Advertising and Consumer Memory

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Abstract

The paper explores the idea that advertising interferes with consumers’ memories of product experiences. We consider a two-period model where a monopolist sells an experience good to a buyer who may only imperfectly recall her first period experience. When advertising activates memory, it enables learning and may induce the buyer to try out the good initially. Moreover, while costly advertising may, as usual, serve as a signalling device, costless advertising enables the monopolist to signal his type by price alone. When advertising distorts postexperience memory, it may offset the distortions caused by monopoly pricing.

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JEL Classification: A12, L12, L15, M37

1 Introduction

This paper explores the idea that advertising interferes with customers’ memories of product experiences. Two distinct influences of advertising on memory are considered. The first part of the paper deals with memory activation. Memory activation refers to the fact that customers are likely to better recall their past consumption experiences with an advertised product than with a non-advertised product. This idea goes back to Nelson (1974) who argues that "advertising increases the probability of a consumer’s remembering the name of a brand" (p. 734). The

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second part of the paper deals with memory distortion. The idea that advertising might distort consumers’ memories draws on psychological evidence that suggests that actual consumption experiences can, ex post, be considerably overshadowed and re-shaped by ads that simply praise the product (see the references below).

We shall consider a monopolist who repeatedly offers an experience good for sale. For our purposes it will be sufficient to look at two periods only. The monopolist faces a single buyer who may not recall correctly her period 1 consumption experience at the beginning of period 2. We ask how advertising affects monopoly profits and overall welfare, and if it can be used as a signal for product quality.

In the first part of the paper, the buyer cannot recall her experience unless the product is advertised in period 1. One might think of a buyer who faces a myriad of product choices that she cannot remember unless products come with an easy-to-memorize name or an eye-catching campaign. The purpose of advertising therefore, is to help consumers to recognize the product again and thereby to bring to memory their experiences with the product.

We shall first consider the case where the buyer’s tastes are subjective and neither known by herself nor by the monopolist ex ante. We show that the monopolist chooses to advertise if the buyer’s outside option is large, because in this case advertising enables the buyer to learn, leading her to try out the product in the first place. The intuition is, roughly speaking, that with a very small outside option, there is no point for the buyer to learn her true taste, as she would choose to purchase the good anyway. With a high outside option, the buyer might want to invest in an experiment with the product in period 1 so as to improve her period 2 decision. But for this investment to make sense, of course, she has to remember her experience in period 2. This is what advertising helps her to do.

We shall then assume that product quality is privately known by the monopolist and seek for conditions for a separating equilibrium in which the high-quality monopolist can signal his type. The differential advantage of the high-quality type is that for a given level of advertising he is more likely to attract repeat purchases than the low-quality type, because the buyer is more likely to recall a favourable experience with the high than with the low type. This advantage can then be used for costly signalling activities either in price or in advertising expenditures. It is this repeat business effect that is at the core of Nelson’s original account, and our approach

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1 For sufficiently low-utility brands, a consumer who remembers the name of the brand will have a lower
is a simple formalization of this idea.

We shall assume that high quality is associated with higher marginal costs. In this case, in the absence of advertising high quality cannot be signalled by price alone. The key reason is the buyer’s imperfect recall which neutralizes the high type’s differential advantage, as it exactly rests on the buyer having some recall. The high type therefore advertises so as to stimulate the buyer’s recall and to thereby materialize his differential advantage. In addition, advertising expenditures may be used to deter the low type from mimicking. Indeed, in the separating equilibrium we derive, both period 1 price and advertising is used as a signal. However, in that it revokes the buyer’s memory, advertising serves an intrinsic function and cannot be replaced by other costly signals such as a high-rent location.

We shall then return to the case of subjective quality and assume in the second part of the paper that the buyer’s experience can, ex post, be influenced by advertising. The basic idea is that the buyer is overflooded by ”signals” about her product tastes, including her actual experience and ads, and that she can only partially memorize both the signals and their sources. When assessing her product valuation ex post, she therefore has to solve a signal attribution problem. At this point we deviate from Bayesian rationality and assume that the buyer, at the point of decision making in period 2, is unaware of how her memory is shaped and takes the signals that she recalls at face value rather than discounting them in a Bayesian fashion.

This implies that an ad that praises the product is likely to distort the buyer’s memory in favour of the product. This is suggested by considerable psychological evidence that we shall review below. While we assume that the buyer is unaware of her memory distortion at the point of decision making, we maintain that, prior to decision making, she anticipates that she might be misled by the ad.3

We shall be interested in how this form of persuasive advertising affects efficiency. Given the buyer has consumed in period 1, the monopolist does not know the buyer’s valuation at conditional probability of repeat purchase than if he did not remember the name of the brand. For sufficiently high-utility brands, the reverse will be the case.” (Nelson 1974, p. 753)

2This is different if high quality is associated with lower marginal costs. Then, already in the one-period case, the high type can profitably price below the low type’s marginal cost, preventing the low type from mimicking.

3This assumption has some reminiscence to models of impulse buying with limited self-control where the current self anticipates the suboptimal behaviour of its future incarnations when facing decisions that require them to exert self-control (see, e.g., Benabou and Tirole 2004).
the beginning of period 2. Therefore, he cannot perfectly price discriminate and sets the usual monopoly price which exceeds the buyer’s outside option. Without advertising therefore, the buyer refrains from purchasing at valuations that truly exceed her outside option but are truly below price, causing an efficiency loss. With advertising however, valuations are shifted up, and some valuations that are truly below price will subjectively appear above price, inducing the buyer to purchase. In other words, advertising increases the number of efficient trades. However, if advertising manipulates valuations very strongly, then the buyer is led to consume also for valuations at which trade is actually inefficient.

If the first effect outweighs the second one, advertising improves efficiency. In this sense, the memory distortions correct for the distortions that arise through monopoly pricing in period 2. In the reverse case, advertising impairs efficiency, and as we will show, the monopolist would then like to commit not to advertise and might benefit from an advertising ban.

Literature
The advertising literature is huge (see Bagwell 2003 for a review). We are not aware of a paper that explicitly conceptualizes advertising as a means to evoke experiential memories. Our signalling model is closely related to work in the tradition of Milgrom and Roberts (1986) who were the first to formalize the repeat business effect as proposed by Nelson (1974). As in this work, the differential advantage that brings about separation in our setup is that the high quality seller benefits more from initial sales. In the Milgrom and Roberts tradition however, advertising does not play a specific role, it is just one of many ways of ”burning money”. In our setup, advertising has an intrinsic function. Even if it were costless, it would enable the high quality seller to use prices as signals.

The second part that deals with memory distortion is in the tradition of the persuasive view that has received little attention in recent work but figures prominently in early writings on advertising. For example, Dorfmann and Steiner (1954) and Dixit and Norman (1978) analyze static monopoly models where consumers respond to advertising in a way that distorts their purchasing decisions, but they do not look at dynamic issues. More generally, our modelling

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4See also, e.g., Hertzendorfer 1993, Horstmann and McDonald 1994.
5The persuasive view can be illustrated by a quote from Robinson (1933, p.5): ”the customer will be influenced by advertisement, which plays upon his mind with studied skill, and makes him prefer the goods of one producer to those of another because they are brought to his notice in a more pleasing and forceful manner.”
of the consumers’ memory distortion in favour of the advertised product is similar to Rabin’s and Schrag’s (1999) modelling of confirmatory bias where individuals tend to bias information about past choices in favour of these choices.

Advertising and postexperience memory distortion
Several studies find that postexperience information influences consumers’ judgement about their actual experience. In Hoch and Ha (1986) subjects were asked first to rate product quality of different brands of polo shirts and paper towels. A subgroup of subjects were then shown ads that praised product quality with slogans such as ”Real Quality, Real Value”. Then subjects were given the opportunity to physically inspect and test the product. By design, polo shirts were relatively similar such that the test evidence was ambiguous. By contrast, test conditions for paper towels provided unambiguous quality evidence. Finally, subjects were again asked to rate the products. While Hoch and Ha do not find an influence of advertising on ratings for the towels, they do find dramatic effects of the ad on quality perceptions for the polo shirts, suggesting that the influence of postexperience information is more important when people cannot unambiguously verify the information. Similar findings are reported in Deighton (1984), Levin and Gaeth (1988), and Smith (1993).

Very close to our modelling is a recent experiment by Braun (1998). Subjects tasted an allegedly new orange juice where the juice’s taste was varied by differential shots of water and vinegar. A subgroup of subjects then saw ads describing the positive taste of the juice. For example, one ad claimed the juice to be ”sweet, pulpy and pure.” Later, subjects were asked to recall their original experience both verbally and by identifying the juice within a sample of others. Braun finds a significant positive influence of advertising on subjects’ taste memories.6 In addition, she finds that the memory distortion effect could be replicated a week later by showing the ads closely before recall.

These findings indicate that advertising might have a potentially strong bearing on con-

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6The statistical effects were corroborated by the verbal statements of the subjects. Quoting from Braun (p. 325): ”For instance, one respondent who had tasted the vinegar-tinged salty orange water and received the ad information described his memory of the orange juice’s taste in these words, ‘I thought it tasted real sweet. It quenched my thirst. Refreshing. It would be a nice eye-opener in the morning. It made me want more.’ Another respondent who tasted the same juice but who did not receive the advertising information described his memory as, ‘I thought this juice was pretty terrible. It was bitter and water-drowned.’"
sumers’ memories. While there is a controversy in the literature on how exactly postexperience information affects consumers’ judgements, whether through an updating process or through overshadowing, there is agreement that marketers can manage consumers’ experiential memories by means of advertising.

The rest of the paper is organized as follows. Section 2 deals with memory activation, including the case with subjective and with objective quality. Section 3 deals with memory distortion. Section 4 concludes.

2 Advertising as memory activation

There are two time periods, \( t = 1, 2 \). There is a monopolist, \( M \), who, in each period, produces an experience good, and there is a buyer, \( B \), who, in each period, purchases at most one unit of the good. The buyer’s instantaneous valuation \( x \) for the good is either ”high” or ”low”, i.e., \( x \in \{ x_L, x_H \} \), \( x_H > x_L > 0 \) and is unknown ex-ante. \( B \)’s belief that her valuation is ”high” is \( \gamma > 0 \). We shall be more specific about \( M \)’s belief below. The probability \( \gamma \) is common knowledge.

We assume that the marginal cost of producing a good of value \( x_k \) is \( c^k \geq 0 \).

At the beginning of each period, \( M \) sets price \( p_t \), and \( B \), observing these prices, decides whether to purchase or not. We denote \( B \)’s purchasing decision in period \( t \) by \( d_t \in \{0, 1\} \), where \( d = 1 \) means that \( B \) purchases, and \( d = 0 \) means that she does not purchase. If \( d = 0 \), \( B \) receives her outside option of \( u > 0 \). We assume \( u < x_H - c^H \), so there are potential benefits from trade.

In addition, in period 1 \( M \) chooses a level \( a \in [0, 1] \) of advertising at cost \( g(a) \). \( g \) is convex with \( g'(0) = 0 \).

Suppose that \( d_1 = 1 \). Then, whether \( B \) can recollect her experience \( x \) in period 2, depends on the advertising activity \( a \). More precisely, let \( R \) (Recall) be the event that \( B \) recalls \( p_1 \), \( a \), \( d_1 \), and \( x \) in period 2, and let \( PR \) (Partial Recall) be the event that \( B \) recalls \( p_1 \), \( a \), and \( d_1 \) but does not recall \( x \) in period 2, and let \( NR \) (No Recall) be the event that \( B \) does neither recall \( p_1 \), nor \( a \), nor \( d_1 \), nor \( x \) in period 2. Then the conditional probability of \( R \), conditional on \( a \) and \( d_1 = 1 \), is equal to \( a \), and the conditional probability of \( PR \cup NR \), conditional on \( a \) and \( d_1 = 1 \), is \( 1 - a \). We will be more specific about the separate probabilities of \( PR \) and \( NR \)
below. We shall throughout assume that $B$ will perfectly recall $d_1 = 0$, conditional on $d_1 = 0$.

As for $M$, we assume that $M$ observes the purchasing decision but is not informed which of the events $R$, $PR$, or $NR$ has obtained before setting price in period 2. All of this is common knowledge to the players. We should emphasise that this implies that $B$ knows the equilibrium that is being played. While she may forget some events that happen along the play path, she can make inferences about these events from her knowledge of the equilibrium.

We shall use the tie-breaking rule that whenever $B$ is indifferent between purchasing and not purchasing, she purchases the good.

### 2.1 Analysis

#### 2.1.1 Subjective taste

In this subsection, we assume that $M$ is not informed about $x$ and shares $B$’s prior about $x$. So, $x$ is $B$’s subjective taste. In this case, it is not necessary to distinguish between the events $PR$ and $NR$. This is because no player has private information in period 1. Hence, period 1 decisions (neither $p_1$, nor $a$, nor $d_1$) do not reveal any information, so $B$’s beliefs in period 2 do not depend on whether or not she can recall $p_1$, $a$, or $d_1$. We shall therefore assume that $P[NR|d_1 = 1, a] = 0$.

We also assume that marginal costs are state-independent and equal to 0.

The game is solved by backward induction. Suppose first, $B$ did not purchase the good in period 1. Then, in period 2, if $u \leq E[X]$, $M$ optimally sets a price of $E[X] - u$, and $B$ receives a payoff $u$. If $u > E[X]$, then $M$ does not offer a sale, and $B$ receives $u$.

Next, let $a$ be given and let $p_2$ be the price set by $M$, conditional on $B$ having purchased the good in period 1. Let $v_2(a, p_2)$ be the expected gross utility, as seen from period 1, that $B$ receives from her optimal decision in period 2 and let $\pi_2(p_2)$ be the associated expected period 2 payments from $B$ to $M$. Thus, $B$’s overall utility from buying at price $p_1$ is

\[ u_1 = E[X] - p_1 + v_2 - \pi_2. \]  (1)

If she does not purchase in period 1, $B$ receives overall utility $2u$ (if $d_1 = 0$, she receives her outside option in period 2). So if it is profitable to make sales in period 1, $M$ optimally sets $p_1 = E[X] + v_2 - \pi_2 - 2u$. His overall profit from selling in period 1—gross of advertising
Advertising affects $M$’s profit therefore only through its impact on $v_2$. Two effects determine the impact of advertising on $v_2$. First, with advertising, $B$ is likely to remember her experience. Thus, advertising improves $B$’s information at the point of decision making in period 2. Second, advertising affects $M$’s period 2 pricing behaviour. We shall now study how these two effects interact and whether they improve $B$’s decision making (and thus $v_2$) as compared to the case without advertising. To do so, we shall distinguish the cases $u \leq E[X]$ and $u > E[X]$.

1. $u \leq E[X]$: In period 2, $B$’s (expected) valuation is either $x_H$ or $x_L$ (if she recalls her experience) or $E[X]$ (if she does not recall her experience). So, given $B$’s outside option $u$, $M$ optimally sets either price $x_L - u$, or $E[X] - u$, or, $x_H - u$. $M$’s respective period 2 profits are

$$\pi^l_2 = x_L - u,$$

$$\pi^m_2 = (1 - a) (E[X] - u) + a\gamma (E[X] - u),$$

$$\pi^h_2 = a\gamma (x_H - u).$$

We shall now assume that $\gamma E[X] > x_L$, this implies that $\pi^l_2 < \pi^m_2$. Therefore, $M$ sets $p_2 = p^m_2 = E[X] - u$ if and only if

$$a < \frac{E[X] - u}{\gamma (x_H - u) + (1 - \gamma) (E[X] - u)} = \bar{\pi} \in (0, 1).$$

In this case, $B$ purchases in period 2 unless she recalls an unfavourable experience, thus,

$$v^m_2 = (1 - a) E[X] + a\gamma x_H + a (1 - \gamma) u$$

$$= a (1 - \gamma) (u - x_L) + E[X].$$

If $p_2 = p^h_2 = x_H - u$, $B$ purchases only if she recalls a favourable experience, thus,

$$v^h_2 = (1 - a) u + a\gamma x_H + a (1 - \gamma) u$$

$$= a\gamma (x_H - u) + u.$$

We compare now $B$’s gross utility under the two pricing strategies. Suppose first that $u < x_L$. In this case, $B$ makes a suboptimal (or "wrong") decision when she chooses not to purchase in period 2. For then she receives her outside option although her valuation for the good is higher.
More specifically, if \( p_2 = p_m^n \), \( B \) makes a "wrong" decision in state \( x = x_L \) if she recalls \( x_L \). In state \( x_H \), she always makes the "correct" decision. If \( p_2 = p_h^n \), then \( B \) makes a "wrong" decision in state \( x_L \) if she recalls \( x_L \) and if she does not recall her experience. In state \( x_H \) she makes a "wrong" decision if she cannot recall her experience. Therefore for any \( a \), \( v_m^n \geq v_h^n \). In particular, if \( p_2 = p_m^n \) and \( a = 0 \), then in each state \( B \) makes the correct decision (as she never recalls an experience). Hence, if \( u < x_L \), 0 advertising is optimal.

In other words, advertising increases the number of "wrong" decisions. This is so, because if \( M \) advertises and thus knows that \( B \) is likely to be informed about her valuation in period 2, he cannot commit to set period 2 prices such that \( B \) always chooses to buy in period 2. In summary:

**Proposition 1** Let \( u \leq E[X] \) and \( u < x_L \). Then there will be no advertising in equilibrium.

Suppose next that \( u \geq x_L \). Then \( p_2 = p_m^n \) implements the "correct" choice in state \( x = x_H \). Yet, in state \( x_L \), \( B \) makes the "wrong" decision if she has no recall. By contrast, \( p_2 = p_h^n \) implements the "correct" choice in state \( x = x_L \). Yet, in state \( x_H \), \( B \) makes the "wrong" decision if she has no recall.

Since under both prices "wrong" decisions are made only if there is no recall, advertising reduces the number of "wrong" decisions in that it provides information. Hence, \( v_2 \) increases in \( a \), and \( M \) benefits from advertising. If advertising costs \( g \) increase rapidly, the optimal level of \( a \) will be below \( \pi \), and \( p_m^n \) will be played in equilibrium. If \( g \) increases moderately, \( p_h^n \) will be played. Notice that \( M \)'s overall profits are always positive, since \( E[X] \geq u \) and \( v_2 \geq u \). We summarize these observations in the following proposition.

**Proposition 2** Let \( u \leq E[X] \) and \( u \geq x_L \). Then there will be advertising \( a > 0 \) in equilibrium.

We turn now to case 2. \( u > E[X] \). The analysis proceeds as in case 1. Notice that it cannot be optimal for \( M \) to charge period 2 price \( p_m^n = E[X] - u < 0 \), since this would imply losses in period 2. Therefore, \( M \) optimally sets \( p_h^n = x_H - u \) and, as above,

\[
v_h^n = a\gamma (x_H - u) + u. \tag{11}
\]

As in the previous paragraph, advertising reduces the number of \( B \)'s "wrong" decisions in period 2 and increases \( v_2 \). A difference to the former case is that \( M \) does not necessarily make
positive overall profits. Given $p^b$, $B$ is left with her outside option in period 2. Since $E [X] < u$, $M$ needs to charge a negative period 1 price to induce $B$ to purchase in period 1. Whether or not $M$ can recoup this period 1 loss in period 2, depends on the size of $v_2$.

More formally, $M$’s overall profit is

$$\pi = E [X] - 2u + a \gamma (x_H - u) - g (a).$$

(12)

This implies the following proposition.

**Proposition 3** Let $u > E [X]$. Let $a^*$ be the unique maximizer of $a \gamma (x_H - u) - g (a)$. Then $a = a^*$ if

$$E [X] - 2u + a^* \gamma (x_H - u) - g (a^*) \geq 0$$

(13)

Otherwise, $a = 0$, and there are no sales in both periods.

The basic idea behind these results is that advertising is used by $M$ if he thereby increases $B$’s willingness to purchase the good in period 1. $B$’s willingness to purchase in period 1 is determined by how good her decision making is in period 2. Advertising helps to improve $B$’s information, but if $B$’s outside option is small, $M$’s pricing behaviour may prevent $B$ to use this information efficiently in period 2. If $B$’s outside option is large however, it is only the prospect to recall her experience with an advertised product that might induce $B$ to try out the good.

We shall now consider what happens, if quality is no longer subjective but objective.

### 2.1.2 Objective quality and signalling

We assume now that $M$ is perfectly informed about $x$, i.e., $x$ can be interpreted as objective quality. We shall throughout assume that $u > E [X]$ and that marginal costs are state-dependent.

We shall assume that it is at least as costly to produce a high-quality good as a low-quality good, i.e., $c^H \geq c^L$ (we shall remark on the other case below). Without loss of generality, we set $c^L = 0$. Our aim is to show that the option to advertise enables the high-quality seller to signal his quality, while in the absence of advertising, in any equilibrium there is essentially no trade in both periods. To do so, we make it most difficult for a separating equilibrium to exist. As will become clear below, this is the case when $P [PR | d_1 = 1, a] = 0$. In this case, given
that $B$ is not reminded to the past by encountering an advertised good, she does neither recall whether she has purchased the good nor what the good’s price has been in the past.

We denote the actions, profits etc. of the two types of $M$ by the superindices $H$ and $L$.

We shall first show that in the absence of advertising, there is essentially no trade in both periods. Again, to stack the desk against a separating equilibrium with advertising, we assume that $B$ can recall first period price and her first period decision in period 2. We have the following result the proof of which is in the appendix.

**Proposition 4** Suppose there is no advertising. Suppose that for all prices $p_1$ and all decisions $d_1$, $P[PR|d_1,p_1] = 1$. Then, in any PBNE there is either no trade in both periods or, if there is trade, then $c^H = 0$ and prices are 0 in both periods and all players are indifferent between trade and no trade.

The intuition is as follows. Suppose the buyer has some memory of her experience. Then the high-quality monopolist could announce a negative price in period 1 (inducing the buyer to buy) because he knows that there is a relatively large likelihood that buyer recalls a favourable experience in which case the monopolist could charge a positive price and recoup her first period losses. For the low-quality monopolist, by contrast, this likelihood would be smaller, therefore he could not offer the same price discount in period 1. But since the buyer cannot recall her experience, the likelihood to recall a favourable experience is independent of the state of the world (even though the buyer may learn something by her knowledge of the equilibrium). Therefore, the low type can costlessly mimic the high type.

This may change in the presence of advertising. Then the likelihood to recall a favourable experience is higher in the high state than it is in the low state (sorting condition), giving room for the high type to reveal himself.

We shall now seek for conditions under which a separating equilibrium exists. Remember that we now assume $P[PR|d_1 = 1,a] = 0$. This means that if $B$ cannot recall $x$ at the beginning of period 2, she has no memory of any action chosen in the past. In other words, while $B$ knows the equilibrium that is being played, she does not know the actual play path, and therefore period 1 actions do not carry over any information to period 2. This implies the following Lemma.

\[ \text{Lemma } \]

7As mentioned above, this assumption makes it more difficult for a separating equilibrium to exist, because if $PR$ obtains, $B$ knows the state from her knowledge of the equilibrium even though she cannot recall her
Lemma 1 Suppose $P[PR | d_1 = 1, a] = 0$. Then there is a PBNE such that in period 2, $p^H_2 = p^L_2 = x_H - u$. If $B$ recalls $x = x_H$, then her period 2 belief $\gamma_2$ is 1, if she recalls $x = x_L$, then $\gamma_2 = 0$, if she does not recall $x$ and observes $p_2 = x_H - u$, then $\gamma_2 = \gamma$, and otherwise $\gamma_2 = 0$. Moreover, $B$ purchases the good if only if she can recall $x = x_H$.

Proof: Suppose $B$ cannot recall her experience. Since $p^H_2 = p^L_2$, prices provide no information. Furthermore, because $P[PR | d_1 = 1, a] = 0$, $B$’s period 2 belief cannot depend on anything that happened in period 1. Hence $\gamma_2 = \gamma$, and her period 2 valuation is $E[X]$. So she would make losses from purchasing. For all prices off the equilibrium path, $\gamma_2 = 0$ is compatible implying no sales at off-equilibrium prices.

Suppose $B$ can recall her experience, then she knows the state and given prices $p^H_2 = p^L_2 = x_H - u$, she buys only in state $x_H$.

Given $B$’s beliefs, it is easy to check that $p^H_2 = p^L_2 = x_H - u$ are optimal prices for $M^H$ and $M^L$.

We shall now look for a fully separating equilibrium in the class of equilibria in which play in period 2 proceeds as described in the Lemma. In a fully separating equilibrium, the state is fully revealed to $B$ prior to her purchasing decision in period 1. Therefore, she cannot purchase from an $L$-type (for this to happen, $M^L$ would need to charge negative prices, and because an $L$-type does not make sales in period 2, $M^L$ would make an overall loss). Therefore, in a fully separating equilibrium, $M^L$’s profit is 0. In particular, $a^L = 0$. For separation to occur, $M^L$ must therefore not get more than 0 from mimicking the $H$-type in period 1. If $M^L$ chooses $(p^H_1, a^H)$, then she gets $p^H_1 - g(a^H)$ in period 1 (notice $c^L = 0$) and makes no sales in period 2. Hence, the first sorting condition is

$$p^H_1 - g(a^H) \leq 0.$$  

(14)

Moreover, $B$ must be induced to buy in period 1. In a separating equilibrium, upon observing $(p^H_1, a^H)$, $B$ knows that her valuation is $x_H$. Moreover, given period 2 play, $B$ receives her outside option in period 2. Hence, the second sorting condition is

$$x_H - p^H_1 + u \geq 2u.$$  

(15)

consumption experience, and would therefore buy from $M^H$ (but not from $M^L$). Thus, $M^H$’s differential advantage is smallest if $P[PR | d_1 = 1, a] = 0$.

\footnote{For computational simplicity, we assume that if $M^L$ is indifferent, he does not mimic $M^H$.}
We shall now look for $p_H^1$ and $a^H$ that maximizes $M^H$’s profit

$$\pi^H = p_H^1 - c^H + a^H (x_H - u) - c^H - g (a^H)$$  \hspace{1cm} (16)$$

subject to (14) and (15). If $\max \pi^H$ is positive, then there is a fully separating equilibrium in which $B$’s belief $\gamma_1 (p_1, a)$ upon observing $p_1$ and $a$ is 1, if $(p_1, a) = (p_H^1, a^H)$ and 0 otherwise. To characterize the maximum let $\hat{a}$ such that $g (\hat{a}) = x_H - u$, and let $a^*$ be the unique maximizer of $a (x_H - u) - g (a)$. Then we have the following proposition.

**Proposition 5**  

(i) If $a^* \geq \hat{a}$, then $a^H = a^*$, $p_H^1 = x_H - u$. Constraint (14) is not and (15) is binding, and

$$\pi^H = x_H - u + a^* (x_H - u) - g (a^*) - 2c^H.$$  \hspace{1cm} (17)$$

(ii) If $a^* < \hat{a}$, then $a^H = \hat{a}$, $p_H^1 = x_H - u$. Both (14) and (15) are binding and

$$\pi^H = \hat{a} (x_H - u) - 2c^H.$$  \hspace{1cm} (18)$$

**Proof:** Note first that for any $a$ the optimal price $p_H^1 (a)$ is given by $p_H^1 (a) = \min (g (a), x_H - u)$ (otherwise, $p_H^1$ could be raised without violating any constraint). To find the optimal $a = a^H$ we shall now vary $a$.

Let $a < \hat{a}$ and consider a variation $a + da$ in $a$. As $a < \hat{a}$, $p_H^1 (a) = g (a)$, thus $dp_H^1 (a) = g' (a) da$. Therefore,

$$d\pi^H (a) = g' (a) da + [(x_H - u) - g' (a)] da = (x_H - u) da.$$  \hspace{1cm} (19)$$

Thus, the optimum cannot be smaller than $\hat{a}$, i.e., $a^H \geq \hat{a}$.

Next, let $a \geq \hat{a}$. Then $p_H^1 (a) = x_H - u$, thus $dp_H^1 (a) = 0$. Therefore,

$$d\pi^H (a) = [(x_H - u) - g' (a)] da.$$  \hspace{1cm} (20)$$

Now notice that $(x_H - u) - g' (a) \geq 0$ if and only if $a \leq a^*$. This implies the claim. □

By inspecting the Proposition, we see that whether $M^H$’s maximum profit is positive depends on the size of $c^H$ relative to the gross benefits from trade $x_H - u$ and to the benefit from advertising. In a separating equilibrium, $M^H$ charges the highest possible price and adjusts his advertising such that (14) is binding. This means that the $L$-type is deterred from mimicking
the \( H \)-type by the costs of advertising and not by a low period 1 price of \( M^H \). This is similar to the Milgrom and Roberts (1986) tradition where advertising amounts to "burning money". However, there are two noteworthy differences. First, in our setup, advertising has a genuine function. In its absence, the \( H \)-type cannot make use of his differential advantage by means of another observable expenditure such as a high-rent location. Second, even if advertising were costless and could thus be mimicked by the \( L \)-type, or if advertising expenditures were unobservable, advertising would enable \( M^H \) to signal its type by price alone. In this case, (14) would be replaced by \( p^H_1 \leq 0 \). It is easy to see that a separating equilibrium then still exists under similar, albeit narrower conditions for \( c^H \) and \( x^H - u \).

**Remark** \((c^H < c^L)\): If the high-quality monopolist has lower costs, then he can signal his type without advertising by the price alone. This is true even in the one-period game and holds therefore, a fortiori, in the two-period game. This is because the high-quality monopolist can set a price \( p^H_1 \in (c^H, c^L) \) between his own and the cost of the low-quality monopolist. Given \( B \) holds the belief that \( x = x^H \) if she observes \( p^H_1 \), then \( M^L \) would not want to mimic \( M^H \) (otherwise \( M^L \) would make losses) and \( B \) and \( M^H \) make non-negative gains.

### 3 Advertising as memory distortion

We shall now study what might happen when advertising influences \( B \)'s perception of her experience ex-post. To do so, we return to the case of a pure experience good and slightly modify the setup. There is now no advertising in period 1. Advertising takes place at the beginning of period 2 after \( B \) has experienced her valuation and before prices are set. We assume that advertising distorts \( B \)'s experience such that it appears to \( B \) as if she had made a more favourable than her actual experience. One might think of this again as a result of limited memory. For example, \( B \) might, in addition to her actual experience, obtain a (completely uninformative) ad telling her that her experience was great. So \( B \) has two "signals", her own experience and the ad. Suppose \( B \), due to limited memory, forgets one of these signals and also forgets whether the signal that she keeps in her memory is her actual experience or the experience suggested by the ad. In this case, \( B \) is likely to recall experiences that are more favourable than her true experience.
We shall now assume that $B$, at the point of decision making, is *not* aware of her memory distortion. This is a deviation from Bayesian rationality, as a Bayesian decision maker would take into account how the information she has has come about. Therefore, she would discount the value of high signals and accordingly revise her valuation of the product downwards. Instead, we assume that $B$ takes the signal that she has at face value.\footnote{The fact that $B$ is unaware of her bias at the point of her purchasing decision has some reminiscence of accounts of impulse buying. Impulse buying is often said to obtain in “hot” states where individuals are overwhelmed by an urgent desire to satisfy their immediate needs (see, e.g., Benabou and Tirole 2004). In such a state an individual is not fully aware of the long-term damage the decision might inflict on her. Likewise, our buyer is not aware that it might be the manipulative powers of the ad that shape her perception of the consumption experience.}

This non-standard assumption is crucial for our results, but we believe that it captures well the psychological evidence mentioned in the Introduction.

While we assume that $B$ is unaware of her bias at the point of decision making, we maintain that $B$, prior to decision making, anticipates that she might be misled by the ad.

To model the persuasive nature of advertising, we shall now assume that $B$’s instantaneous valuation $x$ is uniformly distributed on the unit interval and also that advertising $a$ is binary: either $M$ decides to advertise in period 2 ($a = 1$) or not ($a = 0$). We shall further assume that $c = 0$ and $u > E[X] = 1/2$.

Suppose that $B$ has purchased the good in period 1, and her experience was $x$. Then, if $a = 0$, her perception does not change. If $a = 1$, then she will subjectively perceive her experience as $y(x) = (1 - \alpha)x + \alpha$ for some constant $\alpha \in (0, 1)$. The size of $\alpha$ captures the extent to which $B$’s memory is distorted by the ad.

### 3.1 Analysis

Note first that in equilibrium $B$’s overall utility is $2u$. Since $2u$ is what she can guarantee by abstaining from consumption altogether, she cannot receive less. So, to receive more, she would need to buy the good in at least one period. If she does *not* buy it in period 1, then due to $E[X] < u$, it cannot be that she buys it in period 2 (otherwise $M$ would make losses in period 2). Hence, $B$ would need to buy the good in period 1. However, if $B$ purchased in period 1 and received higher overall utility than $2u$, then $M$ could increase his profits by raising period
1 price.

Given that $B$’s utility is always $2u$, total welfare varies only in $M$’s equilibrium profit, and we can take the latter as a welfare measure. We shall now examine how advertising affects welfare and show that advertising can actually increase welfare.

To do so, we first proceed as in section 2.1.1. Suppose that $d_1 = 1$, and denote by $v_2$ the expected period 2 gross utility for $B$, as seen from period 1, that results from $B$’s decision in period 2. Let $\pi_2$ be the associated expected period 2 payments from $B$ to $M$. Therefore, if $B$ decides to buy in period 1, given $p_1$, she receives overall utility of

$$E[X] - p_1 + v_2 - \pi_2,$$

while she receives $2u$ if she does not buy ($E[X] < u$ implies $d_2 = 0$, if $d_1 = 0$). Hence, $M$ optimally sets $p_1 = E[X] - 2u + v_2 - \pi_2$, and her overall profit is

$$\pi = E[X] - 2u + v_2.$$  \hspace{1cm} (22)

The influence of advertising on profits is thus exclusively determined by its influence on $v_2$. $v_2$ is maximal if $B$ chooses the good if and only if her true valuation $x$ is above her outside option $u$.

Two effects distort $B$’s equilibrium behaviour away from the efficient decision rule: the distortions resulting from monopoly pricing and $B$’s distorted perceptions. The welfare consequences of advertising are determined by how these two distortions interact.

Suppose first that there is no advertising ($a = 0$). Then, given $p_2$, $d_2 = 1$ if $x - p_2 \geq u$. Hence, $M$ faces linear demand $1 - (p_2 - u)$ and the monopoly price is $\hat{p}_2 = (1 - u) / 2$. The lowest valuation at which $B$ buys is thus

$$\hat{x} = \frac{1 + u}{2}.$$  \hspace{1cm} (23)

As $M$ prices above marginal cost, for valuations $x \in [u, \hat{x})$, there is no trade in equilibrium although trade would be efficient. This is the distortion that arises from monopoly pricing.\footnote{It is easy to see that a similar distortion is also present when there is Bertrand competition and sellers cannot observe the buyer’s experience with the good in period 1 (see Krähmer 2003).}

Denote the value of $v_2$ in this case by $\hat{v}_2$. 

10
Suppose now that there is advertising \((a = 1)\). Given \(p_2, d_2 = 1\) if \((1 - \alpha)x + \alpha - p_2 \geq u\). Hence, demand is \(1 - (u + p_2 - \alpha) / (1 - \alpha)\), and the monopoly price is

\[
\hat{p}_2 = \begin{cases} 
(1 - u) / 2 & \text{if } \alpha - u < (1 - u) / 2 \\
\alpha & \text{if } \alpha - u \geq (1 - u) / 2.
\end{cases}
\] (24)

If \(\alpha\) is large \((\alpha \geq (1 + u) / 2)\), \(M\) does best to set price equal to the lowest (perceived) valuation \(\alpha\), and \(B\) will buy for all valuations. Compared to the case without advertising, the number of efficient trades will increase (for \(x \in [u, \hat{x}]\)), but at the same time, trade, too, will occur at all inefficient levels \((x \in [0, u])\), the latter outweighing the efficiency gain of the former.

For small \(\alpha\), \(M\)'s price does not change as compared to the case without advertising.\(^{11}\) The lowest (true) valuation at which \(B\) buys is

\[
x = \frac{(1 + u) / 2 - \alpha}{1 - \alpha} < \hat{x}.
\] (25)

Suppose now that \(\alpha\) is moderate. Then due to her inflated perception, \(B\) buys at valuations at which she would not buy had she correct perceptions but at which trade is actually efficient.

Therefore, the distortion of \(B\)'s perception may correct for the distortion due to monopoly pricing. In fact, if \(\alpha = 1/2\), \(B\) buys if and only if \(x \geq u\), and the efficient decision rule is implemented. Let \(v_2^\alpha\) be the corresponding value of \(v_2\) in the case with advertising. (Note \(v_2^0 = \hat{v}_2\).) A little bit of algebra reveals that \(v_2^\alpha\) increases for \(\alpha < 1/2\) and decreases afterwards with a level below \(\hat{v}_2\) for \(\alpha = 1\). We summarize these observations in the following proposition.

**Proposition 6** Given monopoly pricing, there is an \(\alpha > 1/2\) such that advertising increases social welfare if and only if \(\alpha \leq \alpha^\star\).

We turn now to the question whether \(M\) actually wants to advertise. Clearly, as advertising amounts to an outward shift in demand, \(M\)'s period 2 revenue increases in advertising. Therefore, if advertising costs are moderate, \(M\) will advertise in period 2.

Notice however that advertising reduces \(M\)'s overall profits if \(\alpha > \alpha^\star\). In this case, \(M\) faces a commitment problem in period 1. As \(B\) anticipates that, due to advertising, she will make losses in period 2, she requires an up-front compensation from \(M\) in the form of a lower period 1

\(^{11}\)This is due to the uniform distribution and changes for demand functions with non-constant price-elasticities. The general argument, however, remains the same.
price so as to buy the good in period 1. If $\alpha > \alpha$, this up-front compensation is larger than $M$’s gain from advertising in period 2, and $M$ would like to commit not to advertise. An advertising ban, for instance, would be Pareto-improving.\(^{12}\)

## 4 Conclusion

The paper addresses some issues that arise when advertising interferes with consumers’ memory. As such it only deals with one exemplary element in a wider set of questions that deal more generally with the impact of advertising on consumers’ cognitions and perceptions. For example, suggestive pre-experience advertising is found to have effects on consumers’ actual experiences in that it establishes a schema people later use to judge their experiences (Allison and Uhl 1964). Also, our monopolist-one-buyer structure is only a first and preliminary step. Extensions to multi-firm markets and to more general demand functions are questions for future research. So are questions that deal with entry and regulation. Overall, we believe that research into the interaction of advertising, consumer psychology, and economic outcomes is likely to bring about new insights that complement and enrich the insights of the advertising-as-information tradition initiated by Nelson (1974).

## Appendix

### Proof of Proposition 4

Let $\tilde{p}_1^M, \tilde{p}_2^L, \tilde{p}_1^L, \tilde{p}_2^L$ be the (possibly mixed) equilibrium strategies of $M^H$ and $M^L$. (Notice that $\tilde{p}_2$ may depend on $p_1$ and $d_1$.) Let $\gamma_2 (p_1, p_2)$ be $B$’s period 2 belief, given he observes $p_1$ and $p_2$, and let $\gamma_1 (p_1)$ be $B$’s period 1 belief, given he observes $p_1$ (these beliefs must be consistent with $M$’s equilibrium strategy).

Let $S_1^H$ and $S_1^L$ be the support of $\tilde{p}_1^H$ and $\tilde{p}_1^L$ and let $p_1 \in S_1^H \cup S_1^L$. Define by

$$\hat{x}_2 (p_1) = \max_{p_2} E \left[ X \mid \gamma_2 (p_1, p_2) \right]$$

(26)

$B$’s highest possible expected period 2 valuation, given she observes $p_1$, and let $\hat{p}_2 (p_1)$ be the highest maximizing price, i.e., $\hat{p}_2 (p_1) = \max \{ p_2 \mid \hat{x}_2 (p_1) = E \left[ X \mid \gamma_2 (p_1, p_2) \right] \}$.

\(^{12}\)Clearly, in our two-period model, regulating period 2 price to marginal cost ($p_2 = 0$) would also be Pareto-improving.
Suppose first that \( \widehat{x}_2(p_1) > u + c^H \) (we shall show that this cannot be the case). Then the profit maximizing period 2 price for both \( M^H \) and \( M^L \) is \( p^H_2 = p^L_2 = \widehat{p}_2 = \widehat{x}_2(p_1) - u \). At this price, both \( M \)-types make positive period 2 profits. Since \( p^H_2 = p^L_2 \), period 2 prices are not informative, so \( \gamma_2(p_1, p_2) = \gamma_1(p_1) \). Hence, \( E[X | \gamma_1(p_1)] = \widehat{x}_2(p_1) > u + c^H \). This has two implications. A), as \( B \) gets her outside option in period 2 and has expected valuation \( E[X | \gamma_1(p_1)] > u + c^H \), she can be charged a period 1 price \( p_1 = \widehat{x}_2(p_1) - u \geq c^H \), leaving both \( M \)-types with positive overall profits in equilibrium.

B), given that \( E[X] < u \), it follows that observing \( p_1 \) is indicative of \( x = x_H \). Therefore, there must be a price \( \overline{p}_1 \) in \( S^H_1 \cup S^L_1 \) that is indicative of state \( x = x_L \) (otherwise, \( \overline{p}_1^H \) would place more weight on all prices in \( S^H_1 \cup S^L_1 \) than \( \overline{p}_1^L \) which cannot be the case). Hence, \( E[X | \gamma_1(\overline{p}_1)] < u \) and \( \widehat{x}_2(\overline{p}_1) \leq u \) (otherwise \( \overline{p}_1 \) would be indicative of \( x_L \)). So under \( \overline{p}_1 \), \( B \) would only purchase at negative prices (in both periods), and both \( M \)-types must make 0 profits. Notice however, since \( M \) makes positive profits from charging \( p_1 \), he could benefit from shifting mass away from \( \overline{p}_1 \) to \( p_1 \). So \( \overline{p}_1 \) cannot be in \( S^H_1 \cup S^L_1 \), a contradiction.

Suppose next that \( u + c^L < \widehat{x}_2(p_1) \leq u + c^H \) (we shall show that in this case there cannot be sales in any period). In period 2, since \( p^H_2 \geq c^H \), \( M^H \) cannot make positive profits (otherwise, \( B \) would receive less than \( \widehat{x}_2(p_1) - c^H \) which is less than her outside option). Suppose \( p^H_2 > c^H \). Then if \( M^L \) charged \( p^L_2 \leq c^H \), he would be revealed as the \( L \)-type, and thus it cannot be that \( \widehat{x}_2(p_1) > u \). Suppose \( p^H_2 = c^H \), then if \( p^L_2 = c^H \), then for trade to occur it must be that \( \widehat{x}_2(p_1) = u + c^H \), and \( M^L \) makes positive period 2 profits in this case. So, the only possibility that allows trade in period 2 is \( p^H_2 = c^H \) and \( p^L_2 = c^H \). In this case, since period 2 prices are not informative, it follows as above that \( E[X | \gamma_1(p_1)] = \widehat{x}_2(p_1) = u + c^H \). Hence, observing \( p_1 \) is indicative of \( x = x_H \), and it follows by the same argument as in the previous paragraph that this cannot be the case (\( M^L \) makes positive overall profits at \( p_1 \) but 0 profits at \( \overline{p}_1 \)). This implies that there are no sales in period 2.

For trade to occur in period 1, it must be that there is a price \( p_1 \) with \( E[X | \gamma_1(p_1)] \geq u + c^H \) (otherwise, \( M^H \) would not charge this price, revealing the \( L \)-type). At \( p_1 \), \( M^L \) makes strictly positive profits. Since \( p_1 \) is indicative of \( x_H \) there must be another price that is indicative of \( x_L \) and we can construct a contradiction as in the previous paragraph. Hence, there are no sales in period 1 either.

Suppose finally that \( \widehat{x}_2(p_1) \leq u + c^L \) (we shall show that there cannot be sales at positive
prices in any period). In period 2, there is no sale at a positive price (otherwise $\hat{x}_2(p_1) - u$ would need to be strictly positive). Suppose $B$ purchases at a positive price in period 1. Then $E[X | \gamma_1(p_1)] > u$. Since $E[X] < u$, it follows that observing $p_1$ is indicative of $x = x_H$. But now the same argument as in the previous paragraphs shows that this cannot be the case. Thus there is no sale at a positive price in period 1.

Hence, if there are sales, then price must be 0. For this to be the case, $c^H$ must be 0, otherwise $M^H$ would make losses. □

References


