The Attention Economy

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Abstract

In recent years markets for attention have become a larger and more important part of the economy. The most prominent example is social media. But the market for attention includes mainstream media, advertising, and even university admissions committees. Attention, unlike regular goods, can also be "grabbed" by firms. We analyze a model of the attention economy where there are two types of goods: one which has a potentially higher payoff than the other but requires sustained attention. We begin our analysis with the choice of a single consumer, and then consider competition between firms. We show that "shallow" goods can crowd out "deep" goods and that in market equilibrium shallow goods can come to dominate. An implication is that increased competition in attention markets can be welfare decreasing.

JEL Classification: D01.

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1 Introduction

The notion that our cognitive resources are scarce is not a new one. More than half a century ago Herbert Simon (Simon (1971)) observed that "in an information-rich world, the wealth of information means a dearth of something else: a scarcity of whatever it is that information consumes. What information consumes is rather obvious: it consumes the attention of its recipients. Hence a wealth of information creates a poverty of attention and a need to allocate that attention efficiently among the overabundance of information sources that might consume it."

However much information there was in 1971 it's safe to say that there's a lot more in 2026. And it follows that the poverty of our attention is more acute than ever. This makes the problem individuals' face more pressing. But it also changes the nature of it.

To see this, note that in standard markets consumers make choices from a set of available alternatives. In the attention economy, by contrast, firms are able to *grab* part of consumers' attention. This may lead to consumers losing the ability to focus on what they most value and this, in turn, may effect their choices. It may also lead to socially undesirable outcomes.

There's plenty of anecdotal evidence to support the latter. Haidt (2024) documents US teens routinely spending six to eight hours a day on screens. Among Americans aged 15-24, face-to-face socializing fell by more than 45 per cent between 2003 and 2022. The share of 17-18 year-olds who read a book or magazine daily fell from 60 per cent in the late 1970s to 16 per cent by 2016.

In the US the proportion of people fifteen years or older reading for pleasure decreased 3% a year from 2003-2023. It peaked at 28% in 2004 and was 16% in 2023 (Bone et al., 2025). This is not a US-specific phenomenon. In Australia reading for pleasure in children declined from 79% to 72% between 2017-2022, while the percentage of children with a screentime of 20+ hours a week increased from 16-24% (Australian Bureau of Statistics, 2023).

These facts speak to the quantity of content consumed, but there has also been a profound shift in the type of content consumed. So-called "Microdramas"—short, serialized stories typically running around 2-3 minutes per episode—have expanded rapidly, generating $11 Billion in global revenues in 2025. 83% of this growth was in China, with the US the largest market outside of China. The most cited reason (47%) was because they are "quick and easy to watch" according to Hub entertainment Research. In the UK broadcast TV is in long-term decline (it fell 12% in 2021-22 alone), with attention switching to online-streaming platforms and social media (Ofcom, 2023).

In the face of a barrage of information and with limited cognitive resources, consumers are switching away from *deep* content toward *shallow* content. To put it bluntly, the modern attention economy has led to a triumph of "style" over "substance" (Cowen, 2007; Lanham, 2006).

Wu (2016) goes one step further and claims that competition leads to low-quality content crowding out high-quality content. As he puts it: "Under competition, the race will naturally run to the bottom; attention will almost invariably gravitate to the more garish, lurid, outrageous alternative."

The first part of our paper provides a framework for analyzing how an increase in the amount of information affects consumers' consumption of deep goods (to which we refer as "D-goods") relative to shallow ("S-goods"). The utility consumers receive from a D-good is convex in the amount of attention (or "time") devoted to it. While for an S-good it is approximately linear (marginally convex) in time.

As a consequence of this D-goods can yield a higher payoff than S-goods but they require sustained attention. Think of War and Peace compared to Real Housewives of Beverly Hills. Or The New York Times compared to the National Inquirer.

We then move to a market setting in which two types of firm compete for consumer attention. Firms produce either deep goods (type-D firms) or shallow goods (type-S firms). We show that there exist exactly two equilibria: either only type-D firms exist or only type-S firms exist.

A striking implication of this analysis is that competition can be welfare reducing. In standard markets competition is a good thing. Indeed, under the assumptions of the first-welfare theorem it leads to a Pareto optimal allocation of resources.

We are, of course, not the first to consider markets for attention. One formal strand of the literature models digital platforms—or attention brokers—as intermediaries that sell targeted advertising space to product firms and examines competition, data and welfare in that setting (Chen, ming; Prat and Valletti, 2022). We take a higher-level and more portable view which doesn't focus specifically on the advertising space, but instead firms make a general investment in attention-grabbing that applies across attention markets such as media, entertainment, advertising and university admissions. A growing body of evidence shows that firms increasingly invest in products designed to hijack consumer attention, including strategies that enhance product salience and mechanisms that promote habit formation (Allcott et al., 2022; Bordalo et al., 2016; Eliaz and Spiegler, 2011). As a result, a portion of consumers' attention is no longer under their direct control and is instead involuntarily captured by firms that compete for consumers' time.

These attention-capturing strategies can create well-documented negative externalities, including adverse effects on mental health, addiction, depression, and political polarization (Allcott et al., 2022; Braghieri et al., 2022; Gentzkow and Shapiro, 2006; Gupta and Sharma, 2021). Moreover, social media use is linked to complex welfare effects: individuals may experience disutility from non-participation due to social exclusion or network effects (Akerlof et al., 2026), whereas excessive use can lead to negative utility through the previously mentioned side effects (Allcott et al., 2020; Bursztyn et al., 2025). Hence, attention-grabbing features designed to prolong user engagement, such as infinite scrolling feeds, algorithmic content recommendation, and social feedback mechanisms (Montag et al., 2019), can not only induce users to consume beyond the optimal level, leading to welfare losses, but also reinforce the dominance of highly engaging content that outweighs utility.

This increased focus on attention-grabbing raises the question of whether another key product attribute—quality—has been deprioritized. An example of this trade-off is often observed in media markets, where firms strategically choose content in response to demand and reputational incentives, while institutional constraints and capture can distort information quality (Besley and Prat, 2006; Gentzkow and Shapiro, 2006). More recent work further highlights a quantity–quality trade-off, whereby increased entry can expand content supply but reduce average quality (Chen and Suen, 2023).

In this environment, attention is not entirely under the control of the consumer. A large literature in psychology shows that goal-directed attention can be overridden by salient information that is high in contrast, surprising, or prominent, thereby distracting agents from their initial goals (Bordalo et al., 2022). In an online context, this mechanism is especially relevant. By tracking the virality of New York articles Berger and Milkman (2012) show that high-arousal content is significantly more likely to attract and diffuse attention.

When modeling firm incentives to produce less reliable but more engaging content, Acemoglu et al. (2024) highlight how social media algorithms shape the popularity and distribution of news, often amplifying content that maximizes user engagement rather than information quality. When it comes to firm incentives in highly engaging environments, they develop a game-theoretic framework and analyze how firms design algorithms that prioritize the delivery of misleading content to like-minded users, creating polarizing and potentially harmful echo chambers.

Relative to this literature our essential innovation is to focus on how attention-grabbing changes the nature of the content which is provided by firms, chosen by consumers, and how competition in the attention economy affects welfare.

The remainder of the paper proceeds as follows. Section 2, which is the heart of the paper, contains our framework. We begin with a single-consumer problem and offer conditions under which consumers allocate their ungrabbed attention to the shallow good rather than the deep one. We discuss methods the consumer can use to defend herself against this attention-grabbing and the negative outcomes it induces. The second part of Section 2 focuses on competition between firms for consumer attention. We highlight how it is possible for shallow goods to dominate the market.

Section 3 extends the model to provide a more complete analysis of the positive and negative effects of competition in the market for attention. Section 4 extends the model to allow consumers to have a taste for variety. Section 5 considers two key applications of our framework: algorithmic attention grabbing and habit formation. Section 6 concludes. Proofs of formal results are relegated to an appendix.

2 The Model

2.1 Consumer Problem

2.1.1 Setup

There is a continuum of consumers with unit mass. A consumer can divide her attention (time) between n goods. Each consumer is endowed with 1 unit of attention such that $\sum_{k=1}^{n} \tau_k = 1$, where τ_k is the attention allocated to good k. The utility from good k is $u_k(\tau_k)$, and total utility is given by $U = \sum_{k=1}^{n} u_k(\tau_k)$.

There are two types of goods in the market, D (deep) and S (shallow). Each good k is one of these types and the utility for each type is given by:

$$u_D(\tau_k) = v_D \cdot \tau_k^{\sigma_D}, \text{ for type D}$$

$$u_S(\tau_k) = v_S \cdot \tau_k^{\sigma_S}, \text{ for type S}$$

Where $\sigma_D > 1$ and $\sigma_S = 1^+$. As such, the utility of a type D good is convex in time, while for a type S good it is approximately linear (marginally convex) in time. The quality of each good is denoted by v_D and v_S, with $v_D > v_S > 0$. The payoff functions of D and S goods are illustrated in figure 1.

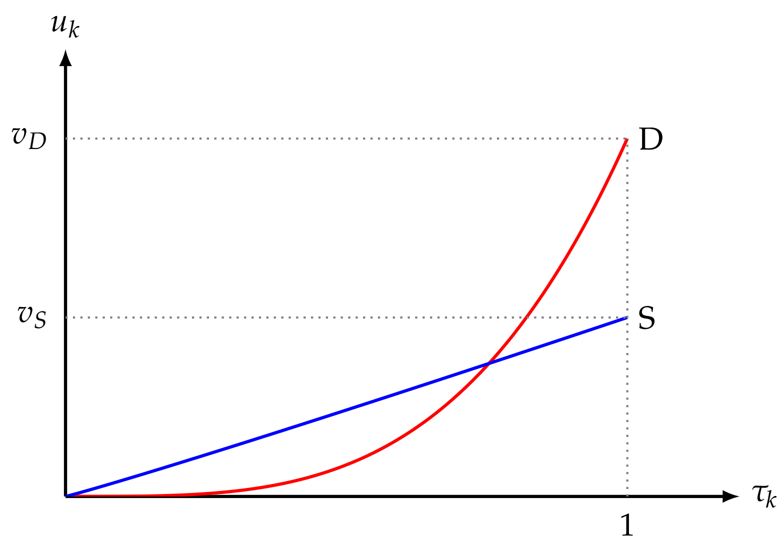


Figure 1: Utilities of type D and S goods

Evidently, type D goods are capable of yielding a higher payoff than S goods but they require sustained attention. Imagine War and Peace compared to Real Housewives of Beverly Hills. Or The New York Times compared to the National Inquirer.

As noted above, consumers have a finite budget for attention. Additionally, the consumers' attention allocation is partly under their control and partly not. The total attention devoted to good k is given by $\tau_k = t_k + g_k$, where g_k is the attention "grabbed" by good k and t_k is the attention that the consumer will freely allocates to good k. Both types of goods have the potential to "grab" some attention. The consumer problem becomes choosing t_k's to maximize utility, subject to their limited attention budget and the amount of grabbed attention.

2.1.2 Analysis

Consider the consumption behavior of agent i in a market where there are two goods of a given type, suppose two D goods, and they have initially allocated $\hat{\tau}_{iD}$ to each good. The remaining attention to allocate is equal to $1 - 2 \cdot \hat{\tau}_{iD}$. Recall that utility from a type D good is convex in time and as such $\frac{d\, u_D(\tau)}{d\, \tau} > 0$ and $\frac{d^2\, u_D(\tau)}{d\, \tau^2} > 0$. Consequently, it is easy to show that the optimal choice for consumer i is to allocate all remaining attention to a single D good, rather than split their time between the two goods.[1] This would also be the case for a market of two type S goods, because of the marginal convexity of the utility function. However, there is a much smaller penalty to consumer i if they did split remaining attention across the two S goods.

Of greater interest is the behavior of consumer i when both types of goods are present in the market. Suppose there is a single type D good in the market (call this good D) and multiple S goods. Both types of goods have distracting, attention grabbing features. Let $g_{-D} = \sum_{k \neq D} g_k$ be the total distraction ("grabbability") by goods other than good D. Furthermore, notice that there is an amount of attention (call this $\bar{\tau}$) in which agent i is indifferent between consuming a D good and S good. Specifically:

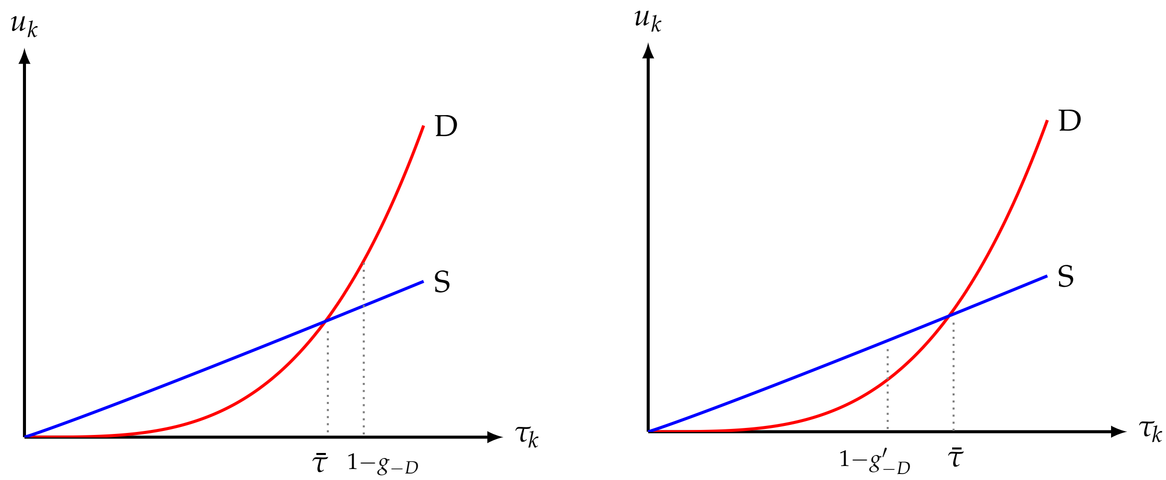
$$\bar{\tau} = (\frac{v_S}{v_D})^{\frac{1}{\sigma_D - \sigma_S}}$$

Consequently, the consumer will optimally allocate their "ungrabbed" attention to the D good if distraction from the other goods is low, $g_{-D} < 1 - \bar{\tau}$. Alternatively, if the other S goods have a high capacity to grab attention, $g'_{-D} > 1 - \bar{\tau}$, then it is optimal to allocate chosen attention to an S good. Intuitively, if agent i is in a market of many distracting goods they choose Real Housewives instead of War and Peace. As their attention is grabbed and dispersed across several goods, they cannot sustain enough attention to reap the benefit of consuming War and Peace. This is illustrated graphically in figure 2. The specific functional form of g_{-D} will be introduced in the firm problem in section 3.2.

2.1.3 Taking a Walk

To illustrate this, consider the following thought experiment. Before cell phones, going on a walk meant being alone with one's thoughts. In this setting, the only good available for

[1] By the same logic, suppose one of the D goods (call this good 1) initially had $\tau'_i = \hat{\tau}_{iD} + \epsilon$ allocated to it. It is optimal for consumer i to allocate all remaining attention to good 1, and none to good 2. Alternatively, if there are two D goods i and j, whereby $\tau_i > \tau_j > 0$, shifting any small amount of attention from good j to good i strictly increases utility.



(a) Low distraction

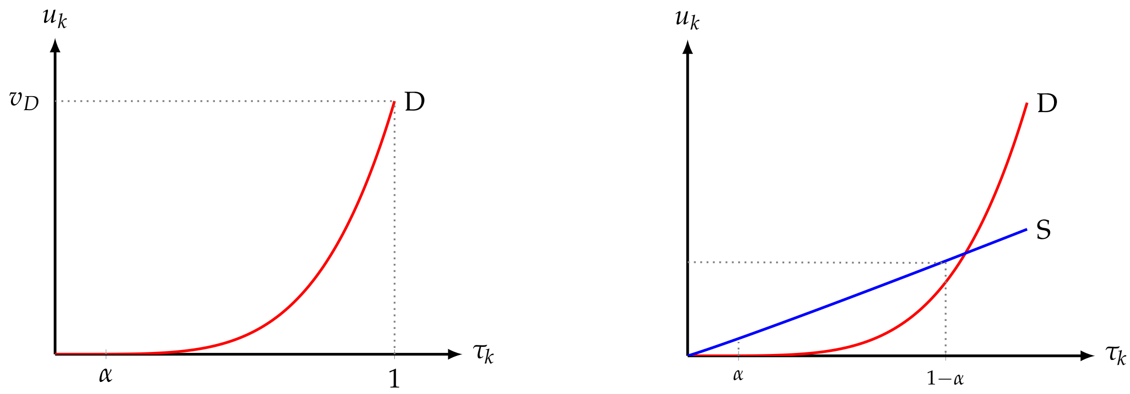
(b) High distraction

Figure 2: Optimal attention allocation for consumer i when the market is high vs low in attention-grabbing goods.

consumption was thinking (a type D good). Given that all available attention is devoted to the same task, the consumer derives their full utility, v_D.

Now suppose a second option is introduced: checking one's emails. This is a type S good with utility v_S. Although a type D good ultimately yields higher utility, this only occurs if attention exceeds the indifference threshold, below this threshold, S yields a higher utility due to its steeper initial payoff.

Both thinking and email-checking capture attention. Lets suppose each type of good grabs the same amount of attention α. If α is sufficiently large, attention is diverted away from thinking and the remaining (ungrabbed) attention is insufficient to achieve a high payoff from thinking, making it optimal to allocate the remaining attention to email-checking instead. Figure 3 illustrates this.



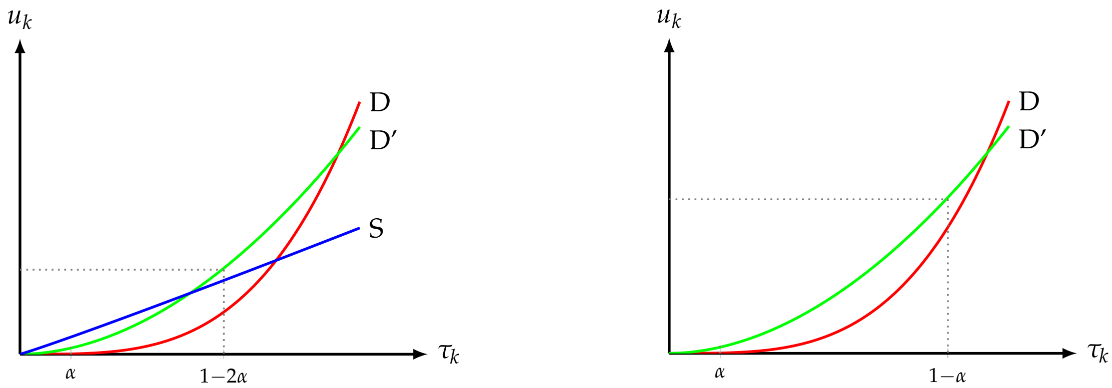
(A) An agent's consumes thinking

(B) An agent chooses email

Figure 3: Utilities when email-checking is introduced

Going a little further now, lets introduce a third option of listening to a podcast. We can think of a podcast as a medium-quality type D good, denoted by D', such that $v_D > v_{D'} > v_S$. Additionally, podcasts do not require as much sustained attention to achieve a high payoff compared to thinking one's thoughts, yet they do require more than email-checking, such that $\sigma_D > \sigma_{D'} > \sigma_S$. When there are two goods grabbing attention (and α is high), the utility derived from allocating all residual attention to a podcast is lower than the utility obtained from fully concentrating on one's own thoughts (panel B figure 4). However, in a setting where emails also capture some of a consumer's attention, allocating the remaining attention to a podcast generates higher utility than devoting oneself entirely to email-checking (panel A figure 4).

Since the utility curve associated with D' is less convex, a higher utility $U_{D'}$ can be achieved from less attention. Thus, once attention becomes fragmented, listening to a podcast yields more utility than either thinking or looking at emails. Essentially, podcasts are welfare-enhancing in the presence of email, yet welfare-reducing in its absence.



(A) Podcasts chosen over email

(B) Podcasts chosen over thinking

Figure 4: Utilities when Podcasts are introduced (with vs without email-checking)

2.2 Competition for Attention

2.2.1 Firm Problem: Setup

There are two types of firms, $\gamma \in \{D, S\}$, that produce either good D or good S. There is a finite, yet large number of potential entrants. We denote the number of firms that enter by $n = n_D + n_S$. This is a simultaneous-move game with two stages. The timing of the game is as follows:

1. Firms decide whether to enter the market. To enter they pay a fixed cost F^γ:

$$F^\gamma = \begin{cases} F^D = \kappa + I^D, & \text{if type D,} \\ F^S = \kappa + I^S, & \text{if type S.} \end{cases}$$

   where κ is a common entry cost and I^γ is a type-specific setup cost.[2] We assume $I^D > I^S$, reflecting good D's higher quality.

2. Firms that enter decide whether to grab attention. $I_i^g \in \{0, 1\}$ denotes firm i's decision to invest in attention grabbing features (such as advertising, notifications, personalized or sensationalist content) and $c_g > 0$ denotes the cost of this invest-

[2]One could also think of it as an investment in the quality of good produced.

ment. We assume a specific functional form whereby if a firm invests in grabbing attention they receive α units of attention. As such α parameterizes the ease or difficulty of capturing consumers attention. If firm i does not invest they do not grab any attention.

The payoff for firm i depends on whether they decide to enter the market and is given by:

$$\pi_{i\gamma} = \begin{cases} \tau_i - c_g \cdot I_i^g - F_\gamma, & \text{if firm } i \text{ enters,} \\ 0, & \text{if firm } i \text{ does not enter.} \end{cases}$$

Where τ_i is the fraction of the population consuming good i. For notational ease we define $C_\gamma \equiv c_g + F_\gamma$. We make two parametric assumptions. First, $c_g < \alpha < F_S$ ensures the payoff of grabbing attention outweighs the cost, but is strictly less than the fixed cost for a type S firm. Second, $F_D + c_g < \frac{1}{2}$ rules out a monopoly market. Notice that the cost to invest in attention grabbing features c_g is a larger proportion of overall costs for a type S firm compared to a type D firm. In this way, S goods can be considered frivolous while D goods are mroe nuanced.

2.2.2 Firm Problem: Analysis

To characterize the equilibria of this game, first consider the attention grabbing behavior of firms in the market. A preliminary result is that, given a firm enters the market, they will always grab attention. Lemma 1 states this formally.

Lemma 1. *Conditional upon entry, all firms of either type $\gamma \in \{D, S\}$ will invest in grabbing attention, such that $I_i^g = 1 \; \forall \; i$.*

To understand the intuition for this recall that agents prefer to consume a single good. As a result, agents prefer to allocate all of their chosen time to the good (within each type γ) that initially has grabbed the most of their attention. Therefore, all firms have an incentive to invest in attention-grabbing features because this is the only way to "win" the consumers ungrabbed time in the presence of competition. Whether a firm is the New

York Times or the National Inquirer, to engage a consumer for a sufficient amount of time their attention must first be captured. In fact, the second-stage subgame is a canonical prisoner's dilemma, in which firm's are collectively better off not investing in attention-grabbing features, but individually have an incentive to deviate, and this inadvertently makes all firms worse off.

There are two important model implications of lemma 1. First, we now have a derived functional form for g_{-D}. Since all firms grab attention we have

$$g_{-D} = \alpha(n-1)$$

The firm problem now equates to a one-stage entry game. This is illustrated in figure 5. If $g_{-D} < 1 - \bar{\tau}$, agents optimally consume D goods and only type D firms can profitably enter. This is because if a type S firm entered they could grab at most attention α. However, given $\alpha < C_S$, profits would be strictly negative and the S firm would not credibly enter. We refer to this as the *D-preferred region*. Conversely, if $g'_{-D} > 1 - \bar{\tau}$, agents optimally consume S goods and only type S firms can profitably enter. We call this the *S-preferred region*.

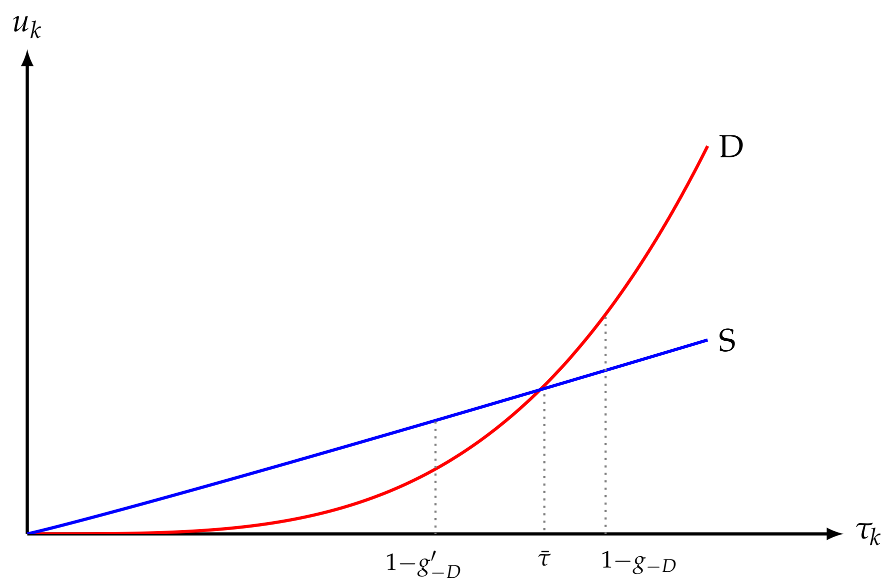


Figure 5: Entry decision for firms. D firms only enter when $g_{-D} < 1 - \bar{\tau}$. Only S firms enter when $g'_{-D} > 1 - \bar{\tau}$.

2.3 Equilibria and Comparative Statics

To this point we have examined optimal consumer behavior and established that entrants always have an incentive to grab attention. We will now characterize the equilibria of this game and consider its comparative statics properties.

2.3.1 Equilibria

Proposition 1. *There exist exactly two equilibria, one in which only type D firms exist, and one in which only type S firms exist. Specifically:*

1. *D-only equilibrium: When* $\alpha < \frac{C_S(1-\bar{\tau})}{1-C_S}$*, an equilibrium exists where* $n_D^* = \frac{1}{C_D}$ *and* $n_S^* = 0$.
2. *S-only equilibrium: When* $\alpha > \frac{C_D(1-\bar{\tau})}{1-C_D}$*, an equilibria exists where* $n_D^* = 0$ *and* $n_S^* = \frac{1}{C_B}$.
3. *Multiplicty: When* $\frac{C_S(1-\bar{\tau})}{1-C_S} \leq \alpha \leq \frac{C_D(1-\bar{\tau})}{1-C_D}$*, multiple equilibria arise where the D-only equilibrium (*$n_D^* = \frac{1}{C_D}$*,* $n_S^* = 0$*) or the S-only equilibrium (*$n_D^* = 0$*,* $n_S^* = \frac{1}{C_S}$*) can exist.*

Figure 6 illustrates the equilibria that arise as a function of the propensity to grab attention in the model (α) and the common entry cost (κ) for a representative case (reasonable parameter values for c_g, I_D, I_S).

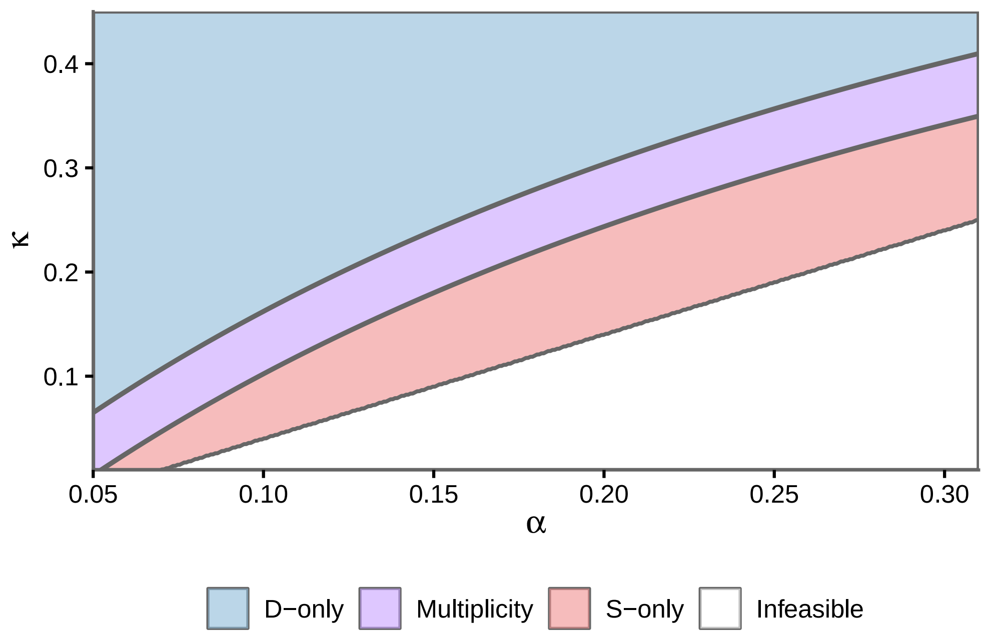


Figure 6: Equilibria characterized by α and κ.

We see in figure 6 that when the ability to grab attention is high, and/or the common entry cost is low, an equilibrium of only type S firms arises. Conversely, when it is difficult to grab consumer's attention and barriers to entry are high, a D-only equilibrium arises. The purple-shaded region indicates the multiplicity of equilibria, where either a D-only or S-only arises. The subtlety here lies in the fact that the consumer's optimal allocation depends on the equilibrium number of firms n^* that enter the market. However, type D firms have higher total costs than S firms which gives rise to this overlap in the parameter space for α.

Given the finite attention budget, $\sum_{k=1}^{n} \tau_k = 1$, an implicit condition in our model is that $\alpha n^*_\gamma < 1$, i.e. in aggregate firms can not grab more attention than is available. In equilibrium, this condition is necessarily met, given $\alpha / C_\gamma < 1$ (recall $\alpha < C_\gamma$). We consider a case off the equilibrium path, where the number of firms that enter and invest in attention grabbing (call this z) is greater than the equilibrium number of firms n^*_γ. If $z\alpha > 1$, then, by symmetry, each firm grabs $\frac{1}{z} < \alpha$. However, this is not sustainable given firms would be making negative profits as $\pi_\gamma = \frac{1}{z} - C_\gamma < 0, \forall\ \gamma$. Note that for $z > n^*_\gamma$, even if firms received α units of attention (no ungrabbed attention), firm entry would still be unprofitable as $\alpha < C_\gamma$.[3] Indeed, a fundamental property of our model is that for a firm to have weakly positive profits, they require some positive amount of ungrabbed, allocated attention $t_{i\gamma} > 0$. We therefore rule out the cases where $z > n^*_\gamma$.

2.3.2 Comparative Statics

What is the effect of a change in entry costs on the composition of firm's and consumer welfare? Figures 6 and 7a provide insight into the effect of competition in the attention economy. Suppose entry costs (κ) are initially high and we are in an equilibrium of relatively few firms, all of which are type D. As entry costs fall, more type D firms enter, this disperses attention (as each firm makes attention-grabbing investments). When attention becomes sufficiently dispersed, consumers want to switch to a type S good. This provides the conditions for entry by S firms to be profitable. With S firms entering and consumers allocating all chosen attention towards S goods, type D firms are unprofitable and exit the market.

Thus, the market shifts from D-only to S-only, and from high-quality content to lower-quality content. This echoes Wu (2016) diagnosis that under competition in the attention market the "race will naturally run to the bottom". The monetization of consumer's attention invariably results in efforts by firms to grab this limited supply of attention, and ultimately the quality of the output produced is degraded.[4]

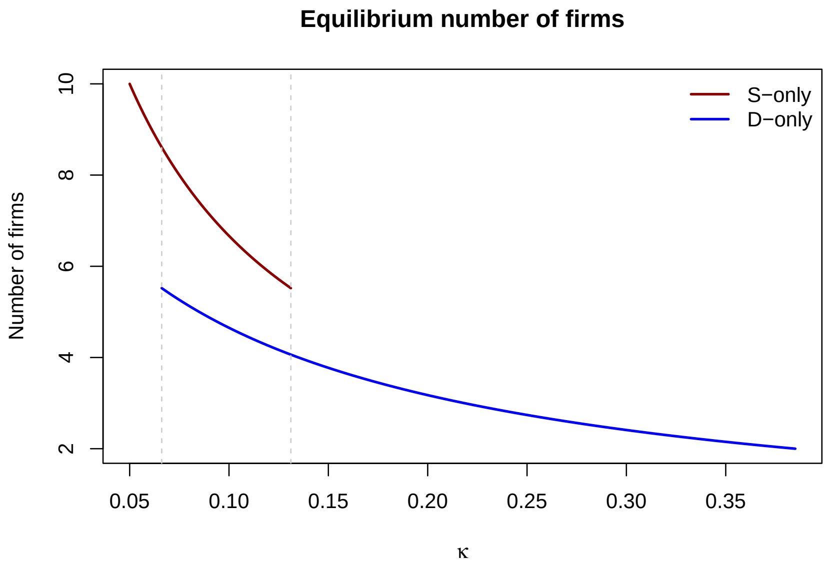
The welfare effects of increased competition are illustrated in figure 7b. In the D-only equilibrium consumer welfare is strictly increasing in entry costs, with $\frac{dU_D}{d\kappa} > 0$ for all feasible parameter values. Intuitively, the convex payoff of type D goods requires a con-

[3]Consider the case where, in the first stage, the maximum number of firms enter, *ex ante* any attention grabbing investment decisions made by firms. This would correspond to $n_1 = \frac{1}{F_\gamma}$, even if each firm now grabbed attention, there is still necessarily some strictly positive amount of residual ungrabbed attention that firms compete over, given $\frac{\alpha}{F_\gamma}\ \forall\ \gamma$.

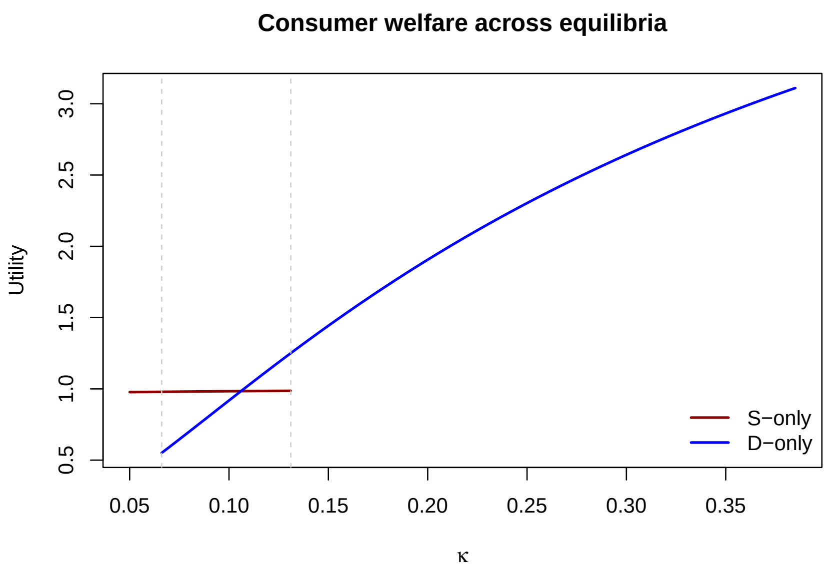
[4]Recent empirical evidence provides causal support for this mechanism. Balbuzanov et al. (2025) conducted a field experiment with news outlets in Kenya, randomly assigning journalists to pay-per-click (PPC) contracts or piece-rate contracts. The PPC contract increased reader traffic and crucially, PPC writers shifted content production away from local news and towards attention-grabbing political stories.

sumer to allocate sustained attention in order to receive a high payoff. When entry costs fall and additional D firms enter the market and grab consumer's attention, it disperses the agents attention to these other D goods. For low levels of allocated attention, D goods have relatively weak payoffs[5], thus welfare decreases. In the S-only equilibrium, welfare is strictly increasing ($\frac{dU_S}{d\kappa} > 0$), but approximately 0. Intuitively, as S goods give virtually the same marginal utility at low levels of attention compared to high levels of attention[6] then as entry costs fall and the number of S firms increase, the penalty to attention dispersion is much smaller relative to the D-only equilibrium. Notice, that for most of the parameter space for κ in figure 7b, utility is greater in the D-only region than the S-only region, reflecting the discontinuous drop in product quality ($v_D > v_S$) across these two equilibria. However, there is a region of κ where $U_S > U_D$. The intuition here is that when κ is sufficiently high and a consumers attention is dispersed, the relatively larger payoff at low levels of attention for S goods compared to D goods means consumers are better off being distracted and having their attention captured by these S goods that provide a larger immediate utility. When consumers are highly distracted they would rather tune in to 20 minutes of Real Housewives than invest the effort to read (or watch) War and Peace for only a short period of time.

[5]One can think of type D goods requiring larger start-up costs than type S requiring focus and a form of "active" consumption.
[6]They are relatively effortless to consume.



(a) Market Composition



(b) Consumer Welfare

Figure 7: Comparative statics on κ: Baseline Model.

What is the effect of a change in the propensity to grab attention on consumer welfare? In the D-only equilibrium utility is strictly decreasing in α, $\frac{dU_D}{d\alpha} < 0$. Intuitively, as D goods are more able to grab an agents attention (perhaps due to algorithms or leaking content on social media) then less of it is allocated to the agent's chosen D good, which provides an increasingly high payoff with more allocated attention. Essentially, attention becomes more dispersed with each firm capturing more of an agent's attention. The negative utility effects of increased α are weakened in the S-only equilibrium, by the same intuition as the comparative static on κ - the marginal payoff for S goods at low vs high levels of attention is virtually the same. This result highlights possible negative welfare effects of technological innovations designed to capture consumers attention, such as algorithms or the recent rise of using TikTok to promote TV shows and film. These technologies can push markets toward lower-quality S goods and away from high-quality D goods.

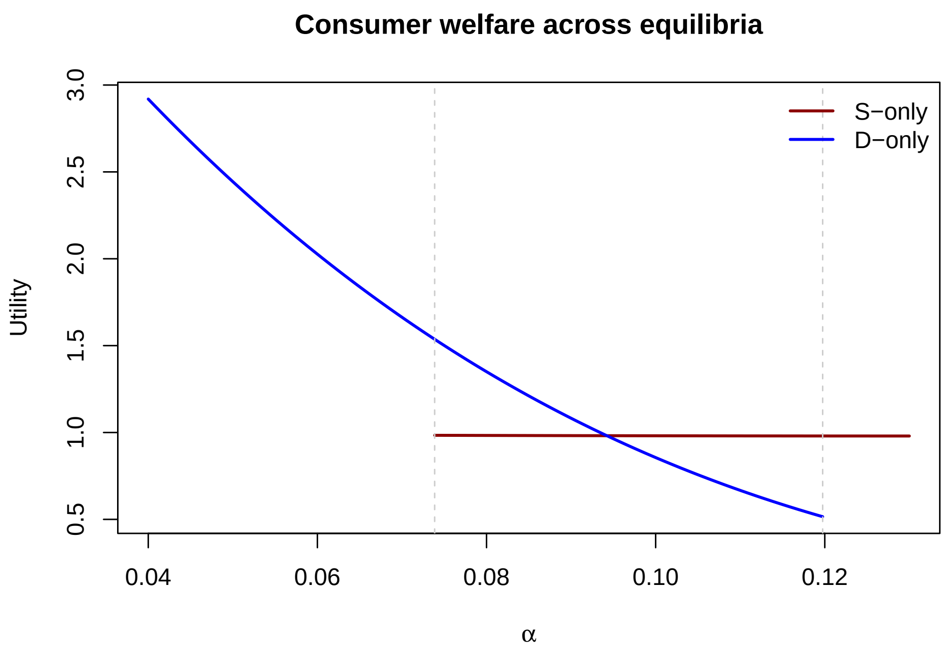


Figure 8: Consumer Welfare - α

2.3.3 Show vs. Substance

With small changes to the model, we can consider a scenario in which a goods ability to grab attention and its type are endogenously related. The change involves relaxing the original assumption that a goods ability to capture attention is independent of its type. Instead, think of type S goods with steeper initial utility profiles as also more effective at grabbing attention. Formally, a type D good captures attention α, whereas a type S good captures attention α', where $\alpha' > \alpha$. Firms face a trade-off between producing high-quality goods with "substance" that requires sustained attention and lower-quality "show" goods that capture attention more immediately and effectively.

An example of this show versus substance trade-off was described by Matt Damon in an interview on the The Joe Rogan Experience. Discussing Netflix's production recommendations:

> "Can we get a big [action sequence] in the first five minutes? We want people to stay tuned in. And you know it wouldn't be terrible if you reiterated the plot three or four times in the dialogue, because people are on their phones while they're watching."

Many type S goods produce highly stimulating, sensationalist content that is designed to keep consumers engaged from the outset, even when the content lacks substance. By virtue of D goods producing more complex, high-quality and thoughtful content, this often comes at the expense of an immediate capture of an audiences attention. Consequently, "showy" goods are able to grab more attention than "substance" goods, and they occupy a larger share of a consumers attentional environment.

If firms choose to produce type S goods, the total amount of distracted attention in the market increases. Attention capture by S firms is equal to $d = \alpha'(n_s - 1)$, which is greater than that of the original model where the efficiency of attention grabbing was independent of a goods type ($\alpha' > \alpha$). When S firms enter the market, an agents attention becomes increasing fragmented making it harder for consumers to achieve high utility from type D goods. As a result, the market can degenerate even more rapidly to an S only equilibrium leading to the triumph of "show" over "substance".[7]

[7] One can easily see how with this model adjustment it preserves the essence of the results from the baseline model. However, now the parameter space for S only firms will be larger and this is because a goods type and attention-grabbing capacity are endogenously related.

3 Extension: Good and Bad Competition

3.1 Setup

A key result of our baseline model is that increasing competition in an attention-based market can be welfare-reducing. However, it is plausible that some amount of competition is welfare-enhancing. We model this by introducing heterogeneity into consumers tastes for type D goods.[8] Specifically, suppose that each consumer i values a given D good as high-quality v_H with probability p or as low-quality v_L otherwise,

$$v_D = \begin{cases} v_H, & \text{with probability } p, \\ v_L, & \text{with probability } 1-p. \end{cases}$$

Where $v_S < v_L < v_H$ and v_D is conditionally independent across goods and across consumers (i.e. consumers have different preferences). This gives rise to a "good" competition channel, whereby increased firm entry improves likelihood a consumers specific tastes are met.

We define an agent's indifference point between a high-D good vs an S-good as τ_H, and the indifference point between consuming a low-D good vs S-good as τ_L, noting that $\tau_H < \tau_L$.[9] This is illustrated in figure 9. Furthermore, we make three assumptions. First, $\underline{p} < p < \bar{p}$, which implies that the probability of valuing any given D good is above some low-probability threshold, but below some very high-probability threshold.

Second, we assume $\alpha > 2c_g$, which is a slightly stronger assumption on α than in the baseline model. Third, $\frac{1-\tau_H}{1-\tau_L} > \omega$ ensures that consumers preference between high and low-value D goods is not negligible.[10] Both $\underline{p}$, $\bar{p}$ and ω are defined in the appendix.

[8] Note, that for simplicity tastes remain homogeneous for S goods. This is because, in reality consumers are likely to have stronger preferences for a particular D good, such as reading War and Peace or The English Patient, compared to S goods - Real Housewives vs the Kardashians. Incorporating heterogeneous tastes across type S goods has no meaningful impact on our results in the section.

[9] This is because $(\frac{v_S}{v_H})^{\frac{1}{\sigma_D-\sigma_S}} < (\frac{v_S}{v_L})^{\frac{1}{\sigma_D-\sigma_S}}$.

[10] The first assumption is important for the incentive for firms to grab attention and the the existence of a

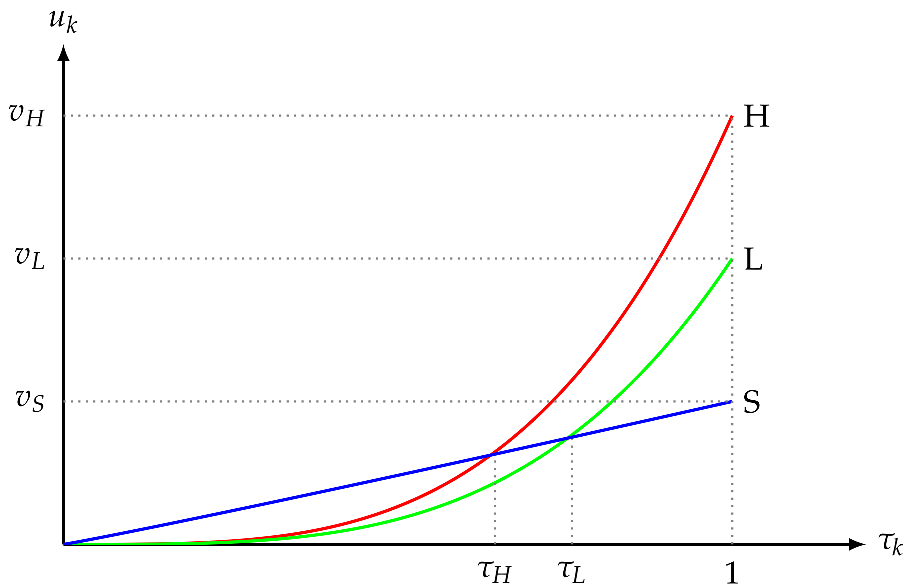


Figure 9: Heterogeneity in consumer preferences

3.2 Analysis

Compared to the baseline model, the differing preferences agents have over different D goods leads to great nuance of their optimal behavior. There are three cases. Firstly, when distraction in the market is low, $g_{-D} < 1 - \tau_L$, then agents always consumer an type D good, even if they value all goods in the market as low-quality. Second, when there is an intermediate level of distraction $1 - \tau_L < g_{-D} < 1 - \tau_H$ agents will only consume a type D good if they value at least one of the D goods in the market as high-quality, otherwise they will optimally choose an S good. Finally, if firms have a high capacity to grab attention, $g_{-D} < 1 - \tau_H$ then agents will always allocate ungrabbed attention to an S good. This intermediate case gives rise to the possibility of an equilibrium in which both type D and type S firms exist. This is because there will be some fraction of consumers who do not value any of the D goods as high-quality, and S firms can serve this side of the market. Note that in this co-existence equilibrium, our Lemma 1 result still holds,

unique, coexistence equilibrium. The second is for ease of characterizing equilibria. If the inequality is reversed it simply creates a larger region of multiplicity. It does not meaningfully change our results.

with all entrants grabbing attention.[11] The intuition follows that of the baseline model (*see Appendix for detail*). Hence, $g_{-D} = \alpha(n-1)$, as before.

In the high (low) distraction world it is only profitable for type D (S) firms to enter. In these cases, firm profit functions are identical to that of the baseline model. However, in the case of an equilibrium with both type D and S entrants, the structure of firm payoffs changes. Let $\lambda(n_D)$ denote the fraction of agent's consuming a D-good. In the coexistence equilibrium notice that $\lambda(n_D) = 1 - (1-p)^{n_D}$. Therefore, we have,

$$\pi_D = \alpha + \frac{\lambda(n_D)}{n_D}(1 - \alpha\, n) - C_D \tag{1}$$

$$\pi_S = \alpha + \frac{1 - \lambda(n_D)}{n_S}(1 - \alpha\, n) - C_S \tag{2}$$

Furthermore, we have the following equilibrium condition for total market attention.

$$n_D\, \tau_D + n_S\, \tau_S = n_D\, C_D + n_S\, C_S = 1 \tag{3}$$

This states that the sum of the market shares captured by each individual type D and S firm is equal to the total amount of attention in the market. We will now formally characterize the equilibria of this game.

Proposition 2. *There are three types of equilibria. An equilibrium with only type D firms, one with only type S firms and a coexistence of both type D and S firms.*

1. *D-only: When α is low there exists an equilibrium where only D firms exist, with $n_D^* = \frac{1}{C_D}$ and $n_S^* = 0$. Specifically, $\alpha < \frac{C_D(1-\tau_L)}{1-C_D}$.*

2. *S-only: When α is high there exists an equilibrium where only S firms exist, with $n_D^* = 0$ and $n_S^* = \frac{1}{C_S}$. Specifically, $\alpha > \frac{C_S(1-\tau_H)}{1-C_S}$.*

[11] Richard and Rob, some tighter parametric assumptions are required here, it wold be worth double checking my logic for this point.

3. *Coexistence: When α is in an intermediate range there exists a unique co-existence equilibrium with $n_D^* > 0$, $n_S^* > 0$ and $n \in (\frac{1}{C_D}, \frac{1}{C_S})$. Agent's consume either an S good or a high-quality D good. Specifically,* $\frac{C_D(1-\tau_L)}{1-C_D} < \alpha < \frac{C_S(1-\tau_H)}{1-C_S}$.

4. *Multiplicity: When* $\alpha = \frac{C_D(1-\tau_L)}{1-C_D}$ *a mulitplicity of equilibria arises where only D-firms exist or there is coexistence. Also, when* $\alpha = \frac{C_S(1-\tau_H)}{1-C_S}$ *multiple equilibria arise where only S-firms exist or there is coexistence.*

Figure 10 illustrates these different equilibria across the feasible α and κ parameter space, for a representative case. Evidently, a D-only equilibrium exists when the ability to grab attention is low and the number of entrants is high. Furthermore, there is large parameter space in which co-existence is possible, while the S-only equilibrium exists when there are low barriers to entry and a sufficiently high ability to capture attention. The dotted grey line shows how equilibrium changes with the common entry cost κ (for a fixed $\alpha = 0.03$) and is used for the comparative static.

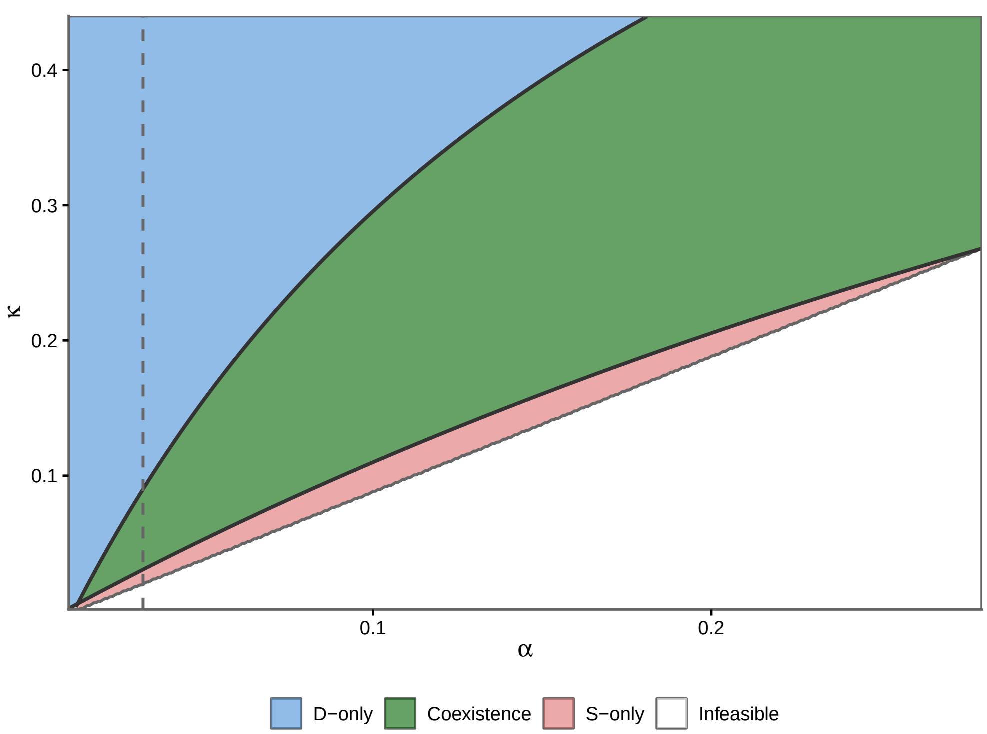


Figure 10: Equilibria characterized by α and κ - Extension 1.

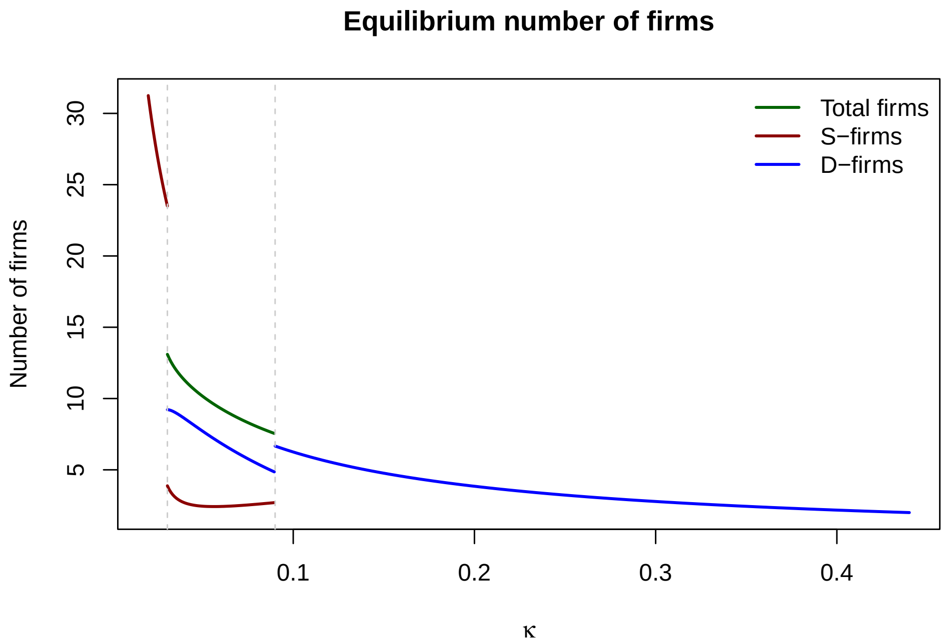
3.2.1 Comparative Statics

We first examine the impact of changes in the entry cost κ on the composition of firms in the market. Initially, with high barriers to entry, only type D firms can profitably enter the market. However, as entry costs lower and more D firms enter attention disperses. Once attention has become sufficiently dispersed it is optimal for consumers who do not value any of the D goods as high-quality, to consume a type S good. This enables entry of some S firms who compete for this segment of the market. Once entry costs have fallen dramatically, attention becomes so dispersed that consumers prefer to consume an S good over any type D good. Note that given the complex looping nature of the D firm entry and the probability consumers choose a D good in the coexistence equilibrium, it is possible for the number of S and D firms to move non-monotonically as κ changes. This is illustrated in figure 11a.

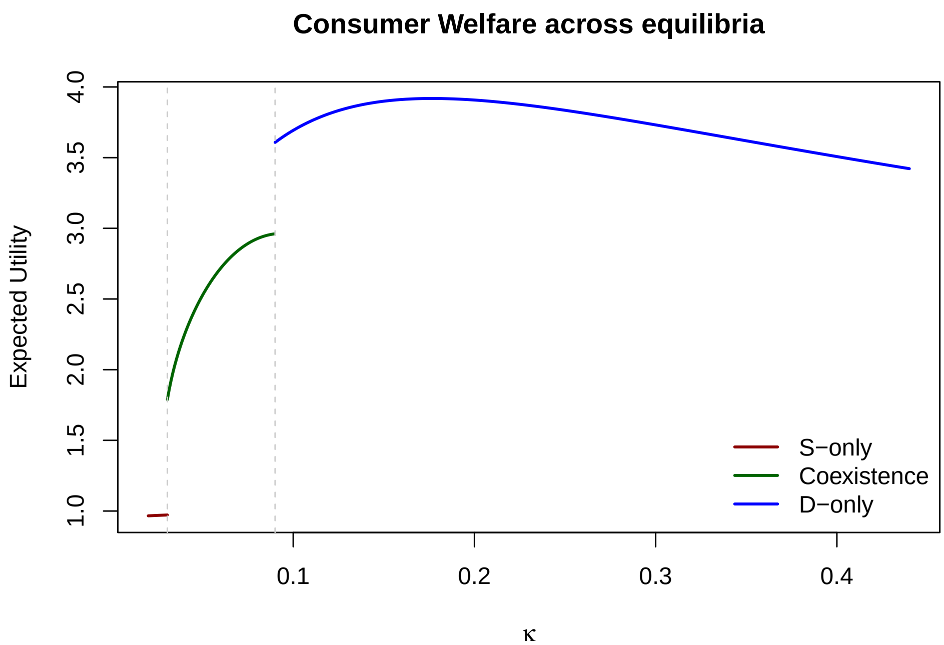
The key result of the extended model is the effects of competition on consumer welfare. Figure 11b illustrates that competition can be both welfare-enhancing and welfare-reducing. In the D-only equilibrium, for this particular parameterization, competition is mostly beneficial. This occurs because the increased number of type D entrants when entry costs decrease improve the probability of a better match between firm and consumer (high-quality), i.e. consumers specific tastes are met. At the same time, through the mechanism of attention dispersion that was detailed in the baseline model, increased entry can reduce welfare. Welfare tends to monotonically decline once the negative effect of attention dispersion outweighs the increased probability of a high-quality match. Furthermore, Figure 11a illustrates that there can be a discontinuous drop in welfare across the different equilibria. This is driven by the exit of type D firms, as a relatively larger number of S firms enter, increasing attention dispersion. Note that the discontinuous decreases in utility across equilibria as κ falls, and the clean monotonic increase and then decrease in welfare as more firms enter holds for many, but not all parameterizations. It tends to not hold if certain parameters take extreme values. For intuition, consider the probability of a high-quality match p, when this value is very small, then the negative welfare effect of attention dispersion will dominate.

This is because when there is a low-probability of a high-quality match, the expected utility from an additional entrant is low relative to the cost of reduced attention allocated to the consumers chosen good. Conversely, when p is very large, then there is already a high chance of a good firm-consumer match such that the additional entrants reduce welfare as attention dispersion dominates.[12] An intermediate value of p gives rise to hump shaped welfare. *Additional details on good and bad competition are offered in the appendix.*

[12]We can see this because that $\frac{d^2\lambda(n_D)}{dn_D\, dp} < 0$ when p is large, and $\frac{d^2\lambda(n_D)}{dn_D\, dp} > 0$ when p is small. Note, here $\lambda(n_D) = 1 - (1-p)^{n_D}$ as before, but in the D-only equilibrium is interpreted as the fraction of agents consuming a high-quality D good.



(a) κ and firm composition.



(b) κ and consumer utility.

Figure 11: Comparative statics on κ - Extension 1.

3.3 Remark: Coexistence

An important result of our extended model is that existence of an equilibrium in which there are both type D and S firms in the market. This was incorporated by introducing heterogeneity into consumer tastes for D goods. However, one can imagine other adjustments to our baseline model that would also give rise to a coexistence equilibrium. We will briefly discuss two alternative model choices that would produce such a result: 1) different aptitudes for D goods across agents, and 2) heterogeneity in effort costs to avoid distraction.

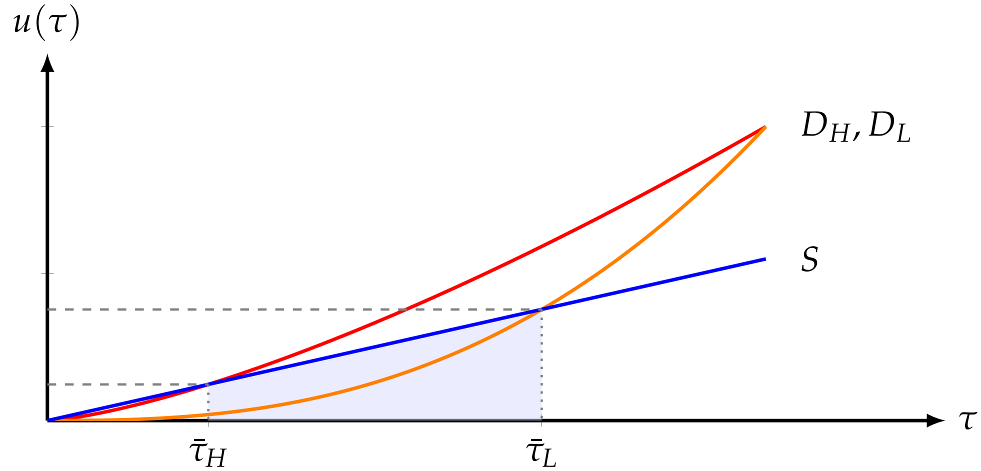
3.3.1 Aptitude for D goods

We can create a setting in which coexistence of D and S goods is possible by simply allowing consumers to differ in aptitude for type D goods. For example, individuals who are accustomed to reading and comprehending complex text may require less sustained attention before the utility derived from a book exceeds the utility derived from a lower-effort type S good. Yeung (1999) demonstrated that expertise reduces the cognitive load required to process and engage with complex material.

Let $a_i > 0$ denote consumer i's aptitude for type D goods. A consumer's aptitude will impact utility accumulating rate; more apt consumers will require less attention before reaching a high-payoff region. A way of thinking about this within the model is by changing the utility function of type D goods for higher aptitude subjects. $u_{Di}(\tau) = v_D \tau^{\sigma_D - a_i}$, whenever $\sigma_A - a_i > 1$. The utility of S goods remains the same for all consumers, while D goods have the same utility for lower-ability consumer as the standard model.

Under equal attention allocation τ_e, the apt agent will choose a type D good whenever $v_D \tau_e^{\sigma_D - a_i} > v_S \tau_e^{\sigma_S}$. We can then easily demonstrate that the threshold level of attention at which the consumer is indifferent between D and S becomes $\bar{\tau}_i = \left(\frac{v_S}{v_D}\right)^{\frac{1}{\sigma_D - a_i - \sigma_S}}$, and since $\frac{\partial \bar{\tau}_i}{\partial a_i} < 0.$, consumers with greater aptitude for type D goods require less sustained attention before a high-quality good becomes a more attractive option than the type S

alternative.



High aptitude reduces the attention threshold at which type D dominates type S.

In the graph we can see the blue shaded region where the two different types of consumers would demand different goods. Consumer D_H has a preference for type D goods, while D_L optimally consumes S.[13] Thus, within this region firms can enter the market and profitably produce either D or S goods.

3.3.2 Heterogeneity in cognitive control

Imagine a variant of the model in which agents have the ability to avoid some attention-grabbing efforts by firms, but this incurs a cognitive or mental effort cost.[14] Research suggests that re-orienting attention from a distractor to a target is an effortful executive function (Kukkonen et al., 2025; Spagna et al., 2023), and it has been found that mental effort is often preferentially avoided (Kool et al., 2010).[15] Suppose agents can avoid a subset of the attention-grabbing attempts of S-firms, but in doing so incurs a mental effort cost q. Agents can avoid $b \leq \psi\, n_S$ where $\psi < 1$. Furthermore, we have a heterogeneous population of agents where there are both “high-cost” agents, in which it is very costly for them

[13] Assuming that there is a positive mass of consumers for both high and low type, the cost of producing D is still lower than the profits the firm would derive by selling it to the D_H population (or D_L). This can be mathematically represented by $min(D_H, D_L) > C_D$.

[14] One could also think of it as a financial cost, the way people pay for adblockers or app limits.

[15] Inzlicht et al. (2018) notes that there are situations where effortful activities bring positive utility.

to disengage from a firms attention grabbing attempts, and "low-cost" agents. This reflects individual differences in executive control affect the avoidance of effort (Kool et al., 2010). The "high-cost" agents pay an effort cost Q_H to not have their attention grabbed by a given S-firm. The "low-cost" agent incurs effort cost Q_L, and $Q_L < Q_H$. As a result, three equilibria will exist, D-only, S-only and co-existence. The co-existence case arises because, there exists an intermediate level of distraction where it is optimal for the high-cost agents to not avoid any attention-grabbing efforts and consume an S good, while for "low-cost" agents it is optimal to avoid distraction efforts by b number of type S firms and consume a D good. For the latter group, this is because avoiding attention-grabbing efforts from a subset of the type S firms increases their residual ungrabbed attention, such that the D good is optimally consumed. Consequently, both type D and S firms profitably enter. This extension also builds in an interesting feature of the model where there is a trade-off between the mental effort exerted to detach from attention-grabbing efforts and the additional volitional attention that can be allocated to an agent's preferred D-good.[16] An intuitive example of this is a situation in which an individual prevents responding to emails or scrolling her Twitter feed when notifications ping on her phone, so she can retain enough bandwidth to watch an episode of *Succession* later that day. Furthermore, in a dynamic version of this variant whereby an agent can learn over time to more (or less) efficiently avoid distraction, i.e. a "high-cost" type can learn to become a "low-cost" type and vice versa, the model demonstrates the path-dependent nature in an individuals attentional behavior, and how individuals may get tramped into an equilibrium of consuming either all D or all S goods.

[16]Formally, there exists some threshold $\bar{Q}$, and $Q_L < \bar{Q} < Q_H$, in which the trade-off for low-cost agents between switching from an S good to B yet incurring a disutility $b \cdot q$ is optimal, while it is suboptimal for the high-cost agents.

4 Extension 2: Taste for Variety

4.1 Setup

Our analysis so far has considered a situation in which agents prefer to consume a single good. Nevertheless, it is plausible that agents would in fact have a preference for some variety among the goods they consume. In this section, we extend the model to incorporate a small disutility of a consuming a good of either type γ beyond some level of attention, denoted $\hat{\tau}$. Specifically:

$$u_k(\tau_k) = \begin{cases} u_k^0(\tau_k), & \text{if } \tau < \hat{\tau}, \\ u_k^0(\tau_k) - \theta(\tau - \hat{\tau}), & \text{if } \tau \geq \hat{\tau} \end{cases}$$

where $u_k^0(\tau_k)$ denotes the original utility function.

The parameter θ captures the size of the disutility, such that a large θ indicates a strong preference for variety. We assume an intermediate range for θ where $\underline{\theta} < \theta < \bar{\theta}$ (*see appendix*). Note that $\underline{\theta} \approx 0^+$ such that only a possibly small preference for variety is needed to generate the results of our model. Furthermore, we assume $C_S < \hat{\tau}$. Finally, for ease of characterizing the different equilibrium, we assume $\underline{\delta} < C_D < \bar{\delta}$ (*see appendix*). This defines an intermediate range for C_D in which the larger fixed costs for type D vs S firms is non-neglible, but it is not very large (unless the difference in quality between D and S goods is also very large, $v_D >> v_S$). It does not meaningfully effect our results.

4.2 Analysis

The disutility from consuming a good beyond $\hat{\tau}$ results in a concave payoff for type S goods when more than $\hat{\tau}$ units of attention has been allocated to it. Suppose, there are only type S goods in the market. It is now optimal for the agent to consume any S good for $\hat{\tau}$ attention, before switching to a different S good (as their marginal utility is convex). Consequently, if $\hat{\tau} < t_i$ (agent i's total ungrabbed attention) then the agent will optimally "cycle" over m different goods, allocating attention $\hat{\tau}$ to each, where $m < n_S$.[17] Herein, we will refer to this as the "S-switch" case. Conversely, in a market of only type D goods, an agents behaviour mirrors that of the baseline. This is because the convex payoff dominates any taste for variety, such that they optimally allocate all ungrabbed attention to a single D good. Consequently, there are three cases of consumer behaviour. Let $\tilde{\tau}$ denote an agents indifference point between consuming a single D good and m type S goods (we assume $\tilde{\tau} > \hat{\tau}$). When distraction is low, $g_{-D} < 1 - \tilde{\tau}$ agents consume a single D good. When distraction is in an intermediate range, $1 - \tilde{\tau} < g_{-D} < 1 - \hat{\tau}$, agents optimally switch across many S goods. Finally, when attention grabbing is very prevalent in the market $g_{-D} > 1 - \tilde{\tau}$ agents only have enough attention to allocate to a single S good. Figure 12 illustrates these three cases.

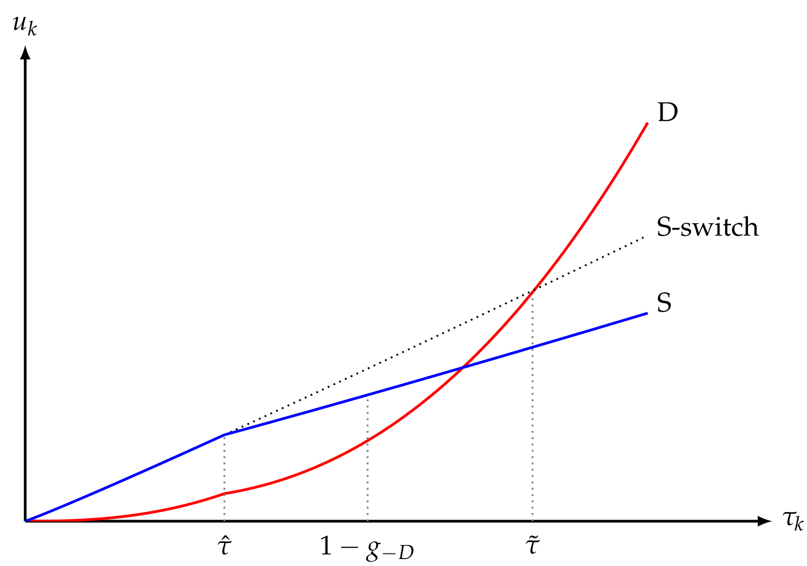


Figure 12: Payoffs for D and S goods - taste for variety

Importantly, both types of firms still have an incentive to grab attention post-entry. For D goods, the intuition mirrors that of the baseline model. Similarly, suppose we have many type S entrants (no type D entrants) and no firms have invested in attention grab-

[17]This is because $\hat{\tau} > C_S$. Note, $m = \frac{1-n_S\,\alpha}{\hat{\tau}-\alpha}$.

bing. A firm always has an incentive to deviate and grab α. This guarantees a market share of $\hat{\tau}$ if no other firm grabs attention. Moreover, if other S firms have grabbed attention, then it is profitable, conditional on entry, to also grab attention as $\alpha > c_g$ (*see appendix for more details*). Consequently, when the level of attention grabbing in the market is low, $\alpha(n-1) < 1-\tilde{\tau}$ only D firms can profitably enter. Conversely, when it is high, $\alpha(n-m) > 1-\tilde{\tau}$ only S firms enter. We formalize this in proposition 3.

Proposition 3. *Three types of equilibria exist:*

1. *D-only equilibrium: When α is low there exists an equilibrium where only D firms exist ($n_D^* = \frac{1}{C_D}$ and $n_S^* = 0$) and agents consume a single good. Specifically, existence requires: $\alpha < \frac{C_S\ \hat{\tau}(1-\tilde{\tau})}{\hat{\tau}-\tilde{\tau}\ C_S}$.*

2. *Multiplicity region: When α is moderate multiple equilibria can arise. One where only type D firms exist and a single good is consumed, or an equilibrium where only S firms exist ($n_S^* = \frac{1}{C_S}$ and $n_D^* = 0$) and agents switch across m goods. Specifically, existence requires: $\frac{C_S\ \hat{\tau}(1-\tilde{\tau})}{\hat{\tau}-\tilde{\tau}\ C_S} \leq \alpha \leq \frac{C_D(1-\tilde{\tau})}{1-C_D}$.*

3. *S-switch: When α is high an equilibrium exists in which only S firms exist and agents switch across m goods. Specifically, existence requires: $\frac{C_D(1-\tilde{\tau})}{1-C_D} < \alpha < \frac{C_S(1-\hat{\tau})}{1-C_S}$.*

4. *S-single: When α is very high an equilibrium exists of only type S ($n_S^* = \frac{1}{C_S}$ and $n_D^* = 0$) firms and agents consume a single good. Specifically, existence requires: $\alpha \geq \frac{C_S(1-\hat{\tau})}{1-C_S}$.*

Figure 13 illustrates the different equilibria across a feasible α and κ parameter space, for a representative case. Evidently, as in the baseline model, an D-only equilibrium occurs when the ability to grab attention is very low and/or th cost to enter for firms is sufficiently high. While the opposite is true for the S-only equilibria. A key result is that not only can an equilibrium arise in which agents now optimally cycle across m different goods, but that there is a larger parameter space in which this can exist, compared to an equilibrium where agents consume a single S good. Consequently, a parameterization of our model in which both $\hat{\tau}$ and κ (high competition) are low, implying a high

m, resembles a kind of consumer behavior in which agents quickly alternate across different goods. Thus, our model captures various phenomena such as channel-surfing, doomscrolling and media multitasking - in which people simultaneously consume various different media outlets at once (such as watching Real Housewives on TV while scrolling on Instagram). In our modern world of highly effective attention-grabbing technologies and low barriers to entry for different forms of content creation (such social media content creators) these consumption patterns have become increasingly common (as the model predicts). For example, American consumers exhibit some of the highest reported rates of media multitasking, with 55% reporting often looking at their phones while watching TV (YouGov, 2023). Additionally, Tandoc Jr et al. (2019) documents a rising trend across all age groups in switching across multiple media outlets, which he calls "platform-switching". Short-form content on these platforms is ubiquitous, this accommodates demand for consumption variety and can result in doomscrolling practices. Several negative cognitive consequences have been identified for these consumption behaviors, with simultaneous media consumption associated with reduced comprehension and fragmented attention (Oviedo et al., 2015; Van Cauwenberge et al., 2014), while short-form content can contribute to addictive behavior on these platforms (Roberts and David, 2025).

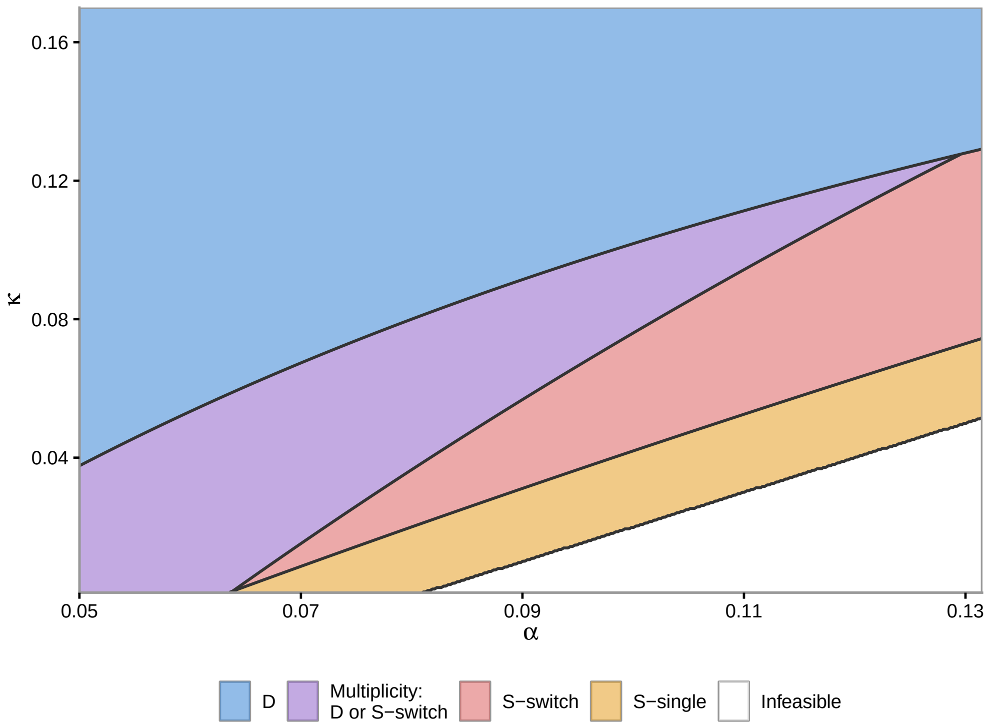


Figure 13: Equilibria characterised by α and κ - taste for variety

5 Applications

This section introduces some applications of the model. The applications explore how attention fragmentation alters consumer choice, how algorithmic recommendation systems shift firm incentives toward attention-grabbing goods, how differences in consumer aptitude affect the consumption of high-quality goods, and how habit formation can amplify attention capture over time. Overall, these extensions highlight mechanisms through which modern digital environments may shift markets toward the production and consumption of lower-quality but more engaging type S goods.

5.1 Algorithms

When deciding between producing a type D or type S good, $\gamma \in \{D, S\}$, a firm's ability to capture consumer attention influences its optimal production choice. Empirical evidence suggests that algorithmic recommendation systems increase user engagement and exposure time. Dekker et al. (2025) show that algorithmic feeds significantly increase time spent on social media platforms. Within the context of our model, this technological change can be represented as an increase in the amount of attention a firm is able to capture, from α to α', where $\alpha' > \alpha$.

Here we demonstrate how relatively minor modifications to the framework can generate a setting in which firms capable of implementing algorithms will always choose to produce type S goods. Consider a market with only two firms. A platform (firm 1) that can grab attention and produce either type D or S goods, and an outside option (firm 2) type D good that never grabs attention. The production costs satisfy $1 > C_D > C_S$.

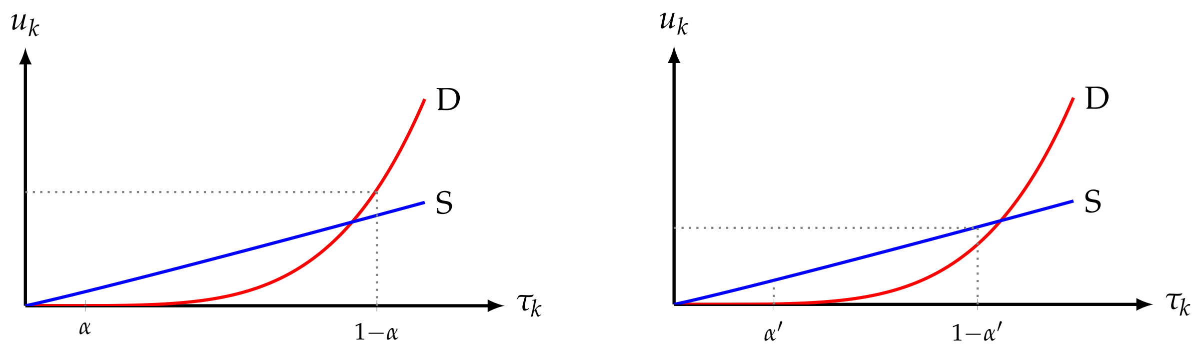
Suppose first that Firm 2 operates in a non-algorithmic environment, where the maximum amount of attention that can be captured is α. In this setting, consumers retain sufficient ungrabbed attention to allocate toward type D goods and eventually achieve high utility from them. Consumers therefore prefer type D goods whenever these generate higher utility, implying that Firm 2 maximizes profits by producing a type D good and securing the whole market—as agents optimally allocate attention to the D good that has initially grabbed the most attention. Now suppose Firm 2 can implement an algorithmic recommendation system that increases its attention-capturing ability from α to α', where $\alpha' > \alpha$. This reflects the firm's ability to provide highly personalized and salient content that is more likely to capture attention. Consumers now have substantially less remaining attention available to allocate toward type D goods and are no longer able to realize their long-run utility benefits. Instead, consumers derive greater utility from immediately engaging type S goods, implying that Firm 2 maximizes profits by producing a type S good and secure the whole market.

Given the firm's profit function, $\pi = \tau - C_\gamma$, it follows that once algorithmic attention capture becomes feasible, producing a type S good is always profit-maximizing [18].

The intuition is that algorithms increase a firm's ability to capture and retain consumer

[18] since $1 - C_D < 1 - C_S$.

attention, reducing the amount of remaining attention consumers can voluntarily allocate toward higher-substance goods. Anticipating this fragmentation of attention, firms become increasingly incentivized to produce low-cost, highly engaging type S goods that generate immediate utility rather than high-quality type D goods whose benefits require sustained concentration to be realized.



Non-algorithmic world

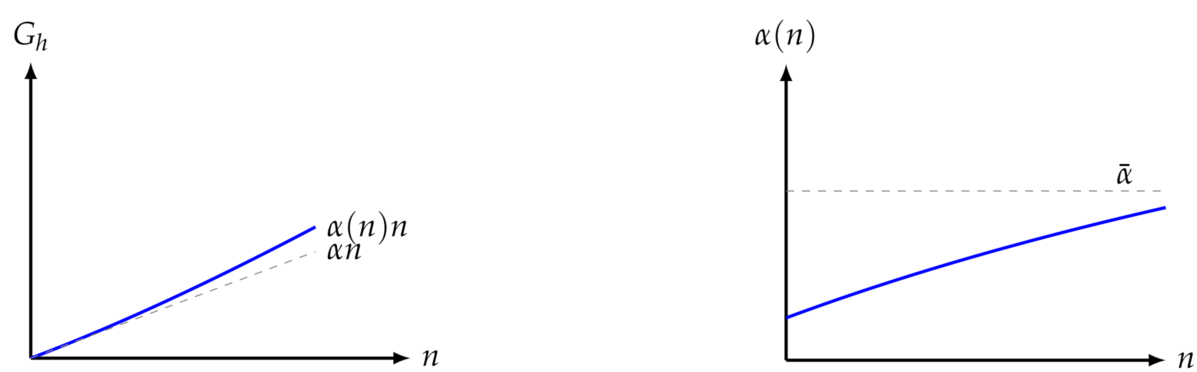
Algorithmic world

5.2 Habit-formation in attention grabbing

Within our framework, we can also imagine a setting in which attention capture is self-reinforcing. Specifically, having one's attention captured by a firm may raise an individual's susceptibility to having their attention captured by other firms. Therefore, an increase in the number of firms competing for attention not only increases the amount of attention-grabbing attempts, but also the efficiency of the attention capturing cues that make consumers prone to distractions and involuntary attention allocation.

The interaction between the addictive design of "attention merchant" platforms (Wu, 2016) and the habit-forming nature of distraction can drive self-reinforcing attention capture. Several studies have documented how increased exposure to attention-grabbing cues (e.g. short-form content, notifications) worsen sustained attention and impair attentional control (Castelo et al., 2025; Chen et al., 2023; Kushlev et al., 2016; Yan et al., 2024). Furthermore, Dabbish et al. (2011) finds that external interruptions predict self-interruptions the following hour, which is interpreted as possible sensitization to distraction. A similar phenomena exists in the value-driven attention capture literature, whereby a stimuli previously associated with a reward captures attention much later even when it is no longer rewarded and task-irrelevant (Anderson et al., 2011; Anderson and Yantis, 2013), indicative of the habit-forming nature of attention grabbing. Anderson and Wood (2021) demonstrated that social media platforms are designed around rewards and cues that cultivate habit formation encouraging continued use. Indeed, Wojtowicz et al. (2019) microfound this cue-based, habit-formation mechanism, which in turn can give rise to what they call "attentional addiction".

Recall from our baseline model that firms grab a fixed amount of attention α. Consequently, we have $G_b = \alpha n$, where $G = \sum_{i=1}^{k} g_i$ denotes an agents total grabbed attention. We incorporate the habit-forming nature of attention-capture by modifying the functional form of grabbed attention. Suppose that when a firm grabs attention they receive $\alpha(n)$, where $\alpha'(n) > 0$ and $\alpha''(n) < 0$. Specifically, we formulate $\alpha(n) = \alpha + (\bar{\alpha} - \alpha)\frac{n}{n+\zeta}$. Where $\alpha < \bar{\alpha} < C_S$ and ζ dictates how quickly α approaches the maximum amount of captured attention. As such $G_h = \alpha(n)\ n$ is an increasing convex function (see figure 14). This implies that the various, common cues platforms use to grab attention (notifications, short-form sensationalist content, infinite scroll and auto-play), interacts with the habit-forming nature of distraction to create a positive network effect in attention capture (figure 14a).



Total grabbed attention as a function of the number of firms

Grabbed attention as a function of the number of firms

Figure 14: Habit-formation in grabbed attention

There are two main results from this setting. Firstly, the parameter space in which the S-only equilibrium exists is now larger, and for the D-only equilibrium it is smaller (*see Appendix B*).[19] Secondly, the welfare-reducing effects of competition in our model is intensified relative to the baseline model. As a result utility is strictly worse in the D-only equilibria, while the effect is negligible in the S world.[20] Figure 15b in *appendix B* illustrates this in a comparative static of welfare and entry costs. Consequently, the self-reinforcing nature of attention grabbing increases convergence to a market dominated by S goods and creates greater attention dispersion, which is detrimental to consumer welfare. This is particularly relevant to our the current digital environment where cues and attempts to capture consumers attention are ubiquitous.

[19]Recall from baseline model that the threshold level of α before a switch from the D to S equilibrium was $\alpha > \alpha_b$ where $\alpha_b \equiv \frac{C_S(1-\bar{\tau})}{1-C_S}$. In this extension the new threshold level is $\alpha > \alpha_e$ where $\alpha_e \equiv \frac{1}{\zeta C_S}\left(\frac{C_S(1-\bar{\tau})(1+\zeta C_S)}{1-C_S} - \bar{\alpha}\right)$. If $\bar{\alpha} > \frac{C_S(1-\bar{\tau})}{1-C_S}$, which must be the case if we are in a parameter space where a B-only equilibrium exists, then it is easy to show that $\alpha_e < \alpha_b$.

[20]It is easy to show that $U_b^A > U_e^A$ where U_b is the utility in the baseline model, and U_e utility in the current variant.

6 Appendix A: Proofs

A.1. Proof of Lemma 1.

Proof. Consider the case where there is $n = 1...j$ type D firm's in the market and $I_j^g = 0 \, \forall \, j$. By symmetry, firms would split the market. Consequently, firm i has an incentive to invest in grabbing attention and secure the entire market. This is because firm i will grab attention α, and recall from section 3.1.2 that agents optimally allocate all ungrabbed attention to a single good. As a result all consumers will allocate their chosen attention to firm i. Furthermore, suppose all other firms $i \neq j$ grab attention. Firm i's best response is to also grab attention given post-entry profits will be positive as $\alpha + t_i > c_g$ (even if firm i receives no ungrabbed attention, $t_i = 0$) yet will be 0 if they don't grab any attention. Therefore, all incumbents have an incentive deviate and $I_j^g = 1 \, \forall \, j$. This is analogous for a market of only type S firms (given the very marginal convexity of S good's payoff). Furthermore, this result holds in a market with both firm types. Consider a market of high distraction $g'_{-D} > 1 - \bar{\tau}$ (section 3.1.2) such that agents optimally consume S goods. Conditional upon entry, a D firm still has an incentive to grab attention and earn positive post-entry profits as $\alpha > c_g$ (otherwise, 0), as per our parametric assumption. This holds for S firms in a low distraction market. Consequently, the stage 2 game is a prisoners dilemma, shown schematically below.

	Firms $j, \; j \neq i$	
Firm i	$I_j^g = 1$	$I_j^g = 0$
$I_i^g = 1$	$min(\alpha - c_g, \frac{1}{n} - c_g)$	$(1 - c_g, 0)$
$I_i^g = 0$	$(0, 1 - c_g)$	$\frac{1}{n}$

Note, that we rule out the case where $\alpha n > 1$, as this is never a feasible equilibrium (see section 2.3.1 for a discussion). Indeed the maximum n possible is $n = \frac{1}{F_S}$, and $\frac{\alpha}{F_S} < 1$ as $\alpha < F_S$. Also, recall that we rule out monopoly cases as $C_D < \frac{1}{2}$, which ensures firms always have an incentive to deviate and win some ungrabbed attention from competitors.

$\square$

A.2. Proof of Proposition 1.

Proof. A firm will only enter if total profits are weakly positive. Therefore, the equilibrium profit conditions are $\pi_D^* = \pi_S^* = 0$. Recall from section 3.2.2 that type D firms will only enter when $\alpha(n-1) < 1 - \hat{\tau}$ because in this region consumers optimally consume a single D good. A type S firm cannot profitably enter because $\pi_S = \alpha - C_S < 0$. The reverse is true when $\alpha(n-1) < 1 - \hat{\tau}$, with only type S firms profitably entering. Consequently, there are two cases. Consider case I with only type D firms. The profits of D firms that enter the market is given by,

$$\pi_D = \alpha \; + \; \frac{1 - \alpha(n_D - 1)}{n_D} - C_D$$

Using the profitability condition $\pi_D^* = 0$, we get $n_D^* = \frac{1}{C_D}$. Plugging $n_D^* = \frac{1}{C_D}$ into $\alpha(n_D - 1) < 1 - \hat{\tau}$ gives the following condition for an D-only equilibrium, characterized by α:

$$\alpha < \frac{C_D(1-\bar{\tau})}{1 - C_D}$$

By the same logic, in case II the number of type S firms in equilibrium is given by $n_S^* = \frac{1}{C_S}$. Combining this with the condition that $\alpha(n_S - 1) > 1 - \hat{\tau}$ we get the following condition for the S-only equilibrium, characterized by α:

$$\alpha > \frac{C_S(1-\bar{\tau})}{1 - C_S}$$

Note that,

$$\frac{C_S(1-\bar{\tau})}{1 - C_S} < \frac{C_D(1-\bar{\tau})}{1 - C_D}$$

This results in the multiplicity equilibria case in proposition 1. The subtlety here is that multiplicity arises because the optimal choice of agent i depends on the number of firms that enter the market, yet type D and S firms have different costs. Therefore, there is a parameter region for α in which either the D-only or S-only equilibrium could exist. $\square$

A.3. Comparative Statics - Baseline Model.

The impact of κ on the number of firms is straightforward, with $\frac{dn_\gamma}{d\kappa} = -\frac{1}{(C_\gamma)^2} < 0$.
Effect of κ on utility,

$$\frac{dU_\gamma}{d\kappa} = \frac{dU_\gamma}{dn_\gamma} \cdot \frac{dn_\gamma}{d\kappa}$$

Where,

$$\frac{dU_\gamma}{dn_\gamma} = -v_\gamma\, \alpha[\sigma_\gamma(1-\alpha(n_\gamma-1))^{\sigma_\gamma-1} - \alpha^{\sigma_\gamma-1}] < 0$$

The square bracketed term is positive given $\alpha n_\gamma < 1$ as $\frac{\alpha}{C_\gamma} < 1$. Hence, the derivative is strictly negative for all feasible parameters. Hence, we have $\frac{dU_\gamma}{d\kappa} > 0$. Utility increases as barriers to entry rises.
Effect of α on utility,

$$\frac{dU_\gamma}{d\alpha} = -v_\gamma\, (n_\gamma-1)[\sigma_\gamma(1-\alpha(n_\gamma-1))^{\sigma_\gamma-1} - \alpha^{\sigma_\gamma-1}] < 0$$

A.4a. Extension 1: Attention-grabbing behaviour of firms

Let's consider whether our Lemma 1 result holds in the extension case. In a market of only type D firms (S firms), then there is always the incentive for one D firm (S firm) to grab attention, with the reasoning analogous to the baseline model.

The incentives change when there is a coexistence of firms. Consider, a case where there is only a single S firm and at least one D firm. The S firm receives at most $1-p$ attention if they do not grab any. Note, the $1-p$ is specifically when there is only a single D-firm, for $n_D > 1$ they would receive even less. Therefore, conditional on entry, the S firm will always grab attention if $p\alpha > c_g$ or $p > \frac{c_g}{\alpha}$. When $n_D > 1$ the single S-firm would grab even more than $p\alpha$ so this condition is sufficient. Now consider the opposite case where we have a single D firm and at least one S firm. The D firm receives ungrabbed attention p even if it does not grab any attention. They will invest in attention grabbing if $\alpha(1-p) > c_g$ or $p < 1 - \frac{c_g}{\alpha}$. These conditions are sufficient. To see this consider now that instead of a single D firm there is more than one, while there is at least one S firm. Now, the D firms must compete with each other for the fraction of consumers who have high-quality draws of D firms. Consequently, D firms receive $< p$, providing an additional incentive to deviate and grab attention (as they will then receive p if no other firms do).[21] The logic is the same for $n_S > 1$, thus the above conditions on p are sufficient. Taken together, we assume that $\frac{c_g}{\alpha} < p < 1 - \frac{c_g}{\alpha}$, and $\alpha > 2c_g$ so that this set is non-empty.

Note that these parameter restrictions are conservative, given a coexistence of a single D and S firm would not be a stable equilibrium as $C_S + C_D < 1$. Indeed, a marginal loosening of these restrictions would l ikely not have alter firm behavior. More specifically for a general case of $n_S = 1$ and $n_D > 1$, we can derive a less restrictive lower bound for p, i.e. $p > 1 - (1 - \frac{c_g}{\alpha})^{(\frac{C_D}{1-C_S})}$[22]. Moreover, if we retain the $\alpha > c_g$ assumption from the baseline model, and only assume that p meets the condition outlined in equation 4 below, then it would not materially affect our results, except for the rare case of co-existence with either a single D or single S firm.

Rob and Richard, I suppose for the above we have that n is continuous but impose a domain restriction that $n_D, n_S > 1$ (as in the co-existence it is possible to get, for instance $n_S < 1$ and $n_D > 1$ and vice versa). I believe two additional (yucky) assumptions on p would ensure that we always have $n_D, n_S \geq 1$. These are,

$$p > \frac{C_D - \alpha}{(1 - \alpha(\frac{1-C_D+C_S}{C_S}))}$$

[21] Effectively, they have an incentive to win the contested ungrabbed attention available to firms of the same type.

[22] Using this renders the above $p > \frac{c_g}{\alpha}$ unnecessary, notice in the new p condition it collapses to $p > \frac{c_g}{\alpha}$ when $n_D = 1$ (implied by $C_S = C_D = 0.5$). For a non-empty set we no longer needs $\alpha > 2c_g$, but still something stronger than $\alpha > c_g$

and,

$$p < 1 - \Big(\frac{C_S - \alpha}{1 - \alpha(\frac{1-C_S+C_D}{C_D})}\Big)^{\frac{C_D}{1-C_S}}$$

This was from a quick play around, but should be checked. There is hopefully also a cleaner way to do this.[23]

A.4b. Extension 1: Parameters - $\underline{p}, \bar{p}, \omega$.

We make an additional lower bound assumption on p,

$$p > max\Big(1 - \frac{1}{exp(\frac{2\alpha(C_D - C_S)}{C_S - \alpha})}, 1 - \frac{1}{exp(\frac{C_S(C_D-\alpha)}{C_S-\alpha})}\Big) \tag{4}$$

Taken together with the previous assumptions on p gives us,

$$\underline{p} = max\Big(1 - (1 - \frac{c_g}{\alpha})^{(\frac{C_D}{1-C_S})}, 1 - \frac{1}{exp(\frac{2\alpha(C_D - C_S)}{C_S - \alpha})}, 1 - \frac{1}{exp(\frac{C_S(C_D-\alpha)}{C_S-\alpha})}\Big) \tag{5}$$

and,

$$\bar{p} = 1 - \frac{c_g}{\alpha} \tag{6}$$

In regards to ω, this assumption is simply for ease on characterising equilibria. Recall that the coexistence case arises when,

$$\frac{C_D(1-\tau_L)}{1-C_D} < \alpha < \frac{C_S(1-\tau_H)}{1-C_S}$$

Implicit in this is the assumption that,

$$\frac{1-\tau_H}{1-\tau_L} > \frac{C_D(1-C_S)}{C_S(1-C_D)}$$

[23]Could do same process to derive p conditions such that $n_D, n_S \geq 2$, this would then not require a change to the $\alpha > c_g$ assumption I believe.

As such we define,

$$\omega \equiv \frac{C_D(1-C_S)}{C_S(1-C_D)}$$

Note that if we relaxed this assumption and let $\frac{1-\tau_H}{1-\tau_L} < \omega$, then the parameter region for α where,

$$\frac{C_S(1-\tau_H)}{1-C_S} < \alpha < \frac{C_D(1-\tau_L)}{1-C_D}$$

would give rise to a multiplicity of equilibria where either an D-only, S-only, or coexistence equilibria could arise. It does not meaningfully change our results. Hence for simplicity we keep $\frac{1-\tau_H}{1-\tau_L} > \omega$. This will hold as long as the preference between a high-quality and low-quality D good is sufficiently strong (alternatively, there is not a very large cost gap between D and S firms).

A.5. Proof of Proposition 2.

Proof. Deriving the D-only and S-only equilibria is straightforward and mirrors the process of the baseline model. The sole difference is that instead of a single indifference point $\bar{\tau}$, there are the two indifference points τ_H and τ_L. The former is used to establish the S-only equilibrium, while the latter is used for the D-only equilibrium.//

For the co-existence case the equilibrium conditions are $\pi_D^* = \pi_S^* = 0$ with $n_D^* \in (0, \frac{1}{C_D})$ and $n_S^* \in (0, \frac{1}{C_S})$. Additionally, note that equation 3 can be rearranged to the following,

$$n_S = \frac{1 - n_D\, C_D}{C_S}$$

Co-existence only occurs when the total attention allocated to agent's chosen good, denoted $\tau^* = 1 - \alpha(n^* - 1)$, is in the range $\tau_H \leq \tau^* \leq \tau_L$. This means an agent consumes either a S-good or a high-D good. When τ is in the specified range, $\lambda(n_D) = 1 - (1-p)^{n_D}$. Using the equilibrium conditions, firm's payoff functions (equations 1 and 2) and the market attention condition (equation 6), we can write firm payoff's as a function of the number of D-firms.

$$\pi_D(n_D^*) = \alpha + \frac{1-(1-p)^{\,n_D}}{n_D}\left(1-\alpha\, n_D - \frac{\alpha}{C_S}(1-n_D\, C_D)\right) - C_D = 0 \tag{7}$$

$$\pi_S(n_D^*) = \alpha + \frac{C_S\,(1-p)^{\,n_D}}{1-n_D\, C_D}\left(1-\alpha\, n_D - \frac{\alpha}{C_S}(1-n_D\, C_D)\right) - C_S = 0 \tag{8}$$

We define the following function as,

$$f(n_D^*) = \pi_D(n_D^*) - \pi_S(n_D^*) = 0 \tag{9}$$

The n_D^* that satisfies equation 9 uniquely solves for the equilibrium number of D (and therefore S firms) in the co-existence case (equations 7 and 8).

We can re-write equations 7 and 8 as follows,[24]

$$\pi_D(n_D^*) = \frac{g(n_D^*)}{n_D\, C_S} \tag{10}$$

$$\pi_S(n_D^*) = -\frac{g(n_D^*)}{1-n_D\, C_D} \tag{11}$$

where,

$$g(n_D) = n_D\, C_S(\alpha - C_D) + \Big(1-(1-p)^{n_D}\Big)\Big(C_S(1-\alpha\, n_D) - \alpha(1-n_D\, C_D)\Big) \tag{12}$$

which gives,

$$f(n_D^*) = g(n_D^*)\underbrace{\left(\frac{1}{n_D\, C_S} + \frac{1}{1-n_D\, C_D}\right)}_{d(n_D^*)} \tag{13}$$

Notice that $\forall\, n_D \in (0, \frac{1}{C_D}), d(n_D^*) > 0$. Therefore, $g(n_D^*)$ determines the sign of $f(n_D^*)$. As a result, $f(n_D^*)$ has a unique root over $n_D \in (0, \frac{1}{C_D})$ if $g(n_D^*)$ does, and $f(n_D^*) = 0$ if and only if $g(n_D^*) = 0$. Existence follows from an application of the intermediate value

[24] For $\pi_S(n_D)$ add and subtract $\frac{\alpha\, n_D\, C_S}{1-n_D\, C_D}$ from the payoff function.

theorem. Notice that as $n_D \to \frac{1}{C_D}$, $\pi_S(n_D^*) \to -\infty$. Also, $\pi_D(\frac{1}{C_D}) < 0$ is finite. Therefore, $\lim_{n_D \to \frac{1}{C_D}} f(n_D) \to -\infty$. If $\lim_{n_D \to 0} f(n_D) > 0$, then continuity of f implies that at least one n_D exists such that $f(n_D) = 0$. While $f(0)$ is undefined, $g(0) = 0$. We can show that for a certain parameter constraint on p, $g'(0) > 0$, which implies that $f(0^+) > 0$.

$$\begin{aligned} g'(n_D) = C_S(\alpha - C_D) + \alpha(C_D - C_S)\big(1 - (1-p)^{n_D}\big) \\ + (1-p)^{n_D}\big(C_S(1 - \alpha n_D) - \alpha(1 - n_D C_D)\big)\big(-\ln(1-p)\big) \end{aligned} \tag{14}$$

And,

$$g'(0) > 0 \text{ iff, } -\ln(1-p) > \frac{C_S(C_D - \alpha)}{C_S - \alpha}$$

Alternatively,

$$p > 1 - \frac{1}{exp(\frac{C_S(C_D-\alpha)}{C_S-\alpha})} \tag{15}$$

Under this assumption an equilibrium exists. To show uniqueness, it is sufficient to show that $g(n_D)$ is concave, $g''(n_D) < 0$, as this implies that $g(n_D)$, and by extension $f(n_D)$, has a single root over $n_D \in (0, \frac{1}{C_D})$.

We have,

$$g''(n_D) = \Big((1-p)^{n_D} \ln(1-p)\Big) \underbrace{\Big[2\alpha(C_S - C_D) - (\ln(1-p))\Big(C_S(1 - \alpha\, n_D) - \alpha(1 - C_D\, n_D)\Big)\Big]}_{h(n_D)} \tag{16}$$

Notice that $((1-p)^{n_D} \ln(1-p)) < 0$, and so $g''(n_D) < 0$ iff $h(n_D) > 0$. We cannot globally sign $h(n_D) > 0$ over $n_D \in (0, \frac{1}{C_D})$. However, $h'(n_D) = \ln(1-p)(C_S - C_D)\alpha > 0$, and so the following parameter condition on p can be imposed in order for $h(0) > 0$,

$$h(0) > 0 \text{ iff, } -\ln(1-p) > \frac{2\alpha(C_D - C_S)}{C_S - \alpha}$$

Alternatively,

$$p > 1 - \frac{1}{exp(\frac{2\alpha(C_D-C_S)}{C_S-\alpha})} \tag{17}$$

Therefore, if $p > max\Big(1 - \frac{1}{exp(\frac{2\alpha(C_D - C_S)}{C_S - \alpha})}, 1 - \frac{1}{exp(\frac{C_S(C_D - \alpha)}{C_S - \alpha})}\Big)$ there exists a unique co-existence equilibrium, with $n_D^* > 0$ and $n_S^* > 0$.[25]

$\square$

A.6. Decomposing channels of good and bad competition

To illustrate the welfare effects resulting from the competing channels of attention dispersion and improved consumer-firm match, we examine the D-only equilibrium. However, note that similar dynamics can occur in the coexistence equilibrium.

In the extension 1 of our model, we are in the D-only equilibrium when $\kappa > \frac{\alpha}{1-\tau_L+\alpha} - c^d - I_D$. In this equilibrium, an agents expected utility is given by,

$$E(u) = \Big(1 - (1-p)^{\frac{1}{C_D}}\Big)\Big(v_H\Big(1 - \alpha(\frac{1}{C_D} - 1)\Big)^{\sigma_D}\Big) + (1-p)^{\frac{1}{C_D}}\Big(v_L\Big(1 - \alpha(\frac{1}{C_D} - 1)\Big)^{\sigma_D}\Big) \\ + (\frac{1}{C_D} - 1)\Big(p\, v_H\, \alpha^{\sigma_D} + (1-p)v_L\, \alpha^{\sigma_D}\Big) \tag{18}$$

The derivative of expected utility w.r.t to κ is,

$$\frac{\partial E(u)}{\partial \kappa} = \frac{\partial E(u)}{\partial n_D}\frac{\partial n_D}{\partial C_D}\frac{\partial C_D}{\partial \kappa} = -n_D^2\,\frac{\partial E(u)}{\partial n_D} \tag{19}$$

Therefore, if $\frac{\partial E(u)}{\partial n_D} > 0$, then $\frac{\partial E(u)}{\partial \kappa} < 0$ and if $\frac{\partial E(u)}{\partial n_D} < 0$, then $\frac{\partial E(u)}{\partial \kappa} > 0$.

We can re-write equation 18 as,

$$E(u) = \Big(1 - \alpha(n_D - 1)\Big)^{\sigma_D}\Big(v_H - (v_H - v_L)(1-p)^{n_D}\Big) + (n_D - 1)\Big(\alpha^{\sigma_D}(p\, v_H + (1-p)\, v_L)\Big) \tag{20}$$

Or,

$$E(\tau, B, n_D) = \tau^{\sigma_D}\, B + (n_D - 1)\, S \tag{21}$$

Where,

[25] It could also be considered a constraint on the cost gap between D and S firms.

$\tau(n_D) = (1-(n_D-1)\alpha)$, which is the amount of time toward chosen D good. Decreasing linearly in n_D.

$B(n_D) = \Big(v_H - (v_H - v_L)(1-p)^{n_D}\Big)$, is the expected quality of chosen D good (better match). Increasing (at a decreasing rate) in n_D.

$S = \Big(\alpha^{\sigma_D}(p\, v_H + (1-p)\, v_L)\Big)$, is the additional utility from attention grabbed by an additional D-firm in the market. This additional utility is small, given α units of attention on an D good gives little payoff due to convexity.

Therefore,

$$\frac{dE(u)}{dn_D} = \underbrace{\frac{\partial E(u)}{\partial \tau}\frac{\partial \tau}{\partial n_D}}_{\text{lost chosen time, } < 0} + \underbrace{\frac{\partial E(u)}{\partial B}\frac{\partial B}{\partial n_D}}_{\text{better match, } > 0} + \underbrace{\left.\frac{\partial E(u)}{\partial n_D}\right|_{\tau,B}}_{\text{extra grabbed attention, } > 0} \tag{22}$$

Which is,

$$\frac{dE(u)}{dn_D} = \underbrace{-\sigma_D\, \alpha\, \tau^{\sigma_D-1}B}_{\text{lost chosen time, } < 0} + \underbrace{\tau^{\sigma_D}(v_H - v_L)(1-p)^{n_D}\ln(\frac{1}{1-p})}_{\text{better match, } > 0} + \underbrace{S}_{\text{extra grabbed attention, } > 0} \tag{23}$$

A nicer way to write this could be,

$$\frac{dE(u)}{dn_D} = \underbrace{\frac{\partial E(u)}{\partial \tau}\frac{\partial \tau}{\partial n_D} - \left.\frac{\partial E(u)}{\partial n_D}\right|_{\tau,B}}_{\text{net cost to attention dispersion, } < 0} + \underbrace{\frac{\partial E(u)}{\partial B}\frac{\partial B}{\partial n_D}}_{\text{better match, } > 0} \tag{24}$$

Typically, for small n_D, $\frac{dE(u)}{dn_D} > 0$ and $\frac{dE(u)}{dk} < 0$. Lowering entry costs when there only a small number of firms can be welfare increasing (better match dominates). However, when n_D is large the welfare-reducing channel of attention dispersion dominates and $\frac{dE(u)}{dn_D} < 0$ with $\frac{dE(u)}{dk} > 0$. This hump shape will typically occur when p is moderate. Too high and there isn't much benefit of an extra draw, and too low it requires many draws to get a high D at which point unallocated attention has been sufficiently reduced. Also, when α is too large, the attention dispersion effect dominates and you do not get a hump shape (need low to moderate α). A stronger preference, high $v_H - v_L$ will also lead to the hump shape in welfare, as there is a larger benefit to the consumer when there tastes are met, and therefore initial increases in competition (lowering κ) have a positive effect on an agents utility.

A.7 Extension 2: Boundary conditions for parameters $\underline{\theta}, \bar{\theta}, \underline{\delta}, \bar{\delta}$

We assume that the magnitude of the preference for variety θ is in the range $\underline{\theta} < \theta < \bar{\theta}$. Where,

$$\underline{\theta} \equiv \frac{v_S(1 - m\ \hat{\tau}^{\sigma_S})}{1 - \hat{\tau}},\ \bar{\theta}^{26} \equiv \frac{v_D(1 - m\ \hat{\tau}^{\sigma_D})}{1 - \hat{\tau}}$$

These boundaries represent the choice an agent faces between consuming a single type S (type D) good and m different S (D) goods, in the presence of a disutility cost θ. When θ lies in our intermediate range then an agent prefers to consume a m different S goods compared to a single S good, but they also prefer a single D good to m different D goods. This has a nice economic interpretation given the convexity of D means an agent would not want to switch even if they do have a preference for variety, while they do in the S case when the payoff (in the absence of disutility θ) is approximately linear. Note that $m\ \hat{\tau} = 1$, and because $\sigma_S = 1^+$, then $\underline{\theta} \approx 0^+$, such that only a very small penalty is required to induce optimal switching across S goods. The converse is true for D goods. It is simplest to interpret θ as a small penalty.[27]

[26] It actually may be more precise to define $\bar{\theta} \equiv \frac{v_D(1-\tilde{\tau}\cdot\hat{\tau}^{\sigma_D - 1})}{\tilde{\tau}-\hat{\tau}}$, as $\tilde{\tau}$ is the smallest amount of attention required to consume an D good, at which the difference between a single D good and m different D goods is smallest due to the convexity of type D.

[27] $\theta << \bar{\theta}$.

We also assume an intermediate range for C_D with $\underline{\delta} < C_D < \bar{\delta}$. Where,

$$\underline{\delta} \equiv \frac{C_S \hat{\tau}}{\hat{\tau} - C_S(\tilde{\tau} - \hat{\tau})}, \; \bar{\delta} \equiv \frac{C_S(1-\hat{\tau})}{1 - \tilde{\tau} + C_S(\tilde{\tau} - \hat{\tau})}$$

The interpretation is that C_D is larger than C_S in a non-negligble way, yet is not very large relative to the gapy in quality between v_D and v_S (contained in $\tilde{\tau}$). the assumption is made for ease of characterising equilibria and specifically for defining the multiplicity region. If for instance we assumed $C_D > \bar{\delta}$ it would just expand the multiplicity region for α and give rise to a small parameter region in which all 3 equilibria could exist.

A.8 Extension 2: Proof of proposition 3.

Let's first consider the effect of the preference for variety on firm's decision to grab attention $I_i^g \in \{0,1\}$. In the D-only region the logic is identical to that of the baseline model, given the convexity of an D good means agents optimally consume a single good as opposed to switching across many. Consider a market of only S goods and recall it is optimal for agents to only consume any type S good for attention $\hat{\tau}$. If no firms invest then firm i would split the market and receive F_S units of attention. Consequently, firms always have an incentive to deviate and guarantee $\hat{\tau}$. Moreover, if $I_j^g = 1 \; \forall \; j \neq i$, then firm i's best response is to also invest given at a minimum $\alpha > c_g$ (and 0 otherwise). In a market of both type D and S firms, it is always optimal to invest conditional upon entry following the same intuition of the baseline model. Thus, our lemma 1 result holds in this variant of the model. The figure below illustrates this schematically.

	Firms $j,\ j \neq i$	
Firm i	$I_j^g = 1$	$I_j^g = 0$
$I_i^g = 1$	$min(\alpha - c_g, \frac{1}{n} - c_g)$	$(\hat{\tau} - c_g, 0)$
$I_i^g = 0$	$(0, \hat{\tau} - c_g)$	$\frac{1}{n}$

Note, here we are assuming that n is not sufficiently small, i.e. that C_S is not unreasonably large. Our $\hat{\tau} > C_S$ captures this.

Now that we have established that all firms will invest in grabbing attention ($I^g = 1$) post-entry, we can solve for equilibria using the conditions that $\pi_S^* = \pi_D^* = 0$. As in the baseline model, dependent on the level of distraction and attention-grabbing, an agent will consume either a single D or a single S good. Consequently, we get two possible market structures, one where there are only D firms and $n_D = \frac{1}{C_D}$, or only S firms and $n_S = \frac{1}{C_S}$ (profit functions are identical to proposition 1). We get an D-only equilibria when the level of attention grabbing is low, specifically, $\alpha(n_D - 1) < 1 - \tilde{\tau}$. Using this and $n_D = \frac{1}{C_D}$ provides the parameter region (characterised around α) for an equilibrium of D firms and agents consuming a single good - $\alpha < \frac{C_D(1-\tilde{\tau})}{1-C_D}$.

Conversely, when the level of attention grabbing is moderate-high, i.e. $\alpha(n_S - m) > 1 - \tilde{\tau}$, we get only type S entrants. Specfically, this arises when $\alpha \geq \frac{C_S\ \hat{\tau}(1-\tilde{\tau})}{\hat{\tau}-\tilde{\tau}\ C_S}$.[28] Within a market of only S firm we can an equilibrium where agents consume m different goods, and we can get an equilibrium where agents consume a single good. For the former, this occurs if $1 - \tilde{\tau} < \alpha(n_S - m) < \hat{\tau}$, and if we solve for α this gives,

$$\frac{C_S\ \hat{\tau}(1-\tilde{\tau})}{\hat{\tau}-\tilde{\tau}\ C_S} \leq \alpha < \frac{C_S(1-\hat{\tau})}{1-C_S}$$

For the latter, when the propensity to grab attention is very high, agents only consume a single S good, as the remaining ungrabbed attention $t_i < \hat{\tau} - \alpha$. This is given by; $\alpha(n_D - 1) > 1 - \hat{\tau}$, which can be characterised around α as $\alpha \geq \frac{C_S(1-\hat{\tau})}{1-C_S}$. Finally, given our assumption on C_D, there exists a multiplicity region - as outlined in proposition 3, in which both the D only equilibria and the S-switch equilibria can arise.

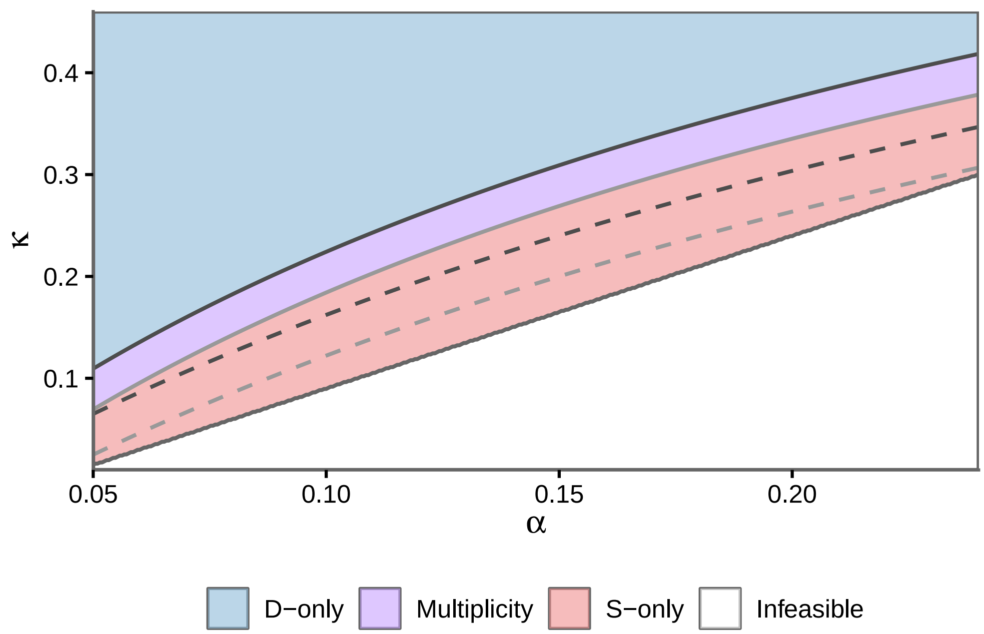
[28]recall that $m = \frac{1-n_S\ \alpha}{\hat{\tau}-\alpha}$)

6.1 Appendix B: Graphs - Habit-forming application

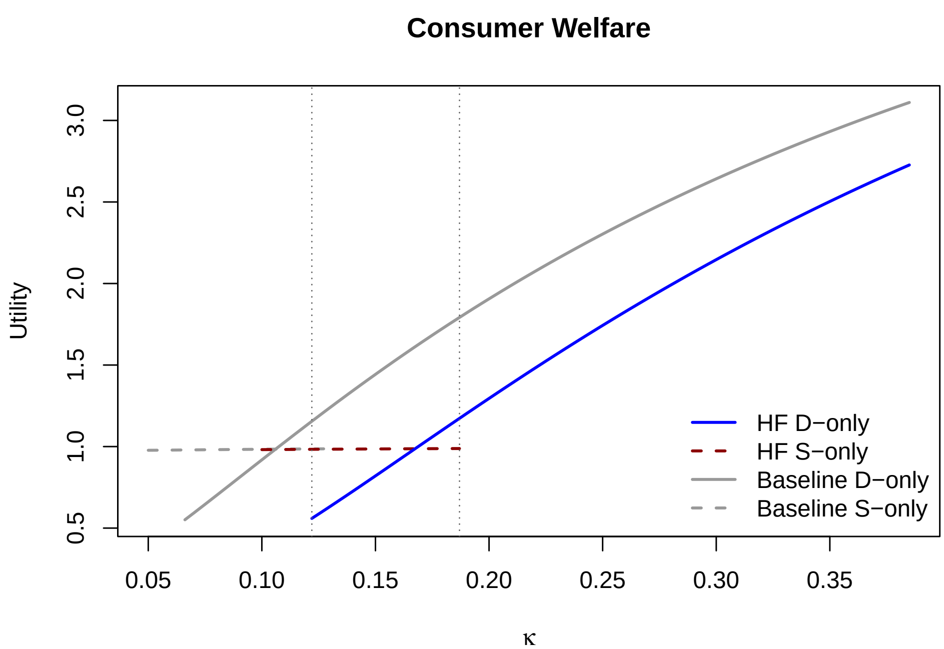
These graphs refer to section 6.5 which incorporated habit-formation network effects in attention grabbing, and illustrate the equilibrium outcomes within a setting where attention capture is self-reinforcing.

In figure 15a, the solid grey lines represent the D-only/multiplicity and the S-only/multiplicity boundary lines. The dashed lines represent the boundary lines for the different equilibria in the baseline case - for the same set of parameter values. The dark grey lines (solid and dashed) demarcates the boundary between D-only and multiplicity, and the light grey lines demarcate the multiplicity and S-only threshold value(s). Evidently, the solid lines lie strictly above the dashed lines, indicating the larger parameter space in which a S-only equilibrium can arise.

Figure 15a depicts that in the S-only equilibrium, the effect of self-reinforcing attention capture is negligble (red dotted line vs light grey dotted line). However, in the D-only equilibrium there is a clear decrease in utility at all feasible values of k (blue solid line vs grey solid line). This is a consequence of greater attention dispersion as more entrants - when k falls - increasingly allows firms to capture more attention, due to the habit-forming nature of attention grabbing.



(a) Equilibria



(b) Consumer Welfare

Figure 15: Habit-formation vs Baseline. Note, in figure 15a and 15b $\bar{\alpha} = 1.5\alpha$ to ensure that $\bar{\alpha}$ changes in line with α, this other parameters ensure that $\bar{\alpha} < C_S$ always. Also, in figure 15a the parameters are the same as in figure 6. Similarly, the parameters in figure 15b are the same as figure 7b.

6.2 Appendix C: Parameter values for figures

Below are the different parameter values used for the phase diagram and comparative static figures throughout the paper.

	Figure									
	6	7a	7b	8	10	11a	11b	13	15a	15b
κ				0.08						
I_D	0.07	0.075	0.075	0.075	0.05	0.05	0.05	0.124	0.05	0.075
I_S	0.01	0.01	0.01	0.01	0.002	0.002	0.002	0.03	0.01	0.01
c_g	0.05	0.04	0.04	0.04	0.01	0.01	0.01	0.05	0.05	0.04
$\bar{\tau}$	0.65								0.65	
$\hat{\tau}$								0.28		
$\tilde{\tau}$								0.7		
v_D		4.5	4.5	5.5						4.5
v_S		1	1		1	1	1			1
v_H					6.75	6.75	6.75			
v_L					1.35	1.35	1.35			
σ_D		3.51	3.51	3.51	2.51	2.51	2.51			3.51
σ_S		1.01	1.01	1.01	1.01	1.01	1.01			1.01
α		0.1	0.1			0.032	0.032			0.1
ζ									1	1
p					0.25	0.25	0.25			

Table 1: Parameter values by figure. When left blank it is because parameter values are not required or are endogenously determined in the figure. Note, for phase diagrams in figure 6 and 13 a fixed $\bar{\tau}$, $\hat{\tau}$ and $\tilde{\tau}$ were set for simplicity. However, for the phase diagram in figure 10 τ_H and τ_L were constructed via the parameters related to an agents payoff - v_S, v_H, v_L, σ_D and σ_L. This was to explore how altering these underlying values (such as the quality gap between type D and S affected the shape of the welfare curves. The computed values translate to $\tau_H =\approx 0.28$ and $\tau_L \approx 0.82$. In the comparative statics the parameters related to an agents payoff were assigned values, also leaving the indifference thresholds implictly calculated and hence not reported in the table below.

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