



Exploring equity: How equity norms have been applied implicitly and explicitly in transportation research and practice



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ABSTRACT

By definition, equity is concerned with justice. On a societal level, equity is concerned with the just distribution of resources in society. Because a wide range of theories of just distribution exist, equity considerations are multifaceted and create a normative conceptual space in which theories can be considered, argued, and applied. In the past few decades, the concept of equity has received increasing attention within the transportation literature, both within academic journals and practice-oriented books and reports. These works present various theories of justice, either implicitly or explicitly, within the context of transportation financing, investments, and service allocations. While explicit normative reviews as well as arguments have been presented, implicit applications and imprecise definitions of equity theories have largely obfuscated and oversimplified this expansive topic. Within a predominantly western, US and euro-centric context, this article uses concepts and theories from the fields of social psychology, philosophy, and economics to understand and clarify the concept of equity within the field of transportation.

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1. Introduction

Interest in equity within the transportation profession has exploded in the past few decades. While the delivery of equitable transportation systems has been presented as an ideal by many, few have managed to articulate what equity *is*, let alone how to functionally achieve it within a transportation setting. This conceptual confusion stems from the fact that equity is a wide-reaching concept rooted in the study of ethics and morality. In the introductory article of a special issue on Equity in Transport, Di Ciommo and Shifan (2017) note that moral debate “is inevitable—although mostly invisible—in transport project appraisal” (p. 148). In other words, ethics have always been at play in transportation, but the explicit consideration of ethics through the lens of equity has only become mainstream within the past few decades. Moreover, it is difficult to engage in a moral debate when you do not realize there is a debate to be had, i.e. when morals in transportation remain “mostly invisible”. Even with the realization that there is a debate to be had, it is difficult to engage effectively in that debate without an understanding of relevant concepts.

Accordingly, the primary goal of this paper is to provide transportation researchers and practitioners a broad, common base of understanding of the concept of equity, particularly the different types of theories that fall under the umbrella term of equity. Section 2 introduces key concepts for the paper such as how the concepts of equity, justice, and fairness relate to one another. Additionally, the distinction between positive and normative analyses within the field of economics – and how it parallels the difference between distributional effects and equity analyses – is discussed. Section 3 presents fundamental theories of equity and the key distinctions among them. The theories presented in this section are informed by – and support the analysis of – the transportation literature found in Section 4. Because the literature considered was largely generated by US- and Euro-centric authors, the theories presented in Section 3 are from predominantly western European thinkers.

It is important to note that each of the theories presented in Section 3 is the subject of entire bodies of literature spanning centuries of thought and debate. Readers familiar with the study of philosophy or welfare economics will likely command a deeper understanding of many (if not all) of these theories than what is presented in this article. The goal of Section 3 is not to capture the full depth and breadth of these theories; the goal is to present a brief explanation of core theoretical tenets and underlying assumptions to highlight differences and similarities between them.

Section 4 builds on the concepts and theories presented in Sections 2 and 3 to explore the often piecemeal and occasionally contradictory ways in which various theories of equity have been presented and used, both explicitly and implicitly, within the transportation literature. The goal of this section is to alleviate conceptual confusion by highlighting differences and contradictions in order to clarify them. It is not a comprehensive review of transportation equity literature but rather a sample of existing resources available to anyone seeking equity definitions within the transportation literature. Primary sources (journal articles) as well as derivative works (reports and books) are included in this analysis to capture the range of resources considered by academics as well as practitioners. Section 5 concludes the article with recommendations for best practices.

2. Key concepts

This section introduces concepts fundamental to understanding how equity has been discussed and operationalized, both implicitly and explicitly, in transportation. Section 2.1 explains why equity is such a difficult concept to define concisely, let alone operationalize, and Section 2.2 provides clarifying terminology and associated concepts. The goal of this section is to provide readers with precise definitions of terms that are used throughout the remainder of the paper.

2.1. The conceptual space created by equity

While the word equity can be used with regard to monetary valuations of property, the primary dictionary definition states that equity is “justice according to natural law or right specifically: freedom from bias or favoritism” (“Equity | Definition of Equity by Merriam-Webster,” 2019).

Modern transportation discussions surrounding equity mostly evoke this primary, justice-oriented definition. While this single-sentence definition may appear simple and straightforward, to understand (let alone operationalize) the concept of equity, one must first understand the concept of justice. The book *Perspectives on Social Justice: From Hume to Walzer* consider the contributions of primary western philosophers. They discuss Pareto’s assessment that, because different individuals can hold different value systems and therefore competing claims of justice, this “essential contestability ... renders [the concept of justice] meaningless” (Boucher and Kelly, 1998, p. 78). In response, Boucher and Kelly (1998) explain that:

“At the highest level of abstraction, the definition of justice is uncontroversial: i.e. giving each person his due, in conformity with proper principles and procedures. Exactly what these principles and procedures should be is open to conflicting interpretations, however. ‘Empty’ rather than ‘meaningless’ would seem to be a more accurate way of describing the concept. Given that nature abhors a vacuum, it would be futile to expect people to refrain from ‘filling’ this emptiness with their subjective feelings and values (‘intuitions’)” (pp. 78–79)

By extension, equity can be viewed as an empty concept that must be filled. Put another way, when authors use the term ‘equity’, they generate a conceptual, normative space. Authors then fill this space either explicitly with clearly defined arguments or implicitly with whatever idea of justice intuitively comes to mind. Equity within the field of transportation has essentially created a normative space that many positively-trained researchers and practitioners rushed to fill, often implicitly.

2.2. Positive is to normative as distributional effects is to equity

The distinction between positive and normative analyses was first proposed by Robbins (1984) relative to the study of economics. Robbins (1984) distinguishes between assessments of the world as it *is* (positive) vs. the world as it *ought to be* (normative). Positive analyses provide powerful, consistent methods to understand the world around us; once a positive analysis is framed and the logic is established, the execution of that logic requires computation, not thought (Chu-Carroll, 2013, pt. IV). Proponents of positive economic analytical methods cheekily refer to this as “Mindless Economics” and argue that only positive economic analyses produce results that are objective enough to be called Economics (Caplin and Schotter, 2008, pt. I). They argue that these fixed, axiomatic interactions analyzing individual’s revealed preferences of demand through monetary valuations represent objective, irrefutable, neutral truth. For example, Pareto’s opinion of justice as a “meaningless” concept follows a positive line of reasoning (Boucher and Kelly, 1998, p. 78).

However, as proponents of “mindful” (normative) economics point out, both normative and positive, non-economic fields of inquiry add value and are necessary to frame positive analyses with intention (Caplin and Schotter, 2008, pt. II). Beyond problem framing, normative understandings help determine what is to be done with the knowledge produced by positive methods. As Robbins states, “[t]here is nothing in [positive] economics which relieves us of the obligation to choose” (Robbins, 1984, p. 152). This relationship is presented in Fig. 2.1.

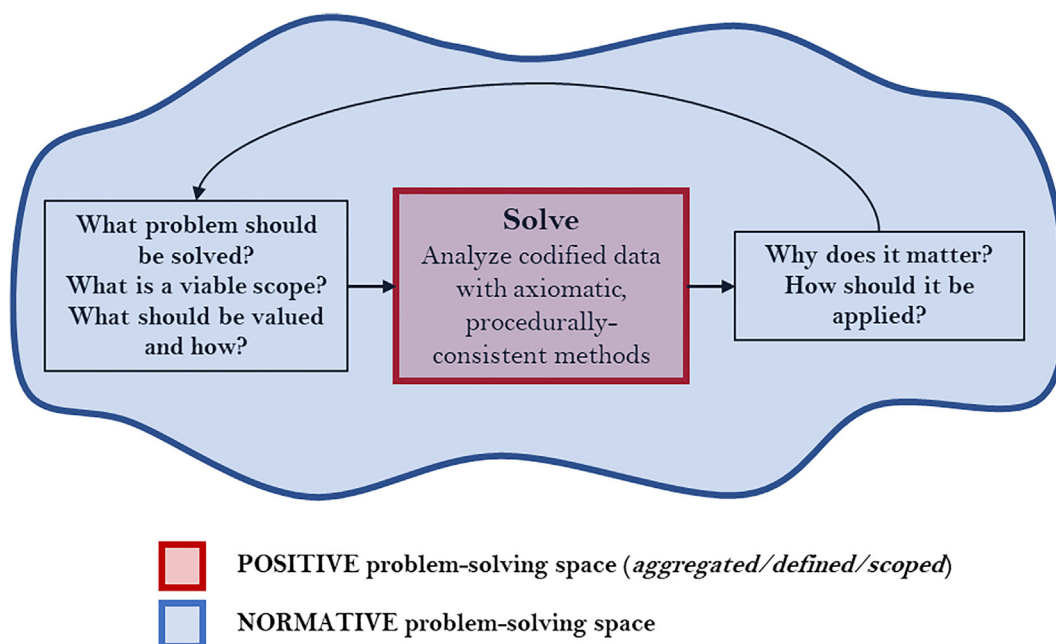


Fig. 2.1. The relationship between positive and normative fields of inquiry.

The distinction between positive vs. normative analyses that Robbins first identified within the field of economics over a century ago serves as a helpful guide to understanding the confusion over the concept of equity within transportation today; rather than asking purely positive questions of revealed preference travel data, more and more transportation researchers and practitioners now also ask logical questions of stated preference data (how transportation *could* function) as well as normative questions (how transportation *ought to* function).

The use of the terms 'equity' or 'justice' suggest a normative value judgement because these concepts are inherently normative. Many authors, however, simply present how transportation *does* or *could* function, typically employing distributional effects analyses to do so. Rather than explicitly stating a normative interest, these studies imply a normative perspective within the methods used and the recommendations given. In contrast, studies that explicitly comment on how transportation *ought to* function make this normative valuation explicit. While not an exact comparison (some assessments of how transportation *is* do not necessarily employ distributional effects analyses and many distributional effects analyses consider how transportation *could be* rather than simply what *is*), this means that distributional effects are to equity as positive is to normative.

Example cases are presented in Section 4, but to provide a brief illustration of this point, consider a (theoretical) shared bicycle fleet. A positive distributional effects analysis would simply present the facts of the fleet and its utilization. For example, bikes are often concentrated in neighborhoods X, Y, and Z whose populations fit the socio-economic categories of m, n, and o. A distributional effects analysis of that fleet with an implied normative perspective might say that, if fleets were re-balanced, they could improve general accessibility of {all citizens; citizens in neighborhoods X, Y, and Z; citizens in neighborhoods U, V, and W, etc.} – depending on who the author proposed to improve accessibility for, a normative value judgement is implied. In contrast, an equity analysis would make an explicit value judgement and propose a distribution to meet that goal. For example, bikes should be rebalanced so that all citizens have equal access to them OR (though not necessarily mutually exclusively), because citizens in neighborhoods U, V, and W currently have inferior access to bikes, therefore bikes should be rebalanced to better serve citizens in neighborhoods U, V, and W.

While distributional effects analyses are a necessary component, they constitute only part of an informed, intentional equity assessment; on their own, they simply state facts but do not engage in normative thought and are therefore not equity analyses in and of themselves. Although they go beyond merely characterizing the present state, distributional effects analyses that project what *could* happen imply and obfuscate normative ideologies. In contrast, intentional equity analyses explicitly present either multiple theories of equity and compare related, positive assessments against one another, or explicitly argue for the use of a particular theory of equity and use it to propose a just distribution according to that theory. This means that a single, positive 'answer to equity' is not possible because the concept of equity inherently denotes a normative space for discussion. Authors interested in performing equity analyses must understand this in order to fill this normative space explicitly rather than implicitly.

A command of positive findings and normative theories from tangential fields of inquiry provide useful framing to fill this conceptual space explicitly. Positive analyses of human behavior are studied in the fields of psychology and sociology. The systematic, logical development of normative theories of resource distribution occur within the fields of philosophy and economics. These theories of justice establish logical rules to provide an adequate and fair accounting of competing claims to finite goods within society.

3. Filling the conceptual space of equity: Theories from related fields

This section presents theories from the fields of sociology, psychology, philosophy, and economics to frame and partially define the theory of equity. This section serves three main purposes: to orient a reader unfamiliar with theories of equity; to provide the precise, concise definitions necessary to complete the assessment presented in Section 4; and to demonstrate commonalities and differences between theories. This overview is by no means comprehensive in depth or breadth, but it does present the reader with concepts relevant to the analysis of transportation literature contained in Section 4. Because the literature considered was largely generated by US- and Euro-

centric authors, the theories presented are from predominantly western European thinkers.

3.1. Egalitarianism and equality

Similar to equity, the terms equality and egalitarianism cover a wide range of concepts and theories and are often oversimplified. “Egalitarianism is a trend of thought in political philosophy. An egalitarian favors equality of some sort: People should get the same, or be treated the same, or be treated as equals, in some respect” (Arneson, 2013). These terms are extremely broad and contested because two individuals may identify as egalitarians and argue in the name of equality but reach completely different conclusions depending on the type of equality each assumes.

To help differentiate between types of equality (and associated egalitarian thought), more precise terms exist. Aristotle identified two types of equality of treatment: numerical and proportional. Numerical equality (also known as simple equality) treats individuals as equal by “granting them the same quantity of a good per capita” (Gosepath, 2011, pt. 3.1). In contrast, proportional equality “treats all relevant persons in relation to their due” (Gosepath, 2011, pt. 2.2). Determining what someone is due is a separate exercise, but proportionality essentially accounts for the idea that some people deserve a greater share of resources, either because they are different in some way (ex: the difference in total caloric intake between an adult and a child) or because they have contributed to society in different ways (ex: the difference in income between a doctor and a sales clerk).

Formal and moral equality have also been defined. Under formal equality, if “two persons have equal status in at least one normatively relevant respect, they must be treated equally with regard to that respect” (Gosepath, 2011, pt. 2.1); putting this in terms of the doctor and sales clerk example, formal equality recognizes that it is just for sales clerks to be paid different wages relative to doctors, but demands that all doctors performing the same work be paid the same, and all sales clerks performing the same work be paid the same. Moral equality was introduced in the eighteenth century to establish the idea that all humans are created equal; up to this point, “it was assumed that human beings are unequal by nature – i.e., that there was a natural human hierarchy” (Gosepath, 2011, pt. 2.3). Moral equality is more concerned with dignity and respect than the details of resource distribution and may seem like an obvious, unspoken given to many contemporary readers. Indeed, moral equality serves as the foundation for all of the theories presented in this article.

3.2. Smith, libertarianism, Marx, and utilitarianism

In one application of moral and proportional equality, Adam Smith laid out the theory of supply and demand in his 1776 book *Wealth of Nations* (Fleischacker, 2020). Smith asserts that no formal evaluation of ‘normatively relevant respects’ is necessary to value goods or labor in society because, in a market allowed to operate freely, supply and demand will naturally interact until valuations at the equilibrium are reached. In other words, while sales clerks or doctors may perform similar roles compared to others within their group, some individual clerks or doctors may perform better than their counterparts and therefore earn higher pay. He also presents the user-fee paradigm in which he asserts that, if carriages pay for exactly the amount of roadway maintenance they generate based on their weight and distance traveled (i.e. a proportional amount), roadway funding would be inherently fair (Smith, 1789).

Informed in part by the theories of Smith, libertarianism is an ideology that has been developed by a wide range of thinkers in recent centuries. Libertarianism posits that “agents initially fully own themselves and have certain moral powers to acquire property rights in external things” (van der Vossen, 2019, pt. 1). Just, free acquisition of resources is key to libertarian theories which “conceive of distribu-

tive justice as largely (sometimes exclusively) historical in nature” and “reject theories that look merely at outcomes or end-state distributions” (van der Vossen, 2019, pt. 3). Libertarians focus on individual rights and processes and insist that “justice poses stringent limits to coercion. While people can be justifiably forced to do certain things (most obviously, to refrain from violating the rights of others) they cannot be coerced to serve the overall good of society, or even their own personal good” (van der Vossen, 2019, intro).

Because it is an ideology that has been developed by many over a long period of time, there is no single libertarian consensus regarding the exact limits of what individuals can be justifiably forced to do, with a spectrum of beliefs ranging from Left to Right (van der Vossen, 2019, pt. 4). Right-leaning libertarians have the strictest sense of individual liberty, believing that individuals, so long as they acquire resources in a just manner, have the right to use (or destroy) their property as they please and that external powers (such as a state) cannot force or coerce individuals in any way to pay for things such as military, police forces, or roadways. They believe that self-possessed individuals can, as necessary, organize and manage resources and services more effectively than what they perceive as otherwise coercive state forces.

Left-leaning libertarians believe that some level of protections for natural resources are necessary to maintain “equally valuable shares of natural resources for everyone” (van der Vossen, 2019, pt. 4). This assumes a simple equality baseline and dictates that those who “acquire more than their share (understood in terms of per capita value) owe compensation to others” (van der Vossen, 2019, pt. 4). In the name of natural resource preservation and improvement, some left-leaning libertarians also believe that “enforceable requirement to pay” can be justified for some state-like services (such as militaries, police forces, and roadways) (van der Vossen, 2019, pt. 5). Essentially, they believe that individuals can justifiably be forced to pay for public goods because “the provision of these public goods will increase the value of natural resources, making the taxed amounts a case of self-financing” (van der Vossen, 2019, pt. 5).

In contrast, utilitarianism focuses on the optimization of end-state resource distribution in whatever way maximizes the welfare of society as a whole, even if that means resources are only distributed to a few or the process of distribution infringes on the individual rights of others (Mill, 1895). Utilitarianism does not care about existing or previous states of society; it is only concerned with the maximization of whatever social outcome is deemed most important at that moment in time (Binmore, 1998). For a utilitarian, moral equality means that all individuals are given equal weight in the calculation of aggregate social welfare. Taken to its extreme, this means that no individual has the right to life if the taking of that individual’s life would lead to a maximized aggregate outcome.

Marxist ideologies share the libertarian interpretation of moral equality as a right to life, but the similarities largely end there. Originally published in 1875, Marx popularized the slogan “from each according to his ability, to each according to his needs” (Marx, 2008). He suggests that under individualist, capitalist systems, those in power tend to monopolize and hoard resources, and that the inevitable response to this is a popular uprising to establish state ownership and distribution of resources, beginning with a transitional, socialist state and eventually leading to a communist state. According to Marx, all individuals have an equal right to having their basic needs met, and societal resource distributions that do not accomplish this are unacceptable.

This highlights a fundamental distinction between process versus end-results equity (Tresch, 2014). Assuming equally self-possessed and free individuals engage in just resource acquisition, a Right-leaning libertarian would argue that any distribution of resources that resulted from free-market exchange would be fair. A Left-leaning libertarian would add constraints to avoid natural resource degradation and support minimalistic public resource management that bolsters this free-market exchange, however the over-arching emphasis on pro-

ness remains consistent. Because a libertarian is fundamentally concerned with process, any outcome is fair so long as the rules of the game were upheld. Under this theory of justice, decreases in collective, aggregate welfare are fair and just. This is in direct conflict with a utilitarian, end-results focus under which infringing on individual rights to life, liberty, property, and contract would be deemed fair and just if they resulted in a maximized, aggregate outcome.

3.3. Rawls, al-Sadr, sufficientarianism, and prioritarianism

Two of the most famous justice theorists of the 20th century, Muhammad Baqir al-Sadr and John Rawls, offer some balance between these dichotomies. al-Sadr builds on an extensive history of Islamic philosophical and economic thought to present a concept of equity that falls somewhere between Smith and Marx (Khan and Bhat, 2011). In his book *Iqtisaduna (Our Economy)*, al-Sadr advocates for principles of dual (individual and state) ownership of resources and constrained economic freedoms (al-Sadr, 1982). These are the necessary conditions he identifies to achieve a just society, because it must develop in a way that reduces the benefit gap and ultimately eradicates poverty. This conceptualization of equity is rooted in the Islamic belief that the poverty that exists in the world is inherently unjust and must be corrected. This theory also posits that wealth monopolies among the ultra-rich are harmful to those in possession of the riches as well as the poor to whom those riches should be distributed.

Similarly, Rawls's *A Theory of Justice* put forth the concept of 'justice as fairness' (Rawls, 1971). In (very) brief, Rawls assumes rational, self-interested actors (whose true position in society is hidden by a 'veil of ignorance') seeking to maximize their individual claims to the social primary goods of income and wealth. While every individual has an equal claim to basic liberties (the principle of greatest equal liberty), "[s]ocial and economic inequalities are to satisfy two conditions: first, they are to be attached to positions and offices open to all under conditions of fair equality of opportunity (the principle of fair equality of opportunity); and second, they are to be to the greatest benefit of the least-advantaged members of society (*the difference principle*)" (Martens, 2017, p. 66). The principle of fair equality of opportunity mirrors proportional equality, because beyond equal access to opportunity (defined as positions and offices), individuals should be compensated according to the proportional importance of their position and office i.e. a doctor should make more money than a sales clerk. The difference principle, however, is the conclusion most unique to Rawls in the western philosophical canon. As a result, references to Rawlsian equity tend to refer predominantly to the difference principle.

Sufficientarianism and prioritarianism are equity theories that, beyond the basic assumption of the moral equality of humans, are not egalitarian in nature. Sufficientarianism operates on "the observation that justice requires first and foremost the avoidance of misery" and seeks to establish a threshold of insufficiency to accomplish this (Martens, 2017, p. 170). Once established, it is assumed that above the threshold, goods are best distributed through free market exchange whereas below the threshold, goods are best distributed by the state. Prioritarianism "is based on the view that benefits matter more the more worse-off the person to whom the benefits accrue" (Martens, 2017, p. 171). Functionally, prioritarianism resembles sufficientarianism, but rather than drawing a single, hard-cut threshold to designate between a zone of need vs no specific need, it assumes a continuous curve of needs vs unit value of resource distribution. Neither necessarily speaks to the structure of society but both can serve as guiding principles when working from an assumed state of injustice towards a state of justice within society. For example, prioritarianism is implied by Marx, al-Sadr, and Rawls.

Notably, sufficientarian and prioritarian theories are distinct from egalitarian theories (Arneson, 2013; Holtug, 2017). Every theory

presented in this section assumes the equal value of human life (albeit in various ways) and can therefore be considered egalitarian in the broadest sense of moral equality. However, where egalitarian theories emphasize equality or balance in some way, sufficientarian and prioritarian theories focus on minimizing misery. They assume an imbalanced world and advocate for resource distributions that improve the lives of those who are already suffering from less resources (sufficientarianism) or from the standpoint of overall welfare (prioritarian); while this may move the world towards a more balanced, equal stasis, that is not the goal for a pure sufficientarian or a prioritarian.

The other theories assume a universal approach to the distribution of resources in society as a whole and are therefore not intended for disaggregate, partial application. Rawls himself stated that his theory of justice is only intended to be applied "to the basic structure of society" and "that the application of the difference principle as a single principle by itself leads to 'nonsense'" (Martens, 2017, p. 68). Moreover, these theories predominantly (if not exclusively) concern themselves with monetary resources; the difference principle is inherently designed to assess distributions of the basic goods of income and wealth. Holistic theories only retain their logical validity when applied universally; in other words, the component parts of an holistic theory such as Rawls's cannot logically be applied in isolation to any disaggregate component of society, and certainly not to a good other than income or wealth.

3.4. Sen and Nussbaum – The capabilities approach

To deal with the inability of holistic theories to deal with disaggregate components of society or with goods other than wealth, Sen's *The Idea of Justice* expanded Rawls's theory by introducing the idea of comparative states of social justice so that societies might recognize shades of justice and methods to improve justice within society rather than simply drawing lines between 'just' and 'unjust' (Sen, 1999). Rawls's theories were expanded further into the capabilities approach (Nussbaum, 2001). The capabilities approach focuses on an individual's 'capabilities' (the range of things an individual can realistically do or be) rather than on 'functionings' (what an individual has done or become)¹. Rather than focusing on outputs to determine just deserts, the capabilities approach focuses on improving input potential in the form of functionings by improving individual's capabilities; in this way, the capabilities approach establishes the concept of freedom as justice. Nussbaum approached the concept from "Marxian/Aristotelian idea of truly human functions" (Nussbaum, 2001, p. 13) and Sen approached it from development economics. Sen's theory ultimately strives for moral equality, whereas Nussbaum recognizes that, in a world of constrained resources that is already so functionally out of balance, it is reasonable to aim for a threshold improvement rather than complete equality and is therefore sufficientarian in nature.

To aid in the process of disaggregating, Nussbaum identified a list of ten Central Human Functional Capabilities (CHFC) i.e. the concrete elements of life that all people need to lead a life befitting the dignity of a human. The CHFC serve as guidance to determine what aggregate components of society deserve additional equity consideration. Nussbaum's (2001) list of ten CHFC include the following transportation-related capabilities:

- "Bodily Integrity" defined in part as "Being able to move freely from place to place" (p. 78)
- "Affiliation" defined in part as "to engage in various forms of social interaction" (p. 79)
- "Play. Being able to laugh, to play, to enjoy recreational activities" (p. 80)

¹ Excellent summaries of the primary theories put forth by each of these individuals as well as a number of other modern philosophers are presented and applied to the transportation sector in Martens's (2016) book *Transport Justice*

- “Control over One’s Environment ... B. Material” defined in part as “Being able to hold property (both land and movable goods), not just formally but in terms of real opportunity; and having property rights on an equal basis with others” (p. 80)

The combination of CHFC and the emphasis on freedom have made the theories of Sen and Nussbaum incredibly powerful and pervasive in the 21st century; modern, western, democratic theories of just development ultimately rest on the work of these two philosophers who, though they began their work in different contexts, have been collaborating for years to advance their theories (Nussbaum, 2001). For example, the United Nation’s Sustainable Development Goals (UN SDGs) are based on the CHFC.

The capabilities approach does share one major similarity with the others; it is a universal theory of society. Essentially, each of these theories function on the assumption that everyone in society is constantly operating within that singular theory. However, in their book *Equity: Theory and research*, Walster et al. (1978) present and discuss equity from psychological and sociological perspectives. They find that, while equity theories such as equality and proportionality are fundamentally at odds with one another in their pure, theoretical form, they are applied interchangeably in the real world, with individuals practicing some form of equality or proportionality (or something in between) depending on the situation and their intuitions.

3.5. Intuitionism and the application of equity theories

The theory of intuitionism addresses this reality. Intuitionism assumes a rational actor who will draw on all relevant theories as well as their intuitions to determine what is or is not fair within a given context (Stratton-Lake, 2020). This concept of ethical pluralism is diametrically opposed to the ethical monist theories such as utilitarianism (welfare) or Marxism (need) in their pure forms. While the lack of a universal concept of justice has been deemed problematic because it can lead to conflicting value judgements and provides limited consistency, it accurately captures the way in which most people apply theories of justice.

Critical to the interplay between philosophical theories and their practical application is the concept of efficiency. Using an Edgeworth box², Barr (2012) explores the societal theories of libertarianism, utilitarianism, Rawls, and socialism (part of a Marxist ideology) to conclude (in part) that “all first-best socially just distributions are also Pareto efficient³” therefore “[e]fficiency in this case is a necessary condition for social justice” (Barr, 2012, p. 48). While each of these societal theories identify different distributions of resources as fair, to achieve any of these idealized, optimal distributions, Pareto efficiency relative to that theory of social justice must be achieved. For example, while a libertarian may view bureaucratic processes as inherently inefficient and wasteful, a Marxist would argue that the process is necessary to safeguard equitable resource distribution. That same Marxist, however, would still desire efficiency within that bureaucratic process, because inefficiency would waste resources that should otherwise be distributed to the individuals their system seeks to safeguard.

While this emphasis on Pareto efficiency provides a general, societal-level theoretical base-case, Sen argues that distributions optimized purely on utility efficiency of objective goods do not necessarily optimize the distribution of individual freedoms (Sen, 1993). This plays to the ultimate argument that optimizing based on monetary val-

² The Edgeworth box for this example assumes a fixed size and fixed efficiency in production and product mix i.e. it provides a framework to discuss a “first-best solution” for resource distribution (Barr, 2012, p. 46).

³ Given multiple, potential distributions and the relative utility curves they provide individuals, a curve that intersects all of the potential utility curves provides a curve of Pareto efficiency. Pareto efficiency “incorporates two value judgements: social welfare is increased if one person is made better off and nobody worse off; and individuals are the best judges of their own welfare” (Barr, 2012, p. 46).

uations of observable traits alone cannot capture the full value of social goods whose value extends beyond the readily quantifiable; in addition to transportation, primary examples of this include healthcare and education.

Transportation, healthcare, and education represent unique social goods because they relate to Nussbaum’s Central Human Functional Capabilities (CHFC). As a result, according to a capabilities approach, they can and should be treated with special care by policy makers. Both the form and function of such social goods must be considered in order to properly account for their value and determine distributions. For example, while healthcare includes and is heavily influenced by its objectively measurable form (hospitals, number and type of medical professionals, medications, etc.) and their objectively measurable outcomes (prevalence of diseases, mortality rates, etc.), the value associated with a healthy society strays into the realm of normative considerations. In other words, the function of a healthy society is ultimately derived from more than just the sum of its parts (i.e. its objectively measurable form(s)).

To measure these subjective components, *Development Microeconomics* explores sociological findings to highlight the effect of human and social in addition to physical capital on overall social welfare (Bardhan and Udry, 1999, chap. 11); while physical capital considers only objectively measurable resources (such as property and wealth), human capital accounts for tacit knowledge held by individuals and social capital considers the effect of connections and human interaction on both human and physical capital production (Coleman, 1988; Neef, 1998; Schuller, 2001). In addition to human and social capital, Lin (2000) also recognizes cultural capital, or the knowledge of social norms and broader content that can be used for personal satisfaction or to demonstrate social status. These works all find that increases in physical capital do not always correlate with increases in human, social, or cultural capital. Moreover, they find that social capital plays a key role in the development of all forms of capital and therefore on overall social welfare.

Some of the most fundamental and commonly cited theories covered in this section - libertarianism, utilitarianism, Marxism and the works of Rawls⁴ - focus exclusively on the distribution of physical capital. This is problematic from a transportation standpoint because while transportation relies on and effects physical capital, it also relies on and effects human, social, and even cultural⁵ capital. Moreover, these theories assume a holistic, universal application to society as a whole and break down when applied in a disaggregate manner, especially when applied without logically-argued theoretical extensions.

Similar to Walster et al.’s (1978) theory of equity based in psychology and sociology, the theory of intuitionism recognizes this reality and is particularly relevant within the context of democratic societies; democracies inherently seek multiplicity and actively oppose the application of a single, universal, social ethic. To deal with both of these issues, Sen and Nussbaum’s capabilities approach provides a disaggregate theory of equitable distribution that accounts for physical, human, social, and cultural capital.

The philosophical theories of equality, libertarianism, utilitarianism, and Rawls consider equity in a theoretical society and operate outside of time and space, or a-historically. In contrast, the works of Marx, al-Sadr, and Sen and Nussbaum’s capabilities approach account for the world as it is within their theories of equity. By empirical observation, all of these theorists find the base-case, existing state of the world to be inequitable and engage concepts of sufficientarianism, prioritarianism, and equality in various ways in their pursuit of remedying existing inequity in the world. However, while these theories account for historical antecedents, spatial attributes of society are

⁴ While al-Sadr also focuses on physical capital, he does so within the context of Islamic human, social, and cultural capital

⁵ From the London Underground to Route 66 to the crosswalk symbols of East Berlin, transportation carries cultural significance in a wide variety of ways.

Table 3.1
A summary of theories and associated categories of underlying assumptions.

Theory	Fundamental Argument	What is ideal?	Resource	Focus	Base Case
Simple Equality	Everyone has equal humanity so deserves equal resources	Equal distribution	Physical Capital	Ends	a-historical
Formal Equality	Some reasonable distinctions between individuals exist within society (i.e. people can be categorized), but those within a given category deserve equal	Equal distribution within groups, differences justifiable between groups	Physical Capital	Ends	a-historical
Proportional Equality	Different people earn different resources – balance the equation of what is deserved and what is received	Circumstance-informed unequal distribution	Physical Capital	Ends	a-historical
Utilitarian	Resources should be distributed in whatever way maximizes aggregate welfare	Maximized aggregate benefit	Welfare	Ends	a-historical
Libertarian	Protect individual liberty and contracts – non-coerced, self-possessed individuals trading freely is fair	Individual liberty	Physical Capital	Process	a-historical ⁶
Marx	Distributions “from each according to their ability to each according to their need” is just	Needs-based unequal distribution	Physical & Human Capital	Ends	Contextual
Smith (user-fee)	Individuals paying for what they use is fair	Individuals pay for their impact (cost-focused)	Physical Capital	Process	a-historical
Pareto	Distributions optimized to the point at which welfare is improved for as many individuals as possible without decreasing the welfare of any others is fair	Optimized welfare	Welfare	Ends	Contextual
Rawls	Unequal distributions are acceptable if they either 1) are associated with positions that deserve more resources and are accessible to all equally or 2) benefit the least advantaged	Circumstance-informed unequal distribution	Physical Capital	Ends	a-historical
al-Sadr	Poverty is inherently unjust – state and private ownership mechanisms must be used to distribute resources in a manner that eradicates poverty	Poverty eradication/suffering minimization	Physical Capital	Ends	Contextual
Capabilities Approach	If the opportunities legitimately available to individuals are maximized, distributions will be fair	Maximized opportunities for all	Human & Social Capital	Process (opportunity)	Contextual
Sufficientarian	Equality of resources is not fair, but all individuals should have basic needs met	Poverty eradication/suffering minimization	Physical Capital	Ends	Contextual
Prioritarian	Incremental improvements in welfare to those with a lower baseline welfare has greater moral value than the same incremental improvement to someone with a comparatively higher baseline	Individuals with a lower baseline welfare should be prioritized in the distribution of advantages	Welfare	Ends	Contextual
Intuitionism	There is no single theory of justice – morally-developed individuals will intuitively know the best course of action for a given situation	Morally-minded individuals following their intuition	Unspecified	Variable	Contextual

⁶ Left-leaning libertarianism proposes a contextualizing mechanism relative to natural resource distribution

not explicitly considered within the philosophical theories. Despite these limitations, all of these theories have been considered in some form within the transportation literature as demonstrated in Section 4.

Basic information about each theory and points of comparison are summarized in Tables 3.1 and 3.2. Egalitarianism and moral equality are not included as line items in these tables or in Table 4.1 because they are too general; moral equality is a fundamental theory applied in some way by all of the other theories presented. While not all of the theories presented in the tables are considered egalitarian in nature (sufficientarianism for example), egalitarianism is an expansive ideology that accounts for all forms of equality and is therefore also omitted from the tables.

In Table 3.1 the Resource, Focus, and Base Case columns categorize underlying assumptions of the theories presented. The Resource column refers to type of resource assumed in each theory. Most theories argue in terms of the just distribution of physical capital; while utilitarianism and Pareto's theory are often expressed in terms of physical capital, they are specified more broadly in terms of the subjective concept of welfare. Concerning Focus, most of the theories presented focus on end-state distributions (ends) to determine what is just. In contrast, libertarianism and Smith's user-fee paradigm are concerned with process; so long as the rules of the game are followed, the end distribution is fair. The Capabilities Approach is also concerned with process but in the sense of opportunity; it calls for whatever level of intervention will ensure the greatest breadth (and, under Sen's version, equality) of opportunities for all. Finally, each theory assumes some Base Case. A-historical theories present a first-best, ideal, perfectly-just vision for society and are strictly normative. In contrast, contextual theories begin with the world as it already exists and are therefore both posi-

tive and normative in nature; they observe the world as it is and, based on this, propose concepts for how it ought to be. The theories that account for existing states of outcome distribution identify injustices and respond with alternatives intended to make future outcome distributions fairer.

Table 3.2 provides examples of how proponents of each theory would respond to the following prompt: in a society where bicycles serve as the primary form of transportation, what is a fair distribution of bicycles among citizens? This provides a transportation-related example to demonstrate the different ways in which different proponents of these theories approach the same question. Some are complementary, but some are diametrically opposed. All fall within the space of equity.

4. Equity in Transportation: How the conceptual space has been filled

This section reviews the various ways in which transportation authors have attempted to fill the conceptual space generated by equity. Within the transportation literature, various theories of equity have been discussed and applied, sometimes by name and sometimes by definition. Table 4.1 presents a collection of works within the transportation literature that have fundamentally informed the transportation equity discussion to date to demonstrate the variety of theories considered. This section is not a comprehensive review of every transportation paper that considers equity, but it does present the range of philosophical theories of equity considered implicitly and explicitly within US and Euro-centric transportation literature. Works are presented in order of publication date and are included because they have

Table 3.2

A theoretical transportation example: what is a fair distribution of bicycles within a bicycle-centric society?

Theory	Bicycle example
Simple Equality	Give everyone a bicycle.
Formal Equality	Distribute bicycles equally among relevant subsets of individuals. Ex: Give every adult an adult bicycle and every child a child bicycle/Give every person with special needs a special needs bicycle and every able-bodied person the same standard bicycle.
Proportional Equality	Give those who have trained harder or who can pay more nicer bicycles.
Utilitarian	Distribute bicycles in whatever way maximizes the aggregate welfare – if measured in units of bicycles/person, in the case of three people and three bicycles, any distribution (one bike each, three bikes to one person and none to the others, etc.) yields the same result so any are ideal. Measuring in other units such as bicycle utilization in hours/day/person or Likert-scored satisfaction/person would likely yield different results.
Libertarian	Whoever can justly acquire a bicycle can have a bicycle – what constitutes just acquisition will be determined by whoever produced the bicycles and those interested in acquiring them.
Marx	Those with the ability to give a bicycle should give to those in need. Ex:Those who have more bicycles should give to those with less (elders who can no longer cycle should give their bike to younger adults, children growing out of their child bikes should give them to younger children, etc.)/ Those who are skilled mechanics should innovate to provide bicycles to those who are differently abled.
Smith (user-fee)	Those who are able-bodied should help the elderly (by offering rides on rickshaws) and those incapable of riding (young children in child seats). Individuals pay for their use – if they wish to purchase a bicycle and have the funds to do so, they can. If there is a bicycle fleet offering rentals, individuals should pay for the incremental wear and tear their riding causes – those who ride further and on bumpier terrain should pay more, those who ride shorter distances on smooth terrain should pay less.
Pareto	A similar assessment to the utilitarian distribution would be used, however a Pareto assessment is longitudinal and would account for the base case of bicycle distribution. If a base case involved no one with bicycles, the bicycles/person unit example would be constrained such that distributions in which some individuals receive multiple bicycles and some receive none would not be permissible. Similar constraints would apply to distributions measured in other units as well. However, if the base case was some individuals owned multiple bicycles and some owned none, alternate distributions would be possible only if the welfare of no one was decreased – if someone who owned multiple bicycles believed their welfare would decrease if one or more of their bicycles was redistributed, then those bicycles could not justly be redistributed.
Rawls	Those who hold positions of importance within society may earn more (either in the form of more resources to buy more bicycles, buy a nicer bicycle, or in the form of more/nicer/custom bicycles given directly), and/or if unequal bicycle resources could benefit the least advantaged. Ex: provide a rickshaw service or custom bicycles to those incapable of riding a standard bicycle (the elderly and the differently abled).
al-Sadr	Bicycles should be distributed using public and private means in whatever way improves the condition of the poor, ideally moving society towards poverty eradication. Ex: create a public sector program where wealthier households with extra bicycles can donate bicycles for redistribution to poorer households lacking in bicycles. This program would have the authority to mandate This bicycle contributions as necessary if needs are not met by voluntary measures alone.
Capabilities Approach	Distribute types of bicycles and bicycle services such that all individuals have equal cycling capabilities – this means children's bicycles for children, alternative designs for those who are differently abled, and rickshaw services for those who cannot safely ride a bicycle.
Sufficientarian	Distribute bicycles in a way that at least meets a sufficiency threshold – perhaps that has been set at a minimum of one bicycle per household (rather than one per person), or rickshaw service for all at a level of frequency and coverage that meets the basic needs of all for basic cycle transport. So long as basic needs are met, people can own as many and as nice bicycles as they want.
Prioritarian	Distribute bicycles (and/or bicycle services as welfare needs dictate) beginning with the least well-off.
Intuitionism	A morally-minded person should assess the situation, consider alternatives (such as those laid out above), and take whatever course of action seems just within the context of a given situation.

been cited extensively and/or serve as readily accessible resource guides for practitioners.

In some cases, the definitions presented within the transportation literature differ from the philosophical definitions presented in [Section 3](#). To account for this, philosophically precise terminology is associated with each definition found in the literature. In some cases, categories defined by authors mirror philosophical terms (such as 'egalitarianism' or 'Rawlsian') but are not always defined in a philosophically precise manner. [Table A.1](#) in the Appendix presents the studies in greater detail, documenting the exact definitions and scope of transportation application. In both tables the rows that present peer-reviewed journal articles are white, and all derivative works (namely books and reports) are gray. Both types of works are cited because both types are utilized by transportation professionals.

[Bills and Walker's \(2017\)](#) work maps equity theories to positive analysis methods and serves as a useful case study of the nomenclature used in [Table 4.1](#). In their "equity standards", they define the broadest range of theories, providing precise, explicit names for proportional equality, utilitarianism, Pareto, and Rawls (p. 65). They do not, however, provide coverage of Rawls's full theory of just distribution, instead focusing on the difference principle. Given the positive-analysis focus of the paper, this makes sense – Rawls's difference principle provides a welfare function comparable to al-Sadr and a prioritarian approach, but distinct from other approaches such as utilitarianism or Pareto.

Specifically, [Bills and Walker \(2017\)](#) present Rawls as "Rawls-Utilitarianism" defined as "[p]roviding the greatest level of benefits

(utility) to those who are the most disadvantaged" (p. 65). Because it is defined in terms of benefits (utility) rather than physical capital, it is a departure from Rawls's difference principle; because it is presented in terms of utility, the utilitarian qualifier is precise albeit unique. Similarly, they define simple equality in terms of benefits and call it "Egalitarianism/Equality" (p. 65) – this is a departure from the core concept of simple equality which assumes physical capital and expands the realm of interpretations to include valuations such as utility. [Bills and Walker \(2017\)](#) also define a potential equity function that follows the principles of Smith's theory of supply and demand but do not name the theory explicitly, instead naming it "Market-based" equity (p. 65). Additionally, [Bills and Walker \(2017\)](#) specify "Equity Dimensions" also referred to as "Population segmentation" (p. 62). They use the definitions and names 'vertical' and 'horizontal' – the use of these dimensions within the transportation literature is discussed in [Section 4.2](#).

[Table 4.1](#) demonstrates a number of themes and trends within the transportation equity literature that are further explored in the subsections below. Concerning libertarian definitions, only [Pereira et al. \(2017\)](#) explicitly define and name libertarianism in their work, focusing on a Right-leaning version of libertarianism. Both the TRB Special Report 303 (2011) and [van Dort et al. \(2019\)](#) highlight public participation as a form of equity ("participatory") in and of itself. Or, more accurately, public participation provides a means by which those impacted by transportation and land use decisions can make their voices heard, presumably resulting in more equitable end results. This mirrors the Left-leaning libertarians (defined in [Section 3](#)) who hold that, when government intervention is deemed just, strong public

Table 4.1

A summary of theories considered explicitly and implicitly in transportation literature that discusses equity.

Theories Considered	Simple Equality	Formal Equality	Proportional Equality	Utilitarian	Libertarian	Marx	Smith	Pareto	Rawls	al-Sadr	Capabilities Approach	Sufficientarian	Prioritarian	Intuitionism
(Khisty, 1996)		X ^e		X		E			X _{dp}	E	E	X	E	
(Litman, 2002, 2011, 2016, 2018, 2020)		H ^{Ee}				V			V	V	V		V	
(Thomopoulos et al., 2009)	E			X					X _{dp}					
(van Wee, 2011)				X					X ^E		X ^E	X		
(TRB Special Report 303, 2011)					X	X	X _{uf}							
(Walker, 2012)		X	X				X _{uf}							
(Thomopoulos & Grant-Muller, 2013)		X ^e H		X	X	E			X _{dp}	E	E V	X	E V	
(Fol & Gallez, 2014)	E H ^{Ee}			X		V			X _{dp} V	V	V		H ^{Ee} V	H ^{Ee}
(Lucas et al., 2016)									X			X		
(Di Ciommo & Shiftan, 2017)				H		V				V	V		V	
(Pereira, Schwanen, & Banister, 2017)				X	X				X ^E		X			X
(Bills & Walker, 2017)	Ee	X H ^e	X	X		X V	X _{sd}	X	X _{dp} V	X V	X V	X	X V	
(Martens, 2017)				X					X		X	X	X	
(Stewart, 2017)		V		V										
(van Dort et al., 2019)	X ^e	H ^e			X	V X	X _{sd}		V X	V X	V X		V X	
(Behbahani et al., 2019)	E	H ^e X ^e		X		V			V X	V X	V X	X	V	

^a Full citation is “National Research Council (U.S.). Transportation Research Board. Committee on Equity Implications of Evolving Transportation Finance Mechanisms, 2011” but has been shortened to “TRB Special Report 303, 2011” for in-text citations

oversight with clearly-defined rules of engagement is necessary to ensure an equitable result. Thomopoulos and Grant-Muller (2013) also present a Left-leaning, partial version of libertarianism with their environmental equity type. As with any other partial presentation of a theory (with the exception of Rawls), libertarianism is not named outright nor defined in full.

4.1. Egalitarianism, equality, Rawls, and al-Sadr in the transportation literature

Khisty’s (1996) work provided an early attempt at applying fundamental theories of ethics to transportation alternatives analyses. In his paper, he defines six transportation-relevant theories of equity (Khisty, 1996, p. 95). He defines egalitarian policies as those that “reduce any existing social or economic inequalities” to benefit “income groups that are truly in need” (Khisty, 1996, p.96). The language used in this definition touches on a few theories; the focus on income groups in need is a concept echoed by Marx, al-Sadr, and prioritarions, therefore

each of these theories is marked with an ‘X’ in Table 4.1. This definition, however, only captures a portion of these ideologies; it only partially captures the work of Marx because it does not explicitly factor in ability (i.e. from whom do the resources come), and only partially captures the work of al-Sadr because the focus on those in need is not explicitly placed in the context of the broader Islamic belief in poverty as an injustice. This definition is most similar to prioritarianism which, by definition, is not egalitarianism. While both are concerned with the distributions of ends, a truly egalitarian definition would call for the eradication of “any existing social or economic inequities” (Khisty, 1996, p.96). Instead, Khisty uses the word “reduce,” which is more consistent with contextually-aware prioritarianism than a-historical egalitarianism.

This imprecise use of “egalitarianism” is mirrored by Litman (2002), Thomopoulos and Grant-Muller (2013), Fol and Gallez (2014), and Behbahani et al. (2019); Thomopoulos and Grant-Muller (2013) cite directly from Khisty (1996) to specify their “Equity principles” (p. 325). In all of these cases, Rawls is presented as an alternative

to egalitarianism despite the fact that Rawls's theory of justice, taken in its full form, is inherently egalitarian. Beyond the assumption of moral equality, Rawls also assumes equal opportunity among rational, self-interested actors. Rawls's theory is unique because he reaches the difference principle as a logical conclusion to an argument based on these a-historical egalitarian assumptions. Therefore the confusion is twofold; the authors' oversimplify egalitarianism and, in their focus on Rawls's difference principle, they lose sight of Rawls's broader, egalitarian theory of justice.

The authors do, however, define egalitarian theories that are distinct from Rawls's; formal equality (Litman, 2002), simple equality (Fol and Gallez, 2014; Behbahani et al., 2019), and proportional equity (Walker, 2012; Bills and Walker, 2017) are all presented in theory but, with the exception of Bills and Walker (2017), not by precise name. Sometimes they are titled as 'egalitarianism' or 'equality' and sometimes the terms 'egalitarianism' or 'equality' are used within the definition as demonstrated in Table 4.1. Formal equality is assigned where authors define equity in terms of resources distributed equally for any reason of equality that is not exclusively an individual's humanity; when that is the case, simple equality is specified.

Van Wee (2011), Lucas et al. (2016), and Pereira, Schwanen, and Banister (2017) also reference "egalitarianism" in their work, however they handle it precisely. Van Wee discusses the egalitarian theories of Rawls and Sen (capabilities approach), contrasting them with utilitarianism and sufficientarianism. Lucas et al. (2016) focuses on Rawls's difference principle, also accurately contrasting it with sufficientarianism, while Pereira, Schwanen, and Banister (2017) reasonably refer to the work of Rawls as "Rawls's Egalitarianism" (p. 172).

While the majority of works reference Rawls, only van Wee (2011), Martens (2017), Pereira, Schwanen and Banister (2017), and Behbahani et al. (2019) present and consider more than the difference principle. This places the works that focus exclusively on the difference principle closer to al-Sadr than Rawls; while the logical validity of Rawls's difference principle depends on the assumption that all individuals are operating in their best interest within a universally agreed-upon social order, al-Sadr's ideals of prioritarian distribution rest on a fundamental pillar of Islamic belief which dictates that poverty is morally unjust within societies with enough resources to eradicate it.

Concerning al-Sadr, Behbahani et al. (2019) provide a uniquely insightful overview of equity theories. While they present similar imprecisions in their handling of "egalitarianism" and "equal sharing", they classify the theories of equity they present within broader, historical social movements of Ancient Europe (from Plato through the Middle Ages), Christianity, Socialism, Liberalism (Deontological and Utilitarian), and Islam. Further, they suggest equations to operationalize the equity theories they present for use in positive, distributional analyses.

4.2. The imprecise use of the terms 'Horizontal' and 'Vertical' equity

While categorization can be helpful to distill and present complex concepts, inconsistent attempts to categorize theories of equity along the dimensions of 'horizontal' and 'vertical' have created an additional source of confusion within the transportation literature as demonstrated in Table 4.1. In line with Musgrave and Musgrave's (1989) book *Public Finance in Theory and Practice*, these dimensions appeared in the first edition of Litman's report "Evaluating Transportation Equity" which was published online in 2002. Since then, versions of this report have been updated periodically with old versions taken down and replaced each time; the most recent edition was published June 5, 2020. While the document is updated regularly, his definitions of horizontal and vertical equity have not changed. Many (though not all) authors from Table 4.1 cite versions of Litman's report from 2002, 2011, 2016, and 2018 directly in their specification of horizontal and vertical equity.

Litman (2002) defines horizontal equity as "equal treatment of equals ... also called fairness and egalitarianism" (p. 2). The imprecise qualifiers of "fairness and egalitarianism" were removed from the 2016 definition, however the broader definition presented in 2011 and onward states that the equal treatment of equals horizontal equity definition "implies that people should 'get what they pay for and pay for what they get,' unless a subsidy is specifically justified" (p. 2). This broadens the definition to include Smith's user-fee definition of equity and even opens the door to prioritarianism via an intuitionist qualifier. With the exception of Fol and Gallez (2014), most of the authors who cite Litman (2002), Litman (2011), Litman (2016), Litman (2018) focus on the formal equality definition of equal treatment of equals in their definition of horizontal equity; Fol and Gallez (2014) (citing Litman, 2011) instead specify simple equality along with prioritarianism via the same intuitionist qualifier.

Litman (2020) defines vertical equity as requiring "that the allocation of benefits and costs favors disadvantaged people" and is broken out into two subcategories of "Vertical With-Respect-To Income And Social Class" and "Vertical With-Respect-To Need And Ability" (p. 2). The authors who define vertical equity based on a citation of Litman (2002), Litman (2011), Litman (2016), Litman (2018) are consistent in this definition, with Fol and Gallez (2014) retaining the sub-categorization distinction while other authors simply present a single definition of vertical equity that encompasses both subcategories (Bills and Walker, 2017; van Dort et al., 2019; Behbahani et al., 2019).

Then there are authors who do not cite any version of Litman's work but who do define equity concepts in terms of 'horizontal' and 'vertical'. Thomopoulos and Grant-Muller (2013) specify horizontal and vertical "equity types" that mirror Litman (2002), Litman (2011), Litman (2016), Litman (2018) but are constrained by virtue of their focus on regions rather than on people; the theories of Marx, al-Sadr, and Rawls are argued exclusively in-terms of people whereas the capabilities approach and prioritarianism can be applied more broadly. Di Ciommo and Shiftan (2017) define horizontal equity as "the current, utilitarian method of transport evaluation" and they do not make specific reference to income, positions, or ability in their definition of vertical equity, instead focusing exclusively on need (p. 141). Stewart's (2017) work only refers to vertical equity and offers a definition that resembles formal equality and utilitarianism.

4.3. Utilitarianism in transportation: Explicit and implicit

After Rawls, utilitarianism is the second most defined and named theory within the transportation literature. Compared to Rawls, however, utilitarianism is more readily distilled and has been consistently defined with precision within the transportation literature. Not only that, in some cases transportation authors have built upon the underlying theory of utilitarianism. Behbahani et al. (2019) specifies a welfare function for a constrained benefit range utilitarian theory in addition to presentations of utilitarianism and al-Sadr. Van Wee's (2011) handling of utilitarianism is unique and extensive; he discusses the impact of utilitarianism on transportation decision making through Cost Benefit Analyses (CBAs).

As Thomopoulos et al. (2009) recognize, the equity theory of utilitarianism underpins the concept of CBA. Because it focuses "only on the aggregate welfare", it "often does not account for the welfare loss of certain groups or regions" (Thomopoulos et al., 2009, p. 353). Therefore, even if CBA is the existing, codified method of appraisal, that does not necessarily mean that all (or potentially any) stakeholders agree with purely utilitarian principles in transportation.

Concerns with CBA abound in the transportation equity literature; the majority of the works listed in Table 4.1 includes some discussion regarding the ethical limitations of CBA. Martens and Di Ciommo (2017), Pereira, Schwanen, and Banister (2017), and Nahmias-Biran et al. (2017) all argue that CBA is not an appropriate form of analysis for transportation due to its utilitarian roots. In his book *Transport*

Ethics: Ethics and the Evaluation of Transport Policies and Projects, van Wee provides a checklist to determine when CBA is useful in policy decisions, noting that:

“A CBA might provide a reasonable basis for decision making in cases where the winners and losers are more or less equal in their ability to pay, and when it is clear who the winners and losers are, and to what extent they win and lose. In addition, it may be used where uncertainty about dominant consequences is limited, and where the kinds of reasons recommending different policies are widely understood.” Outside of these areas, they suggest that “[a]pplying CBA for comparisons of, for example, investments in roads versus on-demand bus or taxi transport for isolated regions, can be more problematic, and at least requires a check on ethical dimensions.” (van Wee, 2011, p. 48).

Essentially, inherently utilitarian CBA analyses are acceptable in transportation only if they operate within a context that has already been subjected to an initial equity assessment.

This contextual check is critical, especially when applying a-historical theories of equity. While the planning of transportation systems cannot be expected to correct for all experiences of disparities in society, transportation has created and can contribute to the perpetuation and exacerbation of disparities (Sanchez, 2018; van Dort et al., 2019; van Wee, 2011). In the second chapter of his book on transport justice, Martens (2017) provides an extensive argument to demonstrate how “traditional transportation planning ... result[s] in a vicious cycle, which at best maintains existing differences in all dimensions and at worst leads to a continuous growth in inequalities in terms of travel speed, potential mobility, accessibility and revealed mobility, between persons with access to, and persons excluded from, the dominant car-road system” (p. 31). Within this context, seemingly objective tools such as CBA are more likely to actively reinforce disparities in transportation resource distribution.

4.4. Other ethical theories implied in transportation: Discussion and new frameworks

While analyses that employ CBAs imply the ethical theory of utilitarianism, many recent works within the growing space of transportation equity literature also present implied normative theories. This occurs when author(s) present positive analyses in a way that implies an equity norm; analysis methods themselves imply norms and are often paired with policy recommendations.

For example, recent studies present positive analyses of existing distributions of benefits and burdens of new mobility services. Jin et al.'s (2019) study of New York City found that ridehailing services largely compete with transit where there is good transit coverage and complement transit where there is not, however it demonstrates fewer pickups in low-income areas and a negative correlation between pickups and minorities. Jiao and Wang (2020) also assess shared mobility services in New York and conclude that “without effective and appropriate policy and planning guidance, shared mobility may exacerbate transport equity issues” (p. 1). They base this assessment on the high concentration of ridehailing activity serving parts of the city with higher-income, less transit-dependent residents.

These studies present positive analyses of comparative ridehailing resource distribution between population groups segmented by income, transit dependence, and race. Upon finding that ridehailing provides more mobility to individuals who *already* have more mobility options (higher-income, less transit-dependent, white individuals), they suggest that inequity is a concern. The present state of transportation resource distribution is deemed inequitable in some way (i.e. lower-income, transit-dependent, minoritized individuals do not have enough), then they find that the shift with ridehailing exacerbates this base case difference in transportation resource distribution between

groups. Essentially breaches of sufficientarian and capabilities approach is implied, and/or a concern under al-Sadr and prioritarian theories.

Henao et al.'s (2019) report on the distributional effects of ridehailing in the Denver, Colorado region finds that services such as Lyft, UberX, LyftLine, and UberPool have an average vehicle occupancy of 0.8 passengers and increase vehicle miles traveled (VMT) by approximately 83.5% when accounting for deadheading and mode shifts, and a gross wage average of \$15.57 per hour for drivers resulting in net hourly wages between \$5.72 to \$10.46 per hour when accounting for expenses.

Henao et al. (2019) suggest that the VMT findings are in-line with “equity issues” identified by advocates concerned about increased congestion in cities like New York and San Francisco and cuts to transit budgets in favor of ridehailing services in mid-sized cities across the US (p. 1). Concerning the driver wage assessment, the authors state that “[e]quity – and decent wages – for millions of drivers is at the core of this topic” (p. 62). Essentially, this report presents the effects of ridehailing services and assumes readers will view them as proof of the inequity of ridehailing services; while “Equity” is stated in the title, *inequity* is implied. The language surrounding ridehailing suggests an imbalanced proper or proportional equality ideal, and the conversation regarding the driver's wages suggests an infringement on sufficientarian justice.

Similarly, and in the interest of transparency, it is worth noting that past work by the authors of this article has similarly included implied equity norms. Hughes and MacKenzie (2016) refer to “equity of access” but do not define equity explicitly. The implied definition is one of formal equality along regional lines: it is reasonable for people to wait longer for an Uber in low-density areas, but waiting times should not depend on the income levels or racial composition of a neighborhood. The article focuses on the positive, distributive effects analyses of Uber wait times, but it implies certain equity norms in the population segmentation used in the analysis as well as in the discussion used to present results.

Shaheen et al. (2017) and Wong et al.'s (2020) studies focus on developing a new framework for the positive analysis component of equity assessments along with associated policy recommendations. Shaheen et al. (2017) present the STEPS framework which identifies five dimensions that must be considered within an equity assessment: Spatial, Temporal, Economic, Physiological, and Social. Wong et al. (2020) expands on the STEPS framework by defining 18 vulnerable groups that fall on multiple STEPS dimensions to assess shared resource opportunities for members of those vulnerable groups in the event they need to evacuate due to a natural disaster. Their paper presents extensive discussion about the barriers faced by these groups and targeted policy recommendations to increase transportation options among these groups. They essentially present a more precise, carefully-developed, and transportation-relevant alternative to the generic dimensional categories of ‘horizontal’ and ‘vertical’.

Both Shaheen et al. (2017) and Wong et al. (2020) use positive methods to define and focus attention on populations already experiencing disparities in transportation resource distributions and access. They focus on how these populations face barriers to shared mobility access and how policy might address this. Similar to the works of Henao et al. (2019), Jin et al. (2019), and Jiao and Wang (2020), these papers imply inequity based on equity assessments in line with a capabilities approach, al-Sadr, prioritarianism, or sufficientarianism.

Because the concept of accessibility is inherently concerned with the opportunities for travel rather than on travel itself, studies that measure accessibility imply a capabilities approach. Most studies are concerned with cases where citizens fall below some sufficientarian or prioritarian levels, typically presenting this with terms such as social exclusion (Church et al., 2000; Wixey et al., 2005; Preston and Rajé, 2007; van Wee and Geurs, 2011; Lucas, 2012; Fol and Gallez, 2014; Everuss, 2019) or transit captivity (Rutherford and Wekerle,

1988; Polzin et al., 2000; Sanchez et al., 2004; Clifton, 2004; de Vasconcellos, 2005; Golub and Martens, 2014).

4.5. *Explicit equity: Normative arguments and theories specific to transportation*

In addition to providing precise presentations of ethical theories related to transportation, the works of van Wee (2011), Lucas et al. (2016), Martens (2017), and Pereira, Schwanen, and Banister (2017) offer precise presentations of ethical theories related to transportation, and normative arguments regarding how these theories *should be* applied. Pereira, Schwanen, and Banister's (2017) article was published alongside articles by Nahmias-Biran et al. (2017) and Martens and Di Ciommo (2017) in a special issue of *Transport Reviews* on Equity in Transportation. All three ultimately argue that a capabilities approach should be used in transportation planning; both Nahmias-Biran et al. (2017) and Martens and Di Ciommo (2017) use example cases where they compare this approach against the standard, utilitarian assessment method of CBA.

However, of the works listed in Table 4.1, Martens's (2017) book *Transport Justice* is unique. He draws on a variety of just society theories to propose a justice theory specific to transportation. Over the course of eight chapters of reasoned, normative argument, he defends the rather simple and intuitive thesis that "a transportation system is fair if, and only if, it provides a sufficient level of accessibility to all under most circumstances" (Martens, 2017, p. 215).

Martens's (2017) definition of transport justice is a combination of prioritarian- and sufficientarian-constrained capabilities approaches, or what he refers to as a refined prioritarianism. He notes that a just transportation system ultimately requires "real-life agents engaged in democratic deliberation ... to distinguish three domains of the accessibility spectrum: a domain of clearly insufficient accessibility, a domain of clearly sufficient accessibility, and a domain of disagreement" (Martens, 2017, p. 172). Per sufficientarianism, transport falling within the domain of 'clearly insufficient' is the responsibility of the state to rectify through resource redistribution methods whereas transport in the 'clearly sufficient' range is subject to market-based distribution so long as they do not cause harm. While the domains of 'clearly insufficient' and 'clearly sufficient' could be recognized and codified within broader policy statements for consistent application across transport projects, the specific details of any project will likely require additional, democratic engagement to manage distributions within the 'domain of disagreement', because this domain is fundamentally the result of the different theories of equity applied (consciously or subconsciously) by different individuals within society.

Martens (2017) then spends the ninth chapter of his book presenting a case study of Amsterdam's transportation system to demonstrate how his theory of transport justice can be operationalized through positive analysis methods. The tenth and final chapter of the book discusses transportation financing and fair taxation in general as well as justice considerations relative to congestion within the context of the theory of transport justice. In its entirety, Martens's (2017) *Transport Justice* presents a normative, transportation-specific theory of justice, a positive methodology to apply it, and its implications.

In addition to Martens's (2017) theory of transport justice, theories of mobility justice and spatial justice have also been put forth. Proponents of mobility justice and spatial justice argue that Martens's (2017) theory of transport justice is limited by a "narrow focus on transport and urban environments and their oversight of the historical antecedents and embodied aspects of mobility systems" (Everuss, 2019, p. 3). Rather than constructing a philosophical theory of justice, Sheller's (2018) book *Mobility Justice* presents the ways in which racial, infrastructural, migrant, and climate injustices limit the capabilities of individuals in ways not necessarily accounted for within Martens's (2017) theory of transport justice. To address this, mobility justice "concerns overturning marginalization and disadvantage through

intentional inclusion of the excluded in decision making and elimination of unfair privilege. It puts 'oppressed' and 'disenfranchised' groups front and center" (Sheller, 2018, p. 28).

Transport justice and mobility justice are both fundamentally prioritarian and largely complementary theories, they differ, however, in focus. Transport justice emphasizes positive methods to identify distributional effects disparities and the relevant domains in which informed democratic engagement should occur. Instead of focusing time and energy on positive measurements of these existing distributional disparities, mobility justice advocates for immediate and prioritized engagement with known marginalized groups to inform the planning process. Mobility justice argues that, because marginalization is often a product of prejudices held in the majority against those in the minority, basic democratic engagement may reinforce rather than alleviate disparities.

Within the realm of spatial justice, non-motorized mode advocates often focus on the distribution of public right of way (ROW) by mode as an indicator of transportation network fairness. In an application of these concepts, Shi, Wu and Jin (2010) argue that Beijing should implement reforms to redistribute space away from private-vehicles and toward transit-oriented development using a combination of capabilities approach and Marxian principles. They then support their argument with a cluster analysis method to present a positive comparison of physical space allotted to private cars, taxis, and buses within a range of cities in China. They also assess public perceptions of the BRT line in Beijing to find that residents were satisfied with the service, exhibiting a form of public participation to support their argument. Shi and Zhou (2012) also present a series of distributional analyses that are paired with a clearly articulated equity assessment. Based on a review of Rawls, they argue that it is inequitable for the current transportation system to provide greater benefits to vehicle-owning individuals who take up a larger share of the public space with a larger impact on the environment, and therefore lower-income, transit-captive individuals who take up a smaller share of public space with a lower impact on the environment deserve some compensation.

There are, however, compelling arguments to demonstrate that this purely spatial assessment is inherently limited and deficient (Nello-Deakin, 2019). Nello-Deakin (2019) argues that such assessments simply pit modes against each other while ignoring the inherent properties that make each mode unique and useful under different conditions of transportation need and want. Instead, he proposes speed as a better tool to achieve transportation facilities that are fair to a range of modes and therefore user needs and interests. This method requires that a city be divided into corridors predominantly intended for faster, motorized modes, corridors for transit only, and zones with 15 mile per hour maximum speeds. Additionally, public education of rules of the road for non-motorized as well as motorized modes is required under this conceptualization of a just transportation system so that all modes might intermingle safely and efficiently. Essentially, he proposes a proper equality distribution of speed constraints on all modes in a given facility once facilities have first been separated based on considerations of the capabilities approach and prioritarianism.

Additional normative arguments relative to transportation equity exist in the overlap between the transportation and environmental justice literature (Bullard, 2003; Sanchez et al., 2003; Sanchez and Wolf, 2005; Beiler and Mohammed, 2016). In fact, Karner et al. (2020) create a distinction between "transportation justice" vs "transportation equity", noting that "[t]he justice framing is more common among activist groups and nongovernmental organizations... while the term equity is more commonly used by state actors" (p. 2). The authors note that these are echoed in the environmental justice literature where a similar shift in language and framing occurred in the early 1990s.

The connection between transportation and environmental justice are explored in detail relative to governance and the application of relevant sections of the Civil Rights Act. Bullard (2003) focuses on legal and policy considerations, while Sanchez and Wolf (2005) review the

role of metropolitan planning organizations (MPOs) in addressing injustices. Additionally, Sanchez et al. (2003) present a series of positive assessments in the Los Angeles region to support the claim of inequity. Karner (2016) highlights the link between transportation (in)equity and environmental justice policy, exploring both disparities in distribution of emissions and resources, comparing regions in California and finding that lower-income, minority neighborhoods tend to bear the burden of higher emissions while receiving lower investments per capita.

To address these injustices, these studies present policy recommendations at a minimum. Sanchez and Wolf (2005) emphasize the importance of having the communities facing environmental injustice actively engaged and participating in processes to address those inequities. Karner and Marcantonio (2018) present a model to engage in a meaningful way with historically underserved populations as well as an argument for dedicated funding to meet those needs.

These theories and works are predicated on the assumption that the transportation good, in its present form, is inequitably distributed. The foreword of Lucas et al.'s (eds., 2019) book *Measuring Transport Equity* explicitly states that the goal of the book is not to convince readers that transportation inequities exist, it is to address the inequities that are understood to exist. Sanchez's (2018) book presents a comprehensive history of exclusionary practices within transportation and land use planning and practice in the US along with data exploring the inequities faced by individuals of lower-income, black, indigenous, and people of color (BIPOC), those with limited English proficiency (LEP), and those who are aging or otherwise limited in physical or cognitive ability. Prominent examples include the racial discrimination of redlining from the 1920s through the 50s and within the planning process of the interstate highway system (Woods, 2012; Karas, 2015).

Theories of mobility justice, spatial justice, and environmental justice explicitly seek to address historical injustices, emphasizing prioritarian participation to do so. The theory of transport justice does not begin with injustice but presents arguments and positive assessments that can be used to identify and rectify existing disparities. All four theories are transportation-specific and recommend public engagement in some form.

5. Conclusion

Researchers and practitioners have begun to recognize transportation as a unique societal good with properties similar to education and healthcare; like education and healthcare, transportation affects an individual's access to goods, services, and opportunities. As a result, decisions related to transportation systems embody ethical value judgements and are therefore inherently normative.

While the concept of equity has been a popular topic within transportation for decades, careful treatment of the theoretical space generated by the normative concept of equity is only a recent development. In a field dominated by positively-trained analysts, many works on transportation equity are less about the normative analysis of equity and more focused on presenting distributional effects analyses. More accurately, these works can be viewed as equity analyses in which author(s) filled the conceptual space intuitively with some implicit concept of equity.

In many cases, use of the term equity it is intended to imply that the existing state of transportation is inequitable. Given the evidence, such assessments are not only reasonable, but because equity is an inherently normative concept, such value judgements are required to differentiate an equity assessment from a distributional effects analysis. While equity assessments should be at least in part informed by positive information such as distributional effects analyses, they necessarily go beyond positive analysis.

Moreover, it is also important to recognize the normative value systems that positive assessment methods imply; whether one views them as equitable or not largely depends on one's normative beliefs and/or

the context of the analysis in question. With this clearer understanding, perhaps misunderstandings can be circumvented or at least laid out and discussed in clearer terms. In particular, this article categorizes theories of equity based on their underlying assumptions so that researchers and practitioners might better understand how to reasonably apply these theories, or models, of equity.

Not every article employing a statistical model must present every basic statistical proof used to develop that model. Anyone employing a given model, however, should have some basic understanding of those proofs. Specifically, qualifying assumptions for potential models must be understood, explicitly stated, and adhered to for the application of a given model to yield reasonable results. While the internal logic of a given model remains valid, if the realities of a data sample stray too far from a model's underlying assumptions, the application of that model's logic to a data set that does not meet the underlying assumptions on which that model's logic is based will yield unreasonable analytical results.

The theories presented in this article are models of equity; while strict adherents to any of the models would say that their model always yields a reasonable assessment, a broader discussion of the concept of equity requires a broader lens. Each theory offers a set of sound logical arguments, but to determine whether or not it is reasonable to apply a particular theory to a particular situation, one must consider the underlying assumptions of the theory. For example, utilitarianism operates outside of historical contexts; while it offers a powerful, simple logic that is readily applicable, it is often applied without consideration for contextual realities. Specifically, in settings where historical disparities exist, utilitarian logic often exacerbates these disparities. Despite this, utilitarian ethics operationalized in Cost Benefit Analyses (CBAs) have been used extensively within the transportation profession.

Transportation is a fundamental societal service and functionally operates within the historical context of the time, place, and people. As a result, transportation researchers and professionals alike should employ healthy skepticism when employing ethical theories based on a-historical assumptions – while the argument structure of such theories may be perfectly logical in a vacuum, when contextual realities stray too far from the idealized, a-historical assumptions on which these theories are based, these logical structures may fail to provide reasonable, just solutions.

Given this, we recommend the following best practices for transportation professionals:

- Recognize that equity involves both positive analysis and normative value judgments.
- Explicitly state the normative criteria and associated assumptions used to evaluate equity. In particular, recognize the hazards and limitations of relying on a-historical theories of equity when working in such a content-dependent setting as transportation.
- Define theories and categories with precision; while it is not critical to employ the specific jargon of the philosophy literature, it is important to avoid misusing terms with established meanings. Borrowing terms but applying them to our own concepts creates confusion and hinders effective communication and solution development. Similarly, theoretical categories should be named with as much precision as possible. For example, generic categorizations such as horizontal and vertical leave too much room for interpretation and can generate confusion; in contrast, categories based on established concepts such as types of capital, historical context, space, time, etc. are less prone to misuse and confusion.

The concept of equity is expansive. This article covered a subset of predominantly western, contemporary philosophical theories of equity. Most are specified assuming physical capital; while physical capital is a critical component of the transportation resource (i.e. you need money to pay for buses, bus stops, and their various operations costs), so is human capital (i.e. you need knowledgeable profes-

sionals to operate the system in a manner that efficiently utilizes available physical capital). Additionally, the transportation resource impacts physical, human, and social capital. Transport justice, mobility justice, and spatial justice present transportation-specific ethical theories that account for this unique, complex nature of transportation as a resource. Initial positive analysis frameworks and welfare functions have been defined and offer useful starting points, but the work to fill the space of transportation equity has just begun. Future

research is needed not only to explore the practical implications of equity theories for transportation policy and design, but to further refine equity theories specific to the transportation resource.

Appendix

Table A1

Underlying philosophical theories of equity as considered in fundamental transportation literature related to equity.

Citation	Social Justice Theories Considered	Spatial Considerations
(Khisty, 1996, pp. 95–96)	<p>“Theories of Justice”</p> <ul style="list-style-type: none"> • “Equal shares” which “distributes benefits equally (or as equally as possible) among relevant socio-economic groups” i.e. formal equality, or • Utilitarianism, or • “maximizing the average net benefit with a minimum floor benefit of [X] units” i.e. partial al-Sadr/sufficientarianor • “maximizing the average net benefit with a benefit range constraint of [X] units” partial al-Sadr, or • Egalitarianism in the sense of a “regulative procedure ... to reduce any existing social or economic inequalities” to benefit “income groups that are truly in need” i.e. partial Marx/partial al-Sadr/capabilities approach/prioritarian, or • Rawlsian i.e. Rawls’s difference principle 	Yes - the theories are applied to an example city with example regions of analysis and example bus routes
(Litman 2002, p. 3)	<p>“Horizontal” defined as “equal treatment of equals” and “also called fairness and egalitarianism” i.e. formal equality, or “Vertical With-Respect-To Income And Social Class” i.e. Rawls’s difference principle/partial al-Sadr/prioritarian, or “Vertical With-Respect-To Need And Ability” i.e. Marx/partial al-Sadr/capabilities approach/prioritarian</p>	Yes – “Location” noted as a category of equity analysis
(Thomopoulos et al., 2009, p. 352)	<p>“Three fundamental theories can be considered to summarise the main equity theories that exist (Young, 1994). Whilst this may be an oversimplification, it offers an overview of the core principles applied in practice:”</p> <ul style="list-style-type: none"> • Egalitarian: “where everyone has equal rights or benefits for a particular service or scheme” i.e. simple equality, or • Utilitarian, or • Rawlsian “where the aim is to retain the existing status quo between those better- and worse-off, alongside an attempt to improve the situation of those worse-off as much as possible, after everyone has secured one’s fundamental rights.” i.e. Rawls’s difference principle 	
(van Wee, 2011, pp. 26-32, 83)	<p>Income classes (social) considering the following transportation-relevant theories:</p> <ul style="list-style-type: none"> • Utilitarianism, or • Egalitarianism: <ul style="list-style-type: none"> o Rawls, or o Sen (capabilities approach), or • Sufficientarianism 	Yes – notes that if assessments are not divided along social lines, they can be considered along Regions (spatial)
(TRB Special Report 303 ⁷ , 2011, p. 41, 44)	<p>“Type of Equity”</p> <ul style="list-style-type: none"> • “Benefits received” i.e. benefits-focused Smith’s user-fee paradigm • “Ability to pay” i.e. partial Marx • “Return to source” i.e. Smith’s user-fee paradigm • “Costs imposed” i.e. Smith’s user-fee paradigm • “Process (or participation)” i.e. partial libertarian 	Yes – within “Criteria for Grouping Individuals”
(Walker, 2012)	<p>“Equity” appears three times in discussions:</p> <ol style="list-style-type: none"> 1. Comparing competing claims to transit service, he defines an “Equity Goal: Service shall be allocated proportional to population” i.e. he defines equity in terms of proportional equality, noting that this will “draw complaints from all sides” despite being ‘fair’ (p. 128). 2. In the discussion for a “Coverage Goal” he notes “concerns about equity (“we pay taxes too, so we deserve service even if we don’t use it much”)” which considers formal equality – under the equal status of tax-paying citizen, a citizen might demand equal service (p. 118). 3. Finally, he proposes a fare system with a “very smart card” that could calculate the exact cost of your trip based on the “cost of each increment of the trip, divided by the number of people who used that increment” i.e. Smith’s user-fee paradigm, claiming that “[t]his system, and only this system, could be called “equitable”” (p. 143) 	Not in relation to equity
(Thomopoulos and Grant-Muller, 2013, pp. 325–326)	<p>Same as Khisty, but numbered and presented in a different order as “Equity principles”:</p> <ul style="list-style-type: none"> • P1 – utilitarian, or • P2 – equality i.e. formal equality, or • P3 – Rawlsian i.e. Rawls’s difference principle, or • P4 – Egalitarian i.e. partial Marx/partial al-Sadr/capabilities approach/prioritarian, or • P5 – minimum floor i.e. partial al-Sadr/sufficientarian, or • P6 – maximum range i.e. partial al-Sadr Additionally, “Equity types” are established: • T1 – horizontal: “the same benefit to all regions with similar socio-economic characteristics,” i.e. formal equality, and • T2 – vertical: “benefits more the least advantaged regions instead of the most advantaged ones,” i.e. capabilities approach/prioritarian, and • T3 – environmental: focuses on “environmental protection, through direct or compensatory actions and policies,” i.e. Left-leaning libertarian, and 	All principles and types are defined with regard to regions (similar to the way in which Khisty (1996) operationalized his definitions)

Table A1 (continued)

Citation	Social Justice Theories Considered	Spatial Considerations
(Fol and Gallez, 2014, pp. 70–71)	<ul style="list-style-type: none"> • T4 – regional/spatial: “benefits more the remote regions instead of those centrally located,” i.e. capabilities approach/prioritarian, and • T5 – accessibility: “improves accessibility for all regions impacted” i.e. formal equality-constrained capabilities approach <p>Summarizes (Thomopoulos et al., 2009) which considers the following theories as transportation relevant:</p> <ul style="list-style-type: none"> • “Egalitarian: everyone has equal rights or benefits for a particular service or scheme” i.e. simple equality, or • Utilitarian, or • Rawlsian i.e. Rawls’s difference principle Summarizes (Litman, 2011) which considers: • “Horizontal equity: requires that public resources be allocated equally to each individual or group unless a targeted subsidy is specifically justified” and classifies this as “egalitarian” i.e. simple equality unless prioritarianism is justified so partial intuitionism, or • “Vertical” equity with respect to income/social class i.e. Rawls’s difference principle/ partial al-Sadr/prioritarian or • “Vertical” with respect to need and ability i.e. Marx/partial al-Sadr/capabilities approach/prioritarian 	Thomopoulos et al. (2009) presented in terms of regional access, Litman (2011) in terms of individual access
(Lucas et al., 2016)	Divides into: <ul style="list-style-type: none"> • Egalitarian (focused on Rawls’s difference principle), or • Sufficientarianism 	Yes – considered in light of five different components of accessibility, including human
(Di Ciommo and Shiftan, 2017 pp. 141, 146)	“horizontal equity here (i.e. each individual is considered with the same weight)” classified as “the current, utilitarian method of transport evaluation” i.e. utilitarian , or “Vertical” equity or “social equity” defined as “a new appraisal framework based on “needs”” i.e. partial Marx/partial al-Sadr/capabilities approach/prioritarian	Yes – discusses “Place of residence (inaccessible areas/socio-economically deprived areas)” as a variable in need of attention
(Pereira, Schwanen, and Banister, 2017, p. 172)	Defines and discusses these “key theories of justice” relevant to transportation equity: <ul style="list-style-type: none"> • Utilitarianism • Libertarianism • Intuitionism • “Rawls’s Egalitarianism” • Capabilities approach 	Yes – discusses how concept of accessibility operationalizes spatial component of <i>capabilities</i>
(Bills and Walker, 2017, pp. 65, 62–63)	“Equity standards” are defined as: <ul style="list-style-type: none"> • “Basic Needs” i.e. sufficientarian, or • Equality/Egalitarian “Providing an equal level of benefits among all groups of interest. Note that given the different levels of need and value that individuals place on these benefits, equality of benefits may be achieved without the actual amount of benefits being equal” i.e. simple equality of benefits, or • “Market-based ... ‘You get what you pay for’” i.e. Smith’s supply-and-demand, or • “Maximum Average Net Benefit” defined as “Maximizing the average benefit, using a certain amount as a constraint, to ensure that certain groups of interest (the most neglected groups) receive a certain minimum amount of benefit” i.e. partial al-Sadr/sufficientarian, or • Pareto, or • Proportionality i.e. proportional equality, or • “Restorative Justice” or “remediating the existing disproportionality of transportation benefits” i.e. Marx/ al-Sadr/capabilities approach/prioritarian, or • Utilitarianism, or • “Rawls-Utilitarianism” defined as “Providing the greatest level of benefits (utility) to those who are the most disadvantaged” i.e. Rawls’s difference principle “Equity Dimensions” also referred to as “Population segmentation” defined citing Litman (2002) as: “Horizontal equity, which may include spatial and generational equity, refers to the distribution of impacts (costs and benefits) across groups that are considered to be equal in ability and need” also giving travel mode and time-of-day as examples i.e. formal equality and “Vertical equity refers to the distribution of transportation impacts among sub-populations that differ in ability and need, such as different social and income classes, age groups, and disabled or special needs groups” and later noting gender as well i.e. Marx/partial al-Sadr/Rawls’s difference principle/capabilities approach /prioritarian 	Yes – included within the “Horizontal Equity Dimension” though with the note that “in some cases spatial and generational equity are seen as separate dimensions”
(Martens, 2017, pp. 170–173)	Multiple explored (including extensive discussion of Rawls and the capabilities approach), but transportation examples are given for the following: <ol style="list-style-type: none"> (a) utilitarianism (there is no moral value for marginal increases in access – it is constant), or (b) sufficientarianism (establish a fixed cut-off point for sufficient vs. insufficient access), or (c) prioritarianism (places needs/burdens on a continuous spectrum), or (d) “refined prioritarianism” (considers three different curves of moral access distribution for the three domains of insufficient, disagreement, and sufficient) 	Yes – focuses extensively on accessibility as a spatio-human measure that operationalizes the capabilities approach
(Stewart, 2017, p. 244)	Broadly referred to as “Vertical” equity, but just assumes a-spatial application of “fairness” principles with hints of the limits of theories that consider only formal equality and utilitarianism	Yes – called “Horizontal” equity and explored with regard to cordon pricing
(van Dort et al., 2019, p. 3, 21)	Summarizes Litman (2018) which presents the same distinctions for “Horizontal” and “Vertical” as Litman (2002) – see row for Bills and Walker (2017) Additionally: <ul style="list-style-type: none"> • “Substantive equality” is defined the same as simple equality • “Compensatory equity considers how much and in what direction a given social structure, decision, or policy affects those overall outcomes (Taylor, 1970) with the intent of providing resources to all commensurate with individual need” i.e. partial Marx/partial al-Sadr/Rawls’s difference principle/capabilities approach/prioritarian Per Talen (1998): • “distribution of specific resources commensurate with local demand for them” i.e. Smith supply-and-demand • “willingness to pay [assuming this] corresponds to how strongly [a given resource] is needed or desired” i.e. partial libertarian “Equity perspectives” 	Yes – “Geographic Equity”

(continued on next page)

Table A1 (continued)

Citation	Social Justice Theories Considered	Spatial Considerations
(Behbahani et al., 2019, pp. 171-172, 178-179)	<ul style="list-style-type: none"> • “Compensatory Equity” i.e. partial Marx/partial al-Sadr/Rawls's difference principle/capabilities approach/prioritarian • “Geographic Equity” defined as “a mix of horizontal and vertical spatial equity perspectives” i.e. formal equality/Marx/partial al-Sadr/Rawls's difference principle/capabilities approach /prioritarian • “Procedural Equity” i.e. partial libertarian <p>“Horizontal” and “Vertical” used to define “two main categories of equity” citing the 2016 version of Litman (2002) and summarizing the category concept in the same way as Bills and Walker (2017) and van Dort et al. (2019) – see row for Bills and Walker (2017) Equity “theories” or “approaches”:</p> <ul style="list-style-type: none"> • Utilitarianism • “Rawls's theory of Justice” • Egalitarianism or “all human beings are equal, so we should, as soon as possible, reach a point where they can be treated equally” and so must “eliminate any accumulated historical inequality” i.e. simple equality (on the basis of moral equality) • “Equal Sharing” meaning “to divide the added benefits (net benefits) in the society [through] equal distribution among groups” i.e. formal equality • “Narrowing the Gap in Final Benefits” meaning bounded maximization of total net benefits i.e. range-constrained version of utilitarianism/partial al-Sadr • “Limiting the variance in added benefits” meaning “maximization of total net benefits of the society, the constraint that the increase in the profits of the poor is now lower than a certain minimum level” i.e. sufficientarian-constrained version of utilitarianism/partial al-Sadr • al-Sadr 	Yes – operationalizes theories in terms of accessibility and development of comparative regions

⁷Full citation is “National Research Council (U.S.). Transportation Research Board. Committee on Equity Implications of Evolving Transportation Finance Mechanisms, 2011” but has been shortened to “TRB Special Report 303” for in-text citations.

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