Movie Marketing Strategy Formation with System Dynamics: Towards a multi-disciplinary adoption/diffusion theory of cinema-going

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Abstract

This paper proposes a formal theory for the causal mechanisms underlying viewing figures for cinema films. It draws upon a range of diffusion theories, introducing them by using specific illustrations from sociology, epidemiology and marketing. These theories are employed in the construction of a system dynamics model which is then used to explore the marketing of movies. In this model these mechanisms are used to represent interest-based word-of-mouth effects, advertising, experience-based word-of-mouth effects, positive network externalities and disengagement. The model generates a range of behaviour modes and these are described. They offer one possible explanation for why the product lifecycle of many movies is relatively short. By demonstrating the relevance of the various model mechanisms to this particular phenomenon the paper also re-emphasises the isomorphic nature of the constituent diffusion theories. Finally, the model also has potential both for further extension and for use in supporting policy making in the actual social system that was modelled.

Keywords: System dynamics modelling, simulation, marketing strategy, causal mechanisms, formal theory building, product lifecycle, adoption/diffusion processes, Liebenstein effect, bandwagon effect, advertising, positive network externalities.

A. Introduction

This paper describes an exploratory system dynamics model of the marketing of cinema films. It draws upon a range of adoption/diffusion theories, including references to sociology and epidemiology. Understanding processes underlying questions posed in those fields may seem a rather different task than wondering how to entice people to buy a cinema ticket for *Alien vs Predator*. Yet, an aim of this paper is to show that there are numerous similarities, similarities which relate to the causal structure of adoption/diffusion processes. Such an insight is, of course, entirely in the spirit of the view taken in the system dynamics field that, at the right level of abstraction, similar causal mechanisms underlie seemingly highly diverse phenomena (Forrester 1961, 1968). Previous system dynamics-based research, again, on a diverse range of topics but all related to adoption/diffusion theories, includes the work of Homer (Finkelstein, Homer & Sondik 1984; Homer 1987), and Milling (Milling 1974, 1988, 1996; Milling & Maier 1996; Milling 2002)).

System Dynamics and Cinema-going

The phenomenon considered – the marketing of cinema films – is of managerial and sociological interest. The managerial interest is probably clear. To use just one example, Sony Pictures spent around $150 million making

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Spiderman and an additional $50 million on the global marketing campaign for this movie (*The Wall Street Journal Europe*, 30th April 2002). Movies are big business.[1] In parts of the world, both popular cinema and the act of movie going as a social phenomenon play significant roles in shaping people's leisure time and even how they communicate with each other. There will be few readers who have not heard the phrase "May the force be with you", and many will have taken part, however briefly, in conversations about some recent release. Hence, to understand what makes people go to the cinema is of broader sociological interest.

Sociologists have clearly established the importance of both the formalisation of social theories (Hage 1994) and the specific study of social mechanisms (Hedström & Swedberg 1998). In this paper a particular type of formal theory building is used: system dynamics modelling. This is defined by its originator as, "The investigation of the information feedback character of systems and the use of models for the design of improved organisational forms and strategies" (Forrester 1961). The underlying idea may be put thus: social systems may be viewed as collections of reinforcing and balancing loops. To understand the linkage between system structure and behaviour over time, system dynamicists build qualitative maps of fully formulated and parametrised models. These are formal theories which aim to explain why a system behaves as it does and to help in the creation of strategies that lead to improved behaviour.

For the remainder of this paper system dynamics is described via a practical example. However, further work on the relationship of the approach to other forms of sociological theorising is available (Bloomfield 1982; Forrester 1985; Vennix 1996; Lane 1999; 2001; Lane & Husemann 2002).

The Phenomenon Studied

Today, many movies[2] are marketed in a very particular way. To illustrate this, we might compare the release of two films, *2001: A Space Odyssey* and *Saving Private Ryan.*

The actual year 2001 was still some time in the future when the eponymously titled film was released in the English county of Kent among other places. For any schoolboy who had heard about the film, the opportunity to view it could also take some time to arise. Eventually, an advertisement in *The Kent Messenger* showed that it had arrived and was screening in Rochester. Over the following weeks one could watch the progress of the film via the advertisements in that newspaper. After Rochester came Canterbury, after Canterbury, Ashford, then Tunbridge Wells and Maidstone. Thinking back now, one can see that there was just a single print of this film. One can imagine the cans being put into a van - perhaps early on a Sunday morning – to be sent on to the next town for a screening. It was via this sedate stroll that the audience of the whole county of Kent gained access to the film.

Compare that with how *Saving Private Ryan* stormed the US in 1998 (see Figure 1). There was a huge burst of sales when the movie opened, slowly tailing off over a period of some dozen weeks. In fact, by taking a rough account of the cost of making the movie, *Saving Private Ryan* returned a profit about three weeks after its release. This was achieved by having a huge number of prints of the movie and opening it simultaneously in many cities across the US.

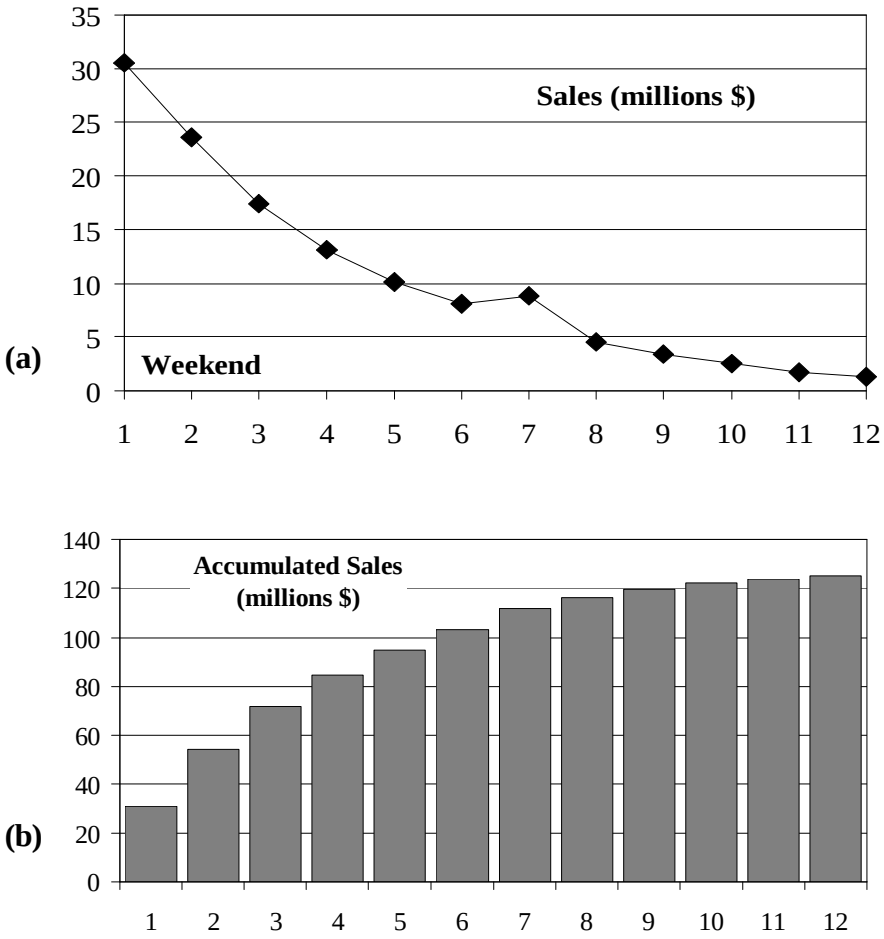


Figure 1. Sales figures for the USA release of *Saving Private Ryan*. Data source: downloaded from: www.un-official.com/SPR/SPRBox.html
(a) Value of weekly ticket sales.
(b) Value of accumulated ticket sales.

This is increasingly the modern way of releasing movies. Many hundreds of copies of the film are made, sometimes in excess of 1000, and an advertising campaign is organised to create interest across the large areas where the movie is released and shown simultaneously in many locations.[3] And the movie comes and goes in a few weeks. This leads to a related question: why is the lifecycle of some movies so short? The marketing literature offers sophisticated models for product lifecycles. A sales pattern of accelerating growth, peaking and down turn is traditionally explained in terms of a sequence of phases; introduction, growth, shake out, maturity and decline (Lambin 1997). With many movies this sequence seems to be highly truncated. Why might this be? This is one of the motivating questions for the modelling study described here. The paper proceeds as follows. In Section B we review a range of formal theories drawn upon to create the model. The main structure of that model is described in Section C and then a range of model runs is presented and analysed in Section D. The paper closes with an assessment of the work.

B. Towards a multi-disciplinary diffusion theory

Cinema going is supposedly strongly influenced by the spread of knowledge of movies via word-of-mouth. This therefore feels as though it has something to do with diffusion. Isomorphic theories of diffusion arise in individual disciplines such as sociology, epidemiology, marketing, economics and system dynamics itself. For example, in *Mathematical Sociology* James Coleman observes that, "There is a general class of theories which may be applied to the phenomenon of social diffusion: diffusion of a piece of information, of a technological innovation, of a belief, of an innovation in fashion, etc. These theories are applicable to situations in which each individual in a group can be characterized as having or not having the attribute being diffused" (Coleman 1963).

The meta-discipline of system science describes the similarities of these theories (von Bertalanffy 1950). Consequently, a great deal is already known about diffusion processes. This section describes how diffusion theories from a variety of those disciplines contributed to the creation of a model.[4]

Sociology: New Drug Adoption by Doctors

The core of a formal theory of the social mechanisms underlying diffusion processes is exemplified by work in the field of sociology (Coleman, Katz & Merzel 1957). The phenomenon studied was the way in which physicians in a geographical region took up the prescription of a newly available drug. One of the possible theories studied was the idea that diffusion resulted from a word-of-mouth mechanism among agents in a 'complete social structure' with heterogeneous mixing.

Sociologically, the idea is straightforward. The heterogeneous group of physicians can be divided into two 'stocks'. First, the group of physicians who at a given time have not adopted the drug but who have the potential to prescribe the drug subsequently. Second, those physicians who at any given time have already adopted the drug in that they are prescribing it for their patients. The groups mix and share their experiences.

The underlying mathematical equations are actually those of the 'logistic model' (Verhulst 1838), represented in Figure 2a as a system dynamics stock and flow diagram, or SFD (Lane 2000). In this representation the two stocks are called, respectively, 'Potential Adopters' and 'Adopters'. The rate at which the drug is adopted is then a function of the rate at which Potential Adopters and Adopters meet.[5]

For this structure to explain adoption it is, of course, necessary for the start value of Adopters to be non-zero, that is, there are one or more 'first users', doctors who have taken up prescription of the drug. In the structure there is then a reinforcing loop, as the greater the adoption rate, the more Adopters there are which increases the rate which leads to yet more Adopters. This loop effect dominates the system at first, producing growth. However, a second loop becomes important in time since the rate reduces the number of Potential Adopters which then reduces the rate, so the stock of Potential Adopters falls more slowly. This is a balancing loop, which eventually slows the system to a halt. Note the balancing loop has an explicit goal of zero for the stock of Potential Adopters, so that a consequence of this structure is that all of the Potential Adopters are converted to Adopters.

Coleman (1963) warned sociologists against 'content-less theory'[6] and therefore tested this model using empirical data (see Figure 2b). Although the first data point means that the early phase - which both the theory and system dynamicists would expect to be exponential - is not well represented in the data, the statistical fit is a good one and is superior to the alternative considered.

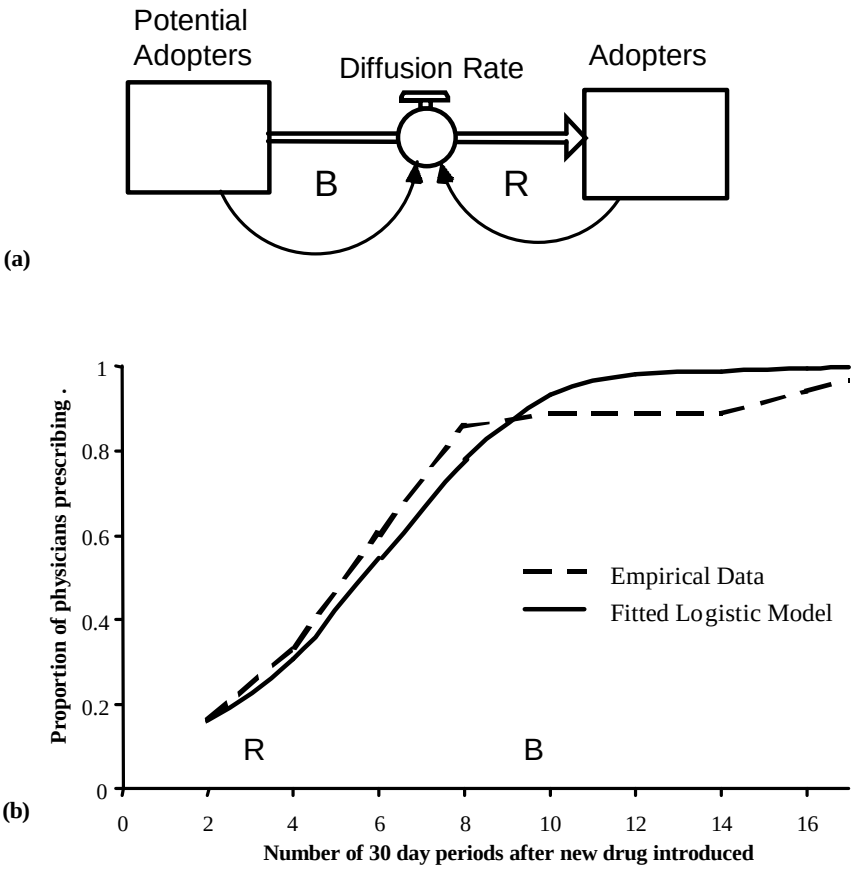


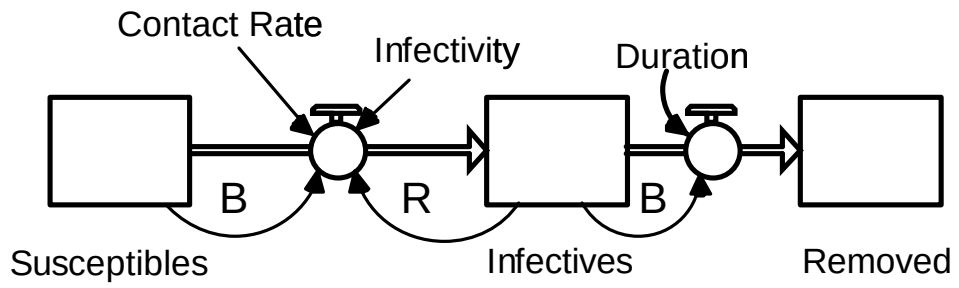
Figure 2. Core adoption-diffusion process; theory and example.
(a) Structure of formal theory for number of physicians adopting the prescription of a new drug.
(b) Progress over time of this process. The chain line shows the empirical data whilst the solid line shows the best-fit logistic model. Note that here the graphs are adopters as a proportion of the whole population (N=56). Adapted from Coleman (1963). The labels 'R' and 'B' indicate the general areas of the logistic curve in which the respective loop dominates behaviour.

The conclusion is that this core theory is a useful one to employ in that it embodies plausible structural assumptions and fits time series data. This same structure may be seen at the heart of various system dynamics studies, for example that of Homer (1987). However, in most cases more features must be added to a logistic model. The contributions from two such extensions are described next.

Epidemiology: The SIR Model

Epidemiology offers an array of diffusion theories to explain the progress of diseases through populations (Bailey 1957; Murray 1989). A theory of exactly the same structure as that just described lies at the core of the 'SIR model' (see Figure 3a). There are two mechanisms in the model. 'Social contagion' occurs as a disease spreads amongst those who are susceptible and who thereby join the group of those who are infective. Clearly at least one person must have the disease for this to occur. The model also requires two parameters for the 'Contact Rate' and the 'Infectivity', representing the mode of contact necessary to pass the disease. This mechanism would have the disease spread via a logistic model and by itself is known as the 'SI model'. The extension of interest here is that after a time those who are ill are 'removed', that is, die or are isolated, or simply recover.[7] This is the SIR model. A third parameter, 'Duration', is therefore required. Structurally, this introduces a second balancing loop to the system which acts to remove people from the Infectives stock at a changing rate such that

the average time spent in the stock is the duration of the infectious period of the disease. The implicit goal of this loop is therefore to reduce the stock of Infectives to zero over time.



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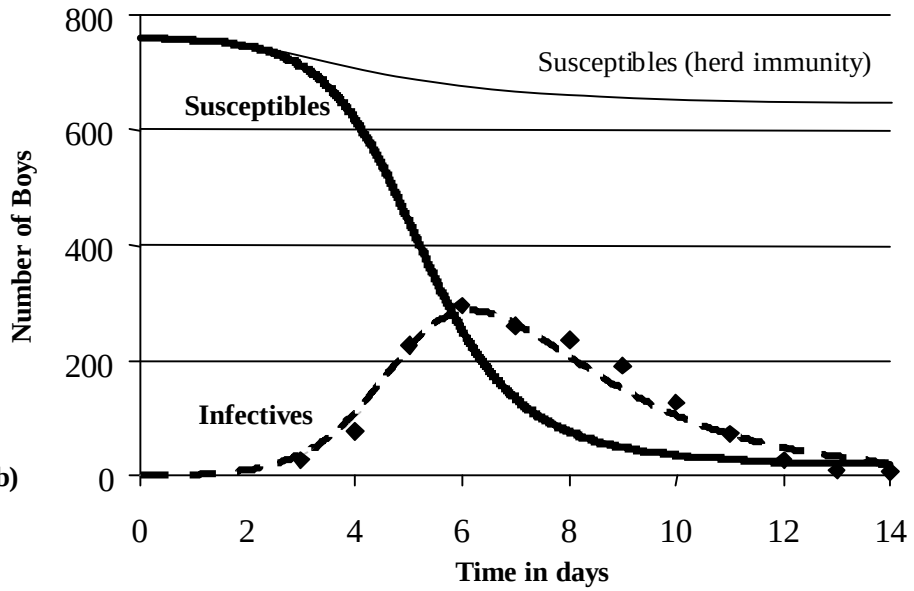


(b)

Figure 3.
(a) Structure of the SIR model, a formal theory for the spread of a contagious disease.
(b) Progress of a flu epidemic through the pupil population of an English boarding school. The black diamonds show the empirical data. The thick lines show output from the best-fit SIR model, with Infectives as a chain line. This data is adapted from Murray (1989). The thin line shows just Susceptibles for an alternative 'herd immunity' run with the same model.

Murray tested this SIR model against empirical data for a flu epidemic in a boarding school (see Figure 3b). His fit is good and shows the characteristic form of an epidemic.[8] The reinforcing loop causes a burst of Infectives and so Susceptibles falls rapidly. The Infective stock is itself drained by the second balancing loop. As a result, people are being removed faster than they are becoming infected. At the end of the run virtually all of the population has had the disease and are now labelled as 'Removed'.

The key point about the SIR model is that, unlike the SI model, its structure does not always produce an epidemic. Changes in the parameters can make the disease die out rapidly. An epidemic may not occur because the type of social/physical contact which has the potential to convey the disease happens rarely. Or because few contacts results in transmission. Or because the disease comes and goes very quickly (either the disease is

something that people recover from quickly, or it kills them quickly). A sample of this behaviour is also shown in Figure 3.[9]

This leads to some general observations about theories which have the structure of the SIR model. First, only the presence of an ill person will start things off. If there is no 'patient zero' then there is no change. Second, the reinforcing loop underlying the social contagion effect is the crucial mechanism underlying the epidemic. It is fundamental if there is to be a surge in Infectives. Third, an epidemic will not occur unless the reinforcing loop is sufficiently strong. In fact, in mathematical terms a necessary condition for an epidemic is that: -

$$\frac{\text{Susceptibles}_0 * \text{Contact Rate} * \text{Infectivity}}{\text{Total Population}} > \frac{1}{\text{Duration}}$$

It is not a sufficient condition by itself in that, if it is fulfilled it does not inevitably result in an epidemic. However, if it does not hold, it is guaranteed that there is not one, since the number of Infectives immediately starts to decline.[10] The fourth lesson is that when the parameters of a situation are such that an epidemic does not occur, there is said to be 'herd immunity' (Fine 1993). That is, the disease is insufficiently contagious or insufficiently enduring for it to take hold of the population and infect a large fraction of them.

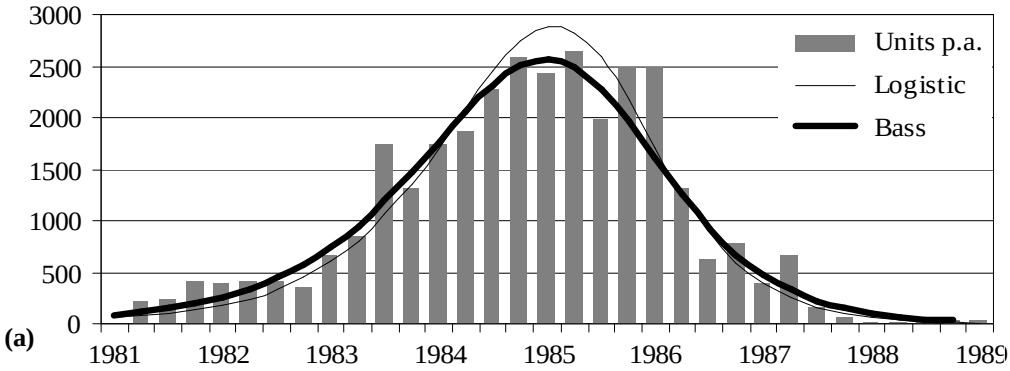
It is probably clear that epidemiology's 'patient zero' is sociology's 'first user'. However, this theory extension to the core diffusion model, as well as the above observations, is best introduced in an epidemiological context before being used to inform the creation and behaviour of the movie model.

Marketing Strategy: The Bass Model

Marketing strategy offers another useful extension to the core diffusion structure. In this context diffusion results from a 'word-of-mouth' recommendation of a product or service between Potential Consumers and (actual) Consumers. By itself this is re-labelled a logistic model again. It too can be compared with empirical data. For example, Sterman (2000) used sales data for the VAX 11/750 micro-computer and found the best-fit model (see Figure 4a).

Models in which the diffusion rate results from word-of-mouth effects involve two assumptions. If anything interesting is to happen then first users are necessary (consumer societies are replete with examples of enticing free give-aways). This is, of course, the 'patient zero' requirement in another form. In marketing strategy it is called the 'start-up problem'. Related to this is the assumption that purchases are only made in an 'imitative mode', that is, a consumer only purchases when having acquired information and/or a recommendation from an existing user and so chooses to imitate that user's purchase decision. These are not unreasonable assumptions but they limit the generality of the theory. This restriction was removed when Bass extended the model to include advertising (Bass 1969).

The extension introduced by Bass is shown in Figure 4b. In this theory, spending on advertising can encourage people to purchase the product in an innovative fashion. As money is spent on advertising this results in a certain proportion of the Potential Consumers choosing to make a purchase.[11] This is a second mechanism, which adds to the word-of-mouth effect to create Consumers. This theory has the same number of parameters as a logistic model (three) since the initial value of adopters is zero. Nevertheless, in the case calibrated by Sterman, Bass' theory can be shown to be a better fit to the empirical data (see Figure 4a).



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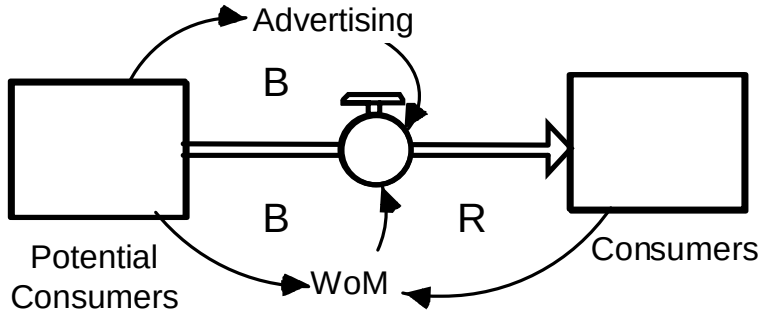


(b)

Figure 4.
(a) Sales rates for the VAX 11/750 computer. The bars show the empirical data. The thin line shows the best-fit logistic model; note the high peak and the low tails. The thick line shows the best fit of Bass' model; note the improved fit to the two tails and to the peak. This empirical data and the best-fit output is adapted from Sterman (2000).
(b) Structure of Bass' formal theory for new product growth.

For the purposes of understanding movie marketing there are four lessons worth drawing from Bass' theory. First, advertising eliminates the start-up problem. There is no need to give away any products in order to initiate the purchasing dynamics - a rather helpful, indeed realistic, property if one is marketing computers. Second, that advertising effect produces Consumers who then act in a way which allows the reinforcing loop to operate. Third, after a relatively short period in which advertising is crucial, that reinforcing effect is then the critical mechanism for creating a burst of sales. These points may be illustrated by a disaggregation of the total adoption rate in the case of the VAX computer (Figure 5). At first sight most of the total rate seems to come from the word-of-mouth adoption, sales from advertising being much smaller. This shows the critical role of the reinforcing loop. However, for the first half year the innovative sales rate is larger than the imitative. Indeed, at the beginning of the run there are no sales caused by word-of-mouth. Sales from advertising are needed to catalyse that effect in the first place. From then on, but only then, word-of-mouth is crucial to drive the reinforcing loop. The fourth lesson is therefore this. If there is some equivalent of 'herd immunity', that is, the product does not inspire a word-of-mouth effect, then advertising alone will find it very difficult (and expensive) to substitute. The ideal situation is that advertising acts as a catalyst, an absolutely crucial one, which then allows a strong reinforcing loop based on word-of-mouth to become dominant and drive sales. If this word-of-

mouth effect is not present then huge amounts of advertising will be necessary to produce sales on a similar scale.[12]

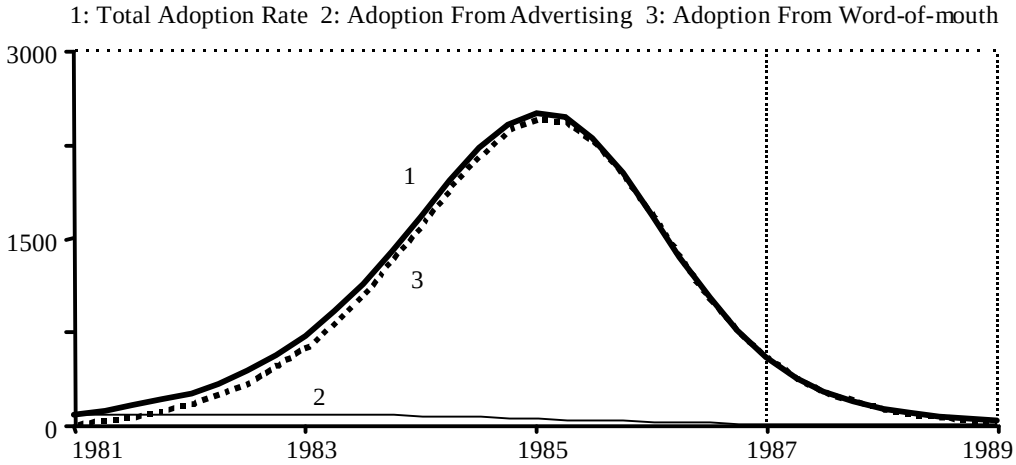


Figure 5. Disaggregation of the total adoption rate for the VAX computer case, showing the actual sizes of the advertising and word-of-mouth components over time. Data generated from the calibration of Sterman (2000).

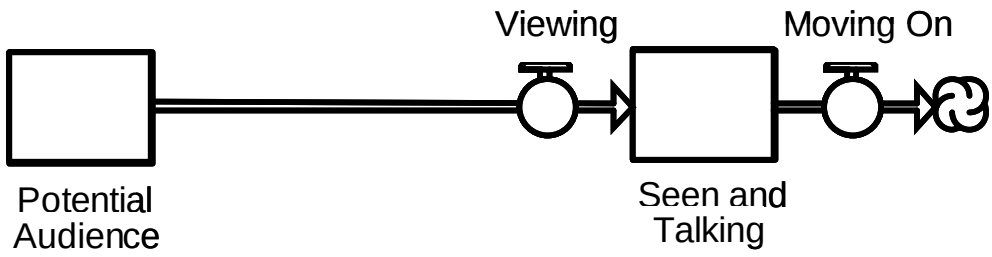
C. Building a Formal Diffusion Theory of Movie Marketing

This section describes how the work on diffusion processes from other disciplines informed the creation of our own formal theory, that is, an exploratory system dynamics model.[13] The following sub-sections describe first how the main stocks of the model were agreed, and then the series of mechanisms included in the model to represent the flows between these stocks. Finally, other assumptions in the model are described briefly.

Establishing the Core Stocks and Flows

Everyday experience and published data easily accessible to any mildly curious cinema goer were sources of information when deciding what the main stocks of the model should be. This was then augmented with the help of information from an individual with direct experience of the movie business. He will be referred to here as Victor. He had worked as an intern in the corporate finance department of a major studio in Los Angeles and subsequently returned to Hollywood to take up a job full time. The authors had initiated the project with the aim of understanding the phenomenon described in Section A. The aim was to begin to explore the mechanisms relevant to marketing strategies in the case of movies.

A simple theory - similar to other diffusion work (Stoneman 2002) - might be formulated based on the SIR model (see Figure 6a). A Potential Audience stands as those who are ‘susceptible’ to receiving information about the movie from a group ‘infected’ with that information by having seen the movie and who are happy to spread their views. Note that this second stock of people is not all those who have seen the movie. Rather, it is those who have seen the movie and who are also still talking about it. That stock therefore has an outflow, as people cease to talk about the film, moving on to some other activity. (This ‘removed’ class is not shown in the figures here but conceptually completes the SIR structure.)



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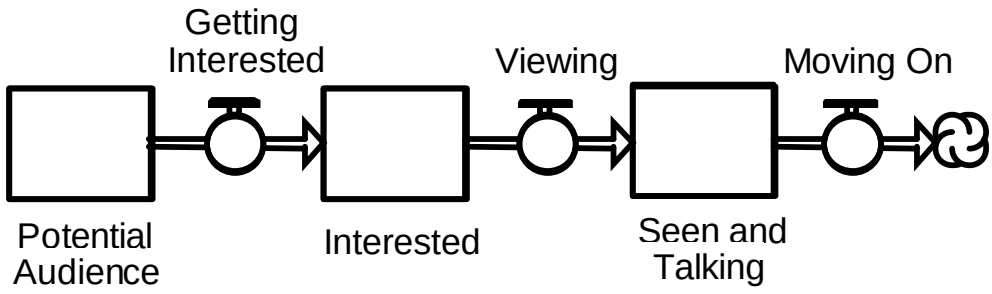


(b)

Figure 6.
(a) Initial SFD of the movie model. Compare with Figure 3a
(b) Core stocks and flows of the movie model.

However, this is too crude a segmentation of the population and diffusion effects. It seemed clear to the authors that people first come to know about a movie prior to its release and may talk about it then.[14] Only after release do they have the opportunity to go to see it, and then share their reaction. (Victor subsequently confirmed the importance of pre-release interest.) This stock flow structure is shown in Figure 6b. Here the Potential Audience may be thought of as those having no knowledge of the movie.

This important extension of the model immediately implied the existence of more than one diffusion process underlying the rates. The four main mechanisms formulated for the rates are described below.

Mechanism I: Interest-based Word-of-Mouth Diffusion

In line with Coleman, the first mechanism employs a logistic model to represent the diffusion of information about a movie when that information is not based on an actual viewing experience. There are various ways in which individuals might come to hear from others about an upcoming movie or a movie on release: comments made at the office, release dates mentioned on a radio programme etc. A new effect results from dedicated internet discussion groups and the creation of unofficial websites which focus on the film. Rather intense discussion and speculations can be produced in such fora.

Various communicated attributes of a movie contribute to the effectiveness of these messages, since they influence the persuasiveness, the 'stickiness factor', of them (Gladwell 2000).[15] Depending on the strength of these effects a movie may become eagerly anticipated as interest feeds on itself. This adds a 'word-of-mouth', or contagion effect between the stocks 'Potential Audience' and 'Interested'. A balancing loop and a reinforcing loop therefore drive the 'Getting Interested' rate in a formulation which is structurally identical to the core diffusion effect described earlier.

Mechanism II: Advertising

As discussed in Section B, the above effect cannot operate without some form of advertising and this idea underlies the second main mechanism in the model. The means of conducting an advertising campaign are many and varied. People may become Interested in a film via advertisements on posters, in newspapers and magazines, on television and radio broadcasts and in cinemas. Coverage in fanzines adds to this. Finally, official websites for movies can provide information which attracts avid internet users at low cost to studios. As well as containing reports and displaying on-set photographs, these sights contain downloadable items such as small 'taster' films to run on a PC.[16]

Structurally, advertising serves to add a new balancing loop to the model. Although free previews of movies are still used, in the manner of Bass' contribution, this mechanism removes the absolute necessity of such 'patient zeros'.

Mechanism III: Experience -based Word-of-Mouth and Positive Network Externalities

When a movie goes on release those who have seen it influence the flows in the model. These effects are the subject of the third mechanism. What people say about a movie – when it is grounded in the experience of actually having seen it - is very important to the success of that movie. This is readily observable and was confirmed by Victor as being considered an important effect.[17]

An initial view of this 'grounded reputation' effect is that it should be a modification of the basic word-of-mouth structure, as used by Coleman *et al.* (1957). In this case this would be that those who have seen the film and are talking about it influence the rate at which members of the Potential Audience become Interested (see Figure 7). The modification to the logistic model is simply that there is an extra stock between the two stocks influencing the flow 'Getting Interested'. Nevertheless, the standard balancing loop and reinforcing loop are created. This is the structure used in the model. However, there are two further elements of how the model represents the grounded reputation effects deriving from the diffusion of information from people who have seen the film and discuss it. These arise as some new flows and an additional feedback effect.

The first element of this diffusion structure is the two new flows shown in Figure 7. Word-of-mouth from people who have seen the film can have detrimental effects. Members of the Potential Audience may never become Interested, instead being 'Turned Off' by what they have heard viewers say about the film. Similarly, even those who had previously been interested in the movie may lose that interest.

The additional feedback effect is the 'bandwagon effect' and expresses the idea that the number of people who have seen the movie can have two levels of influence on diffusion. The first is familiar and treats the number of people able to convey a message about the film via the standard word-of-mouth effect. The new, second influence, simply put, treats the idea that a message concerning a film may be more compelling if that message contains the idea that many other people have also seen the film.

In general terms this is, of course, a positive network externality. Also called the 'Liebenstein effect' or the 'bandwagon effect', this effect occurs when an individual demands a good or service in part because many other people have it (Liebenstein 1948; Rohlfs 2003). Such effects can easily be explained in terms of network connectivity. For example, a system dynamics study examined the take-up of instant messaging software (Größler & Thun 2002). The model assumed that the 'infectivity' of usage of the software would be dependent on its utility to individual users, and that that utility itself increased with the total number of users. For example, if a distinction can be made between the effects of the message 'The software is good, a few of my colleagues

uses it' and those of the message 'The software is good, the whole company uses it' then there is a network effect (Shapiro & Varian 1999).

Such network benefits, in which N people can each contact N-1 others, do apply to some movies. The utility of going to see or having seen a certain movie would have to be related to the social benefits attributed to either. It can increase viewers' pleasure to be able to discuss their experience with N-1 others, where N is large. However, beyond this, it may be that what people value most about seeing a movie is not how good it is so much as whether they can discuss it at work or with friends. An additional element of this is that for reasons of social approbation and inclusion, there is a need for people to experience the same movie as their colleagues, peers and friends. With such 'water-cooler talkie'[18] movies the idea is that there is pleasure and approbation to be gained when one is able to join in a discussion with work colleagues or schoolmates during a break. The reverse side of this utility concerns the loss of an opportunity for such pleasure, and the conformist pressure resulting from the social exclusion and disapprobation resulting from ignorance of the main topic of discussion.

In the case of movies, strong bandwagon effects are possibly more common within some sections of the potential audience, say schoolchildren of certain ages, than others but when they do arise the implication is clear: it matters considerably that everyone sees the same film. The structural representation of such effects appears in Figure 7 as a second reinforcing process.

To avoid confusion with the interest-based word-of-mouth effect created by people who are yet to see the movie, the dual experienced-based word-of-mouth and Liebenstein diffusion effects created by those who have seen it will be referred to from now on as the 'grounded reputation' effect.

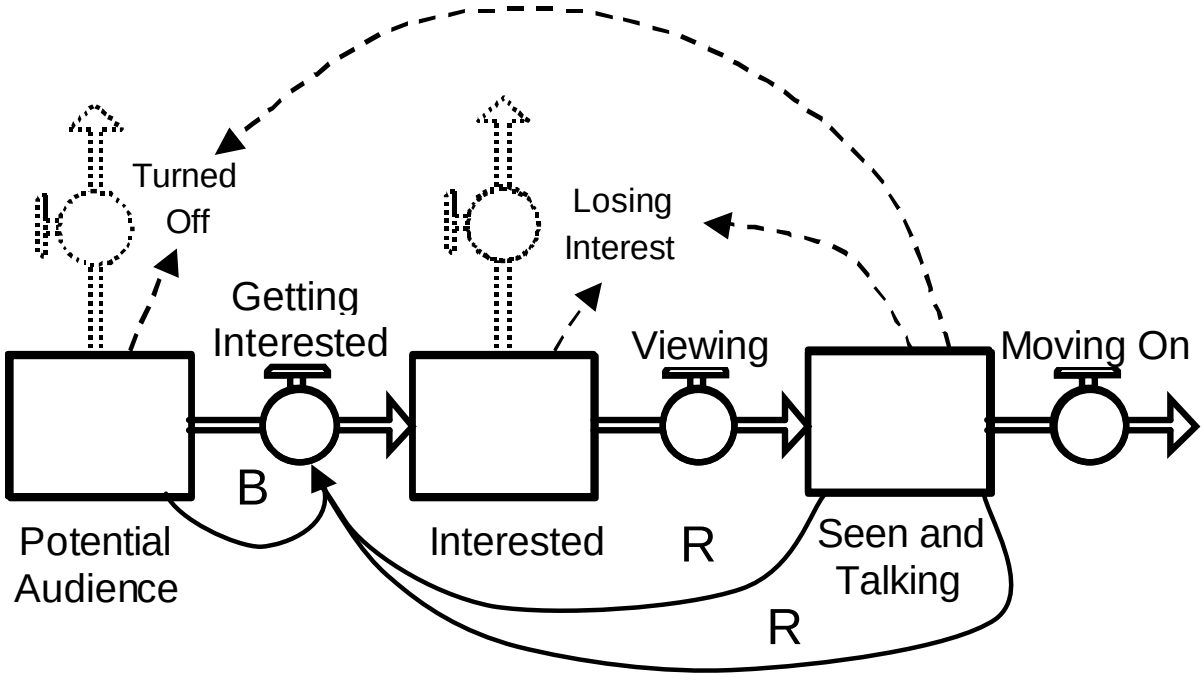


Figure 7. The feedback and flow effects of mechanism III in the movie model. These 'grounded reputation' influences derive from the diffusion of information from people who have seen a movie and discuss it.

Mechanism IV: Disengagement

The last mechanism is structurally straightforward and concerns the influences underlying the 'Moving On' rate (see Figure 7). This extension concerns people who stop talking about having seen the movie, who disengage from it. Structurally, this is the same as moving to the removed class in epidemiological terms.

Why is this a plausible effect to include? Quite simply because at some point after viewing, most people stop talking about a movie. There can be many reasons. They can be thought of as giving up on a 'fad' activity in marketing terms (Sterman 2000). In extremis, this might be related to the standard response of early adopters: these are insecure people who derive a sense of self worth from being cutting edge. If too many people share their activities there is therefore a negative network externality (Rogers 1995). It might be that the available space for people's attention is taken by other movies which follow. It might be that some movies in themselves are made to create an ephemeral response.[19] But for other movies too, there is usually a time when they cease to occupy a place prominent enough in the mind of a viewer to still introduce them into a conversation. Generally, then, this effect might be interpreted quite simply as an acknowledgement of the naturally finite life of the attention that people give to many experiences.

In structural terms this introduces a final zero-seeking balancing loop to the model, which controls the outflow from the Seen and Talking stock. People spend an average time in that stock before moving on, perhaps to a new stock called 'Viewed But No Longer Talking'. This process is analogous to that in Figure 3 in which people flow out of Infectives after average time 'Duration', on into the Removed stock.

Other Main Assumptions in the Model

The model contains all of the above mechanisms as well as a few additional ones. This section deals briefly with some of the other main assumptions built into the model. There are six of these.

First, there is a period of advertising before the movie is released as well as afterwards. The population is not aware of the film before the start of the run. Advertising (and hence interest-based word-of-mouth) creates interest. The scale of that advertising can be changed, as can the length of the pre-release campaign period but during that period viewing is not possible so there can be no grounded reputation effects.

The second assumption in this exploratory model is that movies are treated as being of a given 'appeal' which can be set for each run as a number between zero and one. In simple terms this can be thought of as the satisfaction that the average person comes to feel they have obtained from viewing the film. However, in the model 'appeal' plays a role that is somewhat more complex than this; it is also a proxy parameter which influences the various rates in the model. It therefore acts as a composite for the responses that people have to various types of information about a movie. Hence, people do not get immediate access to the appeal of a movie. Instead, they merely have a version of that appeal as presented via advertising, then one as formed by those who have got interested in the movie. Only after the opening does information emerge about the appeal of a movie to an actual viewer. The perception of a movie's appeal is therefore initially formed by the advertising campaign. This then acts as the anchor point in anchoring and adjusting mechanisms. The adjustments derive from feedback from those who have become interested in the movie and then by those who have actually seen the movie. These feedback effects are subject to perception delays. Changes in 'appeal' – operating via adjustments in the appeal perceived by people at different stages of exposure to information about the movie – then alter model parameters which influence the different diffusion mechanisms in the model. Changing the value of the

appeal parameter therefore allows the model to explore the marketing dynamics of a range of movies in a straightforward way.

Third, in the model all movies are successfully advertised as being of 'high appeal'. This is a separate point from advertising spend and duration. It concerns the impression that the advertising tries to make about the movie. Of course, advertising campaigns can present a film as modest in its aspirations or as an event in the history of cinema and all points in between. Nevertheless, the intention will still be to entice potential viewers to go and see the movie with the idea that it will appeal to them in one form or other; (movies do not advertise themselves as unappealing – intentionally). As a simplifying assumption in this conceptual model these parameters were therefore left unchanged across all runs. This allows the simulation of marketing campaigns of different cost (e.g. more posters) and length (e.g. posters displayed longer) but all presenting their product as one of 'high appeal'.[20]

Four, the 'Viewing' rate is capped by the number of screens at which the movie is being shown. This is an important feature of this model. That the rate of provision of a product or service must in some way be limited by a capacity of some sort is a completely natural formulation for system dynamicists (the work cited at the start of this paper offers examples of this). Some other diffusion analyses exclude this (Stoneman 2002). Simple realism requires its inclusion here. This feature is also crucial in understanding the relationship of the number of prints of a movie that are released and the success of that movie. It is also necessary to the question about the short lifecycle of movies. In the model the number of screens is a policy variable and the utilisation of screens is a monotonic increasing function of those waiting in the interested stock.

Five, people who have become interested in a movie display 'position commitment'. As stated above, the appeal of the film to those who have seen it changes the parameters which control any Losing Interest flow out of the stock Interested. A perception of the movie's appeal is first created by the advertising campaign, then influenced by those who are Interested in it, and finally shaped by the experience of those who have seen the film and are talking about it. Position commitment simply means that the perception of appeal of Interested people is slower to alter. 'Slower' is a relative term and the key comparator is the movie appeal to those who have viewed the film. They are modelled as very rapidly adjusting their perception to the real appeal of the film, since their view is grounded in experience. (Changes in parameters controlling the grounded reputation effects in the two flows out of Potential Audience also occur more quickly. This represents the idea that this group has no anchor and so is also influenced faster by the signals concerning a movie's appeal when those signal are grounded in experience).

Lastly, the model contains an 'experience-based plausibility' effect. This means that signals from those who have viewed the movie have a greater effect than signals from those who are just interested. This expresses the notion that a conversation with someone who has seen the movie is more influential than a conversation with someone who has not. The model contains a relative importance factor which can be interpreted as the relative infectivity of information from someone who has seen the movie compared with the infectivity of an individual whose interest has no such grounding.

D. Model-based Exploration

We are now in a position to introduce a movie to a Potential Audience. In this section we describe a number of model explorations in order to see what the model tells us about possible marketing strategies for films generally, and specifically, how this might relate to the product lifecycle of movies.

Modest Release of a Movie with 'High Appeal'

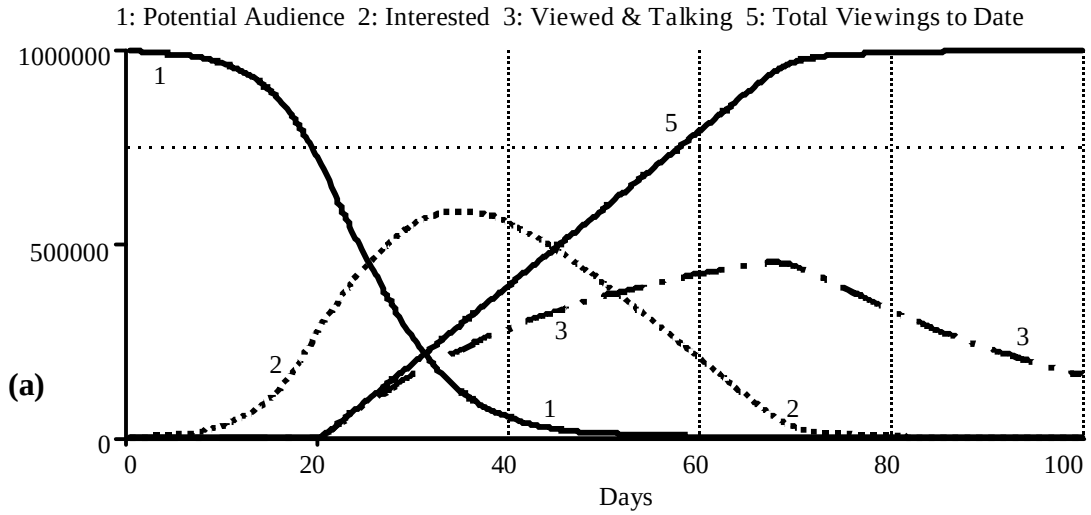
The model should be interpreted as treating a geographical region with a population in the millions. The first exploration simulates the release into that region of a 'high appeal' movie (Appeal=0.8). The movie has a concerted pre-release advertising campaign lasting 20 days and is shown in 20 cinemas. The results are shown in Figure 8.

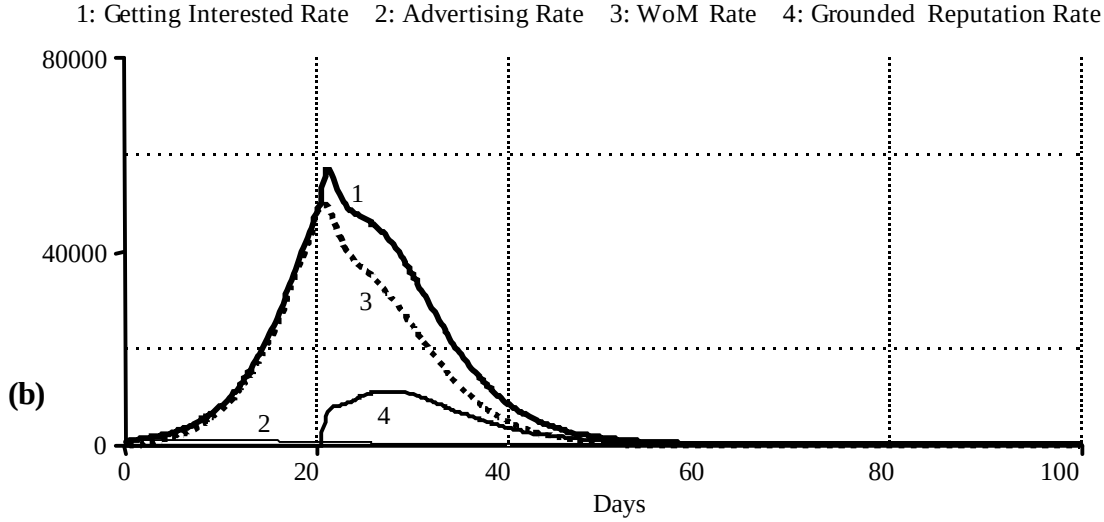
The dynamics of the stocks - the population categories - are shown in Figure 8a. The line labelled as '1' shows the falling away of the Potential Audience whilst line 2 plots the Interested stock. The dynamics here make sense, being similar to that of a flu epidemic, and these two plots can be compared with the Susceptible and Infective pattern in Figure 3b. People become interested in the movie via the 20 day advertising campaign but only after this, when the movie is released, does one see viewers who are talking about their viewing experience: line 3. More people are then becoming interested, as a result of recommendations from those who have seen it but of course this stock is also draining as a result of those viewing. Line 3 therefore shows the effect over time of combining this inflow with this outflow. In time, those who have seen the film stop talking, due to the disengagement mechanism in the model. However, the total that have seen the film at any given time is preserved in line 5. As can be seen, in this run the movie has reached all of the potential market. In this run there is no line 4.

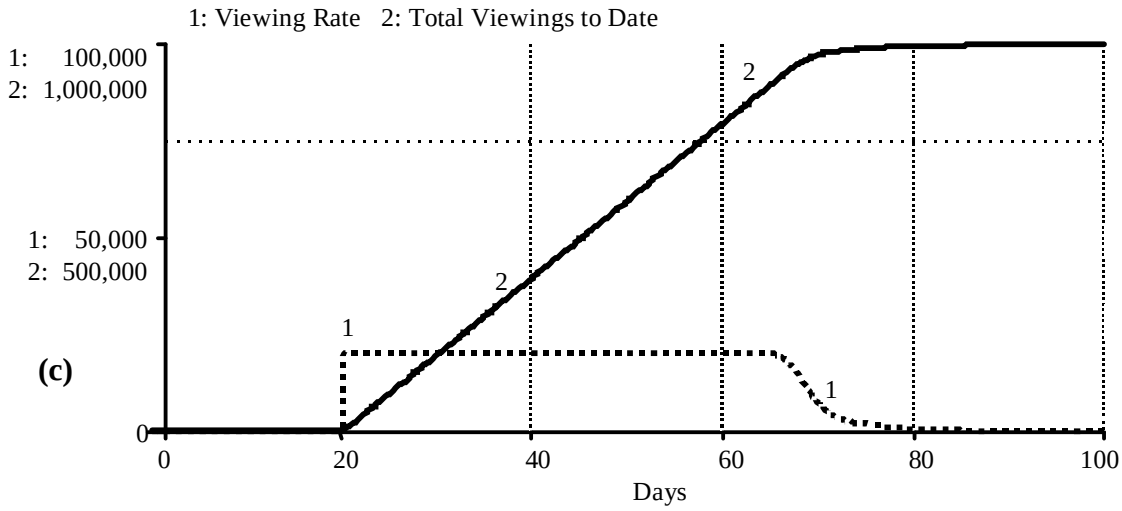
How does interest come about? In Figure 8b, line 1 shows the total 'Getting Interested' rate, the total of a number of effects which causes the inflow into the Interested stock. This is then divided into its constituent mechanisms, revealing why people become interested. First is line 2, the flow created by advertising mechanism first introduced by Bass. This is very small in size but catalytic in its effect. It feeds the interest-based word-of-mouth diffusion effect - analogous to the Coleman *et al*. (1957) diffusion effect and epidemiology's contagion effect - shown by line 3. After release, the grounded reputation effect contributes (line 4). Again, these dynamics make sense; the data in Figure 5 provides a helpful reference.

Finally, what do ticket sales look like? This is shown by line 1 in Figure 8c, the viewing rate. Total viewings are then reproduced in line 2.[21]

Figure 8. (Next page) Model behaviour over time for the modest release of a 'high appeal' movie.
(a) Population categories.
(b) Getting interested rates; combined and components.
(c) Viewing information: rate and accumulated viewings.


1: Potential Audience 2: Interested 3: Viewed & Talking 5: Total Viewings to Date
1000000
500000
0
1
2
3
5
(a)
0
20
40
60
80
100
Days


1: Getting Interested Rate 2: Advertising Rate 3: WoM Rate 4: Grounded Reputation Rate
80000
40000
0
1
2
3
4
(b)
0
20
40
60
80
100
Days


1: Viewing Rate 2: Total Viewings to Date
1: 100,000
2: 1,000,000
1: 50,000
2: 500,000
0
1
2
(c)
0
20
40
60
80
100
Days

Large Scale Release of a Movie with 'High Appeal'

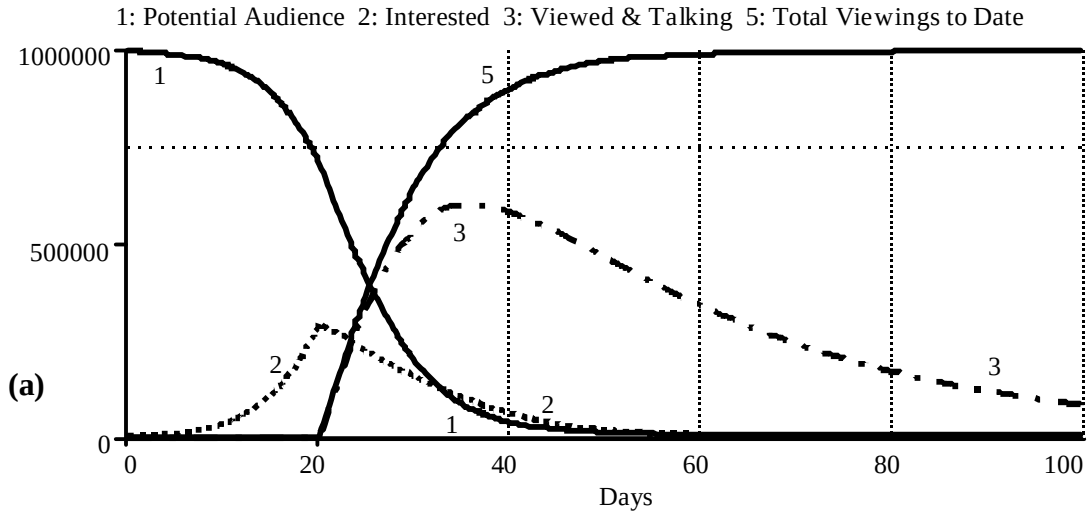
The last run does make sense but for its most important purpose it is a failure. Comparing Figure 8c with Figure 1a, this model does not produce the same behaviour mode as that generated by the release of *Saving Private Ryan* story. The reason for this is that the previous run does not storm the market with lots of prints. This can be simulated by quintupling the number of prints of the movie from 20 to 100. The results are shown in Figure 9.

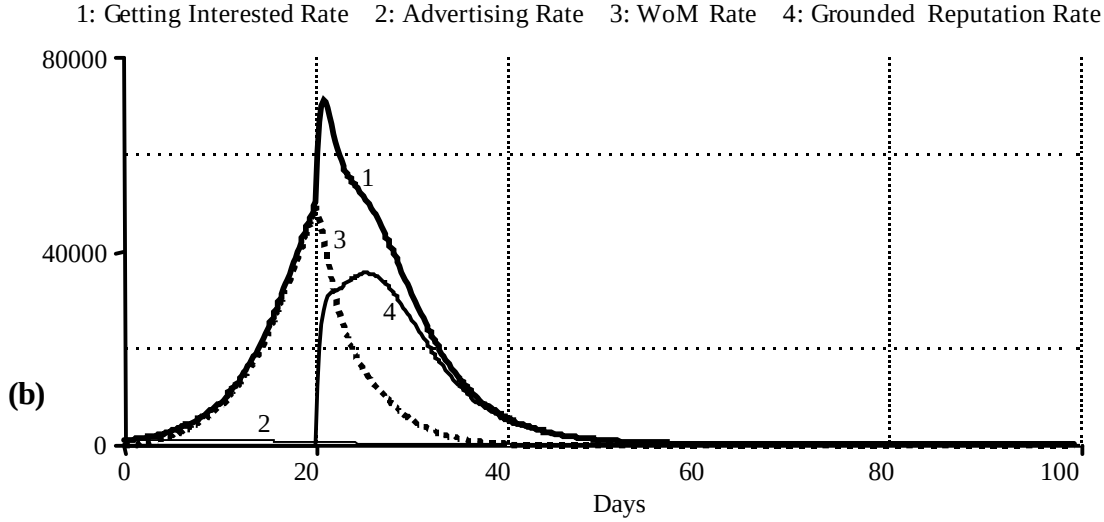
The best comparison to make is between Figure 9c and Figure 1a. The mode of behaviour of lines 1 and 2 are the same as that for the *Saving Private Ryan* data.

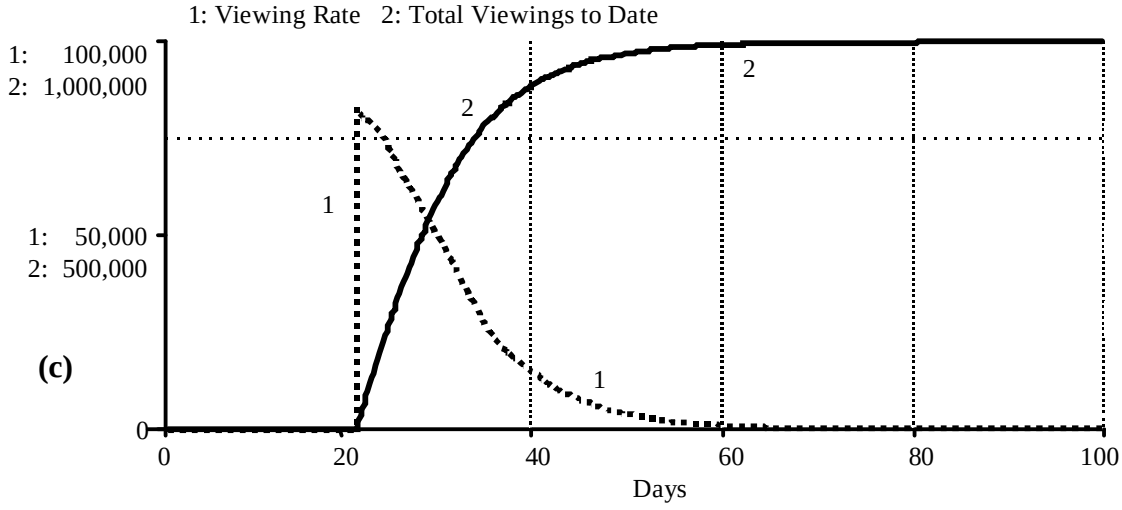
The reason for this can be seen by looking again at the Getting Interested rates (Figure 9b). These are the same as in Figure 8b until it becomes possible to view the movie. Compared with the modest release scenario, the total rate is now bigger. This happens because the grounded reputation effect is a more significant component. Word-of-mouth-based diffusion has reduced but this is simply because such people are more rapidly converted to those who have actually seen the movie. Furthermore, this reduction is more than compensated for by the grounded reputation effect. This is much larger because the increased number of prints has increased the number of people talking about the movie. This is indeed a 'water-cooler talkie' movie.

That account is confirmed by the population data (Figure 9a). In this run interested people (line 2) are converting much faster to those who have seen the movie and are still talking about it (line 3). The plot for total viewings (line 5) looks like the equivalent *Saving Private Ryan* data and shows a faster pay back than the previous exploration. For this reason increasing the number of screens looks like a good marketing strategy.[22]

Figure 9. (Next page) Model behaviour over time for a large-scale release of a 'high appeal' movie.
(a) Population categories.
(b) Getting interested rates.
(c) Viewing information.







Modest Release of a' Movie with 'Low Appeal'

As many observers might guess (and as Victor confirmed) making a highly appealing movie is actually rather difficult. Let us turn, then, to a situation where one suspects that one's movie has turned out rather less

appealing than one might have hoped. The exploration considered in this sub-section simulates the release of a movie with 'low appeal' (Appeal=0.3). This is the only policy change since, again, there is a 20-day advertising period prior to release in 20 cinemas. The results are shown in Figure 10.

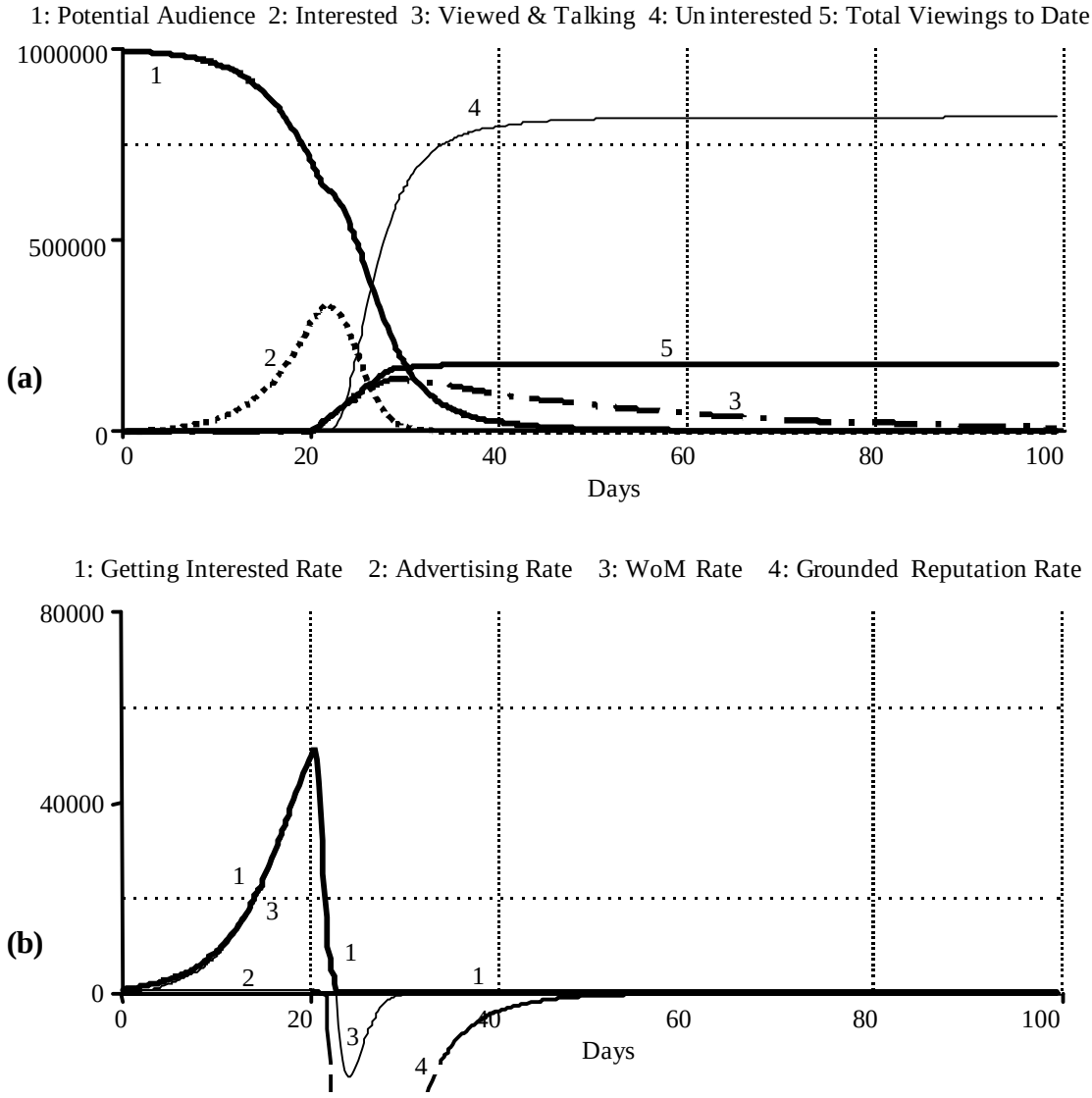


Figure 10. Model behaviour over time for a modest release of a 'low appeal' movie.
(a) Population categories.
(b) Getting interested rates.

As expected, the output during the advertising phase is identical with that in Figure 8. After this, things change, as shown in the population plots of Figure 10a. Here line 4 has appeared, showing a new stock, the number of people who have concluded that they are uninterested in the movie. Indeed, most (though not all) of the Potential Audience (line 1) goes straight into that category, rejecting the movie without ever becoming interested. Why does this happen? Because there are a few vocal viewers for the movie (line 3) but these people

are not saying flattering things. Others then find out that the movie is not very appealing and are turned off. Ticket sales are minimal (line 5). Interestingly, the movie even fails to convert all those who have become interested into actual sales. Compare the peak of line 2 with the plateau of line 5; only ~60% of those who were interested yield sales. The rest are persuaded of the error of their previous interest and move into the uninterested stock.

A look at the getting interested rates is illuminating (Figure 10b). Nothing changes until the movie is released but then, with perception delays, both the interest-based word-of-mouth and the grounded reputation mechanisms have negative effects. In this situation, both Potential Audience and Interested switch to being uninterested in the movie.[23] This is an important finding and can be thought of in epidemiological terms as the population having herd immunity for the movie.

Confronted by such a scenario what alternative marketing approaches are possible? Two are considered below.

Marketing Strategies for a' Movie with 'Low Appeal': Large Scale Release

An obvious first approach is to use the number of prints as a policy lever and scale up the release of the movie, to try to get all of those who are interested in the movie to go to see it before word of its lack of appeal gets out. Increasing the number of prints to 100 produces the behaviour shown in Figure 11.

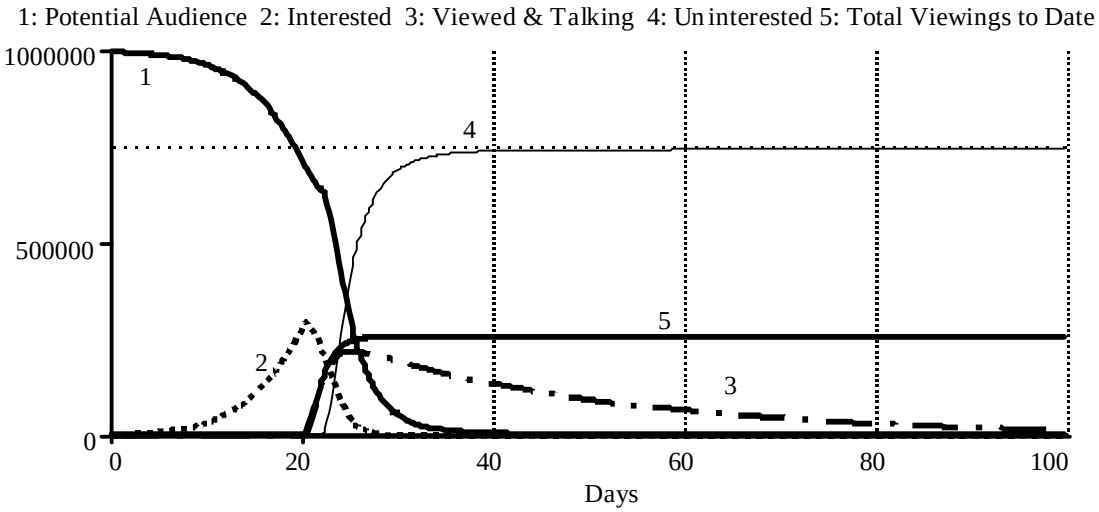


Figure 11. Behaviour of population categories for a large-scale release of a 'low appeal' movie.

The plot shows that this strategy works to some extent. More screening capacity means that the interest created by advertising is harnessed more rapidly so more of that interest is converted into sales. As can be seen, the number of total viewings rises (line 5). However, the movie still gets a bad reputation and the uninterested stock, though falling slightly is still large (line 4). The speed with which the movie acquires its reputation can be observed in the very sharp downturn of the interested curve (line 2). It is the larger screening capacity that creates more people to convey the dire message and so accelerate the diffusion process.

As stated, the number of total viewings rises. Also of interest is the fact that now ~90% of those who were interested in the movie have been converted to ticket sales. This exploration suggests that increasing the number of screens for a less appealing movie is a good marketing strategy because it helps to work around herd immunity.[24]

Marketing Strategies for a' Movie with 'Low Appeal': Prolonged Pre-release Advertising Campaign

In the modest run with the less appealing movie the difficulty was that screening capacity was so low that only a small percentage of those interested attended screenings before interest in the movie collapsed. Adding more capacity is one way around this problem in that it increases the percentage (from 60 to 90). Another approach is to increase the stock of people to which that percentage is applied. In other words, increase the number of people who become interested in the movie before it is released. This can be achieved in two ways (the second is dealt with below). In this exploration it is achieved by having a longer pre-release advertising campaign (with the same spending rate).

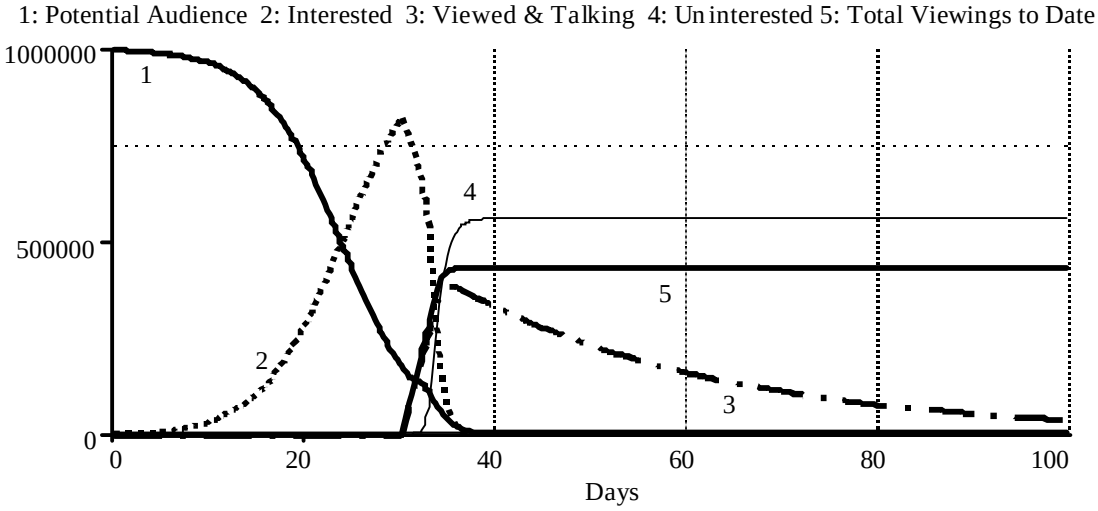


Figure 12. Behaviour of population categories for a modest release of a 'low appeal' movie after a longer advertising campaign.

The exploration shown in Figure 12 shows such a delayed release. Advertising longer produces more interested people, in fact, most of the population (line 2). More ticket sales are accrued (line 5). In this experiment, expectant crowds of interested people rapidly fill the small number of cinemas in which the movie opened. The movie still gets a poor reputation but more viewings are achieved (compare with Figure 10a). Again, delaying the release of a less appealing movie to create more – relatively uninformed – interest looks like another good way of working around herd immunity.

Comparing Marketing Strategies for a Movie with 'Low Appeal' and an Observation

This sub-section looks further at possible strategies for dealing with a film having low appeal. Two such approaches have been considered; increasing screen capacity and prolonging the pre-release advertising campaign. We now add a third strategy, another way of increasing the number of people who become interested before a movie is released. This strategy retains the 20-day pre-release advertising campaign but increases the rate at which money is spent during that period. The results of a more extensive exploration of these three approaches are shown in Figure 13.

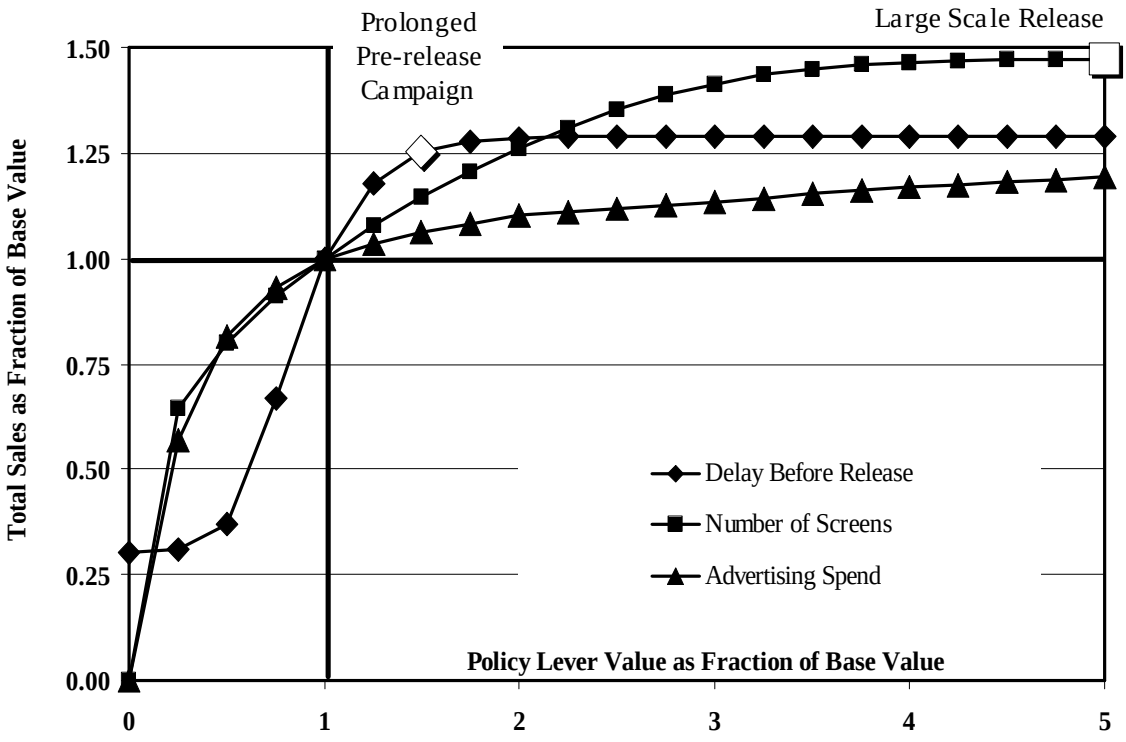


Figure 13. Spiderplot showing the results for a range of experiments with three strategies aimed at increasing ticket sales for a 'low appeal' movie (Appeal=0.3). Data is scaled against a base situation (Figure 10). Hence, the horizontal axis shows the ratio of the value of the policy parameters used in each run to the base value of that parameter. The vertical axis shows the total sales, as a proportion of the sales in the base situation. For clarity, the results for the two specific runs discussed in detail in the text are labelled.

The data is presented as a spiderplot (Eschenbach 1992). This allows for both the display and comparison of a larger number of model explorations.[25] In principle, with sufficient advertising spend, even in the absence of any positive effect from people talking about the movie, advertising is able to inform all of the Potential Audience that the movie exists. However, as discussed in Section B, the Bass model suggests that this is a hard task. The data here confirms that. What immediately becomes clear is that increased advertising spending is not a good way to work around herd immunity. Trying merely to tell more of the people more effectively that the up-coming movie will appeal to them when this will not be the experience of those who actually do see it does not seem cost effective.

Prolonging the pre-release advertising campaign is more effective but plateaus out. For most parameter values greater than one, the most effective strategy is to increase the number of copies of the movie and to increase the viewing capacity.[26]

This also prompts an observation: it would seem that increasing the number of screens for a movie is a good marketing strategy whether the movie proves to have high or low appeal. This is considered further below.

E. Assessing the Theory and Moving Forwards

In this section a broader assessment of the theory is offered alongside suggestions for extending the work.

A Robust Marketing Strategy?

In the light of the theory and the range of runs the model produces is there now a candidate answer to the question: why is the product lifecycle of many movies relatively short? There is certainly a suggestion contained in the exploration above: it would appear to make good sense to aim for certain kinds of high volume distribution; a corollary of this would be that the Potential Audience is only exposed to any given movie for a relatively short period of time. Nowadays, the use of both national communication (TV, radio, print) and international communication (satellite TV, websites, e-mail) allows advertising campaigns directed at large numbers of people. With this, returning to Coleman (1963), the unit of adoption has also changed. It has changed from towns and regions – as in the release of *2001* – to regions and countries, and sometimes the entire world.[27]

A short product life then could be part of a robust marketing strategy. The strategy would be robust in that it would work for highly appealing movies because a short lifecycle maximises the benefit of positive network externalities and yields faster payback. (It may also turn the movie into more of an event and so sell more complimentary products.) For less appealing movies a short product life works around the resistive effects of 'herd immunity' caused by the movie being poorly received. Here the phrase 'works around' means the use of advertising to create interest and then high viewing capacity to convert that interest to ticket sales before unflattering recommendations respond against the movie. Of course, whether this type of causal explanation is employed by those making these decisions is a moot point. Nevertheless, the model is a formal theory which explains why such an approach – whatever its espoused rationale – might have evolved.

Naturally, making many copies of a movie must increases production costs and may require an increased advertising spend.[28] Nevertheless, having a marketing strategy that is robust to the appeal of a movie is useful. It is useful because appeal is the great unknown in the film industry. Vast resources - money, effort, creativity, special effects work and star fees - can be brought to bear in making a movie. But the resulting sales pattern is not always the mode shown in Figure 9, exemplified by *Saving Private Ryan*. Those vast resources can still generate the failure modes shown in Figure 10-12. The flip side of this coin is the use of relatively modest resources that produce a film which seems to appear from nowhere and captures a huge audience because of very strong recommendations. The 'unexpected hit' mode of Figure 8 can be interpreted in this way. Both responses indicate further that appeal is hard to predict.[29]

There is no recipe that guarantees a movie's appeal. This is pithily summarised by screenwriter William Goldman's remark, "In the movie business nobody knows anything" (Goldman 1984). In such an uncertain environment, any strategy which is robust in its ability to improve outcome is to be valued.

Possible Model Extensions

No model could or should contain all effects believed to operate in the world. A model is like a map of a terrain and, as the MS/OR aphorism has it, 'the map is not the territory'. The selection of the effects to include in a model requires the application of craft skills, and possibly a degree of artistic judgement (Tocher 1963). This

sub-section considers further the effects which could be added to the model as well as other thoughts for moving this work beyond the conceptual stage.

A phenomenon which might be added to the model and which was of great interest to Victor was repeat viewings. Some movies are seen more than once as people return to them to enjoy the experience again and share it with different friends. A significant factor in the success of *Titanic*, this is a dream come true for marketers, an interesting sociological effect to consider including and something to which Bass' work has been applied (for example, Rao & Yamada 1988).[30]

Not unrelated is the possibility of disaggregating the Potential Audience. One could use marketing categories such as 'early adopters', 'early majority', 'late majority' and 'laggards'. In this way different preferences of different groups, and their consequences for 'adoption' of a movie could be studied (Chatterjee & Eliashberg 1990). Or this could be done by social factors such as age and sex, an application of Coleman's 'incomplete social structure' approach (Coleman 1963).

We might explore further the effects of advertising in relation to the target audience of a movie as opposed to the Potential Audience of all people who will be found within an area where a movie is to be screened. Most marketing campaigns (and indeed movies) would appear to be designed to appeal to more or less specific groups of potential viewers. Many movies are firmly placed within genres that are associated with viewers from certain population groups (westerns, romantic comedies, thrillers). Obviously, among the factors to influence the success of a movie would then be the degree to which the movie itself manages to match the expectations of its audience e.g. by including sufficient and sufficiently appealing elements of a genre into which it has been placed – another variation on the quest for 'appeal'. But there would also be the degree to which a marketing campaign has managed to attract into the cinema the kind of viewers to whom the movie is supposed to appeal and whether these are the kind of viewers to whom it will appeal. A movie can be marketed to the wrong crowd; if discovered, this problem may also be addressed.[31] Interesting effects might result from introducing parameters to deal with 'expectations disappointed' (a movie falls short of its advertised appeal) or 'delight of discovery' (a movie exceeds expectations) – both inside and outside a targeted audience.

This also raises questions about the size of the target audience within the Potential Audience and the resources, relative and in total, it would be justified or prudent to employ to make, market and distribute a movie for these intended viewers. The current model was built with reference to the kind of movie for which the resources available and the size of any targeted audience would be sufficient to make considerations of shorter or longer advertising periods and fewer or larger numbers of screens meaningful choices. The success or failure following from assumptions about such factors can already be built into the model by adjusting the value of 'appeal' for a movie, where a film very much appreciated but only by a small number of people would have a lesser value than one that large numbers of people felt reasonably well satisfied by. The successful prediction of such factors would make some difference financially to large or smaller scale operations.

Obviously, from the very beginning, one would like to feel reasonably certain that there are potential viewers in sufficient numbers to recoup the costs of making the movie in the first place. And while it would seem to be impossible to completely divorce final viewing figures from the - virtually impossible to predict - actual appeal of a movie, as we have seen it does appear to be possible to influence them to some degree by employing calculations concerned with advertising and distribution. It would therefore seem reasonable to expect that one could explore some of the relationships between a target audience, the costs of production and advertising and the relative risks and probability of profit involved in varying the sizes of any or all of the above.

A related question would be, why is there such a huge diversity in outlay for production? Do the 'actors' in the system, in this case the producers, perceive the risks of greater outlay as in line with possible gains? And is this the case, given that the appeal of a movie is impossible to guarantee?

One might also add elements based on the observation that certain genre (or sub-genre) movies appear to arrive in bunches, especially if one has just proved successful. On the one hand, this might be a way of benefiting from the creation of a new target audience for, say, pirate movies. On the other hand, there will be more competition. All things being equal, would it be better to be the second or sixth to release a retro 1970s movie? What are the effects of releasing a movie targeted at children on school holiday on the very same day as three other very similar offerings, rather than a week before or after the others?

No consideration of the marketing of movies could be complete without considering viewings outside cinemas, that is, via video/DVD rentals or purchases or via television transmission. This becomes complex because - although individuals are still involved (though as renters, buyers and viewers) - a different constellation of actors and capacities enters the scene (rental stores, retail networks and TV companies respectively). However, work on technological generations may suggest ways of including this effect (Milling 1996; Milling & Maier 1996; Milling 2002).

The emergence of DVDs for rental and purchase has produced some interesting new developments. As videos before them, they can provide a means of reaching an audience beyond those who can be reached via a cinema screen. The latter would e.g. not be practical where the remaining Potential Audience are so scattered that not enough of them can be found within geographical proximity to fill even a small cinema. In this context, an example of a film for which the appeal may well have exceeded its makers' expectations is *Good Bye Lenin*. For its story, the film relies heavily on the very particular time and place in which it is set, East Germany some months after the fall of the Berlin Wall, a setting with which not too many people further away could be expected to be familiar or indeed interested in. Nevertheless, not only was the release a success inside Germany, possibly partly due to a large scale marketing strategy[32]; it eventually crossed over into other countries. In Britain, it was released on a limited number of screens for a relatively short time. However, it then became widely available on DVDs stocked not just by specialists but also in ordinary high street outlets.

Added to this, there is a new phenomenon. The sale of DVDs itself is by now not only an important factor in making the majority of movies viable, some movies achieve higher sales (and would therefore reach more viewers) via DVD than in a previous cinema release. Recent examples include *Finding Nemo* and *Pirates of the Caribbean*.[33] (Which might beg the question to which degree the cinema release of a movie is to be considered as advertising for either the same product in a different version or for another product altogether.) This factor in turn has shortened the overall lifecycle of a movie on its way from the cinema via video/DVD rentals to sales to individuals. Aside from considering the various forms in which movies can be marketed, one might also examine the similarities with other media - books, music CDs – and the marketing strategies that accompany them. For example, it can be observed that large stacks of the same book often appear in shops all over the place (sometimes in more than one country). There are large-scale advertising campaigns to go with some. Many appear to run through their Potential Audience within a short space of time. A few of those with less appeal than their publishers had hoped for, will be moved to form remainder piles almost equal in size to the ones originally at the front of the shop.[34] Then again, books too may exceed all expectations regarding their appeal. The *Harry Potter* novels quickly outgrew their original target audience of children and were both heavily remarketed as well as transported into other media – including movies.

In terms of the current model, calibration must be a next step. This could be achieved via the traditional system dynamics approach of eliciting information from those familiar with the domain being studied (Graham 1980; Richardson, Vennix, Andersen, Rohrbaugh & Wallace 1989; Nuthmann 1994; Vennix 1996). This might be extended to the use of questionnaires to a wider group of people to cross-calibrate parameters (Vennix & Gubbels 1992; Ford & Sterman 1998). Alternatively, the model could be fitted to time series data for similarly performing movies. Again, this is a well-known procedure in system dynamics (Lyneis & Pugh 1996; Graham, Moore & Choi 2002) and software support exists (Eberlein, Melhuish & Peterson 1991). From outside that field, econometric work which fits a range of models to time series data using maximum likelihood functions has much to offer (Stoneman 2002). Since, unlike system dynamics models, such work tends to assume that adoption rates are not limited by any capacity constraints, some careful amendments to this approach might be necessary before use with the model in this paper.

The final area of the model which merits further study concerns the presence of a Liebenstein effect in the relationship between those who have seen a movie and are talking about it to the Potential Audience, thus influencing the 'Getting Interested' rate (see Figure 7). Whilst straightforward diffusion is present, implying one reinforcing loop, the Liebenstein effect implies a second such loop. Calibrating this effect would be important since it may be the significant factor in creating overwhelming success for some movies. Again, work that can be built upon has been produced (Thun, Größler & Milling 2000).

Closing Comment on the Existing Model

Although more than a 'reality check model' (Senge 1990), the model described here remains a conceptual one, that is, a first attempt at a theory which can be used to begin to explore questions of marketing strategy related to movie-going. This being so, beyond suggestions for a robust marketing strategy, what use is the model? We shall close with five remarks.

First, the structure seems reasonable. Certainly, some of the parameters are indicative only. However, since "good models for human behaviour are hard to find" (van Horn 1971) it is reassuring that the causal theory captured in the model is consistent with a range of other adoption-diffusion theories for social systems. Similarly, because the model is consistent with the interested observations of the authors and the insider view of Victor, a degree of face validity has been obtained (Forrester & Senge 1980).

Second, the system dynamics-based theory is an improvement on 'gut feel'. Such models are, to use Forrester's term, 'precise', by which is meant that their assumptions are unambiguously stated (Forrester 1961). Because the mechanisms are explicit they can be debated, tested, challenged, supported and improved. Of itself this is useful but not sufficient. Complex systems are known to behave in a counter-intuitive way (Forrester 1973) and even complete knowledge of an unambiguously described structure is not enough for humans to make inferences about resultant behaviour (Sterman 1989). However, having been imaginative and creative in building a system dynamics model (Forrester 1992), people can be certain that the consequences of the causal structure are rigorously deduced when computer simulation is employed, as has been done here (Sterman 1994).

Third, the model here does extend previous work. The first author became interested in the marketing of movies when lecturing on the work of Eliashberg *et al.* (2001). That paper is essentially an MP-based analysis of how cinema exhibitors might choose and combine different films. The cash flow generated by a given film is fixed as a function which is very similar to the data for *Saving Private Ryan* and that of Figure 9c. Sufficient for

its purpose though it is, to relate to our interests, it lacks an underlying model which generates the behaviour mode (or any others). The model presented in this paper provides such an underlying theory.

This model should also be distinguished from the work of Mahajan *et al.* which has different structural assumptions and was calibrated to one example only (Mahajan, Muller & Kerin 1984). The way in which the appeal of a movie influences other parameters means that the model developed in this paper produces a number of modes of behaviour and can therefore illuminate a range of scenarios.

Finally, although the theory is a fully formulated, parametrised and programmed computer simulation model, an actor in the problem domain understands it. Victor and the first author have discussed the structure and its behaviour and, most importantly, considered its practical implications. This is therefore a piece of system dynamics modelling which has the potential to influence decisions.

This paper has shown how different diffusion theories from disciplines as diverse as sociology, epidemiology and marketing were used to construct a system dynamics model aimed at exploring the marketing of movies. That model is a formal theory of the proposed causal mechanisms. A number of quite complex diffusion mechanisms seem to be in play, representing word-of-mouth effects, advertising, positive network externalities (Liebenstein effects) and disengagement. Even a scoping model of these effects produces some plausible insights via the varied behaviour modes which it generates. It also offers one explanation for why the product lifecycle of many movies might be relatively short. By demonstrating the relevance of the various model mechanisms to this particular phenomenon, the paper also re-emphasises the isomorphic nature of those constituent diffusion theories. Finally, the model has potential both for further extension and for use in supporting policy making in the actual social system that was modelled.

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Notes

1. Two examples serve to give a sense of scale. The movie *Titanic* cost slightly in excess of $ 200 million, an unprecedented figure. By the end of 2003 it had produced a worldwide revenue of $ 1,835 million, making it the most successful film ever. However, *The Lord of the Rings* trilogy cost roughly $ 330 million to make but the first two parts alone had, by December 2003, generated revenues of around $ 1,800 million. (*Der Spiegel*, 5/1/2003).
2. This paper uses the term ‘movie’ because many of the examples referenced here were already being referred to that way. Examples of productions, especially ones for which a high volume of sales was sought via release over large geographical regions, sometimes in different corners of the world simultaneously, proved most readily accessible as large budget English language/Hollywood products. While this may be of a certain significance in itself, we would expect that some of the following would prove useful when looking for similar phenomena in film industries in other parts of the world.
3. An unusual example of the large scale release strategy is described by film writer Dina Iordanova:
   “Made for DM8 million (about $4.7 million) and having earned more than $40 million in revenues to date, Wolfgang Becker’s *Good Bye Lenin!* has done spectacularly well by the standards of European cinema. Within three months of its premiere at the Berlin film festival in February it had been seen by more than 5 million Germans, a total made

possible by good word-of-mouth and a Hollywood-style saturation release of more than 500 prints" (*Sight and Sound*, August 2003).

There can also be great geographical spread of an advertising campaign. When *Spiderman* was on release in the UK in May 2002 the first author visited Moscow and saw that the same poster campaign was also underway there.

4. While e.g. the Bass model is already in use in the field of system dynamics, these theories, self-evidently, were originally formulated in the terms of various other fields. Nevertheless, in the following section they are all presented in using system dynamics symbols and ideas.
5. Two other parameters are necessary to formulate the rate equation in full. The 'Social Contact Rate', or 'Social Mixing Rate' describes the frequency with which members of the group interact with each other in a way which has the possibility for them to discuss the properties of the drug. The 'Take-up Fraction' is then the fraction of occasions in which the meeting of a 'Potential Adopter' with an 'Adopter' results in the former starting to prescribe the drug. We then obtain the equations: -

Adoption Rate = *Social Contact Rate* Take-up Fraction*Potential Adopters*Adopter / Total Population*
Total Population = *Potential Adopters + Adopters*
Adopters = *Adopters (0) + INTEGRAL Adoption rate dt*
Potential Adopters = *Potential Adopters(0) - INTEGRAL Adoption rate dt*

6. The perils of not heeding this warning are frequently – and vigorously - discussed in the field (Abell 1994; van den Berg 1998; Abell & Reyniers 2000).
7. The particulars of the adoption rate formulation change in these different instances of 'removal'.
8. In this empirical data the early phase of exponential growth in infectives is resolved somewhat better.
9. In fact, the model produces behaviour modes between those two extreme cases illustrated. The influence of the model parameters in the final value of Susceptibles is non-trivial since the equation is not analytically tractable. It is therefore not always clear whether a particular run is or is not an epidemic and a degree of user judgement is necessary.
10. In fact, the criterion that the loop involving the variable 'Infectives' is reinforcing in nature at the start of the run is the slightly more restrictive: -

$$\frac{(Susceptibles_0 - Infectives_0) * Contact\ Rate * Infectivity}{Total\ Population} > \frac{1}{Duration}$$

11. Interestingly, the component of the take-up rate resulting from advertising, a rate which is proportional to the left hand stock, is essentially the same as the theory which Coleman *et al.* compared with the fit of the logistic map (Coleman, *et al.* 1957).
12. Obviously the extent of this comparison depends to some extent on the case, and hence the parameters, considered. Nevertheless, the general point stands: advertising is needed in order to activate the reinforcing effect if a surge in sales is to occur.
13. The term 'conceptual simulation model', as recently coined by Größler (2004), could also be applied to this approach.
14. This effect is an example of the view of system dynamicists that information very seldom jumps from a 0 to a 1 state but instead adapts slowly. As a thought experiment the reader may wish to pause and review what knowledge he/she has of movies not currently released. The obvious source is advertisements for movies 'coming soon' but the reader may also have seen 'location reports' or interviews with actors in their Sunday paper. Whether one is much interested in such announcements or not, they can be hard to avoid.
15. The same principle is true of the strength of advertising-based messages and experience-based messages, treated in mechanisms II and III respectively.
16. For example, in November 2003 it was possible to download from www.troymovie.com a 1 min. 22 sec. film which gave a sneak preview of Warner Bros. Pictures' *Troy*. This movie did not even have a release date at that time, "Coming Soon" was the only timing information available. (It was subsequently released in the US in May 2004.)
17. Further information is available to triangulate these assertions and to provide information that is very useful for the model conceptualisation process (Randers 1980). Consider the case of *The Sixth Sense*, a movie released in 1999 which concerns a young boy haunted by the dead. The region 2 DVD contains interviews with the movie's producers which are relevant to mechanism III.

First, there is information on the mode of system behaviour. Producer Barry Mendel observes that, "The most extraordinary thing about the release of the movie was the next two weeks, that the audience just kept growing and growing and growing for this film". Second, producer Frank Marshal suggests an underlying causal mechanism; "… these are spiritual questions that are really answered in the movie … it creates a great word-of-mouth which propels the movie forward".

Another example of the importance of experience-based word-of-mouth effects is the release of *2001*. Bizony gives the following account:

"… they had tried to market Kubrick's movie as family entertainment, a rip-roaring adventure, when, of course, it wasn't that kind of movie at all. For very young children and their unprepared parents, *2001* must have been a very confusing experience. By and large, only audiences at least partially primed in advance to the movie's cerebral demands could emerge from the cinemas completely satisfied with what they had seen. Young college students … were perfect cannon fodder for Kubrick's grandiose audio-visual experiment. Earnestly discussing it among themselves, they 'primed' the next bunch of audiences to go and see it … It wasn't the publicists or the reviewers, but word-of-mouth among younger college student audiences which gradually started filling the movie theatres" (Bizony 1994).

Here experience-based word-of-mouth seems to have been strong enough to overcome an advertising strategy which was, at first, incorrectly targeted.

18. *Sight and Sound*, Jan. 2004, page 20 gives an example of this term in use.
19. For example, an (unnamed here) American critic reviewed *Saving Private Ryan* on her website. She praised the movie highly and at length for reminding audiences of the sacrifices of the US armed forces during and after the Normandy landings in 1944. She then concluded her posting with, "A movie that will stick with you for days" (emphasis added).
20. Advertising presents another set of parameters that might be varied but other effects were the focus of this model so holding constant the nature of advertising was an appropriate simplifying assumption. Obviously it would be interesting to explore advertising effects later. However, this might involve more than the collection of other parameters but could also necessitate the inclusion of other structural effects. For possible extensions of the model see Section E below.
21. Clearly: *Total Viewings to Date = INTEGRAL Viewing Rate dt*
22. It could also be argued that the strength of the grounded reputation effect indicates that this is an 'event' movie which might result in repeat viewings and in the sale of complimentary products such as toys, clothes and soundtrack albums. These would be further reasons why the large-scale release strategy is a good one but these effects are not included in this first-cut model.
23. In terms of Figure 7, negative interest-based word-of-mouth does not mean that the rate 'Getting Interested' goes negative. Neither does this occur if grounded reputation is negative. Instead, the model is formulated for these effects to contribute to the 'Turned Off' rate. Similarly, a negative grounded reputation effect does not reverse Viewing but instead produces the 'Losing Interest' rate.
24. A jaded – and obviously personal - account of this strategy is offered by film critic Nigel Andrews when commenting on *Spiderman*:
    "The story is as old as horror comics, indeed as cinema itself. Due to a genetic defect or mutation, tens of millions of people pay sound money to experience a piece of entertainment you wouldn't hand to a two-year old child. How does it happen? By flim-flam. By hornswoggling. By the organised science of hucksterism. Hype springs eternal, at least in Hollywood, and each time a new record is set for the highest grossing weekend in history, it is trumped by something sillier and more spectacular" (*Financial Times*, 13 June 2002).
25. An alternative presentation would be to transform both vertical and horizontal scales into relative costs. Indeed, considering that money is both spent and earned at different points in time across the different runs, a transformation of the data using NPV might be appropriate.
26. Combinations of strategies are also worth considering, mounting a longer and/or expensive advertising campaign and increasing screen capacity being the most obvious.
27. The final part of a series of science fantasies, *Matrix Revolutions* was released on 5th November 2003 all over the cinema-going world, at precisely the same moment: "The final instalment in the Wachowski brothers' epic cyber trilogy opened yesterday across a mammoth 10,000 screens in 107 markets ranging from the US and Canada to Europe, Russia, India and China" (*The Guardian*, 6th November 2003).
28. It may be, however, that neither effect is that significant. For example, each print of a film costs between €1000 and €2000 so making another 500 copies produces an expense which is small compared with most filming budgets. In the case of advertising spend, each region in which a film is marketed will require a degree of advertising at some time so there is no obvious reason why a large-scale release would increase costs. All it might do is bunch those costs together in a shorter period. Indeed, if the movie does produce strong positive word-of-mouth then it is possible that less advertising is needed because an epidemic effect is produced which then spreads rapidly across the (larger) unit of adoption.
29. Actual examples are not difficult to find. Box office failures and the phrase 'staying away in droves' are observed through the history of cinema, from *Intolerance*, via *The Victors*, *Heaven's Gate*, *The Avengers* and *K-19 The Widowmaker*, to *Gigli*. A fine example of modest expectations turning into box-office hit was Star *Wars* (a fact easy to forget today when it has been re-labelled *Star Wars IV: A New Hope* as part of a multi-movie oeuvre). More recent examples of surprise hits are *My Big Fat Greek Wedding* and *The Fast And The Furious*.
30. Indeed Bass' work has been extended and employed in many ways. For overviews of the range of models created see (Dodson & Muller 1978; Mahajan & Peterson 1979; Mahajan, Muller & Bass 1990).
31. *Event Horizon* may well be highly appealing as a horror movie but was loathed by viewers who had been attracted to it as a science fiction movie. Similarly, *2001*, originally advertised as "a rip-roaring adventure movie", did not live up to the expectations created. The tone of the campaign changed after the release, original "references…were replaced by blatant appeals to the hippy or student 'drug culture' market" including reviews from the *Christian Science Monitor* which apparently had declared that "*2001* is the ultimate trip" (Bizony 1994). However, following the story told by Bizony, it appears more likely that ultimately, the crucial difference was made by word-of-mouth effects.
32. See endnote 3.
33. *Der Spiegel* 10/2004, 1 March 2004. The article also contained an observation on the influence on DVD sales for the first part of the *Lord of the Rings* trilogy by the cinema release of part 2. This could also be seen as a variation on the question of movies as adverts for merchandising.
34. By their nature, movies – viewed in a cinema with an audience - cannot generate low volume sales in the same fashion as books. Books can continue selling at low volume yet remain in their original form. And if books prove unsuccessful, it is possible to change the price label on a book to a fraction of the original price and then sell on the original item. In contrast, once a movie is deemed not to be viable to show in even the smallest cinema, further sales can only be achieved by transferring it onto a different medium (i.e. the aforementioned video or DVD or possibly onto the internet).

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