# Product Presentation Strategies for Cable Television Home Shopping Channels

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## Ⅰ. INTRODUCTION

As of March 1, 1995, the age of cable television has dawned in Korea. By August 1995, 5 months after the first telecast, there are currently 300,000 households connected to the cable. Although this is not a significant number yet, the major barrier that is holding back the growth is the speed at which the cables can be physically laid. The fact that the waiting period for households wanting to be hooked up may be as long as six months is an indication of the underlying growth potential of this market. Once these bottlenecks are resolved, the cable television industry is expected to grow at a rapid pace.

Cable television bring with it a variety of channels and programs that we have not experienced before. At present, cable TV is a host to over 20 channels. Many of them are specialized channels that cater to specific

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interests, such as childrens channels, movie channels, news channels, and documentary channels. Among the variety of channels being offered, home shopping channels are expected to have particular implications for marketing. Currently, there are two home shopping channels in operation--the Korea Home Shopping (Channel 39) and Hi Shopping (Channel 45). Both channels broadcast 14-16 hours a day and are experiencing healthy rates of orders. Industry experts expect the home shopping market to grow at a rate of 100% per year for at least the next several years. Given such growth forecasts, this new form of distribution has the potential to significantly impact the traditional forms of retailing.

The format of home shopping programs is such tat sales person(s) present products on the air while taking telephone orders. Product presentations involves showing the product, describing the main attributes including price, and demonstrating the use of the product. Operating such home shopping channels requires careful planning of how the programs are to be designed. A key programming factor that needs to be considered involves how the air time should be allocated to the presentation of each product such that the overall sales can be maximized. In other words, within a given space of programming time (say, 2 hours), the producers must decide on the optimal number of products that should be presented. Presenting too many products within a short period of time may not give enough time for viewers to comprehend the product and place an order. On the other hand, spending too much time on presenting each product may cause the viewers to become bored and thus switch channels. Both cases will lead to inadequate sales over the entire programming time. The optimal presentation strategy, then, must exist somewhere in between.

The objective of this paper is to derive an optimal length of presentation time for each product based on a reasonable stochastic model of viewing behavior. The proposed model considers two types of cognitive processes involved in viewing home shopping programs. First, it incorporates the time necessary for a given viewer to comprehend the product. Here, comprehension represents acquiring attribute knowledge, thinking about the necessity, usage occasions, fit with the lifestyle, value for money, and the like. Such considerations are necessary before making the purchase decision. Second, the model considers the time it takes for a viewer to become bored from watching product presentations.

These two processes in conjunction with one another are closely related to the literature on the effects of message repetition on attitudes and purchase intentions (Sawyer 1974; Belch 1982). Most studies in this area show that messages gain in impact for a few exposures but that further exposures--beyond the point of "over-learning"--begin to have a negative affect. This literature takes the process view that while increasing exposure initially enhances learning(comprehending) and favorable attitudinal affect, subsequent exposures create tedium and negative affect (Berlyne 1970; Stang 1975). This leads to an inverted-U curve for repetition impact. The implication of this research is that the optimal presentation time of each product must be long enough to allow the maximum proportion of viewers to comprehend the product while it must be short enough so that the minimum proportion will feel boredom.

This paper will first discuss the basic structure of the optimal presentation time model. The basic structure of the model incorporates the two fundamental cognitive processes discussed above. The basic model will then be extended to incorporate factors such as revenues and clutter problems.

## II. OPTIMAL PRESENTATION TIME MODEL

### 1. Basic Structure of the Model

There are two basic events involved in the viewing of home shopping programs. The first event is "comprehension" of the product and the second event is boredom the occurs when watching the presentation of products. We assume that the time until the comprehension event occurs is a random variable that follows the exponential distribution with parameter $\theta$. We further assume that the time until a viewer becomes bored is a random variable that follows the exponential distribution with parameter $\mu$. Thus, comprehension time can be described by the probability density function: $f(t) = \theta e^{-\theta t}$ and boredom time can be described by the probability density function: $g(t) = \mu e^{-\mu t}$.

This implies that events of comprehension and boredom are random with constant likelihoods of occurring at each increment of time. This follows from the nature of the exponential distribution. Additional assumptions of the model are that first, these two random variables are independent of each other. This independence assumption allows for the possibility that a viewer can feel boredom before he/she comprehends the nature of the product. This may occur in situations where a viewer is faced with a totally unfamiliar and uninterested product (for example, a computer illiterate is presented with the latest model of multi-media computer) and is immediately turned-off and thus feels bored before understanding the product. The final assumption of the model is that the comprehension and boredom rates are equal for all products. This implies that the optimal lengths of presentation time for all products will be the same and each product will be on the air for the same length of time. This is an assumption that simplifies the design of the presentation strategy. It may be difficult in reality to vary the presentation times for•each product depending on the comprehension and boredom rates. Rather, the producers may want to derive the optimal presentation length for an average product and use this for all products. Thus, the rates in this model can be deemed as the average of all products.

The desirable event is that the viewer comprehends the product and that he/she has not become bored in the process. The probability of this event is represented by the joint probability $P^{C\cap\overline{B}}(t)$ where C denotes the event of comprehension and $\overline{B}$ denotes the event of not becoming bored. Thus we are attempting to find the optimal length of presentation time that maximizes this probability. Let $\tau$ be the length of the presentation of each product. Then, the probability $P^{C}(\tau)$ that a viewer comprehends the nature of the product by the end of the interval $\tau$ is given by:

$$P^{c}(\tau)=\int_0^{\tau}\theta e^{-\theta t}dt=1-e^{-\theta\tau}$$

Furthermore, the probability $P^{\overline{B}}(\tau)$ that a viewer does not become bored by the end of the interval $\tau$ is given by:

$$P^{\overline{B}}(\tau)=1-\int_0^{\tau}\mu e^{-\mu t}dt=e^{-\mu t}$$

Then, with the independence assumption, the joint probability $P^{C\cap\overline{B}}(\tau)$ can be represented by:

$$\phi(\tau) = P^{C}(\tau) \cdot P^{\overline{B}}(\tau) = (1-e^{-\theta t})e^{-\mu t} \qquad (1)$$

And the objective is to find the optimal length $\tau$ that will maximize equation (1) above. Differentiating (1) with respect to $\tau$ and setting it equal to zero gives the optimal length of presentation $\tau^*$:

$$\tau^* = -\left(\frac{1}{\theta}\right)\ln\left[\frac{\mu}{\mu+\theta}\right] \qquad (2)$$

That is, finding the value of $\tau^*$ that satisfies equation (2) maximizes the probability of the desirable event of comprehending and no boredom.

Here, we define z where z equals mean time till becoming bored ($1/\mu$) divided by mean time till comprehension ($1/\theta$). Thus in our model, z is equal to $\theta/\mu$. This is a useful measure in tracking the properties of $\tau^*$ under various magnitudes of $\theta$ and $\mu$. Though in a different context, Morrison (1981) has extensively shown the properties of $\tau^*$ under various magnitudes of z. Applying Morrison's findings to the problem at hand, we can make several interesting observations. Table 1 gives the values for $\tau^*$ and $P^{C\cap\overline{B}}(\tau)$ under various values of z. Here, $\mu$ was set to 1.0. The same comparison under different values of $\mu$ is discussed later. Note that $\tau^*$ here represents the optimal length of presentation as a proportion of mean time till boredom event.

When the comprehension rate is equal to the boredom rate (i.e., $\theta = \mu$ and z=1), the desirable event ($C\cap\overline{B}$) occurs only one quarter of the time even when the product is presented for the optimal length of time. As z

TABLE 1

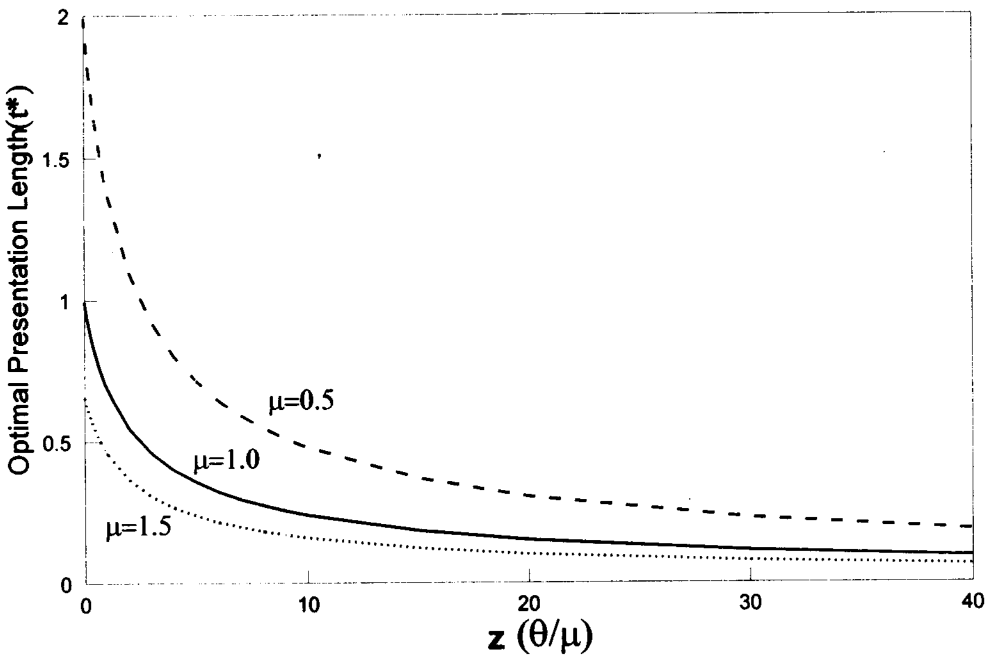
Optimal Presentation Lengths from the Basic Model

| | z | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 50 | 20 | 10 | 5 | 2 | 1 | .5 | .2 |
| $\tau^*$ | .079 | .152 | .240 | .358 | .550 | .692 | .810 | .910 |
| $P^{C\cap\overline{B}}(\tau)$ | .907 | .817 | .715 | .582 | .385 | .250 | .148 | .067 |

(Modified from Morrison 1981)

becomes larger (i.e., comprehension rate becomes proportionately larger than the boredom rate), the optimal length as a proportion of mean time till comprehension becomes smaller and the probability of the desired event $(C \cap \overline{B})$ becomes larger. This says that as viewers take shorter and shorter time to comprehend relative to the length of time needed to become bored, the program should devote less and less time on presenting each product while doing so will increase the probability of the desired event. This is intuitively correct. Figure 1 shows this relationship graphically. Additionally, it compares this base case (i.e., when $\mu$=1.0) with other cases when $\mu$ takes on different values. Here, we notice that even for a given proportion z, the optimal presentation length needs to decrease as the boredom rate $\mu$ increases. In other words, because boredom sets in quickly, smaller $\theta$ (i.e., slower comprehension) cannot lead to a big increase in $\tau$.

Figure 1
Behavior of Optimal τ*




2. Model Formulation and Derivation

Here, a few factors are incorporated into the basic structure of the model to arrive at a more realistic and yet parsimonious model of presentation length. First, the objective of the home shopping firm would be to maximize profits rather than the probability described above. If we denote the total length of the program as T, then for a given value of $\tau$ (length of each presentation), the number of products that will appear during the entire program is $T/\tau$. Assuming that a constant proportion $\delta$ of the viewers that reach the event $(C \cap \overline{B})$ will order (purchase) the product, and that all products have equal margins of $\pi$,the expected earning per product can be represented as: $\pi \cdot \delta \cdot P^{C \cap \overline{B}}(\tau)$ and the total earnings during the program can be represented as:

$$\Psi(\tau) = \pi \cdot \delta \cdot P^{C \cap \overline{B}}(\tau) \cdot [\ T/\tau\ ]$$

Second factor that must be incorporated into the model is related to the stream of research conducted by Ray and Webb (Ray and Webb 1976, 1978, 1986; Webb and Ray 1984) concerning the effect of clutter on advertising effectiveness. This line of research, through a series of laboratory experiments, has shown that increasing clutter of advertisements embedded in a TV program (both by shortening each commercial presented within a given period of time as well as by increasing the total time devoted to commercial presentation) has a significantly negative effect on their effectiveness. Specifically, they found that increasing the clutter of non-program material (e.g. commercials, promotional announcements, public-service messages etc.) resulted in decreased attention, recall, and positive cognitive responses (Webb and Ray 1984). The implication of these findings in the present context is that although the term $T/\tau$ will drive the optimal time spent presenting each product $\tau^*$ to be small such that more products will be introduced within a given period of time, increase in number of products presented will probably hinder the comprehension of them by the viewers. This is because as the viewers are exposed to more and more products in a short period of time, their attention will be adversely affected and thus their average comprehension rate will decrease. Specifically, viewers' overall comprehension rate will be greater when each product is on the air for a long period of time as opposed to when each product is on the air for a short period of time. In the context of the model, the comprehension parameter $\theta$ is inversely related to the number of products presented during the program ($T/\tau$) or directly related to length of presentation ($\tau$). The simplest form for representing such relationship is of course a linear function. So the rate of comprehension that reflects the clutter factor can be represented as $k\theta\tau$ where k is an arbitrary constant. Time till comprehension now follows a distribution with probability density function $f(t) = k\theta\tau\, e^{-k\theta\tau t}$ and cumulative distribution function $F(t) = 1 - e^{-k\theta\tau t}$.

The mean of this distribution is now $1/k\theta\tau$. Notice that it is now a function of the presentation length $\tau$. This follows directly from the fact that the rate of comprehension is dependent on how long the presentation of each product is. So now the probability that a viewer comprehends by the end of the interval $\tau$ is given by:

$$P^{C}(\tau) = \int_0^{\tau} k\theta\tau\, e^{-k\theta\tau t} dt = 1 - e^{-k\theta\tau^2}$$

The probability of interest, $P^{C\cap\overline{B}}(\tau)$ is now:

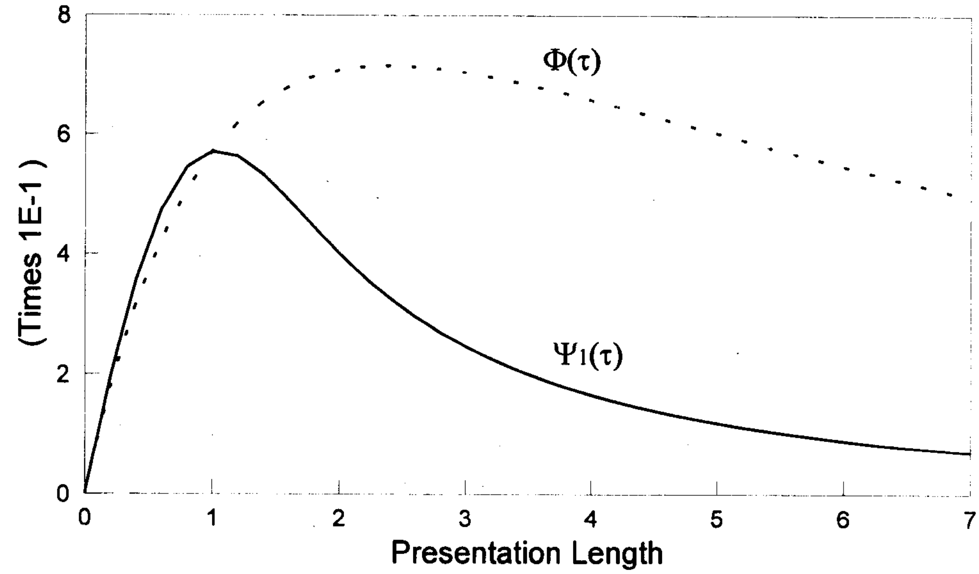
$$P^{C\cap\overline{B}}(\tau) = (1 - e^{-\theta\tau^2})\, e^{-\mu t}$$

Finally, combining revenue and clutter factors into the model, the objective function becomes:

$$\Psi_1(\tau) = (T/\tau)[\ (1 - e^{-\theta\tau^2})\, e^{-\mu\tau}\ ] \qquad (3)$$

Figure 2 compares the graphs of $\phi(\tau) = P^{C\cap\overline{B}}(\tau)$ discussed in section 2.1 and $\Psi_1(\tau)$ when $\theta$ (comprehension rate) = 1 and $\mu$ (boredom rate) = 0.1. For simplicity, we assign values of 1 to $\pi$ and $\delta$. Since both parameters are assumed to be constants, they may in effect be omitted from the model in deriving the optimal presentation length without affecting the resulting $\tau^*$ 1).

Figure 2
Comparison of $\Phi(\tau)$ and $\Psi_1(\tau)$
Comprehension rate=1.0; Boredom rate=0.1




In this particular case, considering revenue and culutter in the objective function results in a smaller optimal presentation time $\tau^*$ as compared to when only $\phi(\tau) = P^{C\cap\overline{B}}(\tau)$ was the objective function. In other words, $\Psi_1(\tau)$ is maximized at a smaller $\tau$ than $\phi(\tau)$. Thus, in general, depending on the shape of the $P^{C\cap\overline{B}}(\tau)$ curve, it might pay in terms of greater total revenue to shorten the optimal $\tau^*$ and present more products in a given period of time.

By differentiating equation (3) with respect to $\tau$ and setting it equal to zero, we can derive the optimal length of presentation ($\tau^{**}$). The derivation is given in Appendix 1. Although it is not possible to solve for $\tau^{**}$ analytically, the optimal presentation time for each product is the value of $\tau$ that satisfies the following equation:

1) Also, in order to facilitate the comparison of graphs in Figure 1, T was set to 1. This in now way affects the following discussion.

$$\tau^{**}=\sqrt{-\left(\frac{1}{k\theta}\right)\ln\frac{1+\mu\tau}{1+\mu\tau+2k\theta\tau^2}} \tag{4}$$

Equation (4) can be solved numerically for $\tau^{**}$ under various values of $\theta$ and $\mu$ using a short program in BASIC and it converges fairly quickly. The basic principle is to first pick a starting value for $\tau$ and calculate the right hand side of the equation to arrive at a new $\tau$. Then place the calculated $\tau$ into the equation to calculate yet another $\tau$. This process is repeated until further calculation does not result in a different value for $\tau$.

## III. NUMERICAL EXAMPLES AND DISCUSSION

Values of $\tau^{**}$ under various values of z $(=\theta/\mu)$ and $\theta$ are given in Table 2. Here, the constant k is set to 1 in order to facilitate the comparison of $\tau^{**}$ with $\tau^{*}$ (optimal length derived from the basic model).

TABLE 2

Comparison of Optimal Presentation Lengths from the Basic and Extended Models

| | | z | | | | | |
|---|---|---|---|---|---|---|---|
| | | .1 | | 1 | | 10 | |
| | | $\tau^{**}$ | $\tau^{*}$ | $\tau^{**}$ | $\tau^{*}$ | $\tau^{**}$ | $\tau^{*}$ |
| $\theta$ | .1 | .917 | .953 | 2.872 | 6.932 | 3.463 | 23.979 |
| | .5 | .197 | .191 | 1.031 | 1.386 | 1.507 | 4.796 |
| | 1 | .099 | .095 | .630 | .692 | 1.044 | 2.389 |
| | 5 | .020 | .190 | .172 | .139 | .430 | .480 |
| | 10 | .010 | .009 | .092 | .069 | .287 | .240 |

The first observation is that the optimal lengths derived from both models decrease for all values of z as magnitudes of $\theta$ and $\mu$ increase. This indicates that as comprehension and boredom rates increase proportionately, the presentation time should be shorter. On the other hand, for a given comprehension rate $\theta$, as the proportion z increases (i.e., as boredom rate $\mu$ decreases), the optimal length $\tau^{**}$ also increases. This is intuitively correct in that as it takes longer and longer for viewers to become bored with the presentation, the producers have the "luxury" of letting the presentation time become longer and longer to maximize the probability of comprehension. It is important to note here that the probability of comprehension does not effect the probability of ordering given comprehension.

Another interesting set of observations are the comparison between $\tau^{**}$ and $\tau^{*}$. Both behave similarly in that they decrease as $\theta$ and $\mu$ become larger proportionally. However, for small values of $\theta$ and $\mu$, $\tau^{**}$ is smaller than $\tau^{*}$ while for larger values of $\theta$ and $\mu$, $\tau^{**}$ is larger than $\tau^{*}$. This indicates that for a given proportion z, when the two rates are small, the revenue factor ($T/\tau$) is dominating and thus it pays to adopt a presentation time that is shorter than $\tau^{*}$ to squeeze in more products into the program. In other words, when $\theta$ and $\mu$ are small, increasing the number of products presented within a program will increase the revenue at a faster rate than it will decrease the comprehension due to clutter. Beyond some threshold values of $\theta$ and $\mu$ however, the clutter factor overwhelms the revenue factor such that the increase in revenues from increased number of products being presented is not enough to compensate form the decrease in comprehension brought about by clutter. So in this case it pays to present the products for a longer period of time than $\tau^{*}$.

## Ⅳ. CONCLUSION

This paper proposed a model capturing the viewing behavior toward cable television home shopping programs. Then, based on this model, optimal product presentation strategy was formulated represented by the length of presentation time. While the model itself was a quantitative representation of the viewing process, the results derived from the model was quite qualitative and intuitive. With managerial judgments about the model parameters themselves or about the proportion z ($=\theta/\mu$), the results from the model can provide insights into the viewing patterns as well as directional guidance in formulating product presentation strategies for home shopping programs.

Beyond the context of home shopping programs, the proposed model can be applied to the issue of advertising length. Specifically, the recent appearance of both very short (e.g., 15-second spots) and very long (e.g., 30-minute informercials) commercials have spawned debates regarding their merits and demerits. This model can address the issues involved in the debate and possibly help in deciding under what conditions short or long commercials will be more effective than the more traditional-length commercials.

Finally, related research in the future should address the issue of empirically estimating the underlying comprehension and boredom rates. While the current model captures the essence of the problem, and provides directional guidance, empirical estimation of the rates would greatly enhance the applicability of the model. Furthermore, the model can be extended to incorporate heterogeneity of the viewing population in comprehension and boredom rates. Whatever the extension may be, the researcher obviously has to make the tradeoff between parsimony of the model and the amount of reality it captures.

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<APPENDIX 1> Derivation of optimal presentation length

The objective function is:

$$\Psi_1(\tau) = (T/\tau)[\ (1-e^{-\theta\tau^2})\, e^{-\mu\tau}\ ] \qquad \text{(A1)}$$

Differentiating (A1) in terms of $\tau$ and setting it equal to zero:

$$\frac{d\Psi_1(\tau)}{d\tau} = -\frac{T}{\tau^2}e^{-\mu\tau} - \frac{T}{\tau}\mu e^{-\mu\tau} + \frac{T}{\tau^2}e^{-k\theta\tau^2-\mu\tau} + \frac{T}{\tau}(2k\theta+\mu)e^{-k\theta\tau^2-\mu\tau} = 0$$

Therefore,

$$\frac{T(1+\mu\tau)}{\tau^2}e^{-\mu\tau} = \frac{T(1+2k\theta\tau^2+\mu\tau)}{\tau^2}e^{-k\theta\tau^2-\mu\tau}$$

And rearranging the terms we get:

$$-k\theta\tau^2 = \ln(1+\mu\tau) - \ln(1+2k\theta\tau^2+\mu\tau)$$

Thus, the optimal $\tau$ must satisfy the following equation:

$$\tau^{**} = \sqrt{-\left(\frac{1}{k\theta}\right)\ln\frac{1+\mu\tau}{1+\mu\tau+2k\theta\tau^2}}$$

## Abstract

The emergence of the cable television era has spawned the introduction of many new television programming formats such as all-news channels, movie channels, channels catering to cultural events, channels for women, and many others. One of the new programming formats that is expected to have interesting implications for marketing is the home shopping channel. As we have observed in other countries, this new form of distribution may potentially have a major impact on the traditional retail industry. This paper presents a model of home shopping channel viewing behavior. This model is then used to formulate optimal product presentation strategies that may aid managers in the design of home shopping programs. Specifically, by formulating a profit-maximization problem based on the model, we derive the optimal length of product presentations and explore its properperties through simulating various situations. The discussion of these properties provide insights about making strategic decisions regarding product presentations.