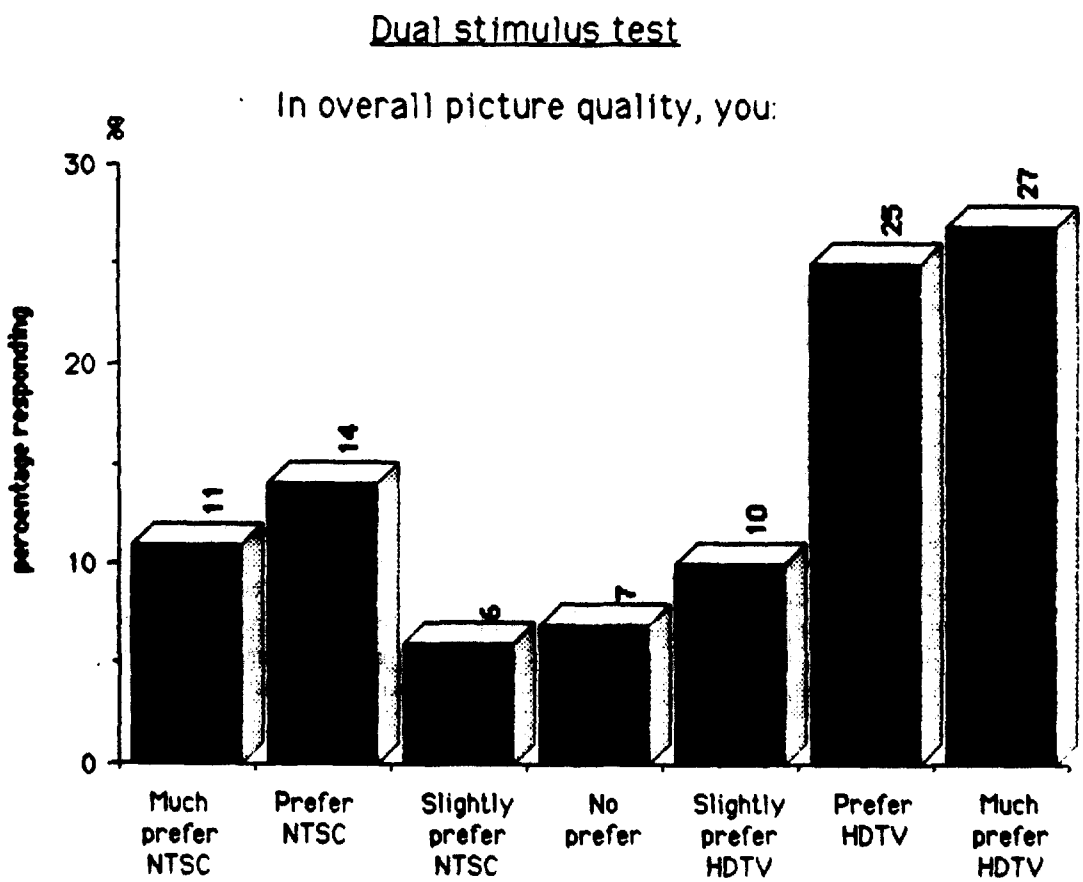
Whether 62% is a little or a lot depends on one's expectations. Clearly, this indicates that HDTV is not the same kind of revolutionary shift in technology as experienced in the transition to color in the 1950s and 1960s in the United States. Although engineers and broadcast professionals see the difference immediately and strongly prefer HDTV, as we will see shortly, the differences are more subtle to the untrained eye of the mass audience. The pattern of discrimination and preference depends a great deal on distance from screen, screen size and the character of the programming material. To the mass audience, the difference between NTSC and HDTV is perhaps more akin to the difference between monophonic and stereo sound. With the right kind of music and listening through earphones which accentuate the separation effect of the two channels, almost all listeners can hear the difference and prefer the stereo effect. Under normal listening conditions through speakers and the complex pattern of reflected sound waves and ambient room noise, the difference is more difficult to discern. We have found such a pattern in our own research on audience perceptions of stereo recordings and stereo television broadcasts.

Scenarios for the growth of HDTV and the possibility it will replace NTSC technology for broadcasting and display vary widely in the character and time-scale. We know that some consumers will pay a premium for a product they are told is higher quality even if they themselves have trouble discerning it in a test environment, they simply want to buy the best available. How fast such a transition might take place will depend greatly on the marketing campaign for the new technology, its price premium and the interaction of programming availability in the new medium and the old. If pushed too hard, too fast and at too high a premium, HDTV could follow a path closer to quadraphonic sound than stereo sound.

We looked more closely at the other elements of our study to see if a distinct difference was evident in viewer responses to NHK HDTV and high quality NTSC. We compared responses of those randomly assigned to the NTSC and HDTV conditions in their evaluation of program interest, liking and emotional involvement. No statistically significant differences were evident. The evaluations for both groups were strikingly similar. We looked at the overall evaluations of screen quality for those randomly assigned groups. Again no overall difference. For two content types out of six used there was a small difference favoring HDTV, but again no dramatic differences. We explored evaluations of color, screen shape, picture sharpness, picture brightness, sense of depth and motion quality and found that viewers did not differentiate across those dimensions. We analyzed the patterns for different demographic groups, heavy television viewers, high tech consumers and found no differences. Younger viewers seemed more discrimating, but the differences were small.

It is well known that one cannot simulate all the complexities of the actual marketplace in experimental settings. Some subjects feel compelled to say they will pay extra for a product just shown them because they do not want to disappoint the researchers who have obviously gone to a great deal of effort to show the product to them. Others express skepticism and disinterest, but may be among the first to buy the product when it is actually marketed. So experience dictates that one should not use

Figure 2


Dual stimulus test
In overall picture quality, you:
%
percentage responding
30
20
10
0
11
14
6
7
10
25
27
Much prefer NTSC
Prefer NTSC
Slightly prefer NTSC
No prefer
Slightly prefer HDTV
Prefer HDTV
Much prefer HDTV

estimates of willingness to pay, as unbiased estimates of what consumers may actually spend in the hubub of the marketplace several years hence, especially when dealing with a new and unfamiliar product. The metric of money is a useful one for understanding consumer attitudes and responses, especially in comparing experimental groups. In our research we are proposing to use marketplace/willingness-to-pay items as particularly useful measures of consumers' attitude strength and preference patterns. We do not put them forward as definitive measures of actual price elasticities in advanced video systems. Only actual marketplace data will enlighten us in that domain.

In this study, after subjects (randomly assigned to either the NTSC or HDTV condition) had viewed two three-minute clips and answered a series of questions about each clip, they were asked the following question:

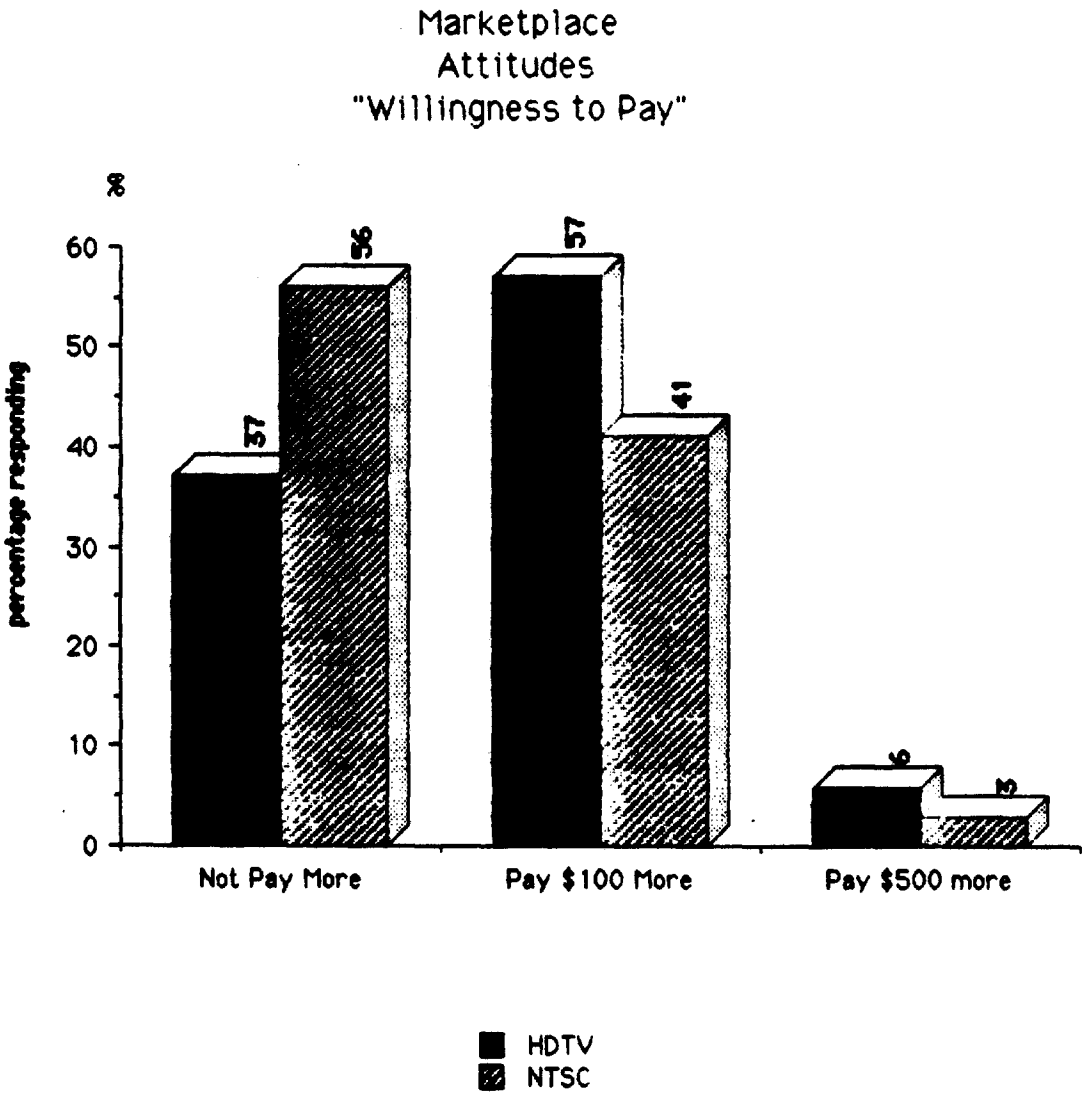
> Considering the two clips of programming you have just seen:
>
> Let's say you decided to buy a new TV set to replace the one you usually watch at home. Would you buy a new set similar to the one you have now or would you be willing to pay $100 more to buy a set like this one?
>
> What if it cost more? Would you buy a new set similar to the one you have now or would you be willing to pay $500 more to buy a set like this one?

These questions elicited the following distribution of responses:

These data reveal three things. First, subjects were impressed with the quality of the sets in all conditions. On average, about half expressed a willingness to pay a premium to buy such a set. Second, there is an increased willingness to pay among those who were randomly assigned to the HDTV condition. 63% of the HDTV viewers expressed willingness to pay a premium compared to 44% of the NTSC viewers. Third, the $100 price point elicits a response, but the $500 price point appears to be well beyond the attitude threshold for these subjects. Only 3% of the NTSC viewers and 6% of the HDTV viewers would pay $500 over the price of a set like the one they currently own. It is difficult to tell whether the difference between the 63% and 44% is a significant one. Further research involving an explicit comparison of willingness to pay for enhanced NTSC versus full HDTV will be necessary to resolve such questions. It bears repeating that these are attitude measures, attitudes oriented toward marketplace decisions assessed at one point in time, with a particular set of technologies and content selections. Numerous conditions could influence future attitudes, market behavior and price elasticities. It would be inappropriate to consider these as either fixed or unbiased estimates of actual marketplace behavior.

Thus far we have demonstrated that people experience HDTV differently from NTSC but the differences are small, subtle and highly influenced by other conditions of the viewing situation. One lesson to draw from such a pattern of findings is that subjective research on advanced television systems is likely to be an area of intense controversy. Because different

Figure 3


Marketplace
Attitudes
"Willingness to Pay"
%
percentage responding
60
50
40
30
20
10
0
37
56
57
41
6
3
Not Pay More
Pay $100 More
Pay $500 more
HDTV
NTSC

interested parties have extraordinarily strong vested interests in showing off one system or another to its best advantage, it is likely that the results of different studies, some of which document "large" differences and others which demonstrate "small" differences will be seen as contradictory and conflicting.

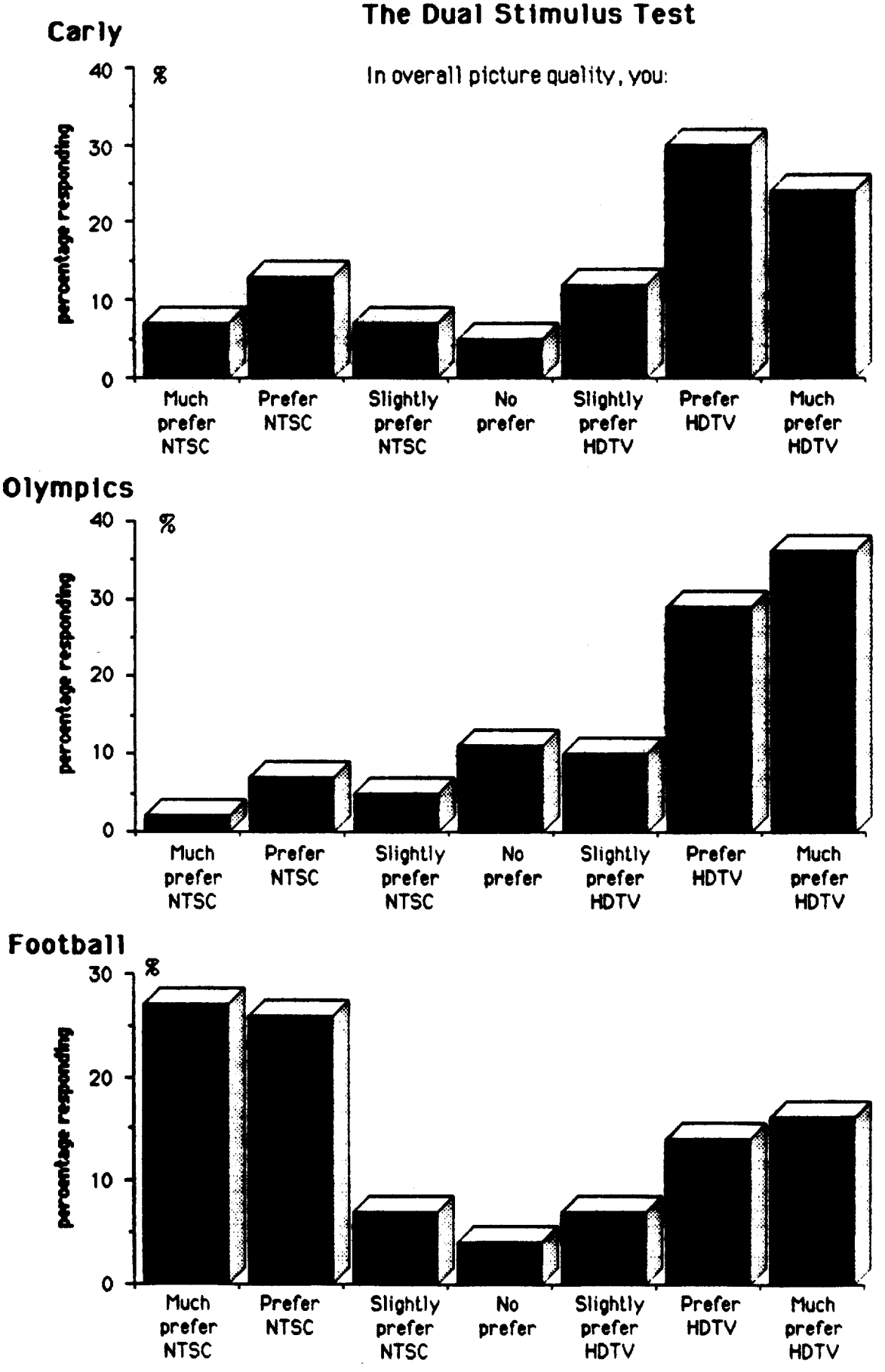
The most important question for the broadcaster, however, is to understand under which conditions the enhanced screen quality of HDTV makes a meaningful difference to typical viewers. Some types of programming, for example, appear to enhance the ability of mass audience consumers to discriminate, others appear to inhibit it. Again, the pattern is complex and subtle. It does not appear to be simply a difference between video-based vs. film-based materials. The side-by-side comparison was run for three different types of programming and we found a different pattern in each case. In the case of the Olympics clip there was a strong preference for HDTV. In the case of the Carly Simon concert there was a preference for HDTV, but less strongly in evidence. In the case of the football clip, most viewers actually preferred NTSC.

It was predicted that the closer viewers sit, the better able they would be to discriminate between NTSC and HDTV and the more they would prefer HDTV. That prediction about mass audience behavior, according to our data, is dramatically supported. Almost all the variance in preference toward HDTV comes from viewers sitting approximately one meter from the screen. First row viewers prefer HDTV to NTSC at a ratio of over 4 to 1 (75% to 17%). Viewers sitting two meters back show a weaker preference for HDTV, a ratio of a little less than 2 to 1 (58% to 32%). Those viewing from three meters see it as almost a toss-up, a ratio of about 1.3 to 1 (53% to 42%). We will continue with extensive research on viewing distance as it is clearly a critical variable to understand.

It is ironic that differences were not clearly perceived at 3 meters because that is the normal viewing distance in the great majority of American homes. It has been dubbed the Lechner Distance, and appears to be invariate, regardless of screen size. It is, no doubt more a function of furniture placement than psychophysics. The one-meter distance is important also, in another sense, as most retail purchase decisions in selecting one television set over another are made at close viewing distances, probably quite close to one meter. This is primarily a function of the distances between aisles and general space constraints in most retail locations rather than consumer preferences. Further subjective research should continue to be conducted at the show-room distance of approximately one meter and the Lechner distance as well at three screen heights (which will almost always be between the other two) for optimal comparison across studies and the ability to project results to real-world viewing and purchase conditions.

Figure 4

Programming Content and System Preference: The Dual Stimulus Test



It is well known that video professionals in general and broadcast engineers in particular evaluate programming and picture quality in a manner quite distinct from the mass audience. An understanding of the underlying technology of video cameras, recorders, transmitters and monitors alerts professionals to look for the things that might be improved through technical adjustment including resolution, interline flicker, line crawl, vertical aliasing, color balance, black level, large area flicker, cross color, cross luminance, motion artifacts, signal to noise problems, multipath interference and the like. Mass audience viewers, in general, are inattentive to these factors. They don't view television that way. They focus on content, not on picture quality. They are consciously aware of picture quality when there is a significant picture quality problem or when they are specifically oriented toward picture quality in an experimental or purchase-decision situation. They may be unconsciously influenced by the character of picture quality, of course, and that is the reason for the Viewing Experience Test design.

So it is of critical importance to assess and compare the responses of both trained professionals and the mass audience to variations in advanced television systems. Some technical differences in display technology which may be patently obvious in a moment's viewing to any media professional, may simply be invisible to mass audience viewers even after an attempt to cue and train them to detect such differences. In other cases, however, we may find that the critical eye of the professional may be a harbinger of mass tastes and discrimination. This difficult question will require extensive further research.

Our comparison of expert and mass audience respondents indicates that, indeed, there is a distinct difference.

Summary and Commentary

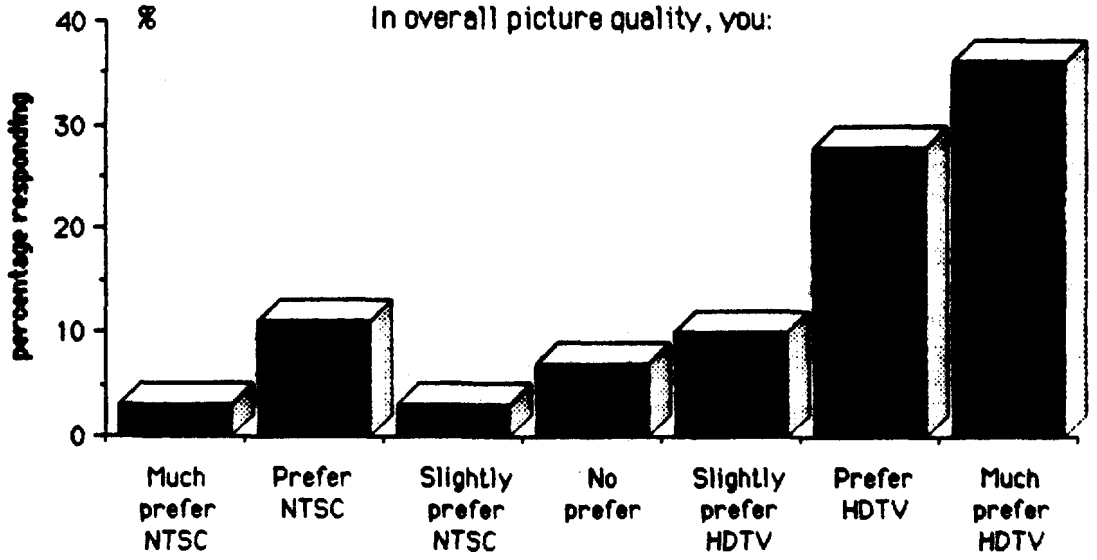
No single study of technical characteristics or subjective responses to advanced television systems could possibly tell the whole story. Although there is the popular myth of the scientist in the laboratory who utters something like, "Eureka, I've found it" on discovering the magic formula, real science and engineering do not work that way. It is a slow painstaking process of research, publication, public discussion and further research. It is a collective process. Disputes over methods and conclusions inevitably arise and consensus must be hammered out in public forums if the process is to succeed.

We have evidence in this study of some fundamental behavioral responses to advanced television technologies which, if they continue to be supported by subsequent research conducted here and elsewhere, could have a significant influence on the evolution of television technology. They are exciting findings, one might argue, for two reasons. First they contradict the accepted wisdom evolving from press releases, informal and non-systemtic tests, and subjective analyses by video professionals which posits that HDTV knocks the socks off everyone who sees it, represents an entirely new medium for storing, transmitting and displaying moving images, and will replace older media just as color TV replaced black and white. Second, they are exciting because they require us to rethink our presumptions about advanced television systems, their introduction and competition with other transmission and display media.

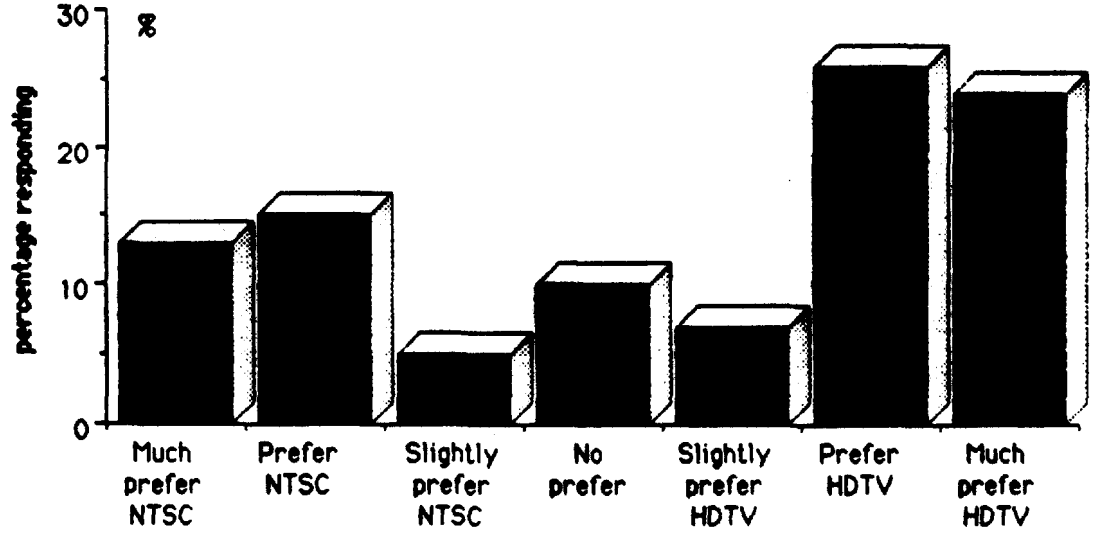
Figure 5

Viewing Distance and System Performance: The Dual Stimulus Test

1 Meter



2 Meters



3 Meters

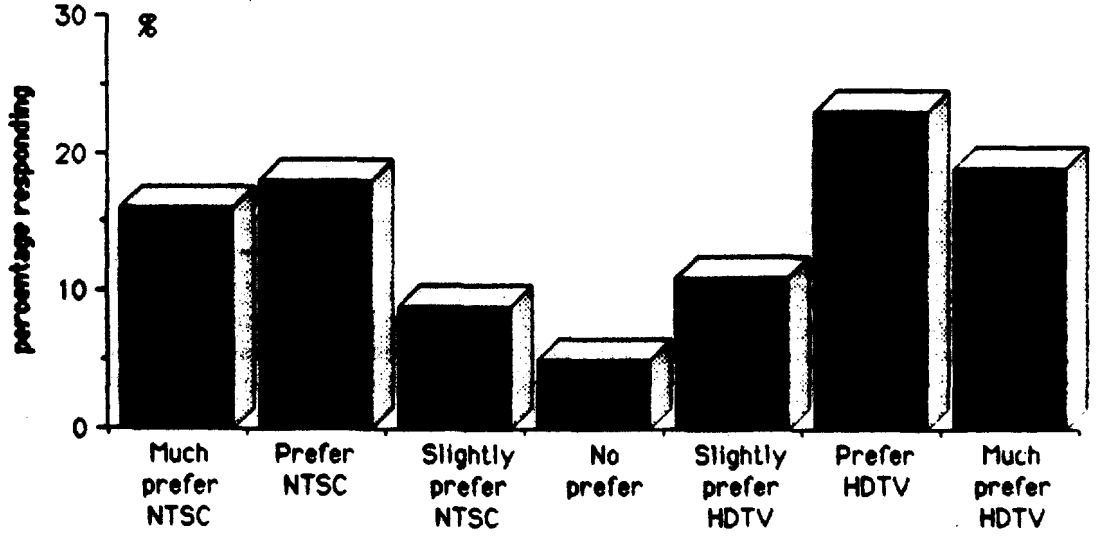
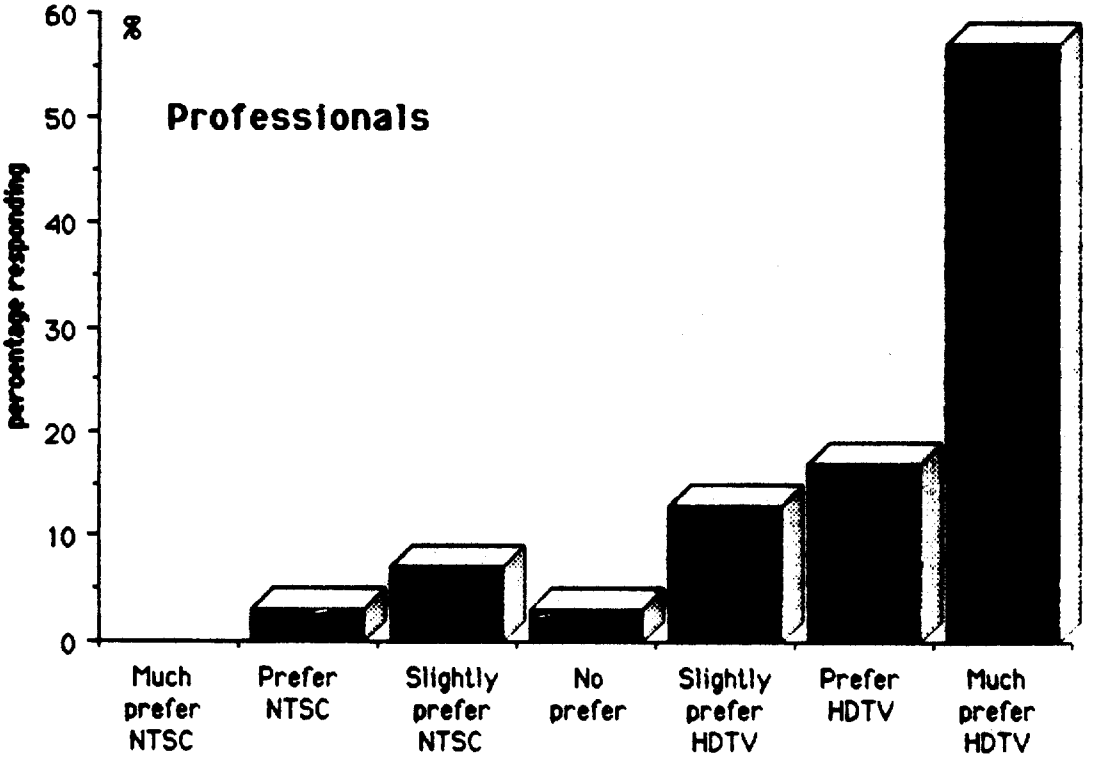
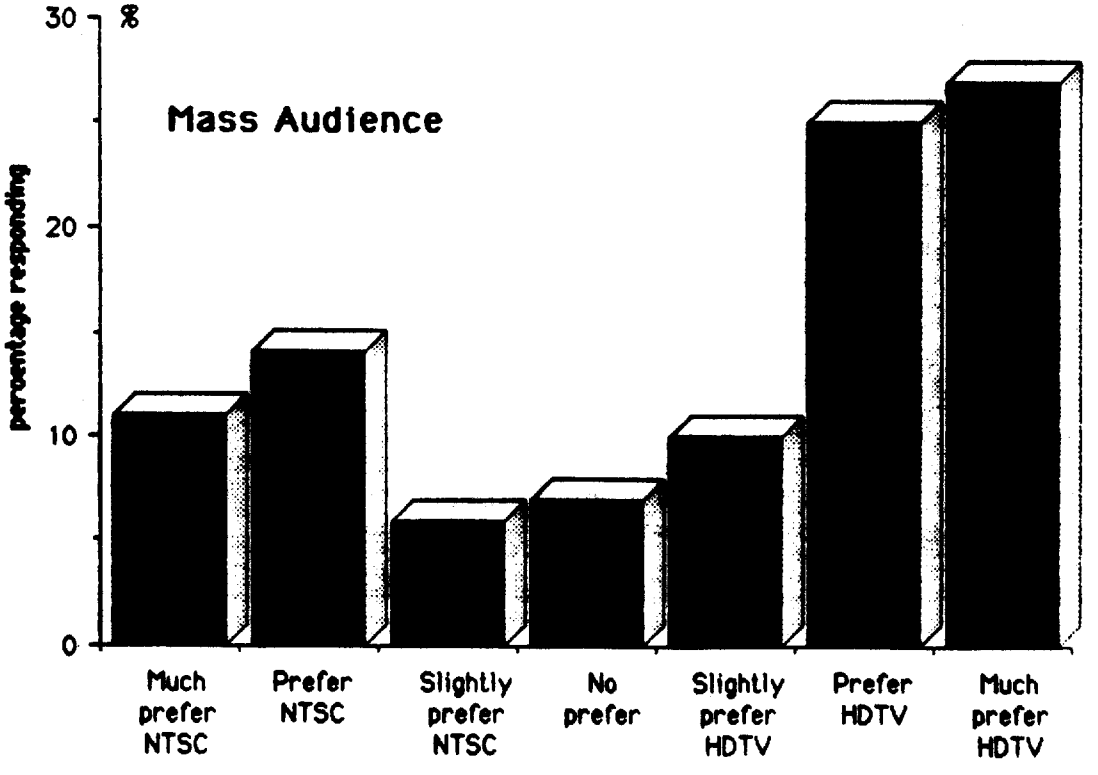


Figure 6

Video Professionals Versus the Mass Audience: The Dual Stimulus Test

In overall picture quality, you:





These data do not indicate that there is no market for HDTV. Nothing of the sort. But they do suggest that the introduction of advanced, high-resolution video systems may turn out to be a slow and complex process more dependent on marketing and the interaction of content and media than on pure technology.

The primary findings are these:

-> Mass audience viewers prefer HDTV to NTSC in simultaneous, side-by-side comparisons. But the preference is not as strong as was expected and is highly influenced by the character of the programming and viewing conditions. We conclude that, to the eyes of the typical television viewer, the difference between NTSC and baseband HDTV is a subtle one highly dependent on environmental factors.

-> Modest changes in experimental design are sufficient to wipe out the preference for HDTV or generate a preference for NTSC. We conclude that significant further systematic research on subjective responses is essential in order to understand the conditions which enhance and those which inhibit a subjective sense of improved video quality for mass audience viewers.

-> As expected, one of the most significant conditional factors was viewing distance. The biggest subjective differences were evident for viewers in the range of 2 to 6 screen heights. Viewers greater than 6 screen heights saw no differences. We conclude that, at normal home-viewing distances of three meters, screens would have to be twice to three times the size of currently available monitors to have a significant subjective impact. That may mean that HDTV will be a projector-oriented video medium.

-> Another significant conditional factor was program content. We have not yet been able to test sufficiently diverse samples of programming to determine which characteristics of the programming make the difference. There is no evidence in this study that systematic differences are evident for film-based versus video-based HDTV.

-> Video professionals and engineers make subjective distinctions between NTSC and HDTV in a manner quite different from the mass audience. Further research will need to be conducted to understand how the dimensions of professional evaluation differ from the mass audience and to what extent they represent an appropriate leading indicator of future audience tastes and behavior.

-> Although subjects prefer HDTV in side-by-side comparisons of screen quality, the subjective impact is apparently not strong enough to generate significant differences in the enjoyment of or emotional involvement in program content. When subjects were randomly assigned to an NTSC or HDTV condition and asked to rate the picture quality of the set they had just seen, the overall differences in screen-quality ratings between the two groups were not significant. A statistically significant higher rating for HDTV was evident, however, in two out of six programming segments shown.

=> Viewers did not indicate a willingness to pay a substantial premium for an advanced video receiver based on what they saw in our test. Roughly half indicated a willingess to pay a $100 premium over a the cost of a set like the one they currently owned. About one in twenty viewers indicated a willingness to pay a $500 premium. Both those randomly assigned to watch NTSC and those assigned to HDTV were asked this question. The numbers were only slightly higher for those who saw HDTV compared to the quality-controlled NTSC we used in this test. This may indicate a significant market for NTSC enhancements. Further research explicitly comparing NTSC with enhanced NTSC and full-bandwidth HDTV will be necessary to provide a meaningful answer to that question. Willingness-to-pay questions answered in a research setting are not necessarily good predictors of actual consumer behavior. The data summarized here are put forward as a form of attitude measure rather than market measure.

=> Subjects were asked to assess the two technologies on a variety of specific technical dimensions including sharpness, color, sense of depth and motion quality. As with our scales of overall picture quality, a preference was indicated for HDTV in side-by-side comparisons. The level of preference was about the same for each dimension. There is no evidence that the subjects discriminate differentially across these dimensions.

=> Background variables such as sex, income, television viewing, and ownership of high-tech consumer electronics do not appear to be related to patterns of preference. The one exception is age. Younger viewers demonstrate a stronger preference for HDTV than older viewers in side-by-side comparisons.

The research reported here is suggestive but not conclusive. The findings will require both replication and elaboration. There is much yet to be learned about how viewers respond to the new possibilities technology provides.

CERTIFICATE OF SERVICE

I, James F. Kelliher, Jr., do hereby certify that copies of the foregoing Motion to File Supplemental Information were served on May 5, 1988 by first class United States mail, postage prepaid to:

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