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Interpersonal influence and pro-societal consumption:

A review of diffusion, conformity, dissemination, translation and reflexivity

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Abstract

Understanding consumption behavior will facilitate the successful deployment of new pro-societal products and behaviors. Interpersonal influence is thought to play an important role in the successive adoption of pro-societal products and behaviors within groups across time, but processes of influence are poorly understood. This paper begins by presenting a typology for new products according functional, symbolic and pro-societal attributes. We then identify and summarize five perspectives on interpersonal influence and pro-societal consumption behavior. Contagion focuses on the effect of functional information flowing among people or groups. Conformity focuses on individual thresholds and motivations to mimic others. Dissemination is the intentional diffusion of information by a core group of motivated individuals. Translation is the tendency for various social groups to negotiate interpretations and valuations of the technology. Finally, reflexivity is a theoretical framework that explains the motivations of individuals seeking to establish lifestyle practices consistent with their self concept in an uncertain modern world. We describe strengths and weaknesses of each perspective and suggest complementarities.

1. Introduction

Understanding consumer purchase behavior will facilitate the successful deployment of new pro-societal products and consumption behaviors—practices that are at least in part valued according to the collective benefits they offer. Social influence is known to play an important role in consumer perceptions, values and behavior, and ultimately in the impacts of environmental policy (Norton, et al., 1998). However, such processes are poorly understood, at least in part due to complexities in separating confounding factors in behavioral outcome data, as well as widespread confusion in terminology, concepts and theory across relevant literatures (Manski, 2000). While the concept of social influence can include interactions and relationships among and between consumers and institutions, here we focus on interpersonal influence as a sub-category that occurs among consumers. This review paper attempts to illuminate the confusion and point towards a framework that integrates ideas from several of these perspectives on interpersonal influence.

Processes of interpersonal influence are typically absent in behavioral models and research (Jackson, 2005). When they are addressed, these processes are most often conceptualized according to diffusion of innovations (DOI) which posits influence as the effect of the flow of functional information among consumers statically categorized according to their “innovativeness” (Rogers, 2003). The DOI perspective is often utilized to add social factors to economic choice models; several recent studies have empirically estimated social parameters representing aggregated preference changes resulting from increasing technology adoption (Axsen, et al., 2009; Mau, et al., 2008), word-of mouth effects (Struben and Serman, 2008), and information search channels (van Rijnsoever, et

al., 2009). However, we argue that the DOI perspective and its applications can oversimplify and mischaracterize processes of interpersonal influence, particularly in cases of products offering pro-societal benefits.

This paper offers two contributions to research on interpersonal influence and pro-societal consumption behavior. First is a two-dimensional typology to conceptualize how a new ideas, behaviors and products may be perceived as new by consumers. After reviewing various literatures, we argue that pro-societal products can be complex. They are not only innovative technologically and functionally, but may also present a radical shift in symbolic benefits and pro-societal values—such shifts will be shown to be integral to interpersonal influence processes. Second, we review literatures on five perspectives on the role of interpersonal influence in consumption behavior, focusing on automotive purchases. Beginning with DOI as a specific and widely used form of contagion model, we review contagion, conformity, dissemination, translation and reflexivity as alternative, and as we will argue, in some ways complimentary perspectives on interpersonal influence. We review each perspective, in turn drawing out concepts and language that can supplement or replace those provided by DOI. A companion paper (Axsen and Kurani, 2010) combines insights gleaned from this literature review with empirical observation to propose a new, integrative framework.

2. Conceptualizing pro-societal product attributes

Here, we focus on a particularly complex type of pro-societal product: electric-drive vehicles. These include: pure electric vehicles (EVs) powered only by electricity from the grid; hybrid-electric vehicles (HEVs) fueled only by gasoline, but using a small

electric motor and battery to improve fuel economy; and plug-in hybrid electric vehicles (PHEVs) that combines aspects of the EV and HEV, potentially operating like an EV for a limited distance, with the addition of a gasoline engine to extend driving range and increase power. Note that the previous sentence briefly defines electric-drive vehicles according to their functional, technological components: what they do and how they differ from the incumbent technology, that is, conventional internal combustion vehicles. Analysts often attempt to assess the likelihood of market success based purely on these technology (and cost) components, such as how continuous or discontinuous a transition is required for the innovation to be adopted (e.g. Ehrnberg, 1995; Robertson, 1971).

However, studying consumer perceptions, we caution against assuming consumers have only a purely technical, functional conceptualization of new products. Consumer valuation of a new product can also relate to a “paradigm shift in beliefs, attitudes, and use” (Adamson, 2003). From a behavioral perspective, this consideration of beliefs and attitudes is an essential addition: what matters is how any technological or functional change is perceived by consumers. To better understand which attributes are important to vehicle buyers, we conceptualize the attributes of a new product according to two dimensions: functional/symbolic and private/societal (Table 1).

Table 1: Conceptualization of PHEV attributes (hypothetical example)

	Functional	Symbolic
Private	Save money Reliable Fun to drive (experiential)	Expression of self-identity Convey personal status to others Attain group membership
Societal	Reduce air pollution Reduce global warming Reduce oil use	Inspire other consumers Send message to automakers, government, oil companies

2.1 The functional/symbolic dimension: What does it do and represent?

The functional/symbolic dimension distinguishes between what the product can do and what it represents. Hirschman (1981) explains that functional attributes are tangible, while symbolic attributes are intangible, where the innovation communicates a new social meaning such as sexiness or status, and may be valued according to fundamentally different processes than functional attributes. Hirschman highlights functional and symbolic attributes as both being important for goods such as automobiles, though perhaps in different ways.

Empirical research supports the notion that motor vehicles are associated with intangible, symbolic motives—often more so than functional motives (e.g. Steg, 2005; Steg, et al., 2001). Gartman (2004) explains that this tendency has existed since automobiles were introduced in the late 19th century, where vehicles were “used not for practical purpose but for leisure activities and public ostentation...the automobile quickly became defined in American culture as an instrument of freedom and leisure, and a symbol of wealth.” Symbolic value has also continued with the introduction of modern day electric-drive vehicles; Heffner et al. (2007) interviewed dozens of HEV owners, discovering that in contrast to the predominately functional and technical characterizations of HEVs in several market, energy, and environmental assessments, symbolism played an important role in buyers’ purchase decisions. Participants described symbols representing widely shared meanings such as “preserving the environment” and “embracing new technology,” as well as more personal meanings such as ethics and individuality. In Table 1, function denotes attributes of functional or instrumental importance, including the basic services of accessibility and mobility provided by an

automobile, or the incremental fuel savings provided by electric-drive; the symbolic dimension includes less tangible attributes, such as the owner's desire to express a certain value or meaning.

2.2. The private/societal dimension: Who is it good for?

The second dimension in Table 1, private/societal, provides a clear distinction between electric-drive and conventional vehicles. Green (1992) describes a private good as being characterized by “exclusive and personal consumption and individual payment.” A public (or pro-societal) good is characterized by “nonexclusive consumption and collective payment” such as “clean air” and “saving endangered species.” Canzler (1999) asserts that motor vehicles have been perceived as primarily private goods, dating back to the original “race-travel-limousine” vision, where initial demand was driven by goals of luxury and prestigious racing. Electric-drive vehicles may diverge from the private good vision, having the potential to produce pro-societal benefits such as reducing air pollution, greenhouse gas emissions, and foreign oil dependence. Thus, electric-drive vehicles can be associated with public welfare, leading Brown (2001) to classify electric vehicles as a “mixed” good with aspects of a private and pro-societal good. In other words, the emergence of electric-drive vehicles may not just be an extension to the race-travel-limousine concept, but could represent a new vision of motor vehicles as benefiting drivers and society: the pro-societal car.

2.3. Attribute dynamics: How might perceptions change?

Behavioral researchers must also account for dynamics in consumer perceptions of functional, symbolic and pro-societal attributes. For an emerging technology, attributes in any quadrant of Table 1 may change, and may do so quickly. Functional attributes of electric drive vehicles change with advances in battery, motor, electronics and materials technology. Current symbolic associations may evolve, solidify or disappear and new meanings may be added (Heffner, et al., 2007). Also, perceptions of pro-societal benefits will be debated and negotiated along with health and emissions research, government regulation, and mobilization by interest groups (Hess, 2007; Smith, 2005)—as observed with electric-vehicles in the 1990s (Calef and Goble, 2007) and HEVs in the last decade (Gleick, 2007). Thus, a behavioral perspective on product adoption should represent how such dynamics affect, and are affected by, the consumption behavior. In the following review we consider five perspectives on the role of interpersonal influence in the development of consumer values.

3. Reviewing perspectives of interpersonal influence and purchase behavior

Interpersonal influence literatures are rife with confusing terminology. Manski (2000) explains how much of this terminology is typically “borrowed” from sociology and social psychology and often loosely defined as “peer influence,” “imitation,” “epidemics,” and “herd behavior.” In this review we attempt to sort through such confusion by precisely defining and comparing five perspectives: contagion, conformity, dissemination, translation and reflexivity. Each perspective summary is structured around questions inspired by Bruun and Hukkinen (2003):

1. What is the new product, and what attributes are important?
2. What are the system boundaries?
3. Who purchases earlier, and why?
4. Who purchases later, and why?
5. What process drives purchase from earlier to later adopters?

A summary of these approaches and questions is presented in Table 2.

(Table 2)

3.1 Contagion: Interpersonal communication

The contagion perspective describes interpersonal influence according to the flow of information among individuals. The term is borrowed from epidemiological studies of how diseases are spread through populations. Contagion can alternatively be called diffusion, a term borrowed from physics that refers to the movements of a substance from higher to lower concentration areas. While contagion includes any interpersonal influence approach that focuses on the effect of information flow, here we focus on DOI and social network analysis as prevalent approaches to the spread of new products and behaviors.

Table 2: Comparing alternative perspectives on interpersonal influence and adoption behavior

	Contagion		Conformity	Dissemination	Translation		Reflexivity
	Diffusion of innovations	Social networks	Thresholds	Critical mass	Social construction	Actor-network theory	Modernity and self identity
1. What is the new thing? (Static or dynamic?)	Innovation (static)	Innovation (static)	Behavior (static)	Collective good (static)	Artifact (dynamic)	Actor (highly dynamic)	Lifestyle practice (highly dynamic)
2. System boundaries? (Static or dynamic?)	Social system of potential adopters, the market (static)	Social network, typically a “bounded” community (static)	Relevant social group (static)	Social system, and critical mass (static)	Relevant social groups: consumers, organizations, government, etc. (dynamic)	All actors: adopters, social groups, organizations, technology, etc. (highly dynamic)	Social system, lifestyle sectors, in context of modernity (highly dynamic)
3. Who buys first?	Innovators and early adopters	The most “connected” individuals, opinion leaders	Instigators	Organizers	Social groups who perceive artifact as a solution to problem	Actors who view adoption as consistent with their “actor world”	Those who find practice is compatible with their self-concept
Why?	Higher “innovativeness”	More likely to receive info	Low threshold	High interest and resources	Interpretation of solution	Not addressed	Narrative of self
4. Who buys later?	Imitators, early to late majority, laggards	Less “connected” individuals	Conservatives	Non-organizers	Social groups that later reinterpret problems or solutions	Actors who are pulled into the “actor worlds” of others	Those who find practice is compatible with self concept
Why?	Lower “innovativeness”	Less likely to receive info	High threshold, social norms, social learning	Efforts of organizers and accelerating production function	Closure	Alignment	Narrative of self
5. What drives influence?	Contagion: interpersonal communication	Contagion: interpersonal communication	Conformity: motivation to mimic, learn from, or join others	Dissemination: willingness of organizers to achieve social good	Interpretation: perceived ability of innovation to solve a problem	Translation: perceptions of other actors and behaviors according to actor world	Reflexivity: creating and sustaining self-concept
Best applied to what types of attributes? (Table 1)	Private-functional	Private-functional	Symbolic (private and societal)	Societal (functional and symbolic)	All	All	All

3.1.1. Diffusion of innovations (DOI)

In DOI, diffusion is “the process in which an innovation is communicated through certain channels over time among the members of a social system...a special type of communication, in that the messages are concerned with new ideas” (Rogers, 2003). The innovation is “an idea, practice or object that is perceived as new by an individual or other unit of adoption” (Rogers, 2003). The likelihood of an innovation successfully diffusing is hypothesized to depend on five main characteristics of the innovation: 1) relative advantage over the product it replaces, 2) compatibility with existing values, experiences and needs, 3) complexity, 4) trialability, and 5) observability of outcomes (Rogers, 2003).

The setting for diffusion is the social system, “a set of interrelated units that are engaged in joint problem solving to accomplish a common goal” (Rogers, 2003). Rather than social systems, Moore’s (1999) business-oriented approach speaks of markets: potential customers with similar needs who reference each other.

Whether they are members of social systems or markets, potential buyers are divided into adopter categories based on the empirical observation of adoption rates following a bell-curve over time. The first to adopt are the innovators, a sub-group characterized as obsessively venturesome, progressive, cosmopolite individuals, usually with a love of technology, and above average education and socioeconomic status (Rogers, 2003). Next are the early adopters who are characterized as visionaries who use extensive social networks to spread information about the innovation to the masses. Following are the early majority, late majority and finally the laggards. Earlier adopters are more interested in the functions of the innovations, and resistant later adopters are

eventually influenced by peer pressure and economic necessity. Individuals are placed in adopter categories according to innovativeness: “the degree to which an individual or other unit of adoption is relatively earlier in adopting new ideas than other members of the social system” (Rogers, 2003).

DOI hypothesizes interpersonal influence is driven by communication including word-of-mouth and mass media. Rogers (2003) classifies two types of information: 1) knowledge includes basic awareness of the innovation’s existence, how it can be used, and potentially its underlying principles, and 2) persuasion which the persuaded individual uses to form attitudes about the overall value of adoption. Both types of information are thought to flow from individuals in the innovator category to those in later adopter categories, with early adopters described as playing a particularly important role as the gatekeepers between technology loving innovators and the functionally oriented majority (Moore, 1999).

Thus within DOI the adoption of an electric-drive vehicle, say an HEV, would primarily be explored from a technological, functional point of view. The targeted social system is the entire new automobile market, though perhaps limited to buyers of vehicle body styles in which an HEV is available. To anticipate the diffusion of HEVs, researchers following the DOI perspective look to new car buyers with higher education and socioeconomic status (e.g. de Haan, et al., 2006; Santini and Vyas, 2005), perhaps with a history of being the first to buy new products. The motives of the first HEV buyers, defined to be innovators, are explained by their general love of technology, along with their willingness and resources to pay a premium to be the first to own and try the new product. After gaining experience with this technology, these innovators provide

feedback within their social networks that diffuses to early adopters. Early adopters may then envision the HEV as having mass market appeal, and through their channels of influence, accelerate the diffusion of positive HEV information to stimulate demand.

We outline several of the criticisms of DOI. First, as acknowledged by Rogers (2003), the concepts and language of DOI are subject to “pro-innovation bias” because the approach is deeply rooted in retrospective analyses of successful innovations (e.g. Coleman, et al., 1957; Ryan and Gross, 1943). DOI provides little insights into innovations that fail, and is not well-suited for predictive applications—where the size and characteristics of the social system are very difficult to ascertain a priori. Second, DOI ignores the broader context for adoption and is vulnerable to errors of “dependent diffusion” where the diffusion of one product depends on another but is misread as independent, and “phantom diffusion” where diffusion is thought to have occurred but did not (Blaut, 1987). Third, DOI does not explain the underlying motivations of consumer behavior. Instead, it relies on the vague, tautological notion of innovativeness as both an explanatory variable and observed outcome (Hirschman, 1980). Further, because innovativeness is likely to be a dynamic trait, it may be inappropriate to assign consumers to static categories (Hirschman, 1980)

Referring to Table 1, Hirschman (1981) argues that DOI focuses on the private-functional attributes of a new product and may be inappropriate for describing new products with symbolic attributes—a limitation also noted by Rogers himself (2003). Further, DOI infers that these private-functional attributes remain static throughout the relevant time frame—neglecting the potential for substantial change over time, such as improvements to vehicle performance, fuel savings, and variety of available designs.

While DOI does allow for the notion of “re-invention” (Rogers, 2003), this concept is not meant to be applied to the complexities of technological development. A final criticism relates to the process of diffusion itself, which asserts that uptake of an innovation starts within the innovative core of a social system, and diffuses uni-directionally to the periphery of less innovative individuals and communities (Blaut, 1987). Blaut argues instead for the notion of “crisscross diffusion” in which new products, ideas and uses can be “generated, transmitted and received” multi-directionally across all parts of a social system.

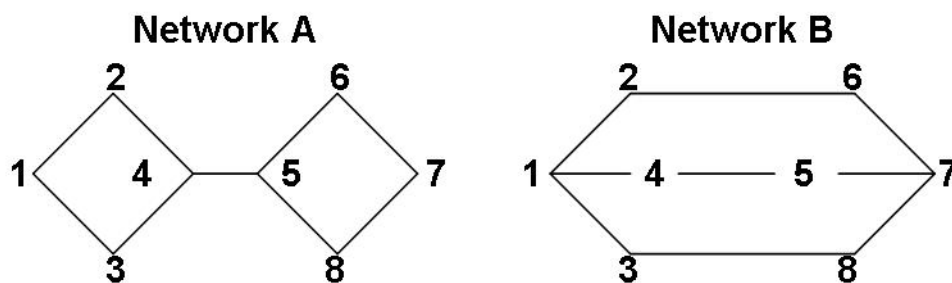
3.1.2 Social networks analysis (SNA)

Instead of focusing on the individual, social network analysis (SNA) explores how the structure of linkages (or ties or relationships) between individuals influences diffusion processes (Degenne and Forse, 1994). In SNA, the timing of adoption is primarily determined by the “connectedness” of individuals to other individuals in the network. Individuals with many social ties are more likely to adopt earlier (Rogers and Kincaid, 1981), corresponding with the DOI notion of early adopters being more cosmopolitan.

Social networks are detailed representations of social systems as patterns or structures of interpersonal communication determined by factors such as “who talks to whom” (Valente, 1995). Fig. 1 illustrates the potential influence of social structure on diffusion patterns (Degenne and Forse, 1994). Although both networks have the same linkage density (the number of effective links divided by the number of potential links), if all else is held constant including the quality of the links, the diffusion of information is

likely to be more rapid and complete in Network B. Also notice the particular importance of the connection between individuals 4 and 5 in Network A; if this linkage is blocked, further diffusion of information is impossible. Granovetter (1973) discusses the importance of this phenomenon in social networks, where the existence of weak ties—interpersonal connections scoring low in time, intimacy and reciprocity—are more likely to serve as bridge linkages between social clusters, and can ultimately do more to create cohesion in an extended social network than a prevalence of strong ties.

Fig. 1: Comparing network structures



Source: Degenne and Forse (1994, p4)

SNA is subject to many of the same general limitations as DOI: retrospective bias, exclusion of external factors, lack of understanding consumers' underlying motives, and focus on static, private-functional information and attributes. Further, identifying the appropriate social network for analysis a priori proves challenging because no single network serves all purposes (Bandura, 2006). Due to challenges of data collection, SNA tends to be best suited for studying small and isolated or bounded communities, such as small-town farmers (Valente, 2005). A final challenge of SNA is its vulnerability to spurious associations between adoption behavior and social proximity to other adopters. For example, Valente (2005) explains that although original analysis of medical

innovation data from Coleman et al. (1957) suggests the importance of social network influence, more recent re-analyses finds no evidence of interpersonal influence playing a role once publicity, aggressive marketing and other external events are accounted for (e.g. Valente, 1995; Van den Bulte and Lilien, 2001).

3.2. Conformity: Thresholds, social learning and social norms

Conformity represents interpersonal influence as occurring through an individual's perceptions of what others are doing or expecting. Conformity includes applications of threshold modeling, social learning theory, and social norm research. The conformity perspective is not as unified as DOI, and does not discuss specific processes of communication. However, conformity provides concepts and language to help understand adoption decisions in social contexts and the dynamics of symbolism.

Strang and Soule (1998) describe threshold models as breaking “with the notion of direct contagion to view potential adopters as responsive to the distribution of present adopters in the population.” Granovetter (1978) provides a classic threshold model of collective action or behavior which he illustrates with rioting behavior. The system boundary for this example is a crowd, which is the relevant social group. The adoption of rioting behavior is determined by each individual's threshold, defined as the proportion of fellow crowd members that must engage in the rioting behavior before the individual will join. The first rioters are instigators with relatively low thresholds, while conservatives riot later (or not at all) due to their higher thresholds. Granovetter explores how different distributions of thresholds among the crowd can significantly influence the overall outcome, often in counterintuitive ways, concluding that the “most important

causal influence on outcomes is the variation of norms and preferences within the interacting group” (Granovetter, 1978).

Granovetter also demonstrates how thresholds vary according to the relationships between individuals, where a friend’s behavior may be weighted more heavily than that of a stranger. To Granovetter, the main strength of threshold models is to understand outcomes that appear to be inconsistent with underlying individual preferences or beliefs. He cites the case of a group of delinquent boys that steal cars to maintain status within their group, where each individual boy acts contrary to the norms they hold in other contexts, e.g. “stealing is bad,” in order to impress others in the group.

The threshold approach has also been used to explore patterns of adoption within SNA. Valente (2005) describes a simple model where an individual’s adoption is determined by their personal network exposure—the percentage of individuals in their personal network that have already adopted the innovation. All else held constant, an individual is most likely to adopt with higher personal network exposure, i.e., more people in the relevant network having already adopted the new thing or behavior. An individual with a lower threshold requires less exposure than one with a higher threshold. More sophisticated models weigh the influence of various individuals by physical or social proximity, similarity of social environment, or other factors.

Similar to DOI’s representation of innovativeness, threshold models typically do not consider the origin of individual preferences (Granovetter, 1978). Plausible mechanisms can be drawn from two related research areas. First, social learning is based on the same premise as threshold models, where the likelihood of adoption “varies in response to how common the behavior is in a relevant social group” (Efferson, et al.,

2008). The driving force behind this premise is not just mimicry, but a process of learning from the outcomes of others in order to increase personal benefits (Efferson, et al., 2008). In other words, the individual's threshold preferences are based on their ability to glean useful information from the behavior of the group. Second is social norm theory. Cialdini (2003) describes two classes of norms: descriptive norms as "perceptions of which behaviors are typically performed", and injunctive norms as "perceptions of which behavior are typically approved or disapproved". Cialdini (2003) asserts that both types of norms can pressure individuals to adopt or not adopt certain behaviors.

Conformity could influence the purchase of electric-drive vehicles in several ways. For instance, a car buyer may want to see a certain number of HEVs on the road, or purchased among friends and acquaintances, before they are willing to buy. A social learning explanation could be that thresholds serve as a cue to better functional performance of HEVs, where higher incidence of other buyers is evidence of superior performance, reliability, or realized fuel savings. Threshold effects could also work within more specialized groups, where an individual wants to see a certain percentage of "fellow environmentalists" adopt before they are convinced of the societal benefits of the technology. On the other hand, the social norms perspective suggests that frequency information could be used to infer a trend to HEV adoption (a descriptive norm), or to interpret that HEV adoption is becoming socially desirable (an injunctive norm).

Threshold processes may help explain the symbolic attributes of pro-societal cars. To establish a particular meaning—whether social prestige, technological advancement, environmentalism or some other message—a certain threshold of prior adopters is required for the meaning to be successfully conveyed. In other words, even if an

individual believes an HEV is environmentally-friendly, to assure this symbol will be successfully communicated to others in their social group they might only adopt after this belief is widely, or sufficiently, shared among their social group as demonstrated by HEV purchase.

Although conformity helps conceptualize the influence of trends on adopters, it does not explain how trends start. Like DOI's failure to explain why innovators act earlier, conformity perspectives lack explanation as to why instigators have lower thresholds and thus act before the mechanisms of social learning or social norms can play a role. The conformity approach does not explain the emergence of new behavior or innovations, nor does it explain where social norms come from, or how they can change.

3.3. Dissemination: Collective action and critical mass

Rogers (2003) defines dissemination as “diffusion that is directed and managed.” We relate dissemination to processes of collective action and critical mass, which apply specifically to issues of pro-societal goods. As noted above, pro-societal attributes are insufficiently accounted for in DOI. In an individual-centric world, we expect pro-societal goods to be under-provided and pro-societal cars to be “under-adopted.” In other words, why would an individual pay extra for an HEV to reduce environmental pollution when the next buyer can purchase an SUV and still benefit from the HEV buyers' contribution? However, the idea of collective action states that “the assumption that individuals act in isolation is usually wrong,” where in most decisions “people are at least generally aware of what others are doing, and often they have social relations that make influence, or even sanctions, possible” (Marwell, et al., 1988). In other words, motivated

individuals can interact and collaborate to provide pro-societal goods that would not have been provided otherwise.

Oliver et al. (1985) categorize societal goods according to the shape of the production function of marginal returns, which can be, for example, decelerating or accelerating. Societal goods with a decelerating production function offer the biggest pro-societal effect with the first few units of resources contributed, while those with an accelerating production function offer larger pro-societal impacts with the addition of later resources after larger initial start-up costs (Oliver, et al., 1985). It is not clear which production function shape best represents the case of electric-drive vehicles. Purely functional-societal benefits, e.g. the contributions of each HEV sold to reducing emissions and petroleum use, are relatively linear while private financial costs may decrease with the development of battery technology. Symbolic-societal benefits may follow an even more complex pattern—for example, the first few HEVs sold may have more influence in inspiring other consumers to “buy green” than later purchases, or these later buyers may complete the critical mass that facilitates the shift of the balance of the population.

The challenge of collective action is to get “some relatively small subset of a group interested in the provision of a public [or pro-societal] good to make contributions of time, money, or other resources toward the production of that good” (Oliver, et al., 1985). Oliver et al. (1985) state that cases with accelerating production functions are the most problematic, where resolution “depends on the rare circumstance of there being a critical mass of persons whose combination of interests and resources is high enough to overcome the feasibility problem.” This critical mass is defined as a “pool of highly

interested and resourceful individuals willing to contribute in the initial regions of low returns” in order to set up the conditions to sustain more widespread action (Oliver, et al., 1985). Where DOI labels the first adopters of private goods as innovators, in dissemination the first to adopt pro-societal goods are members of the critical mass. Like innovators, critical mass members tend to have extraordinarily high interest in the product and above average access to resources (Oliver, et al., 1985).

Critical mass theory can be applied to private goods with societal attributes. Focusing on the diffusion of interactive media (e.g. telephone, email, etc.), Markus (1987) describes the accelerating production functions associated with high start-up network costs and susceptibility for free-ridership later on, a problem that is not sufficiently addressed by the DOI approach. Markus (1987) highlights the importance of reciprocal interdependence, where one user’s inputs depend on another users’ outputs and vice versa. For electric-drive vehicles, potential buyers that are truly interested in functional-societal attributes may face similar barriers; success in reducing pollution, greenhouse gases or oil use cannot be achieved by the individual alone, but also relies on previous and subsequent decisions by others to adopt (and not just vehicle choice, but in other energy-using actions also). A potential buyer might not just look to previous buyers for information, but may also assess the likelihood of further adoption. Where earlier buyers generally face higher private costs than later buyers, success of further purchase is improved by the intentional coordination among some critical mass of dedicated, resourceful pro-societal car buyers. This group acts not only through purchase of the particular vehicle technology, but also by testing, promoting and assigning value to the

vehicles. These groups may be formalized in some cases, as seen with HEV driver groups, but in most cases are less formal networks of loosely connected social groups.

The dissemination approach to diffusion can help conceptualize efforts to coordinate the purchase of products with pro-societal attributes. These concepts and language may be useful for further investigation of innovations involving the patterns of production functions and reciprocal interdependence among buyers.

3.4. Translation: Social construction and interpretation

The translation perspective includes social construction of technology (SCOT) and actor-network theory (ANT)—though only ANT actually uses the term translation. Taken together, these approaches provide a rich set of concepts and language to explore the development and adoption of new products as dynamic, socially defined artifacts.

3.4.1. Social construction of technology (SCOT)

SCOT looks beyond the notion of adoption being driven by the diffusion of a functionally advantageous technology (Bruun and Hukkinen, 2003). Instead, technological change is described as “the culmination of a social process of interactions that (lead) to changed attitudes towards the (technology) and its use” (Bruun and Hukkinen, 2003). The development of a technology follows a multi-directional process, where success in a given direction is determined by the changing problems and interpretations of relevant social groups (Pinch and Bijker, 1984).

A newly introduced artifact—a term intended to emphasize the role of social processes in shaping the innovation of interest—has a high degree of interpretive

flexibility, where social groups have differing interpretations of its meaning and content which influence further technological development (Pinch and Bijker, 1984). These interpretations are “socially and culturally embedded” where individuals in a particular social group tend to have a common perception of a given artifact, known as a technological frame (Bruun and Hukkinen, 2003). In some cases the shared frame is what defines the social group. Eventually the stages of interpretive flexibility (or controversy) reach a state of closure and stabilization where the perspectives of various social groups converge with the streamlining of interpretations among them (Bruun and Hukkinen, 2003).

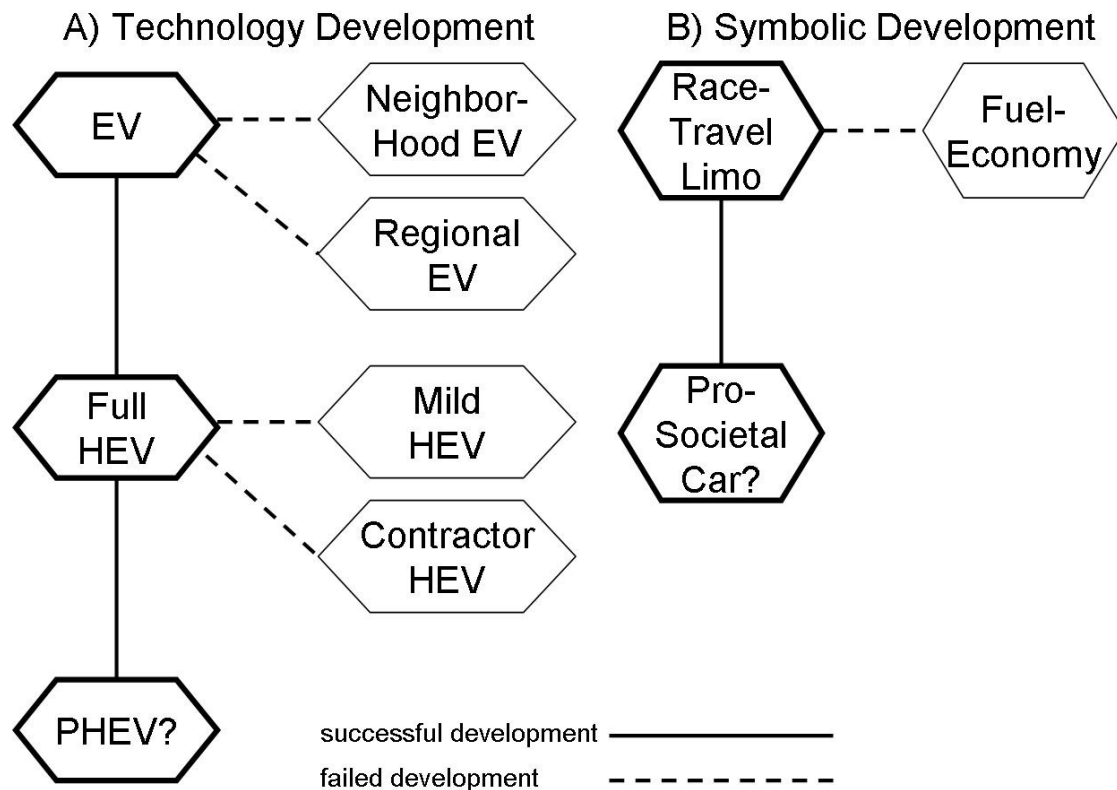
SCOT was originally developed to describe the design stages of a technology including engineering and manufacturing decisions (e.g. Pinch and Bijker, 1984). Kline and Pinch (1996) extend SCOT to analyze the use stage of innovations, exploring the “reciprocal relationships between artifacts and social groups...how the identities of social groups are reconstituted in the process.” Focusing on early automobile use among rural Americans, the authors illustrate how the “anti-car crusade’s” initially negative interpretations of automobiles were gradually overcome by positive interpretations that were both functional, e.g. providing stationary assistance for farm tasks, and symbolic, e.g. reinforcing gender roles. In addition to demonstrating how different social groups can shape the development of a technology, Kline and Pinch (1996) highlight how the development of the automobile also transformed the rural social groups, increasing the connectivity of communities and allowing new methods of saving labor.

The social construction process can be represented visually using a conceptual diagram to depict relationships between social groups and their problems on the one hand

and artifacts and their solutions on the other. In Fig. 2, we adapt Pinch and Bijker's (1984) bicycle diagram to the case of electric-drive vehicles and pro-societal cars. Part A presents one conceptualization of how electric-drive vehicles might have developed in the U.S. auto market. In the early 1990s, full-performance EVs such as General Motor's EV-1 proved unsuccessful. Further development could have followed multiple paths, including lower-range, lower-power neighborhood or regional EVs, or the development and deployment of HEVs. Ultimately, HEVs proved successful with the release of "full" HEVs, such as the Honda Insight and the Toyota Prius. As these vehicles gained popularity, other manufacturers released alternative models utilizing drivetrains with less fuel efficient hybridization, e.g. the Honda Accord Hybrid, or applying hybridization to the use of power tools in "contractor" applications, e.g. the Chevy Silverado Hybrid. Both alternate pathways have so far failed to achieve market success. In recent years, PHEV technology has received substantial attention as the next potential stage of development. This potential is noted by a question mark, though if consumers do not eventually form positive interpretations of PHEVs the technology would also fail (Fig. 2)

Part B of Fig. 2 conceptualizes the development of pro-societal cars on a symbolic level. Starting with the dominant race-travel-limo vision of automobiles described in Section 2.2, the practical notion of fuel economy emerged as a potential alternative pathway in the aftermath of the energy crises of the 1970s, moving towards smaller, cheaper, more fuel efficient cars. However, this pathway gradually disappeared with the advent of less efficient minivans and SUVs and cheaper energy in the 1980s—regressing back to the race-travel-limo vision. More recently, with the growing popularity of HEVs, the pro-societal car concept has emerged as a potential contender.

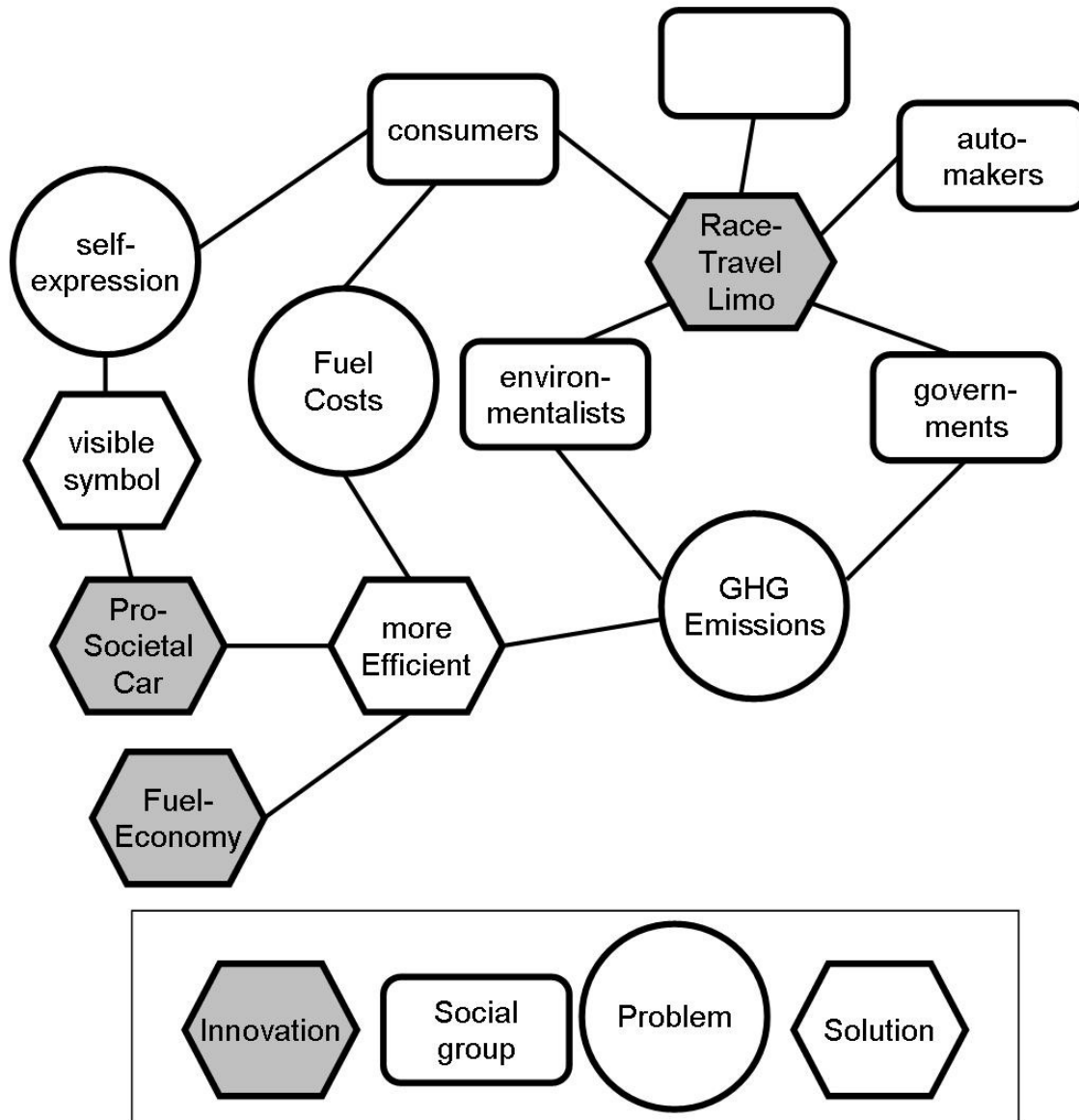
Fig. 2: Illustrative depiction of quasi-linear development of innovations



Source: Adapted from Pinch and Bijker's (1984, p413) depiction of the Penny-Farthing Bicycle

While the diagrams in Fig. 2 help to conceptualize the trajectory of different technologies and symbols, SCOT's greater strength is illustrating how the interpretations of various social groups guide this development process. Fig. 3 is another adaptation from Pinch and Bijker (1984), illustrating the potential drivers of the symbolic development in Part B of Fig. 2. The dominant vision of the race-travel-limo is represented in the gray hexagon, surrounded by several social groups with differing interpretations of what problems need to be solved by technological developments. For instance, consumers may be concerned about high gas prices while environmentalists and governments may focus on reducing greenhouse gas (GHG) emissions.

Fig. 3: Illustration of relevant social groups, problems, and solutions in the development of the pro-social car



Source: Adapted from Pinch and Bijker's (1984, p413) depiction of the Penny-Farthing Bicycle

The fuel economy technology is presented as a potential direction of development, consisting of smaller, more fuel-efficient vehicles using conventional gasoline engines. This efficiency solution solves one problem of consumers (fuel costs) and one problem of environmentalists and governments (GHG emissions). However,

consumers have the additional problem of using automobiles as a form of self-expression: they may interpret this as being unachievable by the smaller, cheaper, low-power fuel economy vehicles. In contrast, pro-societal cars emerge as a technology that not only reduces fuel costs and GHG emissions through increased efficiency, but also provide a visible, higher price, technologically advanced symbol that meets the symbolic needs of many consumers. If other social groups eventually yield similarly positive interpretations of pro-societal cars, the overall interpretation of the pro-societal car as successor to the race-travel-limo could reach a state of interpretive closure.

Brown (2001) provides a further addendum to the original SCOT approach, asserting that certain social groups within the SCOT framework can have particularly powerful influence over the interpretations of other social groups. For instance, when the California Air Resources Board (CARB), a government agency, established the zero-emissions vehicle (ZEV) program in the early 1990s, clean air benefits were highlighted as important criteria in the technological development of vehicles. Brown (2001) argues that CARB's statements and actions served to reopen the interpretive flexibility of the race-travel-limo vision, prompting consumers to consider social attributes as an important concern for buyers of motor vehicles. Thus, social groups that are not actual buyers can also play an important role in influencing the interpretations of consumer groups.

Overall, SCOT is useful for conceptualizing the dynamics of an innovation, the social groups that can guide development (including non-consumers), and the interplay between competing problems and interpretations. However, SCOT alone is not sufficient to explore the diffusion and purchase process; its origins in design stage applications make it less appropriate for more complex problems of user groups and symbolic

interpretations. For instance, Hannemyr (2003) notes that the SCOT concept of closure is overly definitive, where interpretations may streamline at times, but may not fully converge, and any convergence may only be temporary. Moreover, SCOT does not account for processes of social action in technological controversies, or explain how the overall structure of social groups may be heavily influenced or even defined by the technology (Bruun and Hukkinen, 2003).

3.4.2. Actor-network theory (ANT)

Due to such limitations of SCOT, researchers often draw from its less tangible cousin: actor-network theory (ANT) (e.g. Bruun and Hukkinen, 2003; Hannemyr, 2003). The abstract nature of ANT is its strength and weakness. Unlike SCOT, which conceptualizes a structure of roles and relationships among social groups and technologies, ANT provides a level playing field on which everything is an actor—people, groups, ideas, objects, and infrastructure. All actors “take their form and acquire their attributes as a result of their relations with other entities” (Law and Hassard, 1999). The only differences among actors are the “methods and materials that they deploy to generate themselves” (Law, 1992), where relationships and social structures are extremely dynamic. Similar to later applications of SCOT, ANT asserts that while social structure can influence technological change, the reverse is also true. The difference is that ANT steps further in stating that a social group can only be defined by its relationship with the technology and other actors; every actor is defined by its interactions with other actors. Taken in another light, while SCOT states that

technologies are socially defined with malleable interpretations, ANT states that the entire network, social and otherwise, is just as fluid.

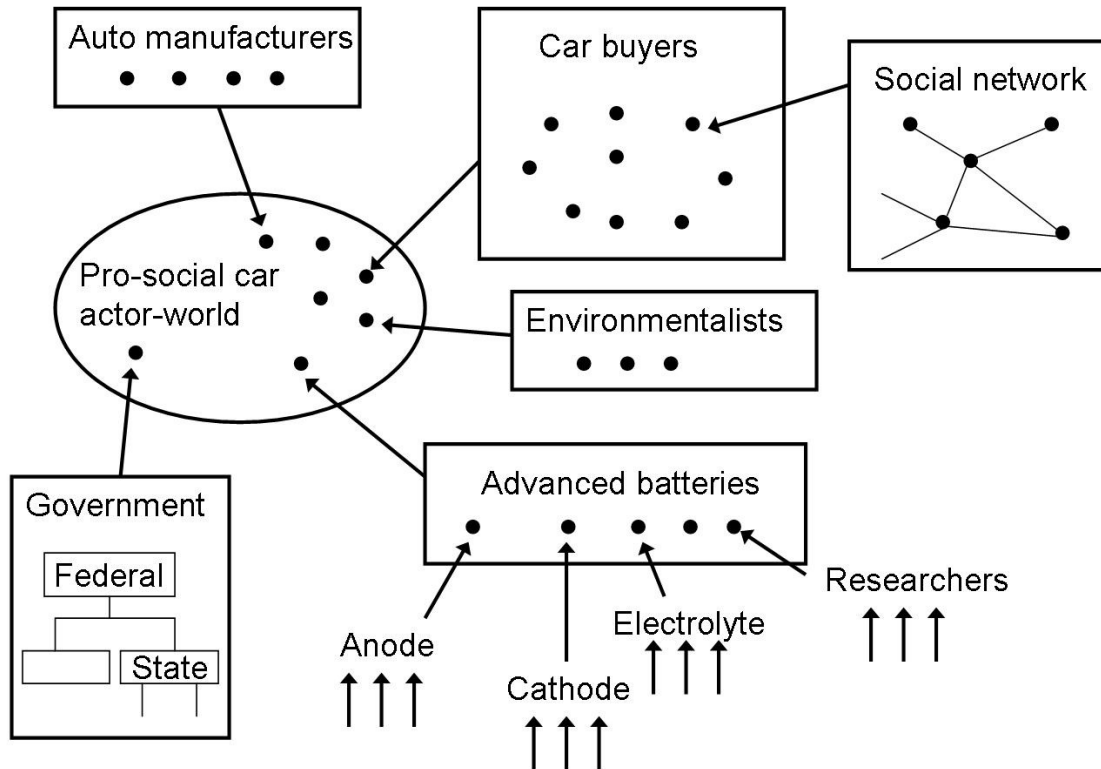
The concept of translation is perhaps the greatest contribution of ANT to a discussion of interpersonal influence. Where diffusion represents the propagation of a static idea or object, translation emphasizes that these ideas and objects change as a result of context and interactions among actors (Pentland and Feldman, 2007). Bruun and Hukkinen (2003) define translation as “the mechanism through which actors can transform themselves, displacing their own identity as well as that of others.” For some applications, translation may be a more accurate representation of how complex ideas spread among actors and social groups, similar to Blaut’s (1987) concept of crisscross diffusion where reinvention is a continuous aspect of the communication process. For instance, information regarding a product’s symbolic and pro-societal attributes may be better described as translation, where interpretations of meaning are continually refined and negotiated among users and observers.

ANT also provides a less definitive concept of closure than SCOT, where an innovation may have multiple scripts which are “mediated, translated, and even changed as time passes, being the product of domination, negotiation, and mutual adjustment” (Hannemyr, 2003). Instead of a finalization of interpretations, ANT presents the concepts of “alignment,” measuring the degree of agreement for a certain translation, and “coordination,” the restriction of interpretive flexibility by rules or conventions (Callon, 1991). Thus, while translations may occasionally streamline through negotiations among social groups, they are always open to revision.

Callon (1986) applies ANT to the case of electric vehicles in France during the 1970s. He describes how Electricité de France's (EDF) presentation of a plan for the deployment of EVs could be represented as an actor-world—a vision of the roles required by all relevant actors. For EDF's vision to play out, consumers would have to be interested in buying the EVs, automakers would have to be willing to shift manufacturing efforts, governments would have to enact pro-EV legislation, and electrochemical batteries—another actor and network of further components—would have to perform adequately. In this sense, Callon describe the EDF as a “spokesman” for the actor network, translating the roles and relationships among actors. In turn, any of these actors can reject such assigned roles and thus prevent EDF's envisioned actor-world from manifesting. Callon (1986, p32) summarizes that the actor network is “distinguished from a simple network because its elements are both heterogeneous and are mutually defined in the course of their association.”

Fig. 4 presents a potential actor-network perspective on electric-drive vehicles, adapted from Callon's (1986) portrayal of EVs. The relevant actor-world is made of many different actors, each of which contains its own network of sorts. The structure of each network may differ: car buyers may include different social networks, governments include a hierarchical order of bodies, and advanced batteries are made up of specific components which are made up by still more specific components and organized by researchers.

Fig. 4: Illustration of the pro-societal car actor-world



Source: adapted from Callon (1986).

In application to pro-societal cars, ANT provides flexibility to the relatively rigid structure of SCOT. For instance, ANT allows for every item in Fig. 4 to experience transformation with development and adoption, including the technologies, social groups, problems and solutions. For instance, the social groups are in part defined by their interpretations of motor vehicle technologies, and some interpretations of problems, e.g., GHGs, may not have emerged until after the presentation of their solution, e.g., pro-societal cars. The translations of other social groups may stimulate an individual to reinterpret their own problems. The individual may then become part of a new social

group of pro-societal car buyers whose existence results from the emergence of pro-societal cars, rather than preceding it.

However, the flexibility of ANT is also a weakness for the present application. ANT includes no causal theory of action (Bruun and Hukkinen, 2003), and can not serve as a predictive model of adoption. However, taken as a supplement to the more rigid structure of SCOT, the concepts and language of ANT enhance the ability of the translation perspective to facilitate the discussion of adoption processes, including the roles of and relationships among multiple heterogeneous social groups, and the dynamic, reciprocal relationships between all the actors involved, including the innovation itself. The explicit incorporation of individual and group-based interpretations and translation can aid the investigation of innovations with attributes in all categories of Table 1.

3.5 Reflexivity: Modernity and the project of the self

The fifth perspective explored in this paper is reflexivity as drawn from Giddens' (1991) approach to self development in the social world. Although this perspective does not specifically focus on consumption or purchase behavior, Giddens theorizes about the underlying driving forces of human behavior (including consumption) neglected in the four perspectives presented thus far.

Reflexivity starts with Giddens' description of modern life "propel[ling] social life away from the hold of pre-established precept or practices" (1991), which we present here as the overall context for the generation and spread of new behaviors. In traditional society an individual had a defined role with expected set of behaviors and interactions with others. In contrast, modernity provides little such direction. Instead, modernity is

characterized by uncertainty in which individuals must actively seek out and create their self-identity. Without the guidance of traditional roles, “the self becomes a reflexive project” (Giddens, 1991), where reflexivity is defined as the dynamic, continuous process of defining and expressing oneself. The self is understood through a reflexively defined biography, or narrative, linking an individual’s past, present and future into a cohesive trajectory of development. This narrative must continually sort events from the outside world into an ongoing story about the self. The ultimate goal of this process of self-exploration is self-actualization in the sense of authenticity or being true to oneself (Giddens, 1991). In short, to cope with the uncertainty endemic to modernity, our behavior is guided by efforts to establish a sense of order, direction, and development for our self-concepts.

Given the vast selection of possible choices an individual faces on a daily basis, Giddens’ (1991) describes the importance of lifestyles as “a more or less integrated sense of practices which an individual embraces, not only because such practices fulfill utilitarian needs, but because they give material form to a particular narrative of self identity.” Instead of agonizing over every choice in effort to create and extend an authentic self-narrative, individuals seek a lifestyle as a package of practices that are associated with their particular trajectory. These practices include fashion, eating, and any other form of symbolic display, such as vehicle purchase and ownership. In essence, lifestyle is the “core” of self identity in the context of modernity (Giddens, 1991). However, a lifestyle is by no means a static package, but also follows a reflexive process, continually open to re-evaluation and negotiation.

Giddens describes lifestyle sectors which may be divided according to locales as settings for specific sets of practices, e.g. home and workplace, relationships, e.g. marriage and friendship, or activities, e.g. work and recreation. Lifestyle sectors are a dynamic and more theoretically elaborate version of the relevant social group concept discussed in other adoption perspectives. Similar to ANT, Giddens' description of reflexivity highlights the indefinite and relationally defined nature of lifestyle sectors. But Giddens adds to ANT a theoretical interpretation of why and how the process of translation occurs in human actors.

Lifestyle and lifestyle sectors can explain aspects of other perspectives reviewed above. DOI's concept of innovativeness may relate to a certain type of lifestyle adopted by individuals who define themselves as cutting edge, technologically advanced individuals, and the practices of this lifestyle include the purchase and use of new technologies. The critical mass groups described in the dissemination perspective may represent another lifestyle adopted by people who want to develop and portray themselves as environmentally aware, socially active individuals, including the practice of driving pro-societal cars and helping to establish positive interpretations of their pro-societal benefits.

In Giddens' (1991) framework, increased ecological concern among individuals relates to the "recognition that reversing the degradation of the environment depends upon adopting new lifestyle patterns." Thus, the adoption of pro-societal cars is not just driven by a motivation for advantageous functional or symbolic attributes, but may instead be one component, or trial, of a more fundamental shift towards an environmental or socially-conscious lifestyle. The visible nature of the pro-societal car can facilitate

reflexivity by prompting users and observers to share and negotiate interpretations. Observers may speculate as to the motivations and lifestyle choices of the driver, assessing if such a practice might fit into their own self trajectory. After adoption, a user may solidify initial interpretations of the vehicle, or modify interpretations based on their experiences and feedback from personal contact and the media. Thus, similar to ANT, the context of modernity is uncertain and interpretations of other actors are subject to constant revision.

An individual's self-concept and commitment to lifestyle practices may be more or less stable subject to different conditions. Turner (1969) describes the concept of liminality as a state in which an individual is "betwixt and between the positions and assigned by law, custom, [and] convention." A liminal state is characterized by "ambiguous and indeterminate attributes," which contrast with the clearly defined attributes of a stable "status system." Liminality may be associated with an individual's life stage, where, for example, they experience higher liminality as a college student or new retiree, and less liminality as a parent with stable child care responsibilities. Liminality may also relate to the structure of an individual's social network, including the diversity of individuals and social groups that they interact with. In this sense, reflexivity is associated with the stability or liminality of self-concept and lifestyle practices.

Ultimately, the reflexivity perspective is not meant as a stand-alone approach to interpersonal influence and consumption behavior. However, it does provide a theoretical backdrop to the other four perspectives reviewed in this paper. Most notably, Giddens supplements the translation approach, particularly ANT, by explaining how and why the multi-directional relationships among actors occur.

4. Discussion and conclusion

Section 2 described the complex nature of electric-drive vehicles in their potential to offer important functional, symbolic and societal benefits. In Section 3 we reviewed how the dominant perspective on interpersonal influence and consumption—contagion or diffusion—focuses on the communication of information concerning the functional attributes of an innovation among adopter categories. We suggest that contagion approaches such as DOI are not conceptually equipped to explain the additional complexity of symbolic and pro-social behaviors or artifacts.

The exploration of four additional perspectives, which we label conformity, dissemination, translation and reflexivity, yields insights into the complexities of the consumption behaviors for different aspects of an innovation. Conformity highlights how the behaviors of others can influence an individual's interpretations of an innovation, as well as tendencies to observe or oppose existing social norms. Dissemination explores the adoption of goods with pro-societal attributes, addressing the important role of an initial critical mass willing to accept high start up costs. Translation describes the socially dynamic nature of innovations, such that interpretations are continuously redefined and renegotiated among social groups who are themselves being redefined and renegotiated. Finally, reflexivity provides a theoretical backdrop to the underlying motivations of adoption processes, describing the individual as a work in progress, continually searching for self development and expression through lifestyle practices.

Table 2 presents a summary of how the five perspectives address the five questions posed at the beginning of Section 3. The bottom row highlights the types of product attributes a given approach may be designed or particularly well suited for—as

conceptualized in Table 1. Note that these perspectives are in some sense complementary; viewed together, each of these perspectives may yield insights into how interpersonal interactions influence the adoption of electric drive vehicles. DOI was designed, and is suited, primarily for private-functional attributes and the flow of functional information; conformity holds potential for symbolic attributes; dissemination describes intentional efforts to promote the adoption of products with pro-societal attributes; and both the translation and reflexivity perspectives address all types of attributes through the interpretations of individuals and social groups. However, no single approach reviewed here seems alone adequate for the study of interpersonal influence and pro-societal consumption—not even the last two; translation does not discuss specific mechanisms of communication and adoption behavior, while reflexivity only provides a theoretical backdrop to processes of adoption.

The intent of this review is to identify alternatives to the diffusion perspective, to illuminate key differences among these perspectives, and help mitigate confusion among literatures of interpersonal influence and consumption. We advise that researchers investigating this complex topic be explicit in identifying the perspective or perspectives they are employing, and explaining strengths and weaknesses of their approach. We also point to many potential directions for future research. In addition to improving contagion models, research could further explore the potential use of conformity models to explain symbolic valuation, as well as the role of dissemination processes that may be less formal than the organized social movements addressed by collective action and critical mass approaches. Further, while models of translation and reflexivity can effectively represent

social dynamics over time, further research can investigate their potential for predictive applications, and implications for environmental policy.

Although Table 2 matches each perspective with the different types of attributes of a new technology, we do not necessarily suggest that each perspective should be independently applied to these different attributes. Such a patchwork of concepts and language might not be particularly useful or interesting. Instead, this discussion could be used as fodder for the construction of an integrative model of interpersonal influence and consumption that can address all the relevant attributes of pro-societal goods and consumption practices. A major lesson from the popularity of DOI is that a simple, common language can enormously enhance the communicability and longevity of a research approach. In a companion paper, we make our own attempt: we propose such an integrative model using concepts explored in this review, apply it to empirical data, and consider implications for environmental policy (Axsen and Kurani, 2010). Further research should explore the validity and usefulness of each perspective in various technological, regional and cultural contexts, and perhaps develop alternative integrative models.

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