Identity Signaling with Social Capital: A Model of Symbolic Consumption

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FOR TO WHAT PURPOSE IS ALL THE TOIL AND BUSTLE OF THIS WORLD? … IS IT TO SUPPLY THE NECESSITIES OF NATURE? THE WAGES OF THE MEANEST LABOURER CAN SUPPLY THEM… FROM WHENCE, THEN, ARISES THAT EMULATION WHICH RUNS THROUGH ALL THE DIFFERENT RANKS OF MEN, AND WHAT ARE THE ADVANTAGES WHICH WE PROPOSE BY THAT GREAT PURPOSE OF HUMAN LIFE WHICH WE CALL BETTERING OUR CONDITION? TO BE OBSERVED, TO BE ATTENDED TO, TO BE TAKEN NOTICE OF WITH SYMPATHY, COMPLACENCY, AND APPROBATION, ARE ALL THE ADVANTAGES WHICH WE CAN PROPOSE TO DERIVE FROM IT. IT IS THE VANITY, NOT THE EASE, OR THE PLEASURE, WHICH INTERESTS US.

ADAM SMITH, THE THEORY OF MORAL SENTIMENTS, 1759

1 Introduction

Demand for products and behaviors change over time. Clothing styles, cars models, music genres, hairstyles, even research paradigms, come and go. These shifts could be interpreted as exogenous changes in consumer preferences, or, following Stigler and Becker (1977) reflect some underlying preference that gives rise to apparent shifts in demand. Economists since Adam Smith and Thorstein Veblen have argued that people care not just about the goods they consume, but also about how they are treated by others. Importantly, however, how we are treated depends on how we are perceived, and how we are perceived depends on what we consume. Consequently, people choose consumption behavior in part to convey information about themselves to others (e.g., whether they prefer Abercrombie or Armani, vote Democrat or Republican, or like rock or rap). Likewise, observers use the consumption behaviors of others to make inferences about other people.

This paper studies these issues by providing a novel framework of identity signaling. Specifically, we look at how people use the consumption decisions of others to infer identity, and how people choose consumption based on the identity inferences made by others. In doing so, our perspective goes beyond existing models of fads, fashions, herds and conspicuous consumption. In prior work, type is often one dimensional (invariably wealth or some proxy for wealth), status ordering is universally agreed upon (i.e. everyone aspires to the same thing), and how trends spread and vanish is not modeled. Here, type is

multi-dimensional, status orderings differ between individuals and social capital is distributed across a social network. In addition, we study the conspicuousness of consumption by explicitly modeling the role of a good's visibility in signaling identity.

This work has two main goals. First, we look to deepen insight around how identity shapes consumer choice when there is heterogeneity in social capital as well as individual preferences. Second, we look to generate predictions about where trends come from, how they spread, and how, when and why they are abandoned. To do so, we present a framework that examines how consumption conveys meaning in a signaling model, where signals depend on more than just how much something costs. Instead, signals depend on the identities that they are associated with, and may be valuable in motivating adoption as well as disadoption behaviors. Further, these identity signals directly affect firm behavior through demand estimation, advertising decisions, and product innovation.

Broadly sketching the model, players select a bundle of consumption choices[1] each period. Utility comes not only from a player's consumption, but also from how that consumption shapes how others' perceive them. In each period, players are randomly matched to another player. The frequency of interaction between any two players forms the game's social network. Players observe others' consumption choices and use that information to make inferences about others' type. How each type is perceived determines the social payoff for each player.[2] Consumers get both intrinsic utility from consumption (e.g., based on functional benefits), as well as extrinsic utility from how consumption decisions affect their social image.

The novelty of our modeling framework lies in demonstrating how identity signaling concerns can explain and predict aggregate changes in consumption. This has implications for a wide range of

[1] These choices are expansive, and can include products, services, or even styles and behaviors.

[2] This paper remains agnostic as to why people care about how they are perceived by others. People may just care about their social image. Or their social image may shape future interactions which people may have preferences over or which may affect their future consumption. Or people may be self-signaling.

marketing phenomena: from viral marketing and limited editions to trends in fashion and technology adoption. Unlike past models regarding why people may conform to a certain new trend, our model explains both why people may adopt trends, but also why they may abandon them. The model thus provides a framework for managers seeking to influence changes in consumers' behaviors. The model also explains puzzles that past models have not explained, such as why some trends emerge from marginalized groups (when most models predict that people seek to emulate only those of higher status), as well as why some groups utilize inconspicuous consumption, or how inconspicuous signals are used to signal identity. By making explicit some of the identity driven components of utility and subsequent consumption decisions, our framework allows us to reproduce the ideas that fashion is a coordination game (Schelling 1978) and acts as a costly signal (Becker and Murphy, 2000; Bernheim, 1994; Pesendorfer, 1995; etc.). The main innovations in our model are the integration of the coordination and the costly signaling models, and the fact that we do not assume that everyone agrees upon the status ordering of types. These two changes allow study of divergent behavior where prior models found only conformity.

The rest of this paper is organized as follows: in Section 2, we review past research and recent experimental findings that provide motivation for our work. In Section 3, we introduce the modeling framework, and analyze the value of a signal and its impact on willingness to pay, consumer choice, and demand. Section 4 discusses the effect of social capital on signaling, the dynamics of consumer choice, and explains how trends in adoption and dis-adoption may come about. We also study the role of signal visibility, and investigate the effect of multiple audiences and identities. Section 5 proposes several application areas for the model, and concludes.

2 Literature Review

Many sociologists (notably Baudrillard, 1970; Boudieu, 1986; Levy, 1959) have studied how what we consume conveys meaning. In economics, the idea is most closely associated with Veblen's *Theory of the Leisure Class* (1912), whose ideas have been more recently formalized by Ireland (1992), Pesendorfer (1995) and Bagwell and Bernheim (1996). Each assumes that the role of fashion is to signal wealth. Similarly, Bikhchandani, Hirshleifer and Welch (1992), Bernheim (1994), Banerjee (1992), Brock and Durlauf (2001), and Bloom (1993) present models of conformity but say little about the other phenomenon we consider. In particular, Banerjee (1992) and Bikhchandani, Hirshleifer and Welch (1992) focus on the role of uncertainty about product quality, which leads to conformity. We abstract away from quality uncertainty in this paper, but focus on elements of individual consumer utility. The link between consumption and identity is introduced by Karni and Schmeidler (1990) with a simple model, but is largely undeveloped.

For the purposes of this paper, we refer to the *meaning* of a consumption choice to be the inference about a player's type when another player observes that choice.[3] Importantly, what people infer about a particular consumption choice depends not only on that individual choice, but on the image created by the equilibrium choices of all players in society (Kuksov and Shachar, 2010). Since the choices of any single individual will have little effect on beliefs in equilibrium, meaning is effectively socially constructed in our economy. Recent work exploring theories of identity by Akerlof and Kranton (2000, 2002, 2005) takes identity to be exogenous, and providing exogenously given norms of behavior that members get utility for adopting. We endogenize why norms of behavior or consumption are followed, and focus instead on how norms arise, and how they evolve. This perspective makes our model more

[3] While the symbolic value of consumption is something long studied by sociologists, economics and game theory allows us to formalize the idea that meaning derives from the equilibrium behavior, aggregated over the behavior of many individual choices. Furthermore, the model demonstrates how variables like cost and network structure shape meaning. Of course the meaning of any particular item depends on many features such as its history, its representativeness, etc. and not just its relationship with identity. However, we will limit the scope of our discussion here to the identity related component of meaning.

akin to the "Acting White" model explored by Austen-Smith and Fryer (2005) where norms of hard work and studying become oppositional to African-American identity. Benabou and Tirole (2006a) offer a model of how identity is formed. We agree that identity formation is important, but that rests beyond the scope of this paper. Benabou and Tirole (2006b) also study the reputational effects of pro-social behavior, while Croson et al. (2009) look at how group affiliation affects charity behavior. We expand their work by examining the identity and reputational effects of consumption in a broader context. In fact, while the paper uses the term goods, the model can be applied to a range of choices—whether it is trends in academic research, votes in elections, adoption of innovations, or norms of behavior.

Diffusion research has examined the role of social influence and contagion on how new products and services get adopted within and across markets (Katz and Lazarfeld 1955, Rogers 1962, Bass 1969). Though much of the early work focused on understanding adoption dynamics at the aggregate market level, more recent work has analyzed the impact of social influence within and across discrete consumer segments (e.g., Steffens and Murthy 1992, Van den Bulte and Joshi 2007). In the context of multimarket and global diffusion, studies have looked at the impact of social influence across countries to understand whether markets develop independently, or are impacted by cross-country influence (for a summary, see DeKimpe, Parker and Sarvary, 2000). While contagion effects across consumer segments have often been identified to be complementary for adoption, at times predatory effects have been observed as well: i.e. more adoption in one segment leads to less in another, and vice versa (Bayus, Kim and Shocker, 2000). In general, diffusion research has stressed the need to better understand aggregate level adoption by explicitly modeling individual consumer level behavior (Muller, Peres and Mahajan, 2009). Our model provides such a mechanism, by incorporating consumer heterogeneity as well as allowing for social interactions within and across market segments, while being flexible enough to permit complementary as well as predatory effects across the many potentially interacting market groups.

Recent work in social network analysis has sought to better represent individual social interactions among networks of consumers to help improve our understanding of aggregate adoption behaviors (Watts 2004). Formal analyses of social networks in the context of adoption takes two distinct perspectives (Van den Bulte and Wuyts 2007). At a macro-level, the focus is on how network level properties, such as density and structure, may impact adoption. At the micro-level, the focus is on how node and link level properties, such as individual characteristics and ties, may impact adoption. In our model, we adopt a reduced form approach for representing consumers' locations within a social network, which allows us to succinctly capture the likelihood of interaction between distinct types of consumers. Such a representation allows us to effectively incorporate the network aspects of social interactions into a formal analysis of individual level adoption.

Recent experimental work (Berger and Heath 2007; 2008; Berger and Rand 2008) has explored how people use consumption and cultural behaviors to signal their identity, specifically by looking at how people diverge from the behaviors of others (also see White and Dahl 2006, 2007). Berger and Heath (2007, 2008) define *divergence* as people selecting cultural tastes (e.g., possessions, attitudes, or behaviors) that distinguish them from other groups and abandoning such tastes when other social groups adopt them. While past research in psychology (Asch, 1956; etc.) and in economics (Bernheim, 1994; etc.) has focused on conformity, people also diverge from others in a coordinated way. We now describe some experiments that examine patterns of divergence and reveal how behaviors and consumption acquire symbolic meaning. These experimental findings, along with past research, provide the basis for our modeling assumptions in the next section.

In Berger and Heath (2008), researchers tracked the use of a cultural product (wristbands) in a particular group both before, and after the product was adopted by outsiders. Yellow Livestrong wristbands were sold to members of a campus dormitory, and the number of dorm members wearing the bands after a week was tracked. Soon after, the bands were also sold to a neighboring academic

focus dorm that was considered the “geeks” on campus. Finally, researchers returned to the original dorm to measure whether people were still wearing the wristband. Consistent with an identity-signaling perspective, almost one-third of the original wearers abandoned the wristband once it was adopted by the geeks. Further, a control condition found no such abandonment ruling out time-based explanations such as boredom. While this experiment does not definitively reveal how these bracelets signal meaning, it does demonstrate that demand for these bracelets depends on the distribution of ownership of bracelets in the community.

Berger and Heath (2008) also conducted more structured experiments showing that it is not only the number of others consuming that affects consumption, but their social type. One experiment examined whether undergraduates would vary their food choices depending on the social group associated with certain types of food. First, depending on experimental condition, undergraduate participants read an article suggesting that either undergraduates or an avoidance group (i.e., graduate students) were the largest consumers of junk food on campus. Graduate students were chosen because while undergraduates did not dislike grad students, or see them as lower status, they did not want to be mistaken for one. Then, undergraduates completed an ostensibly unrelated study on food choice. They made real food choices from actual choice pairs, some of which contained healthy and junk food options. In addition, half the participants made their choices in private, while the other half made them in public view of other participants. As expected, when choice was publicly visible, participants were less likely to choose junk food when it was associated with an avoidance group (graduate students). Berger and Rand (2008) conducted a similar field study in a university cafeteria with similar results.

It is worth noting that these examples represent, at least in part, a social phenomenon, rather than a purely individual one. Previous economic studies of identity have focused on the internalization of norms (Benabou and Tirole, 2007; Akerlof and Kranton, 2000, 2005), and how people use certain behaviors to signal to themselves (Benabou and Tirole, 2007). In contrast, this study shows that subjects

made significantly different choices in the presence of an observer, but did not do so, when choosing privately. This suggests that visibility and identities associated with a particular behavior can have an important impact on whether people select it. Berger and Heath (2008) also find that these effects persist controlling for status concerns, and whether the other identities are liked or disliked.

Taken together, these papers suggest that a significant driver of consumption is "what others are consuming", effectively indicating a consumption externality. Furthermore, this evidence suggests that this consumption externality is different than what has previously been identified. The evidence cannot be explained by what the psychology literature calls, a need for uniqueness (Fromkin, 1970; Snyder & Fromkin, 1980), or as commonly used in economics, snob or status effects (Frank, 1985; Pesendorfer 1995). Instead, the evidence suggests that the relationship between individual choice and group choice depends on identity more broadly. Hence, in the next section, we begin to develop a model that explicitly describes such behaviors.

3 A Model for Signaling Identity

We introduce our framework of social interaction and identity signaling by integrating consumer choice as a coordination game and as a signaling game, and by relaxing the assumption that status is universally agreed upon. These changes allow us to study how behavior diverges from a norm in a coordinated way, whereas previous models focused on conformity.

In this section, signaling is achieved based on coordination and the correlation between type and intrinsic motivation. In the next section, we focus on the distribution of knowledge about a trend in behavior, and examine how consumption obtains signaling value based on the spread of social capital obtained via one's social network.

In the model, every individual is assigned a type, which represents her identity. Type is exogenous, and the perception of type determines how others in society treat any given individual in social

interactions (e.g. avoid, chat, flirt, or flatter). Unlike prior models (Bernheim, 1994; Pesendorfer, 1995; Ireland 1994) where all types are ordered along a universally agreed upon dimension called status, and individuals always prefer to be perceived and treated as someone of higher status; here, we allow players to have any preferences ordering over the different types in society.[4]

Let there be a unit mass of individuals, each with type $\theta \in \Theta$ where Θ is a finite set of cardinality N, and simply for convenience let types be indexed by integers $\{1..N\}$. Let $\theta(j)$ refer to a consumer of the j-th type. Each individual chooses a consumption bundle, $\vec{x} \in \{0,1\}^K$, a vector of K possible goods/behaviors that the individual could buy/adhere to in that period. Individuals are then randomly matched with another player. They observe one of the consumption choices of the player they are matched with (you may own many different hats, but in any given encounter, people only observe one). Let $\mathrm{I} \subset 2^{\Theta}$ be the set of possible identity groups; each type θ can belong to multiple identity groups.

Consumer utility has two key components[5]: let $u_i(\vec{x})$ be the intrinsic preferences for consumption and $v_i(\vec{x})$ be the extrinsic utility from consumption for a player of type $\theta(i)$. Players draw inferences about the other's type based on the other's consumption, and players care about the inferences others make about them over an unordered type-space. Thus, $v_i(\vec{x})$ is an expected "social" utility, taken over all possible other types the player might be matched with, all inferences about her type that her match partner might make, and all possible consumption choices the matched partner might have observed.

Let ρ_k be the probability of observing any good k, which we will call the good's *visibility*. Let π_i^m be the probability a member of type $\theta(i)$ is paired with type $\theta(m)$. Let $\phi_m^n(x_k)$ be the probability, derived from Bayes' rule, that a player of type $\theta(m)$ infers the type $\theta(n)$ having seen the consumption choice

[4] Past papers have typically argued that people care about status for access to non-tradeable goods. Here, we take preferences over perceptions as a primitive, but argue that people care about perception because perception determines how people are treated in social interactions and people arguably have as much diversity over such preferences as they do about what brand of cereal they consume.

[5] We assume that utility is quasi-linear in a numeraire good, effectively assuming that consumption of identity related goods is small relative to total consumption. This approach sidesteps income effects to allow for consistency when we consider cheap signals.

x_k.[6] Let $v_i^n \in \left[-\frac{1}{2}, \frac{1}{2}\right]$ be the utility a player of type $\theta(i)$ receives when she encounters a player who infers that she is of type $\theta(n)$.

Combining intrinsic and extrinsic utility with a random noise term ε (to eliminate corner solutions) gives the following expression for utility for a player of type $\theta(i)$ for a good x_k:

$$U_i(x_k) = u_i(x_k) + \boldsymbol{E}[v_i(x_k)] + \varepsilon_i(x_k), \quad (1)$$

$$\text{where } \boldsymbol{E}[v_i(x_k)] = \rho_k \sum_{\theta(m)\in\Theta}(\pi_i^m \sum_{\theta(n)\in\Theta} \phi_m^n(x_k) v_i^n)$$

Along the same lines, the utility for a player of type $\theta(i)$ for consuming the bundle $\vec{x}$ is:

$$U_i(\vec{x}) = u_i(\vec{x}) + \boldsymbol{E}[v_i(\vec{x})] + \varepsilon_i(\vec{x})$$

The player's problem is $\max_{\vec{x}} U_i(\vec{x})$. We define $\varepsilon_i(\vec{x})$ as an idiosyncratic marginal utility shock for each player i for each good, k, independent of type. Each $\varepsilon_i(x_k) = \varepsilon_{i,k}$ has mean zero, finite variance σ_k^2, full support, and density function $F_k(\varepsilon_{i,k})$. Both $\theta(i)$ and $\varepsilon_i(\vec{x})$ is private information of player *i*.

Formally, the meaning of a choice x_k is $\Pr[\theta = \theta(n)|x_k = 1]$ minus $\Pr[\theta = \theta(n)|x_k = 0]$. The meaning represents a good's signaling value, or how much the choice of a good k shifts the reactions of others. It is useful to introduce the following discrete (partial) derivative notation (this derivative does not depend on other consumption choices because only one choice is ever observed at a time):

$$\Delta\phi_m^n(k) = \phi_m^n(x_k = 1) - \phi_m^n(x_k = 0)$$

For simplicity, we adopt the following functional form for intrinsic preferences:

$$u_i(\vec{x}) = (\vec{\mu}_i - \vec{p}) \cdot \vec{x}$$

where $\vec{\mu}_i$ is a vector of marginal utilities (net of price, $\vec{p}$) for each consumption choice.

We now have the notation needed to define the concept of Willingness-to-Pay (WTP). By $WTP_{i,k}$ we refer to the highest price, p_k, where the average player of type $\theta(i)$ still prefer to choose $x_k = 1$ over $x_k = 0$. Linearity of the specification allows us to consider each good separately:

[6] The game presented is a reduced form for an extensive form game where players make inferences about the others types and then choose interactions based on those inferences.

$$WTP_{i,k} = \mu_{i,k} + \rho_k \sum_{\theta(m)\in\Theta} (\pi_i^m \sum_{\theta(n)\in\Theta} \Delta\phi_m^n(x_k) v_i^n) \quad (2)$$

Note that if there were no extrinsic, social component of utility, this specification means each person would be willing to pay a price up to their intrinsic marginal utility for a good, as is standard. Adding extrinsic motivation can increase or decrease WTP. Note that when a given type's WTP for a good increases, the share, $s_{i,k}$ of type $\theta(i)$ which consumes good x_k increases as well:

$$s_{i,k} = \Pr[x_k = 1 | \theta = \theta(i)] = F_k(WTP_{i,k} - p_k)$$

It will later become useful to note the structure of the social network in which players are embedded. The network is represented as a complete undirected graph, $\mathcal{G}(\Theta, \Pi)$, with each node representing a type, and with the edges represented by the symmetric matrix of match frequencies given by, Π. The network will not matter in this section, but will matter when we consider a repeated version of this game where social capital matters.

Equilibrium in this signaling game will be Pure Strategy Perfect Bayesian Equilibrium. We rely on Schmeidler (1973) for assurance that equilibrium exists in games with a continuum of players and finite actions. As is typical in signaling games, there exists a large multiplicity of equilibria, even after refinements. We do not have a theory of which equilibrium is focal, but we can derive properties that are true of any equilibrium. For the first proposition, it will be useful to define the following:

> ***Definition:*** *An <u>associate</u> of a player of type $\theta(i)$, is a player of another type $\theta(n)$ who the player likes being identified as (i.e. $v_i^n \geq \bar{v}_i$).*
>
> ***Definition:*** *A <u>dissociate</u> of a player of type $\theta(i)$, is a player of another type $\theta(n)$ who the player dis-likes being identified as (i.e. $v_i^n \leq \underline{v}_i$).*

Association is an asymmetric relation between two types that denotes whether a type likes or dislikes being associated with another. With these definitions of associate and dissociate, we can define an identity (or identity group) as the set of types that have the same preferences for association, that is

they have the same associates and the same dissociates. Types within an identity may differ in terms of whom they interact with, but they all want to be identified in the same way. We will later specify $\bar{v}_i$ and $\underline{v}_i$ as the lowest and highest values of v respectively, such that the Proposition 1 holds.[7]

Proposition 1.: *In every Perfect Bayesian Equilibrium of the Identity Signaling game, when comparing it with a nearby equilibrium of a perturbation of the game, the following holds:*[8]

1. Any individual player's willingness-to-pay for a good x_k is ***weakly increasing*** *in the number of associates relative to non-associates who choose to consume x_k.*

2. Any individual player's willingness-to-pay for a good x_k is ***weakly decreasing*** *in the number of* ***dissociates*** *relative to non-dissociates who choose to consume x_k.*

3. Every type in every Identity Signaling game has at least one associate and at least one dissociate.

Proof in Appendix. ■

This proposition considers the effect of willingness to pay. To compare with experimental evidence, recall that the share of a given type consuming any particular good corresponds to the type's WTP. In the Livestrong experiment discussed earlier, when more dissociates had the bracelet it reduced the desirability (i.e., WTP) of the bracelets for the original dorm members. Similarly, in the junk food experiment, the perceived high prevalence of junk food eating by a dissociate group reduced the desirability of junk food for the undergraduates. The asymmetry of the association relation can be seen in the analysis on obesity by Christakis and Fowler (2007) who find that one will tend to emulate the obesogenic behavior of someone they consider close friends, but if the other person does not consider the friendship close, the emulation is not reciprocated.

[7] Note that in the special binary case, where v_i^ncan take only two values, say + 1/2 and – 1/2, then all + 1/2's are associates and all – 1/2's are dissociates.

[8] It should be noted that this proposition depends crucially on the assumption that only one consumption item is observed at a time. If multiple signals were observed, one could get counter-signaling, as in Feltovich, Harbaugh and To (2002).

Two interesting implications arise from the above proposition. To illustrate, consider the simple case where all consumer types are equally likely to interact with any other consumer type; i.e. $\pi_m^n = \frac{1}{N}$. The first observation relates the market share of good *k* among members of an associated group to the magnitude of extrinsic preferences for that good: Since $\Delta\phi_m^n(k) = \frac{s_{n,k} - s_k}{s_k(1-s_k)}\pi_m^n$, we have $\Delta\phi_m^n(k) \geq 0 \rightarrow s_{n,k} \geq s_k = \frac{1}{N}\sum_{\theta(i)\epsilon\Theta} s_{i,k}$. In words, consumption of a good *k* comes to signal membership in $\theta(n)$, only if good *k* has above average share amongst type $\theta(n)$ consumers. A good or behavior will cause a positive shift in beliefs, when it is more popular among that aspirational group. Relating this to the Livestrong experiment, people would consider the bands to signify membership in a particular group of desired associates only if the bands enjoyed above average adoption within that group.

Second, since sign($\frac{\partial(WTP_{i,k})}{\partial v_i^n}$) = sign($\Delta\phi_m^n(k)$); the WTP of a consumer of type $\theta(i)$ for good *k* is increasing in the value of being perceived as a type $\theta(n)$, as long as good *k* enjoys above average share among consumers of type $\theta(n)$. In other words, so long as the good is highly popular among associate types, other types will be willing to pay more for the good the more they value being perceived as an "associate" type. This suggests that so long as the Livestrong bands tend to be popular among associates, then the more a group wants to be perceived as a desired associate, the higher their willingness to pay for the Livestrong bands would be.

We now turn towards investigating the impact of identity signaling on market demand.

Proposition 2.: *Quantity demanded for a social good may be increasing with price. In other words, the demand function may be upwards sloping.*

Proof in Appendix. ■

This proposition is in line with the prior literature on snob effects (Amaldoss and Jain, 2005). To illustrate this point, consider a simple example, where there are only two types, one who derives high intrinsic marginal value, μ_H, for a good and another type who derives low intrinsic marginal value, μ_L,

for a good. The high value type does not want to be associated with the low value type. The low value type does not care about how she appears to others (i.e. she derives the same utility v_L^i for all i). At low prices ($p < \mu_L$), the low value type will consume, and the high value type will not, if their extrinsic cost of association is sufficiently high. At higher prices ($p > \mu_L$), the low value type will not consume any, and the high value type will consume. If there are more high value types than low value types, then quantity demanded will go up.

The implication of Proposition 2 on profits is also of note (and subtly differs from the findings in Amaldoss and Jain, 2005). If in equilibrium, the firm sells at a low price to both segments (this is likely to happen when there are many low value types and the snob effect is not too high), an increase in conformity – or the strength of association that the low type feels with the high type will lead to a higher utility to the low value types and hence higher prices and profits. On the other hand, if in equilibrium the firm sells only to the high value types (this is likely to happen when there are many high value types and the snob effect is high), an increase in snobbishness will have potentially no effect on profitability: since no low value types are buying, the utility of the high value types will not increase with snobbishness, preventing the firm from earning any higher profits due to increased snobbishness.

Proposition 3.: *In the Identity Signaling game, the signal value $\Delta\phi_m^n(k)$ of good x_k, goes to zero when:*

1. *Preferences for that good are sufficiently idiosyncratic relative to type:*

   $\sigma_k \to \infty$: $\forall n: \Delta\phi_m^n(k) = 0$.

2. *Intrinsic motivations are sufficiently high:*

   $min_i\ \mu_{i_k} \to \infty$: $\forall n: \Delta\phi_m^n(k) = 0$ *or* $max_i\ \mu_{i_k} \to -\infty$: $\forall n: \Delta\phi_m^n(k) = 0$

Proof in Appendix. ■

Our prediction is confirmed by Berger and Heath (2008), who find that people are more likely to both signal identity and to infer identity through their choices in 'afunctional' domains, e.g. choice of color or style, rather than power or speed. In other words, people signal in domains where average

intrinsic motivations are close to zero (either positive or negative). Intuitively, when intrinsic motivations dominate extrinsic motivations, consumption choices that provide high intrinsic utility, such as a high quality lawnmower, contain little information about identity because consumer choices in those cases are dominated by intrinsic characteristics of the good. At the same time, a choice that provides high negative intrinsic utility will prevent consumption. When a player is observed using (or not using) a functional good, it is more difficult for the receiver to attribute whether the choice was motivated by intrinsic or extrinsic reasons. Heffetz (2010) looks at consumption patterns in census data and finds that a consumption good's signaling value matters less for goods such as tobacco and insurance, consistent with the idea that functionality (or the lack thereof) makes for less effective signals.

Despite the logic that sufficiently costly signals are not used to signal identity, there are many examples of identity signals that are very costly. For example, groups often use painful tattoos, expensive watches, or costly norms of behavior, as signals of identity. Costly signals are used when there may be an *asymmetry* in association preferences. Extrinsic preferences are *symmetric* for types $\theta(m)$ and $\theta(n)$ if there is no conflict of interest; m is an associate for n implies that n is an associate for m, and similarly m is a dissociate for n if and only if n is a dissociate of m. In such cases, low cost, a-functional signals are efficient. However, if the opposite is true and preferences are *asymmetric* — n is an associate for m while m is a dissociate for n or vice versa — then the simple coordination game breaks down. To capture the impact of such an asymmetry in association preferences, it will be helpful to define the following terms:

> ***Definition:*** *If n is an associate of m, but m is a dissociate of n, we call a player of type m an <u>imitator</u> of type n.*
>
> ***Definition:*** *If n is an associate of m, but m is a dissociate of n, we call a player of type n an <u>insider</u> for type m.*

The existence of insiders and imitators has many interesting implications for signaling identity:

Proposition 4.*: Consider an asymmetric pair of types (an insider and an imitator) in the Identity Signaling Game. If interaction or chance of misidentification with other types is sufficiently small (so that interactions between these two types can be considered in isolation) then the optimal effectiveness of a signal is increasing in the intrinsic utility for insiders and decreasing in the intrinsic utility for imitators.*

Proof in Appendix ■

In the case of only two types, the game resembles a conventional costly signaling game. Increasing the intrinsic utility has two effects on consumption share: the direct effect of making it more appealing, and the indirect effect on the meaning of that good. The direct effect is always positive, and from the above proposition, dominates the indirect effect. This proposition argues that insiders will use signals whose intrinsic utility is correlated with type to avoid imitation—i.e. signals that are low cost for insiders, but high cost for imitators. The standard example is those who wish to signal high wealth will use expensive signals; it is relatively inexpensive for the wealthy to purchase luxury goods.[9] But costs often occur on other dimensions beyond wealth. Consider painful initiation rites such as tattoos. Tattoos have the advantage that once they have been painfully applied, they are costless to wear, but very costly for the uninitiated to copy. Similarly, specialized lingo is costly and difficult to learn, but cheap once the knowledge is acquired. Iannancone (1992) analyzes the case of religious rituals, which serve a similar purpose. The case of highly conspicuous signals like a punk Mohawk haircut is a special case, where insiders of the punk group exploit the fact that imitators worry more about how they are perceived by the mainstream. We return to this point when we discuss signal visibility.

Thus, this model also provides some intuition for how fashion cycles may arise. Insiders adopt a new product, trend or cultural practice. Some imitators begin to adopt as well. Once sufficient imitators have adopted the trend, the insiders may lose interest, and abandon the signal, causing the imitators to abandon the signal as well. Thus the model predicts threshold effects, where once a certain threshold is

[9] Here, we assume wealthier individuals have a lower shadow price of money.

passed, a trend can quickly disappear.[10] The reason it takes time for imitators to adopt new trends can be attributed to a lack of direct knowledge about the trend. In the context of innovation diffusion, often the first segment of *innovators*, *visionaries*, or *opinion leaders* has high intrinsic utility, as they tend to have a better understanding of their needs as well as the available solutions. On the other hand, the segment of *imitators* or *followers* – the *mainstream,* has low intrinsic utility, but high extrinsic utility as they desire validation from the first segment on the choices they intend to make. When the dissociation effect between these two groups is not too strong, innovators may continue to use the product even after imitators come on board, leading to a persistence of adoption for certain goods. We consider such dynamics more formally in the next section.

4 Identity Signaling with Social Capital

In this section, we focus on how social capital shapes identity signaling. We use the term social capital to refer to the knowledge of how to properly execute behaviors, such as the proper way to wear a hat sideways, to accessorize an outfit, or effectively use an innovation. Our notion of social capital combines the traditional usage in economics where social capital refers to social connections (Glaeser, Laibson and Sacerdote, 2002) with the idea of cultural capital, as expressed by Bourdieu (1986). Bourdieu described cultural capital as the nuances of behavior society uses to perpetuate social class. We assume that to participate, some behaviors require specific social capital. Players are endowed with the knowledge to perform one type of behavior. To acquire knowledge to perform more behaviors, they must interact with and observe another player displaying that behavior.

Definition*: A player has the knowledge, $g_k = 1$, to choose a good, $x_k = 1$, when a player has encountered and observed another player using that good, $x_k = 1$, in her history.*

[10] See Berger (2008) for a more thorough discussion of fashion cycles.

We assume that the intrinsic utility from consuming a good is increasing in the share of players with the same type, who have knowledge of the good; or equivalently, familiarity with the good lowers the cost of consuming it. Players begin the game with no history, and thus they begin without knowledge of any goods/trends. At the beginning of each period, let all players of each type acquire knowledge about one additional good that no other player has knowledge of; and which good each type has knowledge of is common knowledge. The use of pure strategy Nash equilibrium also means that all players know the strategies employed by other types. The intuition behind this assumption is that people are aware of what consumption of certain goods and behaviors signify, but they require direct experience with someone using the trend to properly replicate the exact behavior.

To study dynamics, we consider a finitely repeated version of the Identity Signaling game presented in the previous section. Per period utility is now given by:

$$U_{i_t}(\vec{x}_t) = \left(\vec{\mu}_i\left(\vec{g}_{i_t}\right) - \vec{p}\right) \cdot \vec{x}_t \; + \sum_{k \in \{1..K\}} \sum_{\theta(m) \in \Theta} \sum_{\theta(n) \in \Theta} \pi_i^m \phi_m^n\left(x_{k_t}\right) v_i^n \rho_k + \vec{\varepsilon}_t \cdot \vec{x}_t \tag{3}$$

The structure of the game allows us to focus on each player's per period utility, rather than lifetime utility, because a player's actions in any given period has no effect on her payoffs in future periods.[11]

Tractability requires us to make two further assumptions: 1) the variance of the idiosyncratic noise term is sufficiently high so that extrinsic preferences do not dominate intrinsic preferences; 2) in the absence of information derived from the consumption signals, players hold common priors about the type they interact with.[12]. We now consider some properties of the equilibrium:

[11] This is because there are no income effects. Also, since there is a continuum of players, actions by any single player have no effect on the future distribution of social capital.

[12] The fact that the network does not affect their priors can be explained by saying that the situation in which people care about signaling is only in relatively anonymous environments where the frequency of interaction is the same for everybody.

Proposition 5.*: In the equilibrium of the Dynamic Identity Signaling game, the willingness-to-pay for any particular good x_k, for any particular player, is increasing in the number of associates with knowledge about the good and decreasing in the number of dissociates with knowledge about the good.*

Proof in Appendix. ■

The proposition above, which follows directly from Proposition 1., allows us to answer questions about the dynamics of behavioral trends, such as the following question: Who spreads trends?

Proposition 6.*: In the Dynamic Identity Signaling Game, a player of type $\theta(i)$ is more likely in period $t+1$ to emulate the observed consumption choice of an associate type $\theta(j)$ she was matched with in period t, when:*

1) *her type had been matched more with members of type $\theta(j)$ more often in previous periods,*
2) *the player of type $\theta(j)$ that she interacted with had been matched more often in previous periods with other types $\theta(j')$ that the player likes being associated with who also consume that good.*

Proof in Appendix. ■

The implications of this proposition are quite interesting: first, types that have a lot of people who want to be associated with them are more likely to be emulated. Those who interact more with others are more likely to be emulated. Finally, those who interact more with other people that people want to associate with are more likely to be emulated. This has direct implications for managers, regarding consumer types that are more likely to be influential in impacting choice.

Further, part (2) of this proposition goes beyond the popular notions of "innovators/ visionaries/ opinion leaders", and helps explain the concept of the "market maven" (Feick and Price 1987), where certain individuals central in a social network hold a lot of sway on the consumption decisions of others. In our model, mavens are those who are well connected to other people that people want to be like. The well connected may also be more influential because they are more likely to mistaken as a player whom others wish to be associated with. Managers can identify these consumers who are "central" in a

network of associates (e.g., using network measures of centrality such as degree, closeness, and betweenness), to determine who will hold a lot more sway over others.

This proposition also allows us to predict which imitators are most likely to adopt a new trend. From the previous section, the imitators with the most similar intrinsic preferences would more easily adopt the choices of insiders. From this section, we can now add that imitators with the highest extrinsic utility are most likely to adopt, those with the most contact with insiders are most likely to adopt, and those connected to the best connected insiders are most likely to adopt.

Another benefit of adding dynamics to the Identity Signaling model is it allows us to understand how some goods or trends adopted by a type in period t may be dropped by that type in period $t+1$, i.e. θ's that adopt a certain $x_k = 1$ in period t, may choose $x_k = 0$ in period $t+1$. The next proposition examines which trends are likely to persist and which are likely to fade.

Proposition 7.*: In the Dynamic Identity Signaling game, a good x_k that was initially adopted in period t is more likely to increase in popularity in period $t+1$ among others players of the same type (i.e. the share of those adopting that behavior for a given type is increasing) when the initial adopters*

1) *Have more interaction with associates.*
2) *Have fewer imitators of the identity.*
3) *Have fewer interactions with imitators.*

A good will decline in popularity when the opposite is true.

Proof in Appendix. ■

The two propositions above separate out the distinct drivers of (dis)adoption, and suggest that the groups which are most likely to maintain coherent identity signals across periods are insular groups who interact mostly with themselves and people they like to associate with, and who have few imitators. This result suggests why trends often start in traditionally marginalized groups such as inner city youths or homosexual men. Their trends last longer, develop greater coherence, and serve as a convenient focal

point for other groups to adopt. Effectively, some groups with many imitators appropriate the behaviors of marginalized groups because marginalized groups are better at incubating new behaviors. Past models of fashion that depended on status (Simmel, 1904; Pesendorfer, 1995) have difficulty explaining such observations because they focus on status alone. They predict that new fashions start amongst those with high status seeking to distinguish themselves, and trickle down to those with lower status who wish to be seen as high status. In contrast, our model explains why fashion can often move in the opposite direction, and potentially be cyclical. We now illustrate this point with an example.

4.1 The Anatomy of a Fashion Cycle

Our results taken together can help us understand the anatomy of a fashion cycle. The setup allows insiders to adopt a new behavior in any period. Adoption by insiders of a new trend increases as more insiders acquire knowledge of the trend. However, as soon as imitators gain knowledge of the trend, adoption by insiders declines. When imitators gain knowledge of the trend, the signaling value of the trend becomes more and more uninformative, leading more insiders to abandon the trend, which in turn leads imitators to begin to abandon the trend as well. As the previous behavior becomes uninformative, the incentive for insiders to adopt a new behavior now goes up. The results explain not only fads, but also why we may commonly observe cycles in fashion; and how fast new fashions may turnover. Technology, such as digital social media, which accelerates interactions and increases the dissemination of social information, accelerates the rate of adoption as well as abandonment. Similarly, it can be posited that the density of a network also accelerates the cycling of trends.

(insert Figure 1 Here)

To elaborate, consider illustrative example in Figure 1. One might imagine a world with three identities: a marginalized group of inner city youths, a high status group of urban hipsters, and a group of imitators who want to be seen as hip. Inner city youths (Identity Group A) are able to produce new

signals because of their relative insularity. They interact rarely with other identities; therefore, idiosyncratic developments tend to develop and persist. Say they adopt blue hats. Hipsters want to distinguish themselves from the imitators. Hipsters (Identity Group B) have two reasons why they adopt blue hats as well. They encounter and thus observe inner city youth more often than imitators and they are less concerned about being mistaken for one. Blue hats become good identity signals for hipsters. Eventually, the imitators (Identity Group C) who most frequently interact with the hipsters begin to adopt blue hats. When sufficient imitators learn of the blue hat signal, the blue hat signal no longer becomes an effective signal for hipsters, who abandon blue hats, ending that particular trend.

This argument is complementary to the counter-signaling "Too Cool for School" model of Feltovich, Harbaugh, and To (2002). They show that if there are three types: high, medium and low; high status types may adopt the behavior of low status types in order to differentiate themselves from medium types. Feltovich et al. could explain why high status hipsters might adopt the behaviors of low status inner city youths, but could not explain why medium status imitators eventually follow suit. By providing a dynamic story in a richer environment, we explain a greater range of behavior.

4.2 Conspicuous and Inconspicuous Consumption

Until now, we have largely ignored the term ρ_k, which defines a good's visibility. By visibility, we refer to how likely it is for a particular consumption choice, act or behavior to be noticed by an observer. Most prior models of fashion follow from Veblen's idea of conspicuous consumption, focusing on signals that are conspicuous. But being fully conspicuous about consumption may not always be optimal; consumers may benefit from being strategic about revealing information.[13]

[13] In a similar spirit to buyer initiated information revelation, as in Bhardwaj, Chen and Godes (2008).

Visibility plays two roles in the repeated Identity Signaling game. For an individual, higher visibility means a higher chance the identity signal will be observed. For the equilibrium, visibility affects the meaning of the signal, and the likelihood of whether the trend grows or fades away.

Proposition 8.*: In the Dynamic Identity Signaling game, in the period after a new trend is introduced, for the initial adopters:*

1. *There is a* $\rho^* < 1$ *where the persistence of a trend is maximized.*
2. *This visibility that maximizes persistence,* ρ^**, is decreasing in the frequency of interaction with imitators, and increasing in the interactions with insiders.*
3. *As the benefit of being identified as an insider goes up, the optimal visibility increases.*
4. *As the cost of being identified as an imitator goes up, the optimal visibility decreases.*

Proof in Appendix. ■

Thus, perfect visibility may not always be a good thing. Holding other properties constant, in the presence of imitators, in equilibrium, insiders are more likely to continue using a good with a lower visibility than a good with perfect visibility. This proposition illustrates the trade-off between conspicuous and inconspicuous consumption: even though any given player would prefer to use a more conspicuous signal, more conspicuous signals are more quickly appropriated by other identities, and thus are more likely to go away with time. The iconic Burberry checked hat, an accessory of choice for the UK elite, fell prey to this effect around 2004, when soccer hooligans in adopted it en-mass, leading venues to bar anyone wearing the checked hat from entry.[14] Hence, it is sometimes likely that signals with low visibility may be preferred as identity signals than those with higher visibility. This is more likely to happen when there is greater interaction with imitators, when the benefit of being identified as an insider goes down, or when the cost of being identified as an imitator goes up with visibility. This

[14] http://www.independent.co.uk/news/uk/this-britain/burberry-checks-out--of-baseball-caps-to--deter-hooligan-fans-545812.html

proposition has direct implications for product design and innovation, where firms may want to proactively manage the degree of conspicuousness of their offering, depending on the nature of social behavior they anticipate it to generate amongst its consumers. This also depends on how and to whom consumers wish to signal consumption. To discuss this further, we now turn towards understanding the effect of audience and identity plurality on identity signaling.

4.3 Signaling to Multiple Audiences

Another key assumption that interacts with the visibility of signals, is the assumption we made earlier that how people want to be perceived does not depend on the audience. Formally, this is due to the fact that beliefs, $\phi_m^n(\vec{x})$, do not depend on the identity of the receiver. The way people tend to signal different aspects of their identities to different audiences is known in the psychology literature as the "multiple audience problem" (Van Boven et al., 2000). If we extended the model to multiple audiences, there are two possible ways that could affect the impact of visibility

Consider a particular identity that faces social stigma in the mainstream (e.g., homosexual men during the 1980's). This group would like to be identified by others of their type, but not be identified by those of other types. Such an identity may adopt low visibility signals, such as the single earring or what Rubenstein (1995) refers to as the "Old Clone Look" of lumberjack shirts, heavy boots and mustaches. Similarly, Gambetta (2009) analyzes similar signals used by criminals to identify compatriots such as secret languages, coded tattoos and specially positioned scars. Similar dynamics may occur among groups wanting to avoid imitation. Berger and Ward (2010) and Han, Nunes, and Dreze (2010) show that most expensive products use less visible brand identifiers. This allows them to be observed only by people in the know (i.e., fashion students), who prefer subtle signals because they distinguish them from others.

Alternatively, consider an identity (think punk rockers) that enjoys being stigmatized by the mainstream. This identity can have imitators who wish to be associated with the identity but do not enjoy being stigmatized by the mainstream (perhaps, because they have jobs they want to keep). Such an identity may adopt high visibility signals (e.g. Mohawks) to deter imitators.

Thus, in our model, individually, players prefer high visibility signals. However, low visibility slows the spread of knowledge to imitators, and thus some lower visibility trends are more likely to persist. Low visibility helps if players wish to signal different identities to different audiences. High visibility can be used to make imitation more costly.

4.4 Role of Multiple Identities

So far, we have not exploited the possibility that any given type could belong to multiple identity groups. An identity group represents a group of types where members are associates of each other. With multiple identity groups, the possibility arises that for a given consumption choice, $x_k = 1$ signifies one identity group, while $x_k = 0$ signifies another. Austen-Smith and Fryer (2005) analyze the problem of "Acting White", where potentially middle class blacks face the dilemma of choosing between prototypically black behavior (e.g. not studying), and prototypically middle class behavior (e.g. studying). The Identity Signaling framework provides additional insights:

Proposition 9.*: For a given consumption choice, k, when $\Delta\phi_m^{n1}(k)$ is positive for associates of type $\theta(n_1)$ but $\Delta\phi_m^{n2}(k)$ is negative for associates of type $\theta(n_2)$, a given player of type $\theta(i)$ is more likely to prefer the behavior associated with $\theta(n_1)$ and choose $x_k = 1$ when:*

1 *she has more interaction, π_i^j, with others of type $\theta(j)$ who associate with $\theta(n_1)$,*

2 *she has more interaction, π_i^j, with others of type $\theta(j)$ who dissociate with $\theta(n_2)$,*

3 *she has less interaction, π_i^j, with others of type $\theta(j)$ who dissociate with $\theta(n_1)$,*

4 *she has less interaction, π_i^j, with others of type $\theta(j)$ who associate with $\theta(n_2)$,*

5 *she likes being associated with players of type* $\theta(n_1)$ *more, i.e.* $v_i^{n1} > v_i^{n2}$,

6 *The behavior associated with the type* $\theta(n_1)$ *has higher fidelity, i.e.* $\Delta\phi_m^{n1}(k)$ *is higher,*

7 *The behavior associated with the type* $\theta(n_2)$ *has lower fidelity, i.e.* $\Delta\phi_m^{n2}(k)$ *is lower.*

Proof in Appendix. ■

This proposition follows directly from the player's maximization problem and has many managerial as well as policy implications. If a manager or a policy maker wants people to adopt a certain behavior, she can make that behavior more attractive not just by changing the associations of that behavior (through subsides, or advertising for example), but also by changing who that person interacts with (through affirmative action, or service interactions, for example). Alternatively, a manager can change the signal fidelity, by making certain behaviors more accurate predictors of type and certain behaviors less accurate predictors of type. Targeting a particular group's associates, could have multiplier effects, or could be counterproductive if the incentives also worked on the target group's dissociates. Finally, a manager could attempt to influence who a consumer wishes to be associated with, v_i^n, through means such as persuasive advertising if that other group is associated with the manager's brand.

5 Applications of the Identity Signaling Model

In this section, we consider four potential areas of application for the identity signaling framework: the market for identity goods, firm innovation, advertising, social norms and politics.

5.1 Markets for Identity Goods

We have established earlier that demand for social goods can be upward sloping: that is higher prices can yield higher quantity demand. This effect is related to a phenomenon studied by Amaldoss and Jain (2008, 2010) of limited editions. A commitment by the product producer to restrict supply can make an identity signal more effective for the initial adopters. Similarly, the slope of the demand curve

and how it changes over time and across people has implications for profits, and hence tax policy, which depends on the estimates of elasticity of demand.

The identity signaling model is also useful in understanding taste dynamics, or how preferences and therefore demand changes over relatively short periods of time. If we believe the parameterization of the model, where preferences are relatively fixed in the short term, then fluctuations can be attributed to changes in the distribution of consumption, which changes the meaning carried by certain products, ideas or trends, which affects the extrinsic motivations, and ultimately the willingness-to-pay and observed demand. The model allows us to predict that demand changes faster in identity goods, i.e. goods that individuals choose to consume for extrinsic reasons more than intrinsic. Further, popularity cycles should also be faster in identity goods. Identity goods tend to be a-functional and of higher visibility (Berger and Heath 2007). These patterns predicted by the model should be empirically observable in consumer expenditure data.

5.2 Product Innovation

The cyclical nature we demonstrate in fashion will likely be reflected in firm innovation. Our model can hence shed some light on sequential product innovation and product introduction. Once launched in the market, a product first tends to become popular with early adopters and subsequently with the mass market. Once the mass market has adopted the product, the early market might anticipate the launch of the next new product that will enable them to distinguish themselves from the masses. Thus, our model can explain observed patterns of innovation in categories characterized by repeat purchases, where products also are meaningful signals of identity. Though the supply side is not modeled here, a more complete theory could shed light on firm investment decisions, between for example functional vs a-functional innovation, where a-functional innovation is aimed at providing new identity signals whereas functional innovation changes the intrinsic utility of a good.

5.3 Advertising

Another area of firm behavior that this model helps elucidate is advertising. The value of any good depends in part on who that good is associated with. Firms use advertising to associate their products with types that their target market aspires to. The meaning of identity relevant trends depends on who is associated with it, so the model also reflects the benefits of targeted marketing toward early adopters, who are types that others aspire to, or toward "mavens," who are well connected to types that others aspire to. The motivations of firms are also at odds with the motivations of trend originators, at least those with imitators. Profit driven firms want to sell as much as possible. In contrast, insiders often want to restrict adoption. Since people consume additional goods only when they have knowledge of the trend, firms use advertising to increase the number of players with knowledge. Advertising creates associations between products and identities, and more importantly, disseminates information about such associations. Visibility in the model is given exogenously, but by increasing awareness, advertising can also be thought of as increasing visibility.

Advertising is also keenly tuned into the concept of authenticity. One can think of our characterization of preferences as being either intrinsically motivated or extrinsically motivated, as a way to identify which behaviors are authentic. Trilling (1970) citing Rouseau argues that "what destroys our authenticity is society--our sentiment of being depends upon the opinion of other people." Authentic consumption could therefore be defined as consumption that would be chosen given intrinsic preferences alone. Effectively managing advertising content (Mayzlin and Shin, 2011) or engaging in complementary advertising (Bagwell 2007) can play a key role in enhancing authenticity. For example, if firms advertise a particular product in the magazines read by the insiders as well as physical locations frequented by insiders – all appropriate locations approved by the in-group – that is likely to enhance their intrinsic utility.

5.4 Social Norms and Politics

More broadly, identity signaling is relevant for thinking about social norms, and in the realm of politics. Adherence to a norm can be thought of as a consumption decision, like any other. The model suggests that costly social norms are adhered to in order to differentiate themselves from outsiders. However, new norms can be established if enough insiders adopt them. In the realm of politics, support for a candidate is another choice from which identity can be inferred.

Given the plethora of issues that political candidates typically compete on, adopting a position on each of these issues is akin to consuming a vector of goods. Visibility in the model is akin to the conviction of an individual's beliefs on that particular issue, operationalized by how active the individual chooses to be in communicating their position on an issue. How much the receiver cares about particular issues can shape their inference about the sender's identity. Consequently, our model could inform what issues may become popular among voters during political campaigns, issues that may draw out or shun voter discussion, and positions that candidates may find attractive on distinct issues.

These application areas and related issues are important for understanding competition, welfare and policy. The existence of multiple equilibria means that Pareto optimality is not assured in the market place. When people care about identity signaling, consumption creates externalities, suggesting the value of Pigouvian taxes. Similarly, efforts by firms to take advantage of consumers' extrinsic motivations through advertising or innovation can be welfare improving, but could also lead to waste.

5.5 Conclusion

To conclude, this paper presents a model of how people use consumption decisions to infer information about identity, and in turn, how people's consumption decisions are affected by the identity information they signal to others. Such a model demonstrates how the structure of a social network can give consumption meaning. We derive implications for understanding what causes changes in

consumers' willingness to pay for social goods. The model allows us to understand how signals can convey meaning beyond just their cost, and when are signals likely to have high or low value in communication; or vary in effectiveness. We also learn when and why inconspicuous consumption occurs, and where and how trends originate, propagate and terminate; for instance from marginalized but insular groups.

Two additional features of the model are worth mentioning. First, trends arise out of an evolutionary process. Trends arise organically based on the structure of the social network governing social interactions, and individual preferences. The specified equilibrium only requires local coordination. The second feature is that these extrinsic motivations need not necessarily be conscious. While experimental evidence shows that our preferences for junk food depend on who else is eating it (Berger and Heath, 2008), likely many of the subjects were not aware of the influence.

The implications of this model are numerous, ranging from explaining the behavior of advertisers to the evolution of social norms. While the theory was motivated by existing experimental evidence, much more empirical work remains to be done. Potentially, the theory can be tested further in the realms of musical taste, online news, or the fast moving fashion cycles found on Facebook or Twitter. Finally, the framework developed in this research captures intrinsic as well as extrinsic components of consumer utilities, allows for varied degree of interactions within and across consumer groups, and provides for avenues to incorporate firm level decisions in driving adoption behavior. We modestly hope other researchers will build on this framework and develop subsequent models that focus on the many potential application areas in relating identity driven behavior to firm decisions.

Appendix

Proof of Proposition 1.

From Maskin and Tirole (2001), we know there is a nearby equilibrium of the perturbed game.

This proposition follows from the player's maximization problem. A player chooses $x_k = 1$ if and only if $U_\theta(x_k = 1) > U_\theta(x_k = 0)$. Separability of the linear utility allows us to rewrite this condition as:

$$\underbrace{\mu_{i,k} - p_k}_{\substack{\text{intrinsic} \\ \text{motivation}}} + \underbrace{\rho_k \sum_{\theta(m)\in\Theta} (\pi_i^m \sum_{\theta(n)\in\Theta} \Delta\phi_m^n(x_k) v_i^n)}_{\text{extrinsic motivation}} > \varepsilon_{i,k}$$

Recall that $WTP_{i,k}$ is the highest p_k such that the above equation is still positive:

$$WTP_{i,k} = \mu_{i,k} + \rho_k \sum_{\theta(m)\in\Theta} (\pi_i^m \sum_{\theta(n)\in\Theta} \Delta\phi_m^n(x_k) v_i^n)$$

Adding extrinsic utility can increase or decrease the willingness-to-pay. To show the impact of an associate on WTP (the dissociate is the same with signs reversed), consider the share of players of type $\theta(i)$ who set $x_k = 1$:

$$s_{i,k} = \Pr[x_k = 1 | \theta = \theta(i)] = F_k(\mu_{i,k} - p_k + \rho_k \sum_{\theta(m)\in\Theta} (\pi_i^m \sum_{\theta(n)\in\Theta} \Delta\phi_m^n(x_k) v_i^n))$$

Define $s_k = \sum_{\theta(n)\in\Theta} \pi_m^n s_{n,k}$, as the likelihood that a consumer of type $\theta(m)$ interacts with anyone consuming x_k. From Bayes' rule, if more $\theta(n)$ types choose $x_k = 1$, such that $s_{n,k}$ increases by more than s_k, then players are more likely to infer that someone who chooses that good is of type $\theta(n)$:

$$\phi_m^n(x_k = 1) = \frac{s_{n,k}}{s_k} \pi_m^n$$

$$\Delta\phi_m^n(k) = (\frac{s_{n,k}}{s_k} - \frac{1 - s_{n,k}}{1 - s_k}) \pi_m^n$$

Thus when inferences are higher, the difference, $\Delta\phi_m^n(k)$ is higher. Therefore, for v_i^n positive, more adoption by that type increases the extrinsic benefit and willingness-to-pay. Of course, if inferences that a player is $\theta(n)$ increase, inferences that a player is another type must decrease. The net effect depends on the relative weights of v_i^n, as specified in the equation for WTP. We see that the net change on WTP depends on the sign of the following:

$$\sum_{\substack{\theta(n)\in\Theta \\ \theta(m)\in\Theta}} \pi_i^m \Delta\phi_m^n(x_k) v_i^n$$

For v_i^n sufficiently high above some threshold $\bar{v}$, the net effect is an increase in WTP. The same logic applies, for v_i^n sufficiently low, more adoption causes WTP to decrease.

Such a threshold is assured to exist since we could set $\overline{v_i} = \max_{\theta(n)\in\Theta} v_i^n$. From Equation (7) a change in the relative share of $s_{i,k}$ means the inference that a player consuming that good is of type $\theta(i)$ increases while the inference that a player consuming that good is of some other type, decreases. Define $\Delta\Delta\phi_m^n(k)$ to be the net change in $\Delta\phi_m^n(k)$ from a change in $s_{i,k}$ to $\tilde{s}_{i,k}$ (let tilde denote the perturbed equilibrium). Using the fact that $\sum_{\theta(n)\in\Theta}\phi_m^n(\vec{x})$=1 for any $\vec{x}$ and all m, and the definition of $\Delta\phi_m^n(k\,)$, for all m the net change must be zero:

$$\Delta\phi_m^n(k\,) = \phi_m^n(\vec{x}_{-k}, x_k = 1\,) - \phi_m^n(\vec{x}_{-k}, x_k = 0)$$

$$\sum_{\theta(n)\in\Theta}\Delta\phi_m^n(k\,) = \sum_{\theta(n)\in\Theta}\phi_m^n(\vec{x}_{-k}, x_k = 1\,) - \sum_{\theta(n)\in\Theta}\phi_m^n(\vec{x}_{-k}, x_k = 0) = 1 - 1 = 0$$

$\sum_{\theta(n)\in\Theta}\Delta\Delta\phi_m^n(k\,) = \sum_{\theta(n)\in\Theta}\Delta\phi_m^n(k\,) - \sum_{\theta(n)\in\Theta}\Delta\tilde{\phi}_m^n(k\,) = 0 - 0 = 0$

Therefore, if $\bar{v}_i = \max_{\theta(n)\in\Theta} v_i^n$ then for any player of type $\theta(i)$:

$\sum_{\theta(n)\in\Theta}\Delta\Delta\phi_m^n(k\,) = 0$, implying $\Delta\Delta\phi_m^i(k) = -\sum_{\theta(n)\neq\theta(i)}\Delta\Delta\phi_m^n(k)$.

Thus, $\bar{\mathrm{v}}_\mathrm{i}\Delta\Delta\phi_m^i(k) = -\bar{\mathrm{v}}_\mathrm{i}\sum_{\theta(n)\neq\theta(i)}\Delta\Delta\phi_m^n(k) > -\sum_{\theta(n)\neq\theta(i)}\mathrm{v_i^n}\Delta\Delta\phi_m^n(k)$.

Therefore, $\Delta\sum_{\theta(n)\in\Theta}\Delta\phi_m^n(k)\mathrm{v_i^n} > 0$ and so $\Delta WTP_k > 0$.

Note that this implies in the special binary case, where v can take only two values, say $+\frac{1}{2}$ and $-\frac{1}{2}$, then all $+\frac{1}{2}$'s are associates and all $-\frac{1}{2}$'s are dissociates. And we need at least one associate and dissociate.

The proposition depends on distance in network in order to make sure WTP is strictly increasing/ decreasing, because otherwise $\pi_m^n = 0$ and therefore $\forall x_k\colon \phi_m^n(x_k) = 0$. ■

Proof of Proposition 2.

The proposition follows simply from the fact that higher prices can lead to a different equilibrium where the higher price decreases consumption by dissociates of a group, making the good more attractive, so that the increase in extrinsic benefits exceeds the increase in price. ■

Proof of Proposition 3.

The first part follows from Bayes' rule. As the variance of $\varepsilon_{i,k}$ goes to infinity, the probability that willingness to pay is positive in equation (5) is dominated by $\varepsilon_{i,k}$ and thus for all types, the share of players consuming any given good goes to one half, and therefore $\phi_{\mathrm{m}}^{\mathrm{n}}(x_k = 1) = \phi_{\mathrm{m}}^{\mathrm{n}}(x_k = 0)$.

The second part follows from the player's maximization condition. Players choose $x_k = 1$ if and only if Equation (4) holds. Thus as $\forall n: \left|\mu_{\mathrm{n,k}}\right| \to \overrightarrow{\infty}$, $\forall n: s^n(k) \to 1$ or $\forall n: s^n(k) \to 0$, implying $\Delta\phi_{\mathrm{m}}^{\mathrm{n}}(k) \to 0$.■

Proof of Proposition 4.

This proposition follows from an argument analogous to the incentive compatibility conditions from standard signaling results. Call the two types, θ_{im} = *imitators*, and θ_{in} = *insiders*. By the assumption that interaction with others, π_θ, is sufficiently small, or the chance of misidentification with other types, ϕ_m, is sufficiently small, there exists a sufficiently small γ such that interactions with other types can effectively be ignored:

$\sum_{\theta(m)\in\Theta\setminus\{\theta_{in},\theta_{im}\}} \sum_{\theta(n)\in\Theta\setminus\{\theta_{in},\theta_{im}\}} \rho_k \pi_i^m \phi_m^n(x_k) v_i^n < \gamma$, where $\gamma \to 0$.

Specifically, for the types in question, the insider and the imitator, and considering only the good x_k, conditions analogous to the incentive compatibility conditions for a separating equilibrium apply. Given our definitions for insiders and imitators, it is reasonable to assume $v_{in}^{in} > 0$, $v_{in}^{in} > v_{in}^{im}$, $v_{im}^{in} > 0$, and $v_{im}^{in} > v_{im}^{im}$,. We can write the expressions for the optimal market shares as ($\gamma \to 0$):

$$s_{in,k} = Pr\left[\mu_{in,k} - p_k + \rho_k \Delta\phi^{in}(k)(v_{in}^{in} - v_{in}^{im}) + \gamma > \epsilon_k\right]$$

$$s_{im,k} = Pr\left[\mu_{im,k} - p_k + \rho_k \Delta\phi^{in}(k)(v_{im}^{in} - v_{im}^{im}) + \gamma > \epsilon_k\right]$$

Using the envelope theorem, we see that $\frac{\partial s_{in,k}}{\partial \mu_{in,k}} > 0$ and $\frac{\partial s_{im,k}}{\partial \mu_{in,k}} > 0$.

Further, we can rewrite equation (7) to see that the effectiveness of a signal $\Delta\phi^{in}(k)$ is increasing in $s_{in,k}$ and decreasing in $s_{im,k}$: $\Delta\phi^{in}(k) = \left(\frac{\mathrm{s_{in,k}} - \mathrm{s_k}}{\mathrm{s_k}(1-\mathrm{s_k})}\right)\pi_{in}^{in}$. Therefore, the share of consumption is increasing in intrinsic utility, and by equation (9) the optimal signal effectiveness is increasing in $\mu_{in,k}$ and decreasing in $\mu_{im,k}$. ■

Proof of Proposition 5.

A change in the number of players who have knowledge about a good is simply a shift in the intrinsic cost of the good. An increase in knowledge decreases the intrinsic cost of the signal and thus following the same logic from Proposition 4.**,** an increase in knowledge for an associate increases the number of associates consuming that good.

Similarly, an increase in knowledge for a dissociate increases the number of dissociates consuming that good. Therefore Proposition 1. applies.

Note that since the consumption shares are given by $s_{i,k} = F_k(\mu_{i,k} - p_k + \rho_k \sum_{\theta(m)\in\Theta}(\pi_i^m \sum_{\theta(n)\in\Theta} \Delta\phi_m^n(x_k)v_i^n))$, using the envelope theorem, we always have $\frac{\partial s_{i,k}}{\partial \mu_{i,k}} < 1$. ■

Proof of Proposition 6.

Part [1] follows from the expression for social capital acquisition, which equals the expected value of encountering any given type, expected value they consumed that good, and the expected value that consumption was observed:

$$\Pr\left[g_k^i = 1\right] = \sum_{\substack{t\in[1..T] \\ \theta(m)\in\Theta \\ k\in[1..K]}} \pi_i^m s_{m,k_t} \rho_k$$

Then we can see that those who had been matched more often with type $\theta(j)$ in previous periods, are more likely to have acquired the social capital and therefore Proposition 5. applies.

Part [2] follows from the fact that for any good, the share of players of type $\theta(j)$ from equation (10) can be expanded, and we can see that that share depends on type $\theta(j)$'s past interactions. Thus if type $\theta(j)$ has more interaction with other associates of $\theta(i)$, then $\theta(j)$ is more likely to possess the social capital of the behavior of those other associates. As in Part [1], this increases the chance of adoption on the part of players of type $\theta(i)$. ■

Proof of Proposition 7.

This proposition follows from Proposition 5. Players who know about a given trend will continue with the trend so long as the willingness-to-pay exceeds their ε. The more associates of an identity who know about the trend increases WTP by Proposition 5. Having fewer imitators or fewer interactions with imitators decreases the number of dissociates who know about the trend and thus increases WTP. ■

Proof of Proposition 8.

Comparative statics for changes in visibility in the period a new trend is introduced are simplified by the fact that visibility does not directly affect beliefs. For an exogenous change in the visibility of a good, in the period after it is introduced, increase in visibility only affects share of people within distance 1 of the initial adapters who possess the knowledge for that good. The persistence of a signal depends on the WTP, so we will apply Proposition 5.

From Proposition 5. for a given type, $\theta(i)$, we have WTP increasing for an additional associate who knows about a signal, k, and decreasing for an additional imitator who knows about the signal. The number of associates who know about a trend in period $t+1$ is equal to the size of the originating type, $m(\theta(i))$, plus the number of insiders who interacted with the originating type in the first period who observed the signal, $m\big(\theta(i)\big) + \rho_k\, \pi_i^{in}$. The number of imitators who know about the trend in the second period is the number of imitators who interacted with the originating type in the second period who observed the signal, $\rho_k\, \pi_i^{im}$.

Define $\Delta\overline{WTP}_{in}$ as the average increase in WTP per additional insider who has knowledge about a trend, and $\Delta\overline{WTP}_{im}$ the average decrease in WTP per imitator who has knowledge. Note that WTP is increasing in visibility. The change in WTP from the first period to the second period is:

$$\Delta\text{WTP} = \rho_\text{k}\left[\left[m\big(\theta(i)\big) + \rho_k\, \pi_i^{in}\right]\Delta\overline{WTP}_{in} - \left[\rho_k\, \pi_i^{im}\right]\Delta\overline{WTP}_{im}\right]$$

Then, taking advantage of the fact that visibility does not affect the WTP, the first order condition is

$$\frac{\partial \Delta WTP}{\partial \rho_k} = \left[m\big(\theta(i)\big) + 2\rho_k\, \pi_i^{in}\right]\Delta\overline{WTP}_{in} - \left[2\rho_k\, \pi_i^{im}\right]\Delta\overline{WTP}_{im} = 0$$

Hence, the visibility that maximizes WTP is given by:

$$\rho^* = \frac{m(\theta(i))\Delta\overline{WTP}_{in}}{2[\pi_i^{im}\Delta\overline{WTP}_{im} - \pi_i^{in}\Delta\overline{WTP}_{in}]}$$

Thus, optimal visibility, and adoption by the original type $\theta(i)$, is decreasing in the number of interactions with imitators. The third and fourth part of the proposition can also be seen from the impact of changes in $v_\theta(\theta)$ on ΔWTP. Considering only two types, insiders and imitators, $\Delta\overline{WTP}_{in} = \left[v_{in}^{in}\mathbf{E}_\pi[\Delta\phi^{in}] + v_{in}^{im}\mathbf{E}_\pi[\Delta\phi^{im}]\right]\rho_k$.

As the value to an insider for being identified as an insider, v_{in}^{in}, goes up, the optimal visibility also goes up. Conversely, as the cost of being identified as an imitator increases, $-v_{in}^{im}$, then optimal visibility decreases. ■

Proof of Proposition 9.

Comparative statics on the preference parameters for a single player are more straightforward because any given player's maximization problem does not affect the behaviors of others. Thus when considering a player's WTP, the sum of the WTP by construction is simply equal to the difference of utility (given prices are set to zero here), so for comparative statics on WTP, we can apply the envelope theorem.

A player chooses each x_k based on the following inequality:

$$\sum_{\theta(m)\in\Theta}\sum_{\theta(n)\in\Theta}\pi_i^m\Delta\phi_m^n(x_k)v_i^n\rho_k > \varepsilon_{i,k}$$

This proposition follows directly from the player's decision problem. ■

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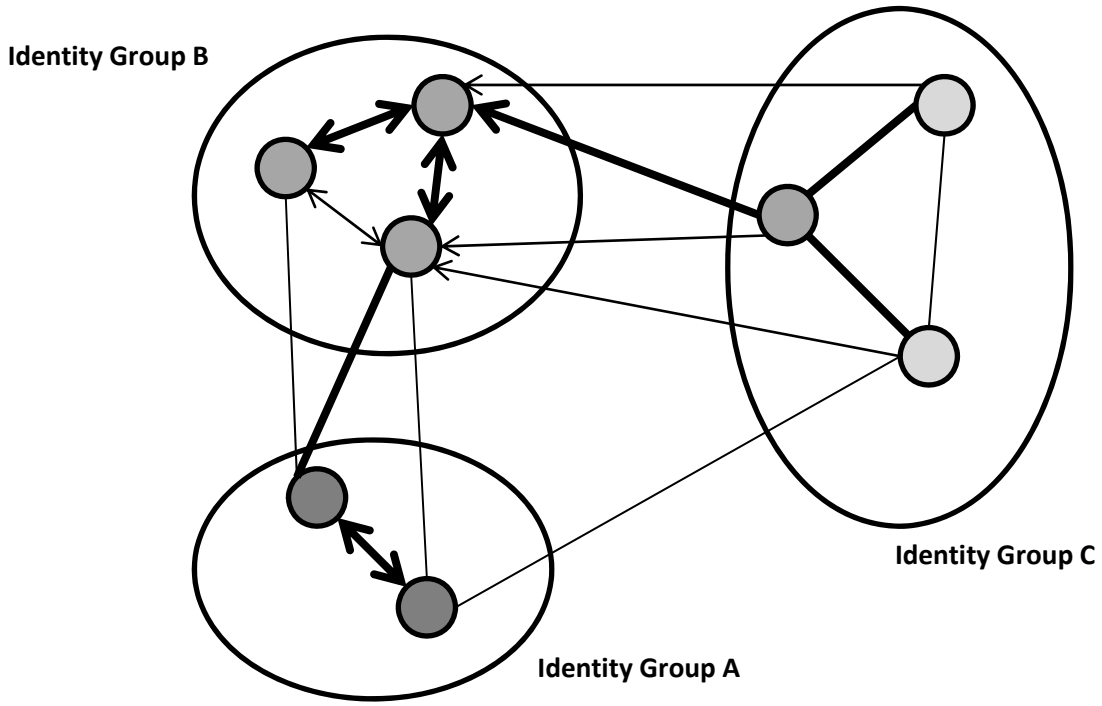
Figure 1



Picture of a Fashion Cycle: Each node represents a type. The thickness of interaction for each edge linking two nodes represents the frequency of interaction. Arrowheads indicate whether a particular type likes being associated with the other type. Ovals collect types into identity groups who share the same preferences for association and dissociation. Shading indicates the current adoption of a new trend. In the diagram, the member of Identity Group C with the most frequent interaction with Identity Group B has just adopted the behavior associated with Identity Group B.