Autonomous people: Identity, agency, and automated driving

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The prevailing discourse on autonomous vehicles (AVs) has not yet developed a sophisticated conceptualization of autonomy and has given insufficient attention to the autonomy of people. In response, this article shifts our attention away from the AV's autonomy and towards that of its user. Autonomy is conceived here as the socially and materially situated capacity of an individual to identify and act on one's own values and desires, a capacity that is desirable for collective political life. This definition is drawn selectively from a survey of thought illustrating the richness of this concept. I then examines how studies of transportation have already made use of certain themes of autonomy in understanding mobility practices beyond dominant utilitarian models. This sets up an examination AVs, where the existing literature tends to use a narrow conceptualization of autonomy. I then briefly examine two examples of unsettled questions in AV development, discretionary user controls and shared ride systems, in light of autonomy. The goal of this article is both to show how autonomy can be productive in understanding mobility practices, and to argue for personal autonomy as a normative value worth pursuing in the technical, political, and social development of automated mobility systems.

Keywords: autonomy, agency, autonomous vehicles, mobility

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1. Introduction

In the coming years, self-driving cars will transform cities as radically as human-driven cars did a century ago. This is the claim of a growing chorus of automakers, technology companies, regulators, and researchers involved with autonomous vehicles (AVs). Although the ways that the automobile has shaped our built environments and everyday lives are now well known, these were far from apparent in the car's early years. Blind spots are endemic to emerging technologies, according to one observation from science and technology studies that "our technical competence vastly exceeds our understanding of the social effects which follow from

its exercise" (Collingridge, 1980: 11). In this spirit, researchers increasingly argue for the study of self-driving cars to pay attention to the "sociotechnical systems that will emerge around them. These changes will not just relate to how we drive or are driven, but also to how we live, how we work and how we build our environment" (Cohen et al., 2018: 259). Indeed, a growing body of work has studied expected impacts of AVs on issues including auto ownership, travel behavior, road congestion, transportation infrastructure, and land use (e.g., Fagnant and Kockelman, 2015; Fraedrich et al., 2019; Litman, 2019; Watzenig and Horn, 2017).

Throughout much of this discussion, one idea is both constantly invoked and yet curiously overlooked: autonomy. The term is applied in a superficial sense to vehicle technologies that sense and act more or less independently of direct human intervention, but is less often invoked as a quality of people. Reviews of literature anticipating the social and political implications of AVs address personal autonomy only indirectly, if at all (Duarte and Ratti, 2018; Milakis et al., 2017). When human autonomy does appear in AV discourse, it is often in the restricted senses of a person's physical control over the vehicle or liability for collisions. In many such accounts, the autonomy of people and vehicles is implied to be a zero-sum proposition, where greater technological autonomy necessarily means less human autonomy. This article aims to illustrate how the concept of autonomy has far more than this to offer our understanding of cities, mobility, and self-driving cars.

Autonomy in its broadest sense refers to the capacity of an entity to generate the laws by which it governs itself. By one typical definition, "being autonomous is acting on motives, reasons, or values that are one's *own*" (Stoljar, 2018). The term "autonomous vehicle" is then something of a misnomer, since, as one AV executive explained, autonomy would be if "[y]ou get into the truck and say, 'I want to go to the office,' and the truck says '*I* want to go to the

beach'" (quoted in Tingley, 2017). Indeed, much of the industry avoids the term, referring instead to "automated driving" or "self-driving cars" (e.g., SAE International, 2014). The terms "automated" and "autonomous" are nonetheless routinely conflated in the popular, legal, and academic discourses around AVs, with little distinction made between a vehicle that acts independently according to human-generated rules and one that generates its own rules for action. Rather than determining the degree to which AVs really are or will be autonomous, however, the task of this article is instead to shift our attention away from the vehicle's autonomy and towards that of its user.

This approach builds on existing work connecting mobility practices to personal autonomy. The automobile has already provided fertile ground for examinations of the relationship between human autonomy and mechanical automation given the resonance of their shared root in *auto*, or self (Sheller and Urry, 2000). In transportation and mobility literature autonomy appears sometimes explicitly but more often indirectly through related concepts of affect, emotion, sociability, freedom, independence, control, and pleasure, all of which address an enactment of personal inclinations in the context of social and material frameworks. Although the transportation accounts generally lack a strong normative position, instead employing autonomy as an explainer of observed behavior, a longstanding tradition in political and ethical philosophy has argued for the intrinsic value of personal autonomy, which is argued to be fundamental to both individual human dignity and the democratic project of living well together.

Much existing work on AVs has "a tendency to splinter off the 'social dimensions'" into separate analytical categories, a separation that risks a deterministic perspective in which social "impacts" are always downstream of technological change (Bissell et al., 2020: 118). Autonomy offers a corrective analytical lens that can help illuminate the complexities of individual human

agency within technological and social structures. After all, AVs "will remain 'driven' by human desires even if these are filtered only through human-designed algorithms" (Cohen et al., 2018: 272). The two contributions of this article are, first, to show how autonomy can be productive in this explanatory capacity when studying AVs, and second, to argue for personal autonomy as a normative value worth pursuing in the technical, political, and social development of automated mobility systems.

The remainder of the article is laid out as follows. The next section lays the theoretical groundwork for the concept of autonomy in order to articulate a particular meaning that can be productively applied to urban mobility. Section 3 then examines how this idea appears in mobility literature, especially in behavior models, studies of affect in transportation, and explorations of the freedoms of driving. Section 4 then turns to AVs. It begins with a survey of the limited engagement with personal autonomy in the AV literature before then proposing two considerations of AV development where autonomy can productively guide analysis: discretionary user controls and shared ride systems. A conclusion then summarizes the case for autonomy while offering a reminder of our collective power to produce technological systems that reflect our values.

2. Autonomy

The concept of autonomy lies at the center of a wide range of modern social and political thought. Although interpretations share a common sense of self-determination or self-governance, it has no single agreed-upon meaning in its manifestations across various theoretical and applied fields. This nebulous idea's openness to diverging interpretations is arguably one explanation for its longevity, as it gains its appeal "as a constellation of related ideals that depend in various ways on one another" rather than as a single solid concept (Baynes, 2007: 552). In this

spirit, the following survey illustrates the idea of autonomy selectively through three lenses: Kant's foundational concept of a rationalist individual autonomy and the relational autonomy of its feminist critique; the collective autonomy articulated in the political theory of Cornelius Castoriadis; and the examination of human autonomy in relation to material technologies. The latter two lenses, in particular, have spatial and urban dimensions that bear emphasizing. This survey serves two purposes. First, it sketches an outline of the productive complexity of this idea, the full coverage of which cannot be adequately summarized here, as a contrast to the simplistic way "autonomy" is so often used in popular discussion of AVs. Second, it offers one concept of autonomy, articulated as *the socially and materially situated capacity of an individual to identify and act on one's own values and desires*, that can guide an evaluation of personal autonomy with AVs.

Philosophical foundations: Kant and critics

The term autonomy, deriving from *auto* for self and *nomos* for law, comes from ancient Greece, where it referred to city-states that governed themselves by their own laws. The idea of a self-governing individual, rather than a city, is not fully explored until the Enlightenment, when Kant uses autonomy as the basis for his moral philosophy. With the Enlightenment's skepticism of religious moral authority, Kant understood the individual as the source of his own morality. However, Kant argued that a person simply following his own interests was not acting morally, but is merely being controlled by his desires. Unlike animals, he said, humans have a free will based in reason, an a priori rationality that exists independently of individual passions, senses, or experience. Kant's sense of reason is universal, both in that it is accessible to all humans and in that it is applicable as a general law to any particular circumstance. Autonomy for Kant means that a person can identify moral law in himself, through his rational capacity, and this autonomy

is important for his understanding of free will and moral accountability. Notice that this autonomy has internal and external dimensions. For Kant, rationality is the means by which one becomes free both from one's own inclinations based in personal experiences and desires, and from subordination to the coercion of an external authority (Kant, 1960, 1998; see also summaries in Baynes, 2007; Campbell, 2017).

While Kant was more concerned with the origins of morality than with the individual per se, a more personal nature of autonomy comes from thinkers like Rousseau, Mill, Heidegger, and on to contemporary philosophers. These have emphasized, in their own ways, a notion of an *authentic self* or *true self* that, by way of autonomy, should be allowed to come into its fullest expression. Unlike Kant's, these accounts champion the particular passions of the individual, finding these desires, not any pure and universal rationality, as the rightful basis of the autonomous self (Oshana, 2007; Taylor, 1992). Work on personal autonomy makes a distinction between *knowing* and *acting on* one's authentic self. The former requires a process of self-reflection through which an individual both identifies her desires and then confirms that they are in fact her authentic desires (Dworkin, 1988; Frankfurt, 1988). The latter requires capacities "necessary to make choices and enact decisions that express, or cohere with, one's reflectively constituted…identity" (Mackenzie, 2014: 17). These enabling capacities can be found both internally and externally (Oshana, 2006, 2007; Raz, 1986). In broad terms, this work on personal autonomy departs from Kant in two main ways: its embrace of the particularities of individual desires, and its attention to the ways that action is shaped by conditions outside the individual self.

These themes are also at the heart of feminist critiques of autonomy, which argue that the concept is inherently gendered. Such accounts begin with the observation that the classical

notion of autonomy, with its emphasis on independence and the primacy of the self, focuses on virtues more often associated with and available to men (Friedman, 2003; Gilligan, 1993). While this has led some to reject the idea of autonomy outright, calling it, for example, a "thoroughly noxious concept" (Hoagland, 1988), others have sought a more feminist conception of autonomy. One such approach is relational autonomy, which emphasizes social connectedness in two distinct ways. First, social relations are a necessary procedural means of achieving autonomy (Baynes, 2007; Nedelsky, 1989), a version of the external enabling conditions mentioned above. This perspective points out that "if we ask ourselves what actually enables people to be autonomous, the answer is not isolation, but relationships—with parents, teachers, friends, loved ones" (Nedelsky, 1989: 12; quoted in Stoljar, 2018). The resulting autonomy, however, might still exist in separation from these relations. In the stronger view, by contrast, social relations do more than enable autonomy; they are the very constitutive substance of autonomy. Drawing on a central thread of feminist thought, the self in this account is inseparable from social relations (Stoljar, 2018). In this substantively relational view of autonomy, "[s]elf trust, self-respect, and self-esteem are thus neither purely beliefs about oneself nor emotional states, but are emergent properties of a dynamic process in which individuals come to experience themselves as having a certain status" (Anderson and Honneth, 2005: 131). Feminist theory is quick to point out that social relationships can limit autonomy as readily as they can expand it, and indeed this question of how women can exercise their own agency under conditions of patriarchal domination is a primary driver of the feminist thought on autonomy. While these accounts of relational autonomy are shaped by such feminist perspectives, mainstream philosophers of autonomy have come to similar conclusions in refusing the assumption of an individualist self (Friedman, 2003).

Writing about feminist accounts of autonomy, Veltman and Piper (2014: 4) concede that "there is now a fair amount of agreement that autonomous agency is saturated with self-other relations."

The political and the city: Castoriadis

While the feminist view of autonomy sees it as inherently social, this autonomy is nevertheless primarily a personal attribute of an individual. To better understand how autonomy can describe a society, and to therefore connect the notion of personal autonomy to the political matters of the city, we turn briefly to the work of Cornelius Castoriadis, a Francophone social theorist who made autonomy a focus of much of his thought in the mid- to late-twentieth century. Castoriadis is useful here not only for his development of collective dimensions of autonomy, but for his insistently normative theorization of why autonomy is politically desirable. His is a compelling answer to the question of why autonomy matters for the city, but the introduction of his thought here is offered as only one of potentially many such responses.

Castoriadis's work envisions social attitudes and arrangements in which people draw on their own, already existing capabilities to overcome structures of oppression. In particular, this struggle is against "alienation," by which he means the subject's separation from itself by some external other that "has assumed for itself the function of defining for the subject both reality and desire" (Castoriadis, 1997a: 178). His primary targets here are dominant institutions, especially the state and capitalism. The only way to overtake such structures of oppression is through autonomy, through which people can become free of the alienating effects of institutions that prevent them from identifying their own desire.

Like many critics of an individualist autonomy, Castoriadis is clear that "autonomy can be conceived…only as a social problem and as a social relation," and goes further to argue that "one cannot want autonomy without wanting it for everyone" (1997a: 183). Unlike the feminist

theorists, however, the aim of his autonomy is not the self per se, but a collective project of overtaking dominant institutions. “No individual autonomy can overcome the consequences of this state of affairs, can cancel the effects on our life of the oppressive structure of the society in which we live” (1997a: 184), he says. Castoriadis is interested not only in the autonomous individual, then, but especially in an autonomous society, which he says is defined by “its activity of explicit and lucid self-institution – the fact that it gives itself its own law, knowing that it is doing so” in a process that is “free and reflective” (1997b: 314). Yet he is also clear that such a society does not exist independently of its constituent individuals:

> “[T]he existence of societies that call themselves into question means that there are individuals capable of putting existing laws into question – and the appearance of such individuals is possible only if something has changed at the same time on the level of the overall institution of society.” (Castoriadis, 1997b, p. 311)

The position Castoriadis articulates here—autonomy as an inseparably individual and collective means of overcoming dominant structures that alienate us from ourselves—has resonance in the work of several other theorists who deal with space and the city explicitly. Lefebvre’s (1996) well known work on the right to the city, for example, envisions a self-managed participation in the production of the city as a necessarily collective endeavor that reduces the state-imposed separation between the people and their work. Lefebvre and others have also celebrated the lived city, noting how everyday practice of agents seeking their own ends in the city both eludes centralized rule and allows for productive inter-personal encounters (de Certeau, 1984; Young, 2011). The city for these thinkers, Castoriadis included, is important both as the site of dominating institutions and as the place where people collectively can manage themselves in resistance to such structures.

Materially situated autonomy: Technology

The discussion so far has pointed out the ways that a person's autonomy is always enabled and constrained by other people. However, autonomy is not only socially situated, it is also materially situated, and a long line of scholarship in philosophy of technology through contemporary work in science and technology studies (STS) has taken up the perennial challenge of locating agency in the relations between people and their things. (The concept of agency in this work sometimes refers to an individual's capacity to act, without explicitly including the identification of one's own desires or situating action within constitutive social relationships. In other cases, however, the discussion of "agency" in human-technological interactions evokes many of the same concerns as "autonomy.") STS scholar Lucy Suchman (2007: 267), for example, is interested in how human-machine interactions reveal "the sense in which subjects and objects emerge through their encounters with each other." Legal scholar Julie Cohen (2012) similarly challenges approaches that begin with an abstract autonomous self and then examine technology as an external force acting upon it. Instead, she says, "the relationship between the embodied self and technology is a mutually constituting one," and technologies "are experienced as altering, extending, or limiting capabilities that we already possess" (Cohen, 2012: 46). Related lines of thought have asked how objects are social relations made durable (Latour, 1990), human agency becomes harder to identify as technologies become more complex (Introna, 2011), technology can emancipate people from relations of inequality (Haraway, 1991) or exacerbate systems of domination (Eubanks, 2018).

In contrast to some of the abstractions found in theories of autonomy, literature on technology and materiality tends to be more attentive to both artifacts and spaces. In describing the emergence of an "automatic production of space," Thrift and French (2002) argued that much

of the city is increasingly the result not of human agency, but software instructions. In response to this view, persistent in subsequent work in the field of digital geographies, Gillian Rose (2017) has argued that such accounts too easily separate human and technological agency, and in their attention to digital transformations give too little theoretical attention to human agency. Working with posthuman thought that rejects the sovereign human subject, she calls for scholars of the digital to "theorize (digital) posthuman agency by thinking it as always already (digitally) sociotechnical" (p. 789). This argument echoes many critiques of technological determinist views which implicitly take the forces of technological change as a given and seek to identify the impacts of such change on a basically passive society. The determinist orientation that overlooks human agency in enacting technological change is common in both popular and academic discourses of AVs (Bissell et al., 2020). Importantly, reinvigorating our view of human agency within sociotechnical phenomena is more than an attempt to better describe how personal autonomy *is* produced and exercised, it also provides openings for the assertion of a normative stance on the question of what kind of autonomy people *should* have within this digitally mediated city. Compared to determinist accounts, such a theory of digitally mediated cities can be "more hopeful...by extending and recognizing ordinary urban denizen's abilities to express political capacity through everyday digital interactions" (Leszczynski, 2019: 13). Autonomy can thus be seen as both the ends and the means of such a technological politics.

Summary

Centuries of thought on autonomy, and an intellectually diverse literature of contemporary applications of the concept, have covered far more ground than is represented in this brief survey. The purpose of this selective introduction has been to draw out features of this concept that can push our understanding and evaluation of the personal experience of mobility into

productive new territory. Autonomy in its Kantian ideal is both an intra-subjective victory of universal reason over individual inclinations and an inter-subjective freedom from external authority. In departures from Kant, the accounts of personal autonomy and the feminist articulations of relational autonomy embrace the unique passions of the individual as part of her authentic identity while also considering the indispensable role of social relations in both enabling and constituting the articulation of that authentic self. In a political context, Castoriadis argues even more strongly for a collectively constituted autonomy through which people can resist institutional domination and express their own true wills. Lastly, a full theorization of human autonomy must account for the ways that technologies open and close possibilities for an individual to reflect on and enact her own desires, without simply putting technology in the explanatory driver's seat. A few persistent themes are worth underscoring here: the struggle between reason and desire, the tension between the independent self and the self in social relation, and the distinction between the capacities to create one's own rules and to act on them. In addition, note that autonomy in these accounts frequently appears as simultaneously a normative value worth pursuing and as an already-existing capacity to be identified. The remainder of this paper seeks out these ideas in the context of mobility and AVs.

3. Autonomy in Mobility

The term autonomy is rarely used in the literature on transportation and mobility. The field is dominated by the instrumental objectives of engineering, which often sidestep psychological or political dimensions of transportation systems. Nevertheless, notions of individual freedom in transportation, the connection between personal goals and travel behaviors, and the role of emotions in the appeal of driving all invoke autonomy by other names. When personal autonomy appears in this literature, it is most often as an explanatory variable, but also occasionally as a

desired objective. This section highlights appearances of relevant themes in literature on driver behavior models, travel behavior models, affect and transportation, and the phenomenology of driving. Despite usually being minority voices in their fields, these are compelling examples of applications of autonomy to mobility that can inspire future work on AVs.

Models of Driver and Travel Behavior

Research from automotive safety and engineering has developed models of driver behavior, which frame the cognitive and behavioral processes of a vehicle operator. Literature in transportation planning, meanwhile, has used travel behavior models for understanding where and how people choose to travel. Each of these has sought to better incorporate the cognitive and affective influences on individual decision-making, but generally lack a close attention to personal accounting of desire and action that characterize autonomy.

Michon's (1985) influential model of driver behavior describes a three-level hierarchy of "control," "tactical," and "strategic" functions of driving. At the lower levels, control functions describe a driver's action to brake suddenly to avoid an obstacle, for example, while the tactical functions describe a longer maneuver like identifying a gap for merging into traffic. At the higher strategic level, the driver makes a plan for the trip, reflecting preferences for destination, route, and timing. Lower-level functions both guided by and necessary for higher-level functions (Michon, 1985). Building on this hierarchy, subsequent models have introduced an additional fourth level, "goals for life and skills for living," which addresses "skills for self-control" as well as the role of driving in "personal development" (Keskinen, 1996). In shifting the analytical lens from vehicle control to self-control (Hatakka et al., 2002), this view situates driving in a much wider personal and social context. In this light, for example, a novice driver's accident might be seen not simply as a failure of road perception or vehicle handling, but as a result of risk-seeking

behavior or capitulation to peer pressure (Laapotti et al., 2001). Broader framings such as these look beyond technical skills to account for differences in individual inclinations, recognizing that "[m]odification of behaviour is not possible without modification, or at least, awareness of personal goals" (Hatakka et al., 2002: 204).

At a different scale, travel behavior models, which describe aggregate behaviors across a transportation system, have also sought to incorporate the role of individual agency in accounting for observed behaviors. Beginning in the 1950s, the dominant "four-step" travel models used population statistics and land use patterns to generate forecasts of demand on a given segment of the transportation network. However, as the goals of transportation planning shifted from forecasting travel to influencing it, the need to understand travel as "a behavioral phenomenon" based on individual decision-making became apparent (Boarnet, 2011). The resulting "activity-based models," developed in the 1980s and 1990s, use a disaggregate approach to examine travel choices at the individual and household levels, using personal data like travel surveys, travel diaries and, later, GPS trace data (Axhausen and Gärling, 1992; Golledge and Gärling, 2002). These sought to better represent human decision-making in travel behavior, from the desire to engage in some distant activity to the plan for making that trip and the actions taken along the way. In contrast to the aggregate models, these addressed the reality that people do not always behave as utility-maximizing economic agents, for example by choosing the fastest route. Instead, an individual's travel behavior is a product of her unique cognitive processes, including motivations, knowledge, and capabilities. Still, these and related models of travel behavior have been criticized for failing to fully incorporate the complexity of human decision-making in travel choices, an omission that can be traced both to the difficulty of collecting the necessary data and to explanatory blind spots of prevailing transportation demand models (Boarnet, 2011).

In these examples, a person's goals, pursued through his individual knowledge and skills in socially and materially constrained travel scenarios, have proven inescapable in explaining decisions about how to make a given journey or operate a vehicle. Without naming it, these models are addressing dimensions of personal autonomy that appear in explanations of both specific driving maneuvers and aggregate travel demand. Yet these higher level cognitive motivators can be difficult to measure and model than the instrumental goals, and they are easily omitted or black-boxed. To the extent that it is addressed, this autonomy is seen primarily as an input to the system, which "can contain thousands of autonomous, 'intelligent' entities that need to be simulated and/or controlled," (Bazzan et al., 2005: 251). In these driver behavior models and travel behavior models that set out to explain, and ultimately influence, auto safety and transportation demand, respectively, personal autonomy has been identified as having explanatory power, but is rarely put forward as an quality worth pursuing in itself.

Affect and Transportation

In a related branch of work, many transportation researchers have responded to utilitarian accounts of travel that overemphasize rational calculations of time and cost by arguing that more affective experiences of transportation are equally important motivators (Anable and Gatersleben, 2005; Gardner and Abraham, 2007; Jensen, 1999; Mann and Abraham, 2006; Steg, 2005; Steg et al., 2001; Stradling et al., 2001). As Steg et al (2001: 164) claim in calling for more empirical research on "symbolic-affective" motivators to supplement the dominant "cognitive-reasoned" explanations, "[c]ar use is not only popular because of its instrumental function, but it also satisfies the need to express yourself and your social position, and it is pleasurable." Similarly, studies of commuters have identified affective dimensions such as prestige (Hiscock et al., 2002), self-identity (Basmajian, 2010; Mann and Abraham, 2006), and stress avoidance

(Anable and Gatersleben, 2005), among many others, as playing important but easily overlooked roles in individuals' travel decisions.

Their interest in affect has many parallels to discussions of autonomy, including an attention to personal desires and the capacity to enact them as well as an awareness of the social situations in which individual emotions and behaviors are constituted. In some cases, the concept of autonomy appears explicitly. It is often characterized as a "desire for control" (Gardner and Abraham, 2007; Mann and Abraham, 2006), a measure on which cars are generally found to compare favorably to public transit. Similarly, Hiscock et al. (2002) find that "[c]ars provided autonomy because car use was seen as being more convenient, reliable and providing access to more destinations than public transport" (p. 119). A related study measures travelers' experiences of autonomy with statements like "I can travel where I want," "I feel in control," and a given travel mode "fits in well with the routine of my life" (Ellaway et al., 2003: 223). In addition to operationalizing the variable of personal autonomy in their models, the research cited in this paragraph is also noteworthy for treating autonomy as a response variable rather than simply an explanatory variable. Because greater personal autonomy has been shown to have long-term psychological and health benefits, these studies argue, expanding autonomy should be an explicit focus of transportation policy (Ellaway et al., 2003; Gardner and Abraham, 2007; Hiscock et al., 2002; Mann and Abraham, 2006).

Elsewhere, social theorists have looked more broadly at the culture of automobility to both examine and challenge the popular notion of the car as a vehicle of freedom. Freund and Martin (1993: 3) document an "auto ideology" in which "the car is a primary means of personal autonomy." This autonomy promises choice, convenience, and power to the driver in ways that "equate physical movement with political freedom" (p. 85). Yet drivers quickly find that the

promised individual freedom of movement is inevitably constrained by countless factors beyond the individual's control: road congestion, traffic laws, scarce parking, vehicle limits, and other drivers (Freund and Martin, 1993). In contrast to the simple narrative of a car and driver navigating to a destination, automobility is a complex cultural and material system of car technology, extending well beyond the individual vehicle (Latham and Nattrass, 2019) with "a distinct combination of flexibility *and* coercion" (Sheller and Urry, 2000: 739). Transportation policy makers have long struggled with the problem that when individuals seek more freedom by driving, they collectively reduce this freedom for everyone (Jensen, 1999).

Phenomenological accounts of driving also point to affective, sensuous, and social dimensions of mobility. In calling for an "emotional sociology of automobility," Sheller (2004) reminds us that driving is not just about moving from origin to destination, but also "intense feelings, passions, and embodied experiences" (p. 222). More than the utilitarian view, an emotional perspective highlights the physical experiences of driving. Understanding the car as an extension of the driver's body (Thrift, 2004) reveals how driving a car can generate in the driver sensations of pleasure or comfort, a sensuousness whose appeal is well known to car advertisers but often overlooked in transportation studies (Freund and Martin, 1993). Similarly, Katz (1999) examines how a driver experiences road rage when, for example, a vehicle comes too close to his own car and he perceives it as an intrusion of his own personal space. Road rage also illustrates how the psychological and physiological experience of emotions cannot be understood as contained entirely within an individual, but have clear social origins in, say, the violation of cultural norm (Katz, 1999). Much attention to interpersonal relations in driving has focused on how drivers effectively communicate with one another in ways that necessarily extend beyond the rules of the road (Haddington, 2012; Juhlin, 2001; Laurier et al., 2012), the type of informal

everyday practices that have frustrated efforts to program artificial drivers. Others, however, have pointed to driving sociability as more than a functional coordination, but as a means of publicly expressing a sense of self in the ways we move across the city. In a study of travelers across several modes, Toiskallio (2002) finds that through practices like choosing a route, negotiating maneuvers, or maintaining physical distance, travelers "try to understand themselves as individual agents" (p. 170) and "create and handle personal principles that support their dignity" (p. 179). Similarly, Basmajian's (2010) oral history study of women's experiences of commuting reveals personally meaningful expressions of identity in relation to social norms playing out in this time and space between work and home.

Seen together, this work has shown driving to be far more than operating a machine or transporting to a destination. Driving is an expression of personal goals and identity, and it generates feelings of freedom or constraint. The roadway is a social space in which people interact and communicate. Although it often lacks a strong normative stance on the personal or political desirability of such phenomena, this literature productively reveals the intrapersonal and interpersonal complexities of mobility.

4. Autonomy and AVs

The discussion of driving and other forms of mobility has examined ideas of freedom, affect, sensuousness, and sociability. The step from these themes to those of autonomy is a small one. However, close attention to such themes is largely missing from the AV literature. In a large part, this can be attributed to the reality that AVs are not yet widespread, and so much the discussion of AVs' social implications is necessarily speculative. The first part of this section introduces some of the ways that concerns with personal autonomy have appeared in the AV literature to date. The second part then pushes these forward to explore through two examples

what a more thorough application of autonomy to an analysis of AV development might look like.

Autonomy concerns within AV literature

Traffic disruptions

One set of concerns about vehicular autonomy has focused on the legal and safety challenges of introducing a non-human agent into the social situations of the street. Traffic laws written to govern interactions among humans can become problematic when they govern the operation of software, which might struggle to interpret abstract principles in traffic codes as humans do (Leenes and Lucivero, 2014; Prakken, 2017). Negotiating interactions with humans in traffic presents a related challenge. Not only must the AV perceive and predict its surrounding traffic environment, it must also communicate its intentions to the humans who are anticipating its behavior (Brown and Laurier, 2017; Surden and Williams, 2016). In this view, the autonomy of the vehicle has a potentially disruptive impact on the mostly stable social arrangement of traffic.

Safety tradeoffs

Such concerns also appear in frequent discussions of AV crash ethics, which have been popularized in "trolley problem" dilemmas describing situations in which some collision is unavoidable, and the AV must choose who will be injured or killed. Transferring the power to make such life-or-death decisions, rare though they may be, from human drivers to opaque machines raises questions about the ethics involved in programming such vehicles (Fleetwood, 2017) and the preferences of users in riding in them (Bonnefon et al., 2016). Discussion of these ethical scenarios often suggests that the increasing autonomy of vehicles means less autonomy

for people. Since much of the appeal of AVs is their promise to be far safer overall than cars driven by humans (Watzenig and Horn, 2017), the implicit bargain that follows is one in which humans must surrender some of their own autonomy to enjoy improved safety, an application of a tension between liberty and security that has long featured in political philosophy. This sense of tradeoff is apparent in the German code of ethics for AVs wrestling with the question of "how personal autonomy and technological imperatives and constraints can be brought into a healthy relation" (Luetge, 2017: 549). In the code, personal autonomy is described as individuals' "freedom of action for which they themselves are responsible," echoing Kant's connection of autonomy and moral responsibility.

Driver control

Studies of stated user preferences for AVs frequently identify a concern for losing the freedom and sense of control associated with driving (Schoettle and Sivak, 2016), echoing the findings of research on affect in transportation behavior. In a Pew Research study of attitudes towards AVs, for example, one woman said "I want to be in control and not have the machine choose what's best for me" (Smith and Anderson, 2017: 32). While this control is often expressed as an instrumental value, as in the case of a driver who wants to maintain control because she expects she will drive more efficiently or safely than an AV, in many cases subjects identify their own autonomy as having intrinsic value. The subjects in one study found certain AV features to be potentially useful, yet evaluated them negatively because they were viewed as "controlling" and therefore jeopardizing personal autonomy (Vrščaj et al., 2020).

Traveling freedom

An alternative view argues that AVs will enhance personal autonomy. Kellerman's (2018)

discussion of personal autonomy in relation to technological automation describes autonomy primarily as a kind of "freedom from" external control, rather than a positive capabilities-based freedom (p. 28). This autonomy will be greater with AVs, he argues, since the greater control over the time and place of movement that automobiles have already provided will only be expanded. Moreover, travelers will now have the ability to do other things in the car, having been freed from the demands of vehicle operation (p. 31). Kellerman concedes that "[i]ndividuals' autonomy will no longer include the power expressed through the choice of routes and through the mastering of car movements," but argues that "the pleasure of being mobile, while lacking these responsibilities and effort, may increase" (p. 135). Stayton and co-authors (2017) similarly claim that freeing people from the tasks of driving makes them more autonomous, even as they are "further embedded in sociotechnical systems that are beyond individual control" (p. 93). Although we cannot yet know whether AV users will share this sense of increased pleasure accompanying reduced control, transportation literature has shown how people find driving a car to be pleasurable in itself, not simply as a means to reach a destination (e.g., Mokhtarian and Salomon, 2001).

Applications of autonomy to AV development

Limited issues of personal autonomy have indeed appeared in discussions of emerging AV technology, but there remain many opportunities to use a richer understanding of the concept to productively engage in the many technical and political questions surrounding AV development. This section briefly introduces two open issues in the development of AV technology and operations that offer such opportunities: the degree and kind of control AVs users have over the vehicle, and the operation of AVs for individual or shared trips. The former highlights questions of intrapersonal dimensions autonomy while the latter points to interpersonal issues, but in either

case the full theoretical range of personal autonomy can be engaged. The purpose of looking at AVs through the lens of autonomy is both descriptive and normative: How *is* or *will* personal autonomy be experienced with AVs? And in what ways *should* personal autonomy be pursued through this technology?

Vehicle control

Although many AV scenarios imagine a fully automated car that can navigate any environment without a driver, vehicle automation is expected to advance much more incrementally. Considerations of how human and AV control should be negotiated in such hybrid scenarios have mostly focused on the lower level of Michon's (1985) hierarchy, the physical operation of the vehicle. However, a broader perspective on vehicle control can also address the higher-level decisions concerning driving as a fulfilment of personal goals. Boeglin (2015: 178), for example, compares possibilities for "*discretionary vehicles*, which would grant individuals maximum discretion over when, where, why, and how their vehicles drive, and *nondiscretionary vehicles*, which would assume almost all operational autonomy from the human driver." For example, will AVs allow their users to select a route, as users of GPS systems can? A different example of discretion is an "ethical knob," (Contissa et al., 2017). This input device would allow users to decide whether the AV should give preference to third parties or to its own passengers in the event of a collision, transferring some degree of both control and responsibility from the vehicle designer to its user. We could similarly consider an AV that allows users to choose an "aggressive" or "defensive" mode governing how it interacts with traffic.

With such examples, AVs can illustrate the idea of "meaningful human control," a concept from the study of human-machine interaction. According to Mecacci and Santoni de Sio (2020), one criterion for meaningful human control over a system is its responsiveness to human

motivation and reasoning. They examine aspects of driving control in partially automated vehicles to reveal potential gaps in accountability between driver intention and the car's action. Such perspectives helps us to see the "trolley problem" scenarios more holistically as taking place within interconnected systems of people, machines, software, and infrastructure, rather than problems in which responsibility must be assigned to an individual agent (Bissell, 2018; Liu, 2017). Clearly the capacity act and the responsibility for action go together in questions of moral accountability, but autonomy expands the scope of this relationship to a broader capacity for the realization and expression of the self. Few would argue that the car is the most important site for such expression, but some have shown that it is one (Basmajian, 2010; Toiskallio, 2002). Even car passengers, the so-called "back-seat drivers," have some expressive influence on driving (Laurier et al., 2008). The control of the user in AVs is unlikely to be entirely eliminated any time soon, but many questions remain about the ways that personal identity might be enacted in the reconfigurations of human-vehicular interface.

Sharing rides

Speculation about the transformative impacts of AVs on urban mobility frequently assume that AVs will not be privately owned by individuals for their own use, as the vast majority of cars are today, but will instead be managed in shared fleets. In the dynamic ride-sharing (DRS) scneario, travelers would take some portion of their trip in the AV together with another passenger with a similar origin or destination, essentially as an automatically operated carpool. Some form of ridesharing is likely necessary to avoid AVs causing an increase in VMT (Levin et al., 2017), and simulations of DRS have shown potential for more efficient travel (Chen et al., 2016; Fagnant and Kockelman, 2018). Such simulations model what is theoretically possible given a region's travel demand patterns, but they cannot tell us whether traveler preferences and

behavior will actually allow a widespread transition from solo travel to DRS. While some stated preference surveys show support for the assumption that travelers will be willing to share rides (Gurumurthy and Kockelman, 2020; Stoiber et al., 2019), others find more uncertainty (Clayton et al., 2020; Pakusch et al., 2018).

Two primary obstacles to ridesharing are, first, the increased trip time associated with waiting for a shared vehicle and making additional stops for other passengers, and second, the discomfort of riding with strangers (Krueger et al., 2016; Lavieri et al., 2017). In each of these, we can see the ways that individual desires for senses of freedom and control might discourage AV ridesharing, as has already been shown in studies of carpooling (Correia and Viegas, 2011). Enjoying the capacity to move at a time of one's choosing while avoiding the impositions of other people are among the individualistic freedoms that have been at the heart of the automobile's success. While this might suggest that ridesharing AVs ought to be avoided if personal autonomy is the goal, a closer look at autonomy complicates the picture. First, more vehicles, as would be expected without DRS, have the cumulative effect of decreasing mobility in the system even as individuals pursue greater freedom (Sager, 2006). Less obviously, the perspective of relational autonomy might challenge the idea that the highest level of personal fulfilment is experienced alone in a car, rather than in negotiating one's identity with fellow passenger in the back seat. Simply identifying autonomy as a value worth considering does not tell AV manufacturers, regulators, or passengers what configurations can support that autonomy. It simply raises an initial question: what do we *want* personal autonomy to look like in the context of mobility?

5. Conclusion

In a recent magazine profile, John Zimmer, whose company Lyft is developing driverless

technology, was asked whether a driverless car could work without a defined destination:

> [Interviewer:] Say you're driving around your neighborhood searching for your lost dog, or you just got dumped and you want to drive through the countryside and clear your head and contemplate the nature of love. How does your driverless car get you around?
> [Zimmer:] In that case I think you'd have to have, like, contemplation mode and lost-dog mode, and I guess those haven't been thought about yet. Now I'll contemplate them. (Amira, 2018)

When the car is seen as simply a means of moving a person from origin to destination, the personal implications of replacing that car's human operator with an artificial driver seem minimal. Yet despite the dominance of this instrumental view in transportation planning, researchers remind us that people often get in the car not to merely arrive somewhere, but because "that travel is the activity, movement is the object, and a destination… is to varying degrees incidental" (Mokhtarian and Salomon, 2001: 697). Driving has also been shown to be a means of expressing identity, exercising independence, feeling power, and seeking thrills. In 1968, Lefebvre lamented modern society's hyper-organization and control but claimed that "the motor-car with its retinue of wounded and dead, its trail of blood, is all that remains of adventure in everyday life, its paltry ration of excitement and hazard" (Lefebvre, 1984: 101). What will AVs mean for adventure and hazard, for independence and expression, for Sunday drives in the countryside?

This article has not set out to answer these questions. Instead, it has proposed the idea of autonomy as a productive and underutilized analytical lens for understanding such social and personal dimensions of mobility with automated technologies. The conceptualization of autonomy introduced here has drawn selectively from an extensive literature to highlight a few salient themes. These include an intrapersonal process of reflection on the particular values and

desires of the self, the capacity to act on those drives, and the constitution of these activities within the subject's social relations. Studies of affect in transportation have already demonstrated how thoroughly these dimensions of autonomy are embedded within the technological artifacts and infrastructures of automobility. Some of these have also shown that personal autonomy is not only an explainer of transportation behaviour, it can also be a positive mobility outcome. In arguing for autonomy as a normative value, this article has introduced Castoriadis's argument that autonomy is a necessary condition for people to collectively escape institutions of control. In a less overtly political register, feminist theorists have argued for the necessity of autonomy for personal fulfilment. Although these qualities touch on themes common to many discussions of autonomy, there are of course alternative articulations of this broad ideal that will prove more productive for given situations.

To be clear, an argument for personal autonomy in urban mobility is not the same as an argument for driving and against AVs. As they take over certain operational functions, AVs may as well be experienced as enhancing travelers' autonomy by allowing for expanded possibilities and greater discretion in different senses of mobility (Kellerman, 2018). The experience of autonomy in human-driven cars, which can be both freeing and constraining (Sager, 2006), illustrates the difficulty of simply labelling any technology "good" or "bad" for autonomy. Similarly, the popular notion that as vehicles become more autonomous people will lose their autonomy in equal measure is misguided. Autonomy is not zero-sum; it is complex and relational product emerging from particular arrangements and interactions of individuals, societies, and technologies.

The ways we move through the city are closely tied to both who we imagine ourselves to be and how we relate to one another. As Mimi Sheller (2004: 221) put it in her examination of

automotive emotions, "[c]ars are above all machines that move people, but they do so in many senses of the word." More and more, AVs will also move us, and they will do so in different ways than cars do now. This paper has focused on autonomy at the scale of the individual traveler as a contrast to the autonomy of vehicles. As a final thought, in an echo of Castoriadis, consider also that society, collectively, has autonomy in its relation with technologies. In discussions of AV "impacts" on society, the question of "when" seems to come up more frequently than "why" or "how." But this determinist language of inevitability deprives us of our agency to direct technologies to reflect our goals, values, and identities. If the autonomy of people is an ideal worth pursing, then we can develop our mobility technologies, including AVs, towards that end. As the people of the city, we collectively have the power to shape it according to our own laws.

References

D. Amira, "John Zimmer Would Rather Die Than Take an Uber," *The New York Times* May 15, 2018.

J. Anable and B. Gatersleben, "All work and no play? The role of instrumental and affective factors in work and leisure journeys by different travel modes," *Transportation Research Part A: Policy and Practice* 39: 2–3 (2005) 163–181.

J. Anderson and A. Honneth, "Autonomy, vulnerability, recognition, and justice," in J.P. Christman and J. Anderson, eds., *Autonomy and the challenges of liberalism: new essays* (Cambridge, UK ; New York: Cambridge University Press, 2005).

K.W. Axhausen and T. Gärling, "Activity-based approaches to travel analysis: conceptual frameworks, models, and research problems," *Transport Reviews* 12: 4 (1992) 323–341.

C. Basmajian, "'Turn on the radio, bust out a song': the experience of driving to work," *Transportation* 37: 1 (2010) 59–84.

K. Baynes, "Freedom as Autonomy," in M. Rosen and B. Leiter, eds., *The Oxford Handbook of Continental Philosophy* (Oxford: Oxford University Press, 2007).

A.L.C. Bazzan, F. Klügl, and S. Ossowski, “Agents in traffic and transportation: Exploring autonomy in logistics, management, simulation, and cooperative driving,” *Transportation Research Part C: Emerging Technologies* 13: 4 (2005) 251–254.

D. Bissell, “Automation interrupted: How autonomous vehicle accidents transform the material politics of automation,” *Political Geography* 65 (2018) 57–66.

D. Bissell, T. Birtchnell, A. Elliott, and E.L. Hsu, “Autonomous automobilities: The social impacts of driverless vehicles,” *Current Sociology* 68: 1 (2020) 116–134.

M.G. Boarnet, “A Broader Context for Land Use and Travel Behavior, and a Research Agenda,” *Journal of the American Planning Association* 77: 3 (2011) 197–213.

J. Boeglin, “The Costs of Self-Driving Cars: Reconciling Freedom and Privacy with Tort Liability in Autonomous Vehicle Regulation,” *Yale Journal of Law and Technology* 17: 1 (2015) 171–203.

J.-F. Bonnefon, A. Shariff, and I. Rahwan, “The social dilemma of autonomous vehicles,” *Science* 352: 6293 (2016) 1573–1576.

B. Brown and E. Laurier, “The Trouble with Autopilots: Assisted and Autonomous Driving on the Social Road,” in (ACM Press, 2017).

L. Campbell, “Kant, autonomy and bioethics,” *Ethics, Medicine and Public Health* 3: 3 (2017) 381–392.

C. Castoriadis, “Marxism and revolutionary theory (1964-1965): Excerpts,” in *The Castoriadis reader* ,Blackwell readers (Oxford ; Cambridge, Mass: Blackwell Publishers, 1997a).

C. Castoriadis, “The logic of magmas and the question of autonomy,” in *The Castoriadis reader* ,Blackwell readers (Oxford ; Cambridge, Mass: Blackwell Publishers, 1997b).

M. de Certeau, *The practice of everyday life* (Berkeley: University of California Press, 1984).

T.D. Chen, K.M. Kockelman, and J.P. Hanna, “Operations of a shared, autonomous, electric vehicle fleet: Implications of vehicle & charging infrastructure decisions,” *Transportation Research Part A: Policy and Practice* 94 (2016) 243–254.

W. Clayton, D. Paddeu, G. Parkhurst, and J. Parkin, “Autonomous vehicles: who will use them, and will they share?,” *Transportation Planning and Technology* 43: 4 (2020) 343–364.

J.E. Cohen, *Configuring the networked self: law, code, and the play of everyday practice* (New Haven [Conn.]: Yale University Press, 2012).

T. Cohen, J. Stilgoe, and C. Cavoli, “Reframing the governance of automotive automation: insights from UK stakeholder workshops,” *Journal of Responsible Innovation* 5: 3 (2018) 257–279.

D. Collingridge, *The social control of technology* (London: Frances Pinter, 1980).

G. Contissa, F. Lagioia, and G. Sartor, “The Ethical Knob: ethically-customisable automated vehicles and the law,” *Artificial Intelligence and Law* 25: 3 (2017) 365–378.

G. Correia and J.M. Viegas, “Carpooling and carpool clubs: Clarifying concepts and assessing value enhancement possibilities through a Stated Preference web survey in Lisbon, Portugal,” *Transportation Research Part A: Policy and Practice* 45: 2 (2011) 81–90.

F. Duarte and C. Ratti, “The Impact of Autonomous Vehicles on Cities: A Review,” *Journal of Urban Technology* 25: 4 (2018) 3–18.

G. Dworkin, *The theory and practice of autonomy* ,Cambridge studies in philosophy (Cambridge ; New York: Cambridge University Press, 1988).

A. Ellaway, S. Macintyre, R. Hiscock, and A. Kearns, “In the driving seat: psychosocial benefits from private motor vehicle transport compared to public transport,” *Transportation Research Part F: Traffic Psychology and Behaviour* 6: 3 (2003) 217–231.

V. Eubanks, *Automating inequality: how high-tech tools profile, police, and punish the poor* (First edition.) (New York, NY: StMartin’s Press, 2018).

D.J. Fagnant and K. Kockelman, “Preparing a nation for autonomous vehicles: opportunities, barriers and policy recommendations,” *Transportation Research Part A: Policy and Practice* 77 (2015) 167–181.

D.J. Fagnant and K.M. Kockelman, “Dynamic ride-sharing and fleet sizing for a system of shared autonomous vehicles in Austin, Texas,” *Transportation* 45: 1 (2018) 143–158.

J. Fleetwood, “Public Health, Ethics, and Autonomous Vehicles,” *American Journal of Public Health* 107: 4 (2017) 532–537.

E. Fraedrich, D. Heinrichs, F.J. Bahamonde-Birke, and R. Cyganski, “Autonomous driving, the built environment and policy implications,” *Transportation Research Part A: Policy and Practice* 122 (2019) 162–172.

H.G. Frankfurt, *The importance of what we care about: philosophical essays* (Cambridge [England] ; New York: Cambridge University Press, 1988).

P.E.S. Freund and G.T. Martin, *The ecology of the automobile* (Montréal ; New York: Black Rose Books, 1993).

M. Friedman, "Autonomy and Social Relationships: Rethinking the Feminist Critique," in *Autonomy, gender, politics* ,Studies in feminist philosophy (Oxford ; New York: Oxford University Press, 2003).

B. Gardner and C. Abraham, "What drives car use? A grounded theory analysis of commuters' reasons for driving," *Transportation Research Part F: Traffic Psychology and Behaviour* 10: 3 (2007) 187–200.

C. Gilligan, *In a different voice: psychological theory and women's development* (Cambridge, Mass.: Harvard University Press, 1993).

R. Golledge and T. Gärling, "Spatial Behavior in Transportation Modeling and Planning," in K. Goulias, ed., *Transportation Systems Planning* ,New Directions in Civil Engineering (CRC Press, 2002).

K.M. Gurumurthy and K.M. Kockelman, "Modeling Americans' autonomous vehicle preferences: A focus on dynamic ride-sharing, privacy & long-distance mode choices," *Technological Forecasting and Social Change* 150 (2020) 119792.

P. Haddington, "Movement in action: Initiating social navigation in cars," *Semiotica* 2012: 191 (2012) 137–167.

D.J. Haraway, "A cyborg manifesto: Science, technology, and socialist-feminism in the late twentieth century," in *Simians, cyborgs, and women: the reinvention of nature* (New York: Routledge, 1991).

M. Hatakka, E. Keskinen, N.P. Gregersen, A. Glad, and K. Hernetkoski, "From control of the vehicle to personal self-control; broadening the perspectives to driver education," *Transportation Research Part F: Traffic Psychology and Behaviour* 5: 3 (2002) 201–215.

R. Hiscock, S. Macintyre, A. Kearns, and A. Ellaway, "Means of transport and ontological security: Do cars provide psycho-social bene®ts to their users?," (2002) 17.

S.L. Hoagland, *Lesbian ethics: toward new value* (1st ed.) (Palo Alto, Calif.: Institute of Lesbian Studies, 1988).

L.D. Introna, "The Enframing of Code: Agency, Originality and the Plagiarist," *Theory, Culture & Society* 28: 6 (2011) 113–141.

M. Jensen, “Passion and heart in transport — a sociological analysis on transport behaviour,” *Transport Policy* 6: 1 (1999) 19–33.

O. Juhlin, “Traffic behavior as social interaction - Implications for the design of artificial drivers.,” in *The social production of technology: On the everyday life of things* (Goteburg, Sweden: BAS, 2001).

I. Kant, *Religion within the limits of reason alone* ,Harper torchbooks, 67 (New York: Harper & Row, 1960).

I. Kant, *Groundwork of the metaphysics of morals* ,Cambridge texts in the history of philosophy (Cambridge, U.K. ; New York: Cambridge University Press, 1998).

J. Katz, *How emotions work* (Chicago: University of Chicago Press, 1999).

A. Kellerman, *Automated and autonomous spatial mobilities* ,Transport, mobilities and spatial change (Cheltenham, UK ; Northampton, MA, USA: Edward Elgar Publishing, 2018).

E. Keskinen, “Why do young drivers have more accidents? Junge Fahrer und Fahrerinnen,” in *Referate der Ersten Interdiziplinaren Fachkonferenz, December 12-14, 1994 in Koln* (Berichte der Bundesanstalt fur Strassenwesen, Mensh und Sicherheit, 1996).

R. Krueger, T.H. Rashidi, and J.M. Rose, “Preferences for shared autonomous vehicles,” *Transportation Research Part C: Emerging Technologies* 69 (2016) 343–355.

S. Laapotti, E. Keskinen, M. Hatakka, and A. Katila, “Novice drivers’ accidents and violations — a failure on higher or lower hierarchical levels of driving behaviour,” *Accident Analysis & Prevention* 33: 6 (2001) 759–769.

A. Latham and M. Nattrass, “Autonomous vehicles, car-dominated environments, and cycling: Using an ethnography of infrastructure to reflect on the prospects of a new transportation technology,” *Journal of Transport Geography* 81 (2019) 102539.

B. Latour, “Technology is Society Made Durable,” *The Sociological Review* 38: 1_suppl (1990) 103–131.

E. Laurier, B. Brown, and H. Lorimer, “What it means to change lanes: Actions, emotions and wayfinding in the family car,” *Semiotica* 191: 1–4 (2012) 117–135.

E. Laurier, H. Lorimer, B. Brown, O. Jones, O. Juhlin, A. Noble, M. Perry, D. Pica, P. Sormani, I. Strebel, L. Swan, A.S. Taylor, L. Watts, and A. Weilenmann, “Driving and ‘Passengering’: Notes on the Ordinary Organization of Car Travel,” *Mobilities* 3: 1 (2008) 1–23.

P.S. Lavieri, V.M. Garikapati, C.R. Bhat, R.M. Pendyala, S. Astroza, and F.F. Dias, “Modeling Individual Preferences for Ownership and Sharing of Autonomous Vehicle Technologies,” *Transportation Research Record: Journal of the Transportation Research Board* 2665: 1 (2017) 1–10.

R. Leenes and F. Lucivero, “Laws on Robots, Laws by Robots, Laws in Robots: Regulating Robot Behaviour by Design,” *Law, Innovation and Technology* 6: 2 (2014) 193–220.

H. Lefebvre, *Everyday life in the modern world* ,Communications series (New Brunswick, N.J.) (New Brunswick, N.J., U.S.A.: Transaction Books, 1984).

H. Lefebvre, *Writings on cities* , trans. E. Kofman and E. Lebas (Cambridge, Mass, USA: Blackwell Publishers, 1996).

A. Leszczynski, “Glitchy vignettes of platform urbanism,” *Environment and Planning D: Society and Space* (2019) 026377581987872.

M.W. Levin, K.M. Kockelman, S.D. Boyles, and T. Li, “A general framework for modeling shared autonomous vehicles with dynamic network-loading and dynamic ride-sharing application,” *Computers, Environment and Urban Systems* 64 (2017) 373–383.

T. Litman, *Autonomous vehicle implementation predictions: Implications for transport planning* (Victoria Transportation Policy Institute, 2019).

H.-Y. Liu, “Irresponsibilities, inequalities and injustice for autonomous vehicles,” *Ethics and Information Technology* 19: 3 (2017) 193–207.

C. Luetge, “The German Ethics Code for Automated and Connected Driving,” *Philosophy & Technology* 30: 4 (2017) 547–558.

C. Mackenzie, “Three dimensions of autonomy: A relational analysis,” in A. Veltman and M. Piper, eds., *Autonomy, oppression, and gender* ,Studies in feminist philosophy (Oxford ; New York: Oxford University Press, 2014).

E. Mann and C. Abraham, “The role of affect in UK commuters’ travel mode choices: An interpretative phenomenological analysis,” *British Journal of Psychology* 97: 2 (2006) 155–176.

G. Mecacci and F. Santoni de Sio, “Meaningful human control as reason-responsiveness: the case of dual-mode vehicles,” *Ethics and Information Technology* 22: 2 (2020) 103–115.

J.A. Michon, “A Critical View of Driver Behavior Models: What Do We Know, What Should We Do?,” in L. Evans and R.C. Schwing, eds., *Human Behavior and Traffic Safety* (Boston, MA: Springer US, 1985).

D. Milakis, B. van Arem, and B. van Wee, “Policy and society related implications of automated driving: A review of literature and directions for future research,” *Journal of Intelligent Transportation Systems* 21: 4 (2017) 324–348.

P.L. Mokhtarian and I. Salomon, “How derived is the demand for travel? Some conceptual and measurement considerations,” *Transportation Research Part A: Policy and Practice* 35: 8 (2001) 695–719.

J. Nedelsky, “Reconceiving autonomy: sources, thoughts and possibilities,” *Yale Journal of Law and Feminism* 1: 1 (1989) 7–36.

M. Oshana, *Personal autonomy in society* (Aldershot, England ; Burlington, VT: Ashgate, 2006).

M. Oshana, “Autonomy and the Question of Authenticity,” *Social Theory and Practice* 33: 3 (2007) 411–429.

C. Pakusch, G. Stevens, A. Boden, and P. Bossauer, “Unintended Effects of Autonomous Driving: A Study on Mobility Preferences in the Future,” *Sustainability* 10: 7 (2018) 2404.

H. Prakken, “On the problem of making autonomous vehicles conform to traffic law,” *Artificial Intelligence and Law* 25: 3 (2017) 341–363.

J. Raz, *The morality of freedom* (Oxford [Oxfordshire] : New York: Clarendon Press ; Oxford University Press, 1986).

G. Rose, “Posthuman Agency in the Digitally Mediated City: Exteriorization, Individuation, Reinvention,” *Annals of the American Association of Geographers* 107: 4 (2017) 779–793.

SAE International, “Taxonomy and definitions for terms related to on-road motor vehicle automated driving systems (J3016_201401),” (2014).

T. Sager, “Freedom as Mobility: Implications of the Distinction between Actual and Potential Travelling,” *Mobilities* 1: 3 (2006) 465–488.

B. Schoettle and M. Sivak, *Motorists’ preferences for different levels of vehicle automation* (University of Michigan Sustainable Worldwide Transportation, 2016).

M. Sheller, “Automotive Emotions: Feeling the Car,” *Theory, Culture & Society* 21: 4–5 (2004) 221–242.

M. Sheller and J. Urry, “The City and the Car,” (2000) 21.

A. Smith and M. Anderson, *Americans’ views on driverless vehicles* (Pew Research Center, 2017) <https://www.pewinternet.org/2017/10/04/americans-attitudes-toward-driverless-vehicles/> Accessed August 14, 2019.

E. Stayton, M. Cefkin, and J. Zhang, “Autonomous Individuals in Autonomous Vehicles: The Multiple Autonomies of Self-Driving Cars,” *Ethnographic Praxis in Industry Conference Proceedings* 2017: 1 (2017) 92–110.

L. Steg, “Car use: lust and must. Instrumental, symbolic and affective motives for car use,” *Transportation Research Part A: Policy and Practice* 39: 2–3 (2005) 147–162.

L. Steg, C. Vlek, and G. Slotegraaf, “Instrumental-reasoned and symbolic-affective motives for using a motor car,” (2001) 19.

T. Stoiber, I. Schubert, R. Hoerler, and P. Burger, “Will consumers prefer shared and pooled-use autonomous vehicles? A stated choice experiment with Swiss households,” *Transportation Research Part D: Transport and Environment* ,The roles of users in low-carbon transport innovations: Electrified, automated, and shared mobility 71 (2019) 265–282.

N. Stoljar, “Feminist Perspectives on Autonomy,” in E.N. Zalta, ed., *The Stanford Encyclopedia of Philosophy* (Winter 2018) (Metaphysics Research Lab, Stanford University, 2018).

S.G. Stradling, M.L. Meadows, and S. Beatty, “Identity and Independence: Two Dimensions of Driver Autonomy,” in presented at the *BEHAVIOURAL RESEARCH IN ROAD SAFETY: PROCEEDINGS OF THE 10TH SEMINAR ON BEHAVIOURAL RESEARCH IN ROAD SAFETY, 3-5 APRIL 2000* (2001).

L.A. Suchman, *Human-machine reconfigurations: Plans and situated actions* (2nd ed.) (Cambridge ; New York: Cambridge University Press, 2007).

H. Surden and M.-A. Williams, “Technological opacity, predictability, and self-driving cars,” *Cardozo Law Review* 38: 1 (2016) 121–181.

C. Taylor, *The ethics of authenticity* ,Massey lectures series (Cambridge, Mass.: Harvard University Press, 1992).

N. Thrift, “Driving in the City,” *Theory, Culture & Society* 21: 4–5 (2004) 41–59.

N. Thrift and S. French, “The automatic production of space,” *Transactions of the Institute of British Geographers* 27: 3 (2002) 309–335.

K. Tingley, “How to Make Cars Cooperate,” *The New York Times Magazine* November 9, 2017.

K. Toiskallio, “The Impersonal Flâneur: Navigation Styles of Social Agents in Urban Traffic,” *Space and Culture* 5: 2 (2002) 169–184.

A. Veltman and M. Piper, eds., *Autonomy, oppression, and gender* ,Studies in feminist philosophy (Oxford ; New York: Oxford University Press, 2014).

D. Vrščaj, S. Nyholm, and G.P.J. Verbong, “Is tomorrow’s car appealing today? Ethical issues and user attitudes beyond automation,” *AI & society* (2020).

D. Watzenig and M. Horn, *Automated Driving: Safer and More Efficient Future Driving* (Cham: Springer International Publishing, 2017).

I.M. Young, *Justice and the politics of difference* (Paperback reissue / with a new forword by Danielle Allen.) (Princeton, N.J.: Princeton University Press, 2011).