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Whose Streets? Justice in Transport Decarbonization and Gender

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Abstract

This paper develops the justice implications of gendered power relations for transport decarbonization. I build on the need satisfier escalation framework by Mattioli (2016) and Brand-Correa et al. (2020) and its account of justice as equality in need satiation. I show that gendered power relations manifest at the level of the provisioning system as a profound gendered division of labor and androcentric biases in the built environment. Based on the German travel survey Mobilität in Deutschland (2017), I document how gendered arrangements in the provisioning system reverberate as gendered inequalities in car access, travel behavior and trip purpose, yet significantly intersect with household income and migration biography. Normatively, I argue that an account of justice recognizant of gendered power relations extends justice to inputs for and conversion rates faced in need satisfaction processes. Building on Susan Okin (1989), I establish that justice additionally requires (i) the intra-household division of labor for need satisfaction to be chosen freely and (ii) equality of opportunity to satiate needs. Androcentric biases in the built environment create gendered conversion rates and constrain equality of opportunity. Consequently, transport decarbonization policy needs to equalize conversion rates for care relative to paid employment when de-escalating carbon intensity to be just.

Keywords: Transport, Human Needs, Climate Change, Gender Division of Labor, Urban Planning, Gender Justice

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1 Introduction

Road transport stands out among all sectors for its inertia towards decarbonization. Despite a strong imperative for rapid and substantial reduction (IPCC 2014; Creutzig et al. 2015), road transport emissions have not yet decreased in the EU (Eurostat 2021). Instead, car use is by now firmly entrenched with diverse day-to-day practices (Cass and Faulconbridge 2016; Mattioli, Anable, and Vrotsou 2016; Manderscheid 2019) as well as with a car-dependent transport system and its politico-economic imperatives (Mattioli et al. 2020). Crucially, transport is closely connected to socio-economic and gender inequality. It is the most unequal consumption category in terms of its energy footprint, with high-income individuals amassing the bulk of energy use while the less well-off may face mobility poverty (Oswald, Owen, and Steinberger 2020). Moreover, the car-oriented transport system, as I will demonstrate, is distinctly shaped by gender power relations and contributes to perpetuating gender inequality.

The intricate connection of transport, carbon emissions and inequality prompts the question of how decarbonization can be made both effective and just. In this paper, I develop the implications of gendered power relations for social justice in decarbonizing transport. I build on the seminal papers by Mattioli (2016) and Brand-Correa et al. (2020) which, taken together, develop the *need satisfier escalation framework*. Needs are understood as universal constituents of well-being which are incommensurable and non-hierarchical and thus distinct from subjective wants. By contrast, need satisfiers are the variable and historically contingent means to satisfy needs. The need satisfier escalation framework presents a normative account of social justice in a climate-constrained world. Based on the premise of the universal right to need satisfaction, justice is conceptualized as *equality in need satiation*. As a result, justice refers to end-states of whether or not needs are satisfied at the individual level. This paper argues that a conception of justice recognizant of gendered power relations extends justice to inputs disposable for and conversion rates faced in need satisfaction processes.[1]

The need satisfier escalation framework demonstrates that a dilemma between inter- and intragenerational need satisfaction arises when need satisfiers escalate in carbon intensity. When individuals rely on carbon-intensive satisfiers like the car to satisfy their needs, they at the same time contribute to exacerbating the climate crisis and thereby constrain the need satisfaction of others, notably in the global South and of future generations on a global scale. Accordingly, equality in need satiation can only be achieved when aggregate need satisfaction does not transgress planetary boundaries. To achieve the just state, decarbonization needs to prioritize needs over wants and to de-escalate need satisfier carbon intensity. Need satisfiers

[1] Conversion rates specify the rate with which inputs translate into outputs (Sen 2001; Robeyns 2000, 2003). Mathematically, for inputs $x_1, .., x_n$ and output y, the conversion rate represents $f(.)$ in $y = f(x_1, .., x_1)$.

interlink in a hierarchical chain of four orders. In case of transport, the car as a product (4^{th} order) provides the service of mobility (3^{rd} order) which, embedded into a distinct culture of car use, is required to perform activities (2^{nd} order). All lower satisfier orders operate within the provisioning system (1^{st} order) which includes physical elements like infrastructure and urban form and social elements like institutions and power relations. Due to the hierarchical relationship, interventions at the level of the provisioning system are most effective for satisfier de-escalation.

Linking the need satisfier escalation framework to feminist geography and urban planning, I show how the provisioning system is distinctly shaped by gendered power relations. At the level of the provisioning system, gendered power relations manifest as a profound gendered division and valuation of labor which translates into androcentric biases in the built environment. Based on a rationalist planning framework, land-use and infrastructure have been tailored to a hypothetical male breadwinner and hinder care trips. As a result, changes in the built environment to facilitate the commute to work not only induced car dependence but also reflect and reinforce the gendered division of labor.[2]

Taken together, the gendered division of labor and androcentric biases in the built environment reverberate as gendered inequalities across the lower satisfier orders. I map the existing literature on transport-related gendered inequalities to the satisfier chain and complement it with an intersectional analysis of individual-level micro data from the German travel survey Mobilität in Deutschland (2017). I disaggregate indicators for all satisfier orders by gender, economic class and migration biography. Race is not elicited. A sizeable gender gap exists independent of household attributes at the higher satisfier orders in terms of employment rates and in the amount of record-day care trips, especially for parents. At the lower satisfier orders, higher income and absence of a migration biography mitigate gender disparities to some extent. Descriptive evidence of systematic inter-group inequalities, however, cannot simply be equated with injustice (Walker 2012). Rather, gendered power relations need to be linked to a normative account of justice and, in particular, to an account of justice in need satisfaction.

Building on feminist welfare theory, I develop the implications of gendered power relations for justice in need satisfaction and derive conditions for transport decarbonization. Since gendered power relations are hierarchical and asymmetric, they may instrumentally affect the individual condition for achieving need satisfaction but are also a matter of justice per se.

[2]I focus on gender as the main principle around which the division of labor is organized yet try to account for intersections with other dimensions of oppression. Gender as well as race are understood as social constructs and mappings of power relations, not a facticity (Aulenbacher 2008).

In particular, I argue that a conception of justice recognizant of gendered power relations extends justice from the end-states of whether or not needs are satiated to also include inputs disposable for and conversion rates faced in need satisfaction processes. Building on welfare theorist Susan Okin (1989), I establish two propositions for justice in addition to equality in need satiation. *Firstly,* justice requires the intra-household division of labor for need satisfaction to be chosen freely. This proposition refers to labor and time inputs for need satisfaction when contributions can be split among cohabitants and to how their intra-household division comes about. *Secondly*, justice presupposes equality in opportunity to satiate needs. Equality in opportunity results from the interaction of inputs for and conversion rates faced in need satisfaction processes. Since androcentric biases in the built environment cause gendered conversion rates for need satisfaction, they constrain equality of opportunity. Consequently, transport decarbonization needs to equalize conversion rates for care relative to paid employment in the built environment *while* de-escalating need satisfier carbon intensity to be just.

The contributions of this paper are threefold: Firstly, I link the need satisfier escalation framework to feminist geography and urban planning. This novel linkage demonstrates how the provisioning system is deeply shaped by gendered power relations and the resulting interrelation between car dependence and the gendered division of labor. Secondly, I provide descriptive evidence on transport-related gendered inequalities to illustrate how gendered power relations in the provisioning system spiral down the transport satisfier chain. I complement the existing literature with an intersectional analysis of the 2017 German travel survey Mobilität in Deutschland. An intersectional approach acknowledges that different dimensions of oppression are not additive but interconnected and interlocked (Davis 1981; Crenshaw 1989). The analysis reveals the complex interactions between gender, economic class and migration biography. Thirdly, I develop the justice implications of gendered power relations for justice in need satisfaction and derive conditions for transport decarbonization. These conditions may serve as a basis to design just de-escalation strategies.

The paper proceeds as follows. Section 2 introduces the need satisfier escalation framework and maps how gendered power relations shape the provisioning system. I present empirical evidence on gendered inequalities across the satisfier chain in Section 3. In Section 4 I reconceptualize justice in need satisfaction to integrate gendered power relations and derive conditions for transport decarbonization. Section 5 concludes.

2 Theoretical Framework

2.1 The Need Satisfier Escalation Framework

In the following section, I synthesize the framework developed by Mattioli (2016) and Brand-Correa et al. (2020) which I refer to as the *need satisfier escalation framework*. The framework provides an account of justice for a climate-constrained world. Justice is conceptualized as equality in need satiation. A dilemma between intra- and intergenerational need satisfaction emerges when need satisfiers escalate in carbon intensity to a non-generalizable level. Carbon-intensive need satisfaction contributes to the ecological crises and thus conflicts with the need satisfaction of current and future others. Resolving the dilemma requires enabling universal need satisfaction without transgressing planetary boundaries in the aggregate.

The need satisfier escalation framework comprehensively conceptualizes the dilemma, it explains how it arises and delineates how it can be solved. It therefore integrates three theoretical building blocks: Human need theory serves as the welfare theoretical foundation to conceptualize the dilemma in normative terms; the systems of provision (SoP) approach provides a systemic account of carbon-intensive consumption; and sociological structuration theory elucidates the (de-)escalation dynamics. In the following, I sketch the three underlying theoretical tenets, relate them to one another and to the specific case of need satisfier escalation in transport.

The need satisfier escalation framework is rooted in the *welfare theory of human needs*. Human need theory can be classified as an eudaimonic theory of well-being. Eudaimonic theories contrast with hedonic theories of well-being like preference satisfaction and subjective happiness. While hedonic theories of well-being equate well-being with subjective mental states, eudaimonic theories view well-being to be the individual 'flourishing' within a social system. Well-being refers to the actions and abilities an individual can perform and has objective content (for a discussion see Lamb and Steinberger 2017; Brand-Correa and Steinberger 2017).[3] In contrast to single-objective hedonic theories, eudaimonic theories suggest that well-being encompasses multiple non-substitutable dimensions. Contemporary theories of human need have been developed by Max-Neef (1991) and Doyal and Gough (1991). While formulated in the language of the capability approach, Nussbaum's list of capabilities (Nussbaum 2000a, 2003) is also closely connected to the concept of fundamental human needs (Gough 2014, 2020). The need satisfier escalation framework, however, does

[3]Eudaimonic concepts of well-being resonate already within the thinking of classical economists like John Stuart Mill, Harriet Taylor Mill and Karl Marx. Contemporary eudaimonic theories of well-being include the capability approach (Sen 2001; Nussbaum 2000b, 2003), multi-dimensional poverty concepts (Alkire and Santos 2013) as well as theories of human need.

not presuppose a particular theory of human need but rather focuses on two central tenets widely shared across theories of human need.

First, needs are distinguished qualitatively from wants. Theories of human need suggest that there exists a finite set of human needs "which [are] self-evident (thus universal), incommensurable (satiable, irreducible, non-substitutable) and non-hierarchical which encompass[es] the range of capabilities or dimension of [human well-being]" (Brand-Correa and Steinberger 2017, 46). Given their universal character, needs are invariant across time and space and thus global and intergenerational in scope.[4] The demarcation between needs and wants is defined in terms of deficiency. Only for the case of needs (not for wants) it holds true that non-satisfaction is linked to objective serious harm to individual well-being.[5] Normatively, human need theories postulate a universal right to need satisfaction. As a threshold concept, needs are satisfied when the satiation threshold is reached. All generations are treated equally; the intertemporal discount rate is zero. Hence justice is (implicitly) understood as inter- and intragenerational equality in need satiation. As a result, need satisfaction (of current and future generation) enjoys moral precedence over want satisfaction.

Secondly, human need theories distinguish needs from need satisfiers which are "everything which (..) contributes to the actualization of human needs" (Max-Neef, Elizalde, and Hopenhayn 1992, 201). In contrast to the universal nature of human needs, need satisfiers are variable and differ historically and geographically. In view of their cultural variance, Max-Neef, Elizalde, and Hopenhayn (1992) suggest that "one of the aspects that define a culture is the choice of satisfiers" (p. 204). Combining the universality of human needs and the spatio-historical particularity of satisfiers allows the approach to be anti-relativist and culturally sensitive at the same time.

Need satisfiers are connected in a hierarchical chain where each element has a necessary relationship with the higher-order elements. The need satisfier escalation framework substantiates the hierarchical relationship suggested by human need theory with the *systems of provision* consumption theory. Consumption is viewed as inextricably linked to production and the broader provisioning system. The need satisfier escalation framework specifies a vertical structure of four orders for a satisfier bundle. A product or technology (4^{th} order) is

[4]However, feminist political theorist Nancy Fraser foregrounds the political character of need *interpretations* in public discourse. With a particular view on welfare state societies and services, she highlights that any thick definition of needs is political in (1) the struggle to establish its status as legitimate political concern, (2) the struggle over sovereignty of need interpretation since it is by no means "unproblematic who interprets the needs in question and from what perspective and in the light of what interests" (Fraser 1989, 294) and (3) the struggle to secure its satisfaction.

[5]Gough (2014) defines serious harm as "fundamental disablement in the pursuit of one's vision of the good" or "impediment to successful social participation."

used to obtain a specific service (3rd order) required for the performance of activities (2nd order). All lower-order satisfiers operate within the socio-technical system of provisioning (1st order) which includes physical and social arrangements. The four satisfier orders are "highly interlocked, reinforce themselves and co-evolve" (Brand-Correa et al. 2020, 318).

Intra- and intergenerational need satisfaction conflict when need satisfaction conflates with carbon-intensive lower-order need satisfiers. A dilemma arises where need satisfaction of one group can only be achieved at the expense of others. While acknowledging cultural-historical variability, the first two theoretical elements cannot yet explain how need satisfiers have changed and, in particular, how they escalated in carbon intensity over time. To explain the escalation dynamics and thus the genesis of the dilemma, the need satisfier escalation framework recurs to *structuration theory* (Giddens 1984). Structuration theory conceptualizes change as socially emergent. The aggregate of intended and unintended consequences of individual decision-making, at a meso level, shape the conditions in which future decision-making takes place "in a non-reflexive feedback loop" (Giddens 1984, 14).[6] Since emergent system properties are both the result of and the medium for individual action, structuration theory posits the duality of agency and structure. It follows that need satisfiers are malleable by intentional and unintentional human action. Structuration processes are historically contingent and explain the specific spatio-historical shape of satisfiers as well as their escalation in carbon intensity over time.

Solving the dilemma between inter- and intragenerational needs requires to establish need satisfaction within planetary boundaries. Universal need satiation serves as the lower bound which must necessarily be secured. Planetary boundaries represent the upper bound which determine the permissible need satisfier carbon intensity as well as the remaining scope for want satisfaction.[7] For decarbonization to be just, it is required to prioritize need satisfaction of current and future generations over want satisfaction to the necessary extent and to decouple need satisfaction from carbon-intensive satisfiers. Decoupling requires de-escalating need satisfier carbon intensity. By intervening into structuration processes at the meso level, satisfier de-escalation implements alternative satisfier bundles to enable need satisfaction with minimum environmental impact. Due to the hierarchical relationship between satisfier orders, changes in the higher orders spiral down to all levels and are thus most effective for

[6]Structuration theory is not the only theory which accounts for path dependencies resulting from human behavior. The framework is in fact compatible with various theories of path dependency.

[7]Consequently, a sustainable consumption corridor becomes the goal of climate policy (Di Giulio and Fuchs 2014; Gough 2020). A similar idea is reflected in the concept of the safe and just space for humanity (Raworth 2012, 2017) and, more broadly, in the philosophical approach of sufficientarism. With infinite generations and zero intertemporal discounting, the scope for decoupling of need satisfaction and GHG emissions determines the corridor's lower level and width.

decoupling.

2.1.1 Application: Decarbonizing Transport

The need satisfier escalation framework clarifies that the car as a particularly carbon-intensive travel mode is not a need per se but acts as a satisfier for both wants and needs. In fact, the car as a product (4^{th} order) represents only the lowest-order element in the chain of satisfiers. It provides the service of mobility (3^{rd} order) needed to perform increasingly car-dependent practices, which are embedded into a distinct culture of car use (2^{nd} order). Overall, car use operates within a socio-technical system of provisioning characterized by urban sprawl, car-oriented infrastructure and public transit under-provision as well as car-supporting institutions and power relations (1^{st} order). Table 1 summarizes the chain of satisfier orders for transport.

Table 1: Transport satisfier chain

satisfier order	transport
1st: provisioning system	car-oriented infrastructure and land-use, institutions and power
2nd: activities	car-dependent practices, car culture
3rd: service	mobility
4th: product	car

Intra- and intergenerational need satisfaction conflict in case of car dependence. Car dependence is defined as "car use (4^{th} order need satisfier) [being] essential to be able to travel (3^{nd}) to access services, opportunities and social networks and/or to under-take practices (2^{nd}) which, within current societal structures (1^{st}), are essential for the satisfaction of human needs"(Mattioli 2016, 123).[8] Car dependence implies the conflation of need satisfaction and car use. This has, however, not always been the case. Instead, car dependence is a result of structuration processes. When cars were in their infancy more than a century ago, only a small wealthy subset of the population could afford to own them. In most cases cars served for leisure purposes and status consumption but were not required for need satisfaction on a broad scale (for a review Mattioli 2016). Structuration processes, however, reconfigured the role of the car in the satisfier chain. As a response to increasing motorization, urban

[8]The definition implies a meso-level understanding of car dependence: Car dependence exists at the level of trips or activities which highlights the role of materials, competences, and collective meanings involved in car use (Mattioli, Anable, and Vrotsou 2016). It does not imply that all trips undertaken with the car to access services are indeed car-dependent. Car dependence is a matter of degrees rather than a dichotomy.

planners reshaped the socio-spatial structure, tailoring land-use and infrastructure towards car use while dismantling public transit. In a feedback loop, the provision of car-oriented infrastructure exacerbated car dependence over time. Moreover, specific institutions and power relations perpetuate car dependence, including the economic and political power of the automotive industry (also see Mattioli et al. 2020).

Conflicts between intra- and intergenerational need satisfaction are strongest if equality in need satisfaction requires equality at the lower orders like car ownership or use. Yet the conflicts extenuate for equality with respect to higher-order elements like accessibility of services and opportunities. While currently often (only) accessible by car, these can theoretically be delivered in a multitude of ways, e.g. with low-carbon travel modes and/or with a reduced amount of travel if service locations were redistributed across space. To minimize the environmental impact of need satisfaction, transport de-escalation entails increasing availability and convenience of low-carbon travel modes (4^{th} order) as well as reducing service use intensity (3^{rd} order) in terms of travel distance and frequency required to access services and opportunities (2^{nd} order). The most effective interventions target the level of the provisioning system (1^{st} order) and include the prioritization of non-motorized means of transport in urban planning, the reconstruction and harmonization of public means of transport and the reversal of urban sprawl, but also involve deeper changes in socio-political power structures which perpetuate car dependence.

2.2 Gendered Power Relations in the Provisioning System

Couched into the language of the need satisfier escalation framework, this section demonstrates how the provisioning system is shaped by gendered power relations and, as a result, how both social arrangements and physical forms are distinctly gendered.[9] De-escalation interventions into the provisioning system aiming at decoupling need satisfaction and GHG emissions thus operate in a deeply gendered terrain.

2.2.1 The Gendered Division and Valuation of Labor

Gender fundamentally structures social relations and processes, including the division of labor (Harding 1986). The SoP views gender as a horizontal social relation which intersects with the vertical provisioning system (Bayliss and Fine 2020). I locate the gendered division of labor as manifestation of gendered power relations in the provisioning system. The gender division

[9]For the focus of this paper, I understand power as a *relation* of domination (Young 1990). Gendered power relations clearly do not represent an exhaustive approach to power. Others have made important contributions by focusing on elite power (Sovacool and Brisbois 2019) and, more specifically, the politico-economic power of the automotive industry (Mattioli et al. 2020).

of labor is a social arrangement and also referred to as *gender structure*. Following political theorist Nancy Fraser (1995), gender relations are characterized as bivalent. Accordingly, group differentiation occurs both along political-economic and cultural-valuational dimensions. Hence, the division of labor operates "between paid 'productive' labour and unpaid 'reproductive' and domestic labour, assigning women primary responsibility for the latter [as well as] within paid labour between higher-paid, male-dominated, manufacturing and professional occupations and lower-paid, female dominated 'pink-collar' and domestic-service occupations" (Fraser 1995, 78) and is inherently coupled with cultural devaluation of labor primarily assigned to women. Accordingly, both care work and the type of occupations coded as female are depreciated culturally. As a reflection of devaluation, care is not conceptualized as labor in dominant economic theories, hence ignored as unproductive. The notion of housework being "unproductive" , however, has only been constructed over the course of the 19th century (Folbre 1991) and is strongly entrenched with race and class (Davis 1981).[10] Feminist economists emphasize that social reproduction necessarily precedes economic production and should be included center-piece in any economic theory (Nelson 1995; Folbre 1994, 1995; Jochimsen and Knobloch 1993, 1997).

The division of labor manifests both at the societal aggregate as well as at the household level. Intra-household inequality continues to be overlooked by standard empirical measures of inequality (Woolley and Marshall 1994; Sauer, Rehm, and Mader 2020). Recent evidence for Germany reports an unadjusted gender pay gap of 21% (Statistisches Bundesamt 2017) and confirms that 75% of the gender pay gap can be attributed to differences in occupations and scope of employment. The division of labor also translates into gendered time use. In 2017, the gender care gap was found to be 52 % in Germany which amounts to 87 minutes per day (Sachverständigenkommission zum zweiten Gleichstellungsbericht der Bundesregierung

[10]In Anglo-Saxon societies, production for household use once used to be strictly sex-divided but equally valued as productive. It was only relegated to be "unproductive" in official census data over the course of the 19th century (Folbre, 1991). As a result, a distinctly gendered separation of the public and the private sphere emerged where contributions to the latter are assigned to women and framed in moral rather than economic terms (ibid.). The construction of the "unproductive housewife" in Anglo-saxon countries intersects with race and class. Embedded into renewed ideal of women's domesticity, the "unproductiveness" of the housewife relied on the availability of household servants to shoulder housework and as such was attainable for middle- and upper-class households only. By contrast, working-class women have long participated in the paid labor market out of necessity. In the U.S., Black women slaves were subjected to physical labor and punishment just as Black men (or worse) and as slaves did not even receive the small wage white working-class women did. Angela Davis points out that „[t]his was one of the supreme ironies of slavery: in order to approach its strategic goal – to extract the greatest possible surplus from the labor of the slaves – the black woman had to be released from the chains of the myth of feminitiy (..) She shared the deformed equality of equal oppression." (Davis 1981, 5–6). Additionally, Black slave women were responsible for domestic work for the slave community. While double-burdened, Black women's labor often prepared the ground for resistance (Davis, 1981).

2017).[11] As a result of gendered time use, women are more often time poor than men (Turner and Grieco 2000). Since also same-sex households tend divide labor unequally based on characteristics other than sex (Schneebaum 2013), especially once their partnership is officially recognized (Schneebaum 2020), it becomes clear that the division of labor is constructed around gender roles.

Importantly, gender intersects with race and class (Davis 1981; Crenshaw 1989). With respect to the division of labor, class and race cross-cut gender as the increasing participation of middle- and upper-class women in the paid labor market often leads to outsourcing care work to racialized or economically disadvantaged women (Duffy 2011), generally for a low wage and even involving transnational migration (Yeoh, Huang, and Willis 2000), rather than sharing care tasks more equally with men.

2.2.2 Androcentric Biases in Infrastructure and Urban Structure

By drawing on feminist geography, I demonstrate how gender structure produced androcentric biases in the built environment (see e.g. Hayden 1982; Mackenzie 1988; England 1991; Darke 1996; Fainstein and Servon 2005 for early contributions). In the following non-exhaustive review, I focus on androcentric biases in land-use organization and infrastructure design as core elements of the physical provisioning system.[12]

At the level of land-use, androcentric bias resides in urban sprawl. Increasingly sprawled suburbs spatially segregate the home from workplaces and supply sites (Mackenzie 1999). Dominated by single-family houses, they often lack public child care facilities. Urban sprawl is designed on the implicit assumption of a male breadwinner and female domestic maintenance, even if this household model is no longer is the norm and may even never have been more than an ideal (Hayden 1982). When two incomes are required, the socio-spatial form privileges a division where one partner is employed full-time while the other – most often the woman - assumes a dual role of care-giver and part-time income-earner (Mackenzie 1999). As a result, the post-war increase in suburbanization did not only serve an economic function of fuelling demand of consumer durables (Westwood and Glucksmann 1991) including cars (Mattioli et al. 2020), but also neatly separated the public and the private sphere as well as social groups.

[11] The gender care gap reports by how much the daily unpaid care work completed by women exceeds the daily unpaid care work completed by men on average.

[12] Beyond social relations expressed in the division of labor, prominent definitions of gender also include gender symbolism and the construction of gendered identities (Harding 1986; Law 1999) which I do not cover in this article (see Law 1999 for an alternative approach). By focusing on social relations and their effects on urban structure, I epistemologically follow what McDowell (1993a) classifies as feminist empiricism in contrast to standpoint and postmodern approaches to geography (McDowell 1993a, 1993b for early reviews of the two strands).

In the U.S., suburbanization also served the social function of spatial racial segregation (Boustan 2010). Overall, suburbanization is entrenched with the (re-)establishment of the gendered division of labor as well as with the spatial exclusion of racialized and economically disadvantaged communities (Beebeejaun and Modarres 2020).

Secondly, androcentric bias is built into the infrastructure layout and operation of roads and public transit (Helen Liggett 1992; Wekerle 2005). In many places both streets and tram line networks privilege radial journeys and public transit schedules are optimized for peak hours. By design, the transport system facilitates the direct commute to the workplace at peak times. By contrast, care-giving activities are mostly lateral, inter-connected multi-purpose trips throughout the day (e.g. Michelson 1985; Greed 2005a; Scheiner and Holz-Rau 2017). Given gender structure, the built infrastructure implicates androcentric bias which may translate into a sizeable "pink tax" , as Kaufman, Polack, and Campbell (2018) demonstrate for New York.

Androcentric biases result from urban and infrastructure planning which assume key roles in structuration processes. The aggregate of the gender division and valuation of labor, in a self-energizing feedback loop, led to a situation where urban structure was reshaped in a way which privileges paid labor over care labor. In many places planning has been (and continues to be) a white male-dominated profession (Hamilton et al. 2005 ; Christensen, Poulsen, and Oldrup 2007). Yet as MacGregor (1995) summarizes, bias in the built environment results from androcentric biases in the planning process and, more fundamentally, from the epistemology underlying the theoretical planning framework. While planners presume to plan for the general public, the "public (..) is defined in male terms" (MacGregor 1995, 33). Yet tailoring planning to a hypothetical average male citizen and his travel requirements presupposes a certain gender-divided household structure and universalizes a male experience. At a deeper level, the androcentric bias originates from the epistemological foundations of the planning framework and its in-built values and assumptions (Sandercock and Forsyth 1990; Law 1999 for a review). The dominant planning framework is rationalist, functional and one-dimensional; it presumes to be apolitical and objective, while instead serving powerful groups (MacGregor 1995).[13] The in-built assumption of what is valued as labor directly reflects gender structure since "(..) promoting economic development and supporting the working man's mobility, whether explicitly or implicitly, were seen as the main objectives of transport infrastructure planning. The typical male travel patterns of travel associated with paid employment and journeys to work was, and still is, privileged as the focus of research (..)

[13]This objection resonates with the broader feminist critique of dominant understandings of rationality and objectivity (Haraway 1988; Harding 1986; Nelson 1996).

women's mobility, not being obviously linked to the economy, did not seem to be important or significant"(Madariaga 2013, 51). As long as a biased planning framework is applied, the gender of the actual planner is only of subordinate importance.

Taken together, it is the bivalent character of gender relations which produces satisfier biases. While the gendered division of labor continues to privilege men to attain positions with decision-making power over infrastructure and urban structure, it is only the interconnection with the social valuation embedded into the dominant planning framework which produces androcentric satisfier bias. In this sense, satisfier choice reflects "culture" .

Importantly, in line with structuration theory, the built environment not only reflects gender structure but also shapes the margins for individual decision-making. If women continue to assume the major responsibility for care, androcentric biases in the built environment make it difficult to cater to multiple and conflicting requirements arising from paid and unpaid labor and, ultimately, may contribute to drive women out of (full-time) employment. Against the backdrop of persistent occupational and wage discrimination, it may appear as the rational choice in different-sex households for the woman rather than the man to renounce the full-time job, thereby naturalizing gender roles (Kern 2020). The built environment thus contributes to reinforcing asymmetric gender structure.

The very structuration processes in infrastructure and urban planning which reinforce car use simultaneously reinforce the gendered division of labor. Car dependence and the gendered division of labor interrelate. For instance, androcentric bias in public transit infrastructure and schedule may reinforce car dependence of care trips given that access to a car (and private childcare) is affordable (Greed 2005a). This interconnection, however, also implies that there is potential to attenuate car dependence and the gendered division of labor at the same time.

3 Empirical Evidence

The interaction of the gendered division of labor and androcentric biases at the 1st satisfier order may reverberate as gendered inequalities across the lower satisfier orders. A vast literature has consistently documented transport-related differences by gender (for reviews McDowell 1993a; Law 1999; Hanson 2010; Madariaga 2013) which can be mapped to the satisfier chain. Gendered differences have been documented for the 4th order car ownership or access (Rutherford and Wekerle 1988; Dobbs 2005) as well as the use of mobility services (3rd order) in terms of trip rates, time and distance travelled (Hanson 2010; Kersting et al. 2020 for reviews). Despite changes in magnitude, the finding that women are less mobile than

men has proven robust over time. Differences have also been documented for the use of other modes, notably public transit and, more recently, cycling (Shaw et al. 2020; Goel et al. 2021). At the 2nd order, car culture is strongly entrenched with masculinity and class (e.g. Gartman 2004; Jain 2005; Ivory and Genus 2010; Balkmar 2019). Gendered differences in trip purpose lead to gendered differences in 2nd order activities. In particular, gendered activities like child escorting and grocery shopping reveal a particularly high degree of car dependence (Mattioli, Anable, and Vrotsou 2016; Motte-Baumvol, Bonin, and Belton-Chevallier 2017; Manderscheid 2019). However, the evidence for different satisfier orders must be brought together from various studies which vary considerably in time and place of inquiry. Moreover, most analysis do not take an intersectional approach (but see Lee, Vojnovic, and Grady 2018).

To overcome those limitations, I provide descriptive evidence across all satisfier orders based on individual-level micro data from the German national travel survey *Mobilität in Deutschland 2017* (MiD). Beyond a rich set of socio-economic attributes, respondents report access to travel modes as well as their exact travel behavior for a record day.[14] I operationalize the four satisfier orders as follows: At the product level (4th order), I measure whether or not the individual has access to a car at any time, including a private car as well as car sharing.[15] At the service level (3rd order), I measure the number of trips, total distance traveled and time spent traveling on the record day, also differentiating by travel mode carbon intensity.[16] At the level of activities (2nd order), I differentiate trips taken for care purposes, including grocery shopping and escorting of others, from other-purpose trips.[17] I report participation in the paid labor market (1st order), differentiating for full-time and part-time employment.[18]

I disaggregate all outcomes by gender, economic class, and migration biography. Race is not elicited. While migration status may mask substantial heterogeneity among (post-)migrants (Sharpe 2019), it is not directly informative for the realities of racialized individuals which may fall into both groups. Information on gender is binary (with the option not to make a

[14]Record days are sampled randomly at the individual level in order to cancel out day-of-the-week or month-specific effects.

[15]All-time car availability is not necessarily identical with car ownership. If a household has fewer cars than eligible drivers, the measure is rather indicative of whether and how the household car(s) are shared.

[16]Carbon intensity can be classified for the main means of transport at the trip level as either high-carbon, including all types of car and motorbike usage, or zero- and low-carbon, including walking, cycling and all types of public transit.

[17]However, care trips are not accurately measurable as they are unnamed and must be retrieved from different categories. This is in line with Madariaga (2013)'s critique of conventional travel survey design. In particular, shopping and escorting may erroneously count trips for leisure as care trips. At the same time, some care trips may be hidden in the category 'errands' which I do not qualify as care purpose since the scope is too broad overall.

[18]Employment record does not include secondary employment, internships or responses with no hourly scope reported.

choice). Economic class is pre-classified on a 5-item scale from very low (1) to very high (5) based on household income. It may thus overestimate womens' actual disposable income in non-single households (Sauer, Rehm, and Mader 2020). I observe 117001 adult respondents from 92233 households with complete information on socio-economic attributes. 52% identify as male and 48% as female. 5% report a migration biography, 5% among men and 6% among women.[19] For a subset of 16262 households, both a female and a male adult member report to the MiD.[20] For the subset I also compute the intra-household difference in outcomes with the man as the baseline category. Yet note that the subset may not be representative for the overall sample. Individuals with missing information on the respective outcome are excluded for the analysis. For the intra-household analysis, the household is excluded if at least one partner reports a missing value.

Provisioning system: Employment Rates

While full-time employment rises in parallel to income group for all subgroups, a substantial gender gap persists conditional on income (Table 2). This is, however, not the case for part-time employment. As Table 3 evidences, part-time employment rates are much lower among men than among women and shares further decrease in income for men. By contrast, a consistent share of 30-40% of women is employed part-time across all income groups. These findings are consistent with the intra-household results (Table 4). For households with both partners observed, the share of households with the man being full-time employed and the woman being employed part-time or unemployed substantially rises in income.

Table 2: Full-time employment (in %)

income group	non-migr. male	migr. male	non-migr. female	migr. female
1	30.7	35.2	11.6	12.3
2	56.4	60.3	19.5	18.7
3	65.3	72.5	34.4	38.5
4	82.2	85.7	37.1	40.2
5	86.8	91.6	45.8	55.8

[19]Migration biography is reported based on self-assessment. The share of self-reported (post-)migrant is significantly smaller than in official statistics (Bundeszentrale für politische Bildung 2020). Figure 2 in the Appendix shows the distribution of income group by gender and migration status.

[20]Same-sex households are not investigated since their number is too limited in the data set to be statistically meaningful.

Table 3: Part-time employment (in %)

income group	non-migr. male	migr. male	non-migr. female	migr. female
1	8.9	9.3	30.7	27.5
2	9.8	8.4	40.8	33.7
3	6.0	6.9	32.5	29.4
4	4.6	4.1	43.3	37.9
5	3.9	2.5	35.6	28.7

Table 4: Households with only men full-time employed (intra-household subsample, in %)

income group	%
1	3.6
2	3.5
3	10.2
4	26.5
5	39.8

Activities: Number of Care Trips on Record Day

On average, women complete significantly more trips with care purposes (Welch's p=0.00). The gendered difference is independent of income group and driven by parenthood (Table 5 and Table 11 in the Appendix). While the median is higher among mothers than among women overall, it is zero for fathers and all men alike. Similarly, at the household level, the woman partner completes an equal or higher number of care trips than the man in 75% of observed different-gender households, irrespective of income (Figure 1).

Table 5: Median care trips among parents on record day

income group	non-migr. male	migr. male	non-migr. female	migr. female
1	0	0	2	1
2	0	0	2	1
3	0	0	2	1
4	0	0	1	2

income group	non-migr. male	migr. male	non-migr. female	migr. female
5	0	0	2	1

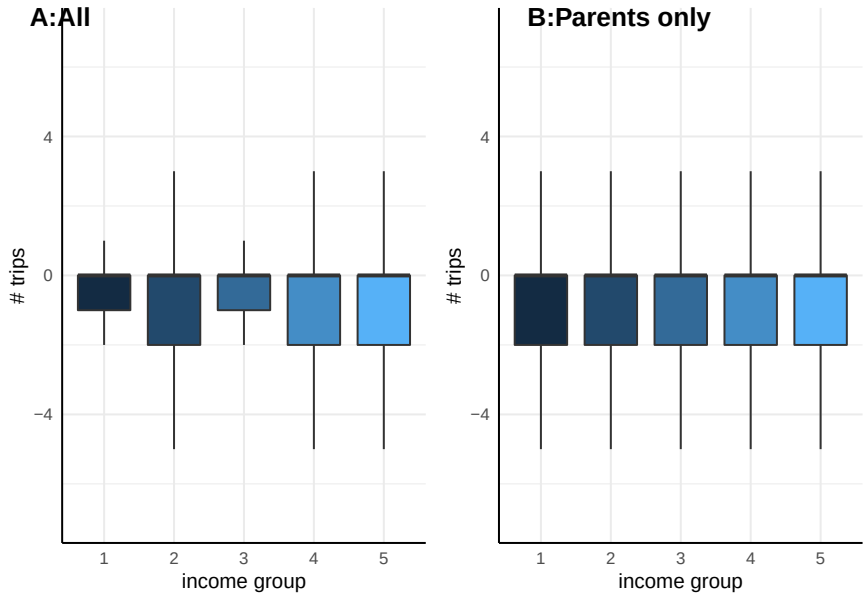

Figure 1: Difference in record-day care trips (intra-household subsample)

Service Use: Mileage Traveled, Time Spent, Trip Rates on Record Day

Record-day mileage and travel time are most closely related to income.[21] As a group, women travel significantly fewer kilometers, they spent less time traveling and take fewer trips on average (all Welch's p=0.00). Within both gender groups, (post-)migrants tend to travel more or equally in the lower income groups but less in the higher income groups than individuals without migration biography. Across subgroups, similar travel distances do not necessarily translate into similar travel times which indicates differences in modal split. Especially low-income groups with migration biography take longer for completing shorter distances. Differentiating by travel mode carbon intensity, women use more low- and zero-carbon means of transport across all income groups, but usage decreases in income (Figure 5 in the Appendix). At the household level, a higher share of men travels more both in terms of time and distance than their female partners than the reverse (Figure 6 in the Appendix). Median trip rates in Table 8 differ by migration status rather than gender.

[21] Additional boxplots can be found for all outcome variables in the Appendix. All boxplots exclude outliers.

Table 6: Median mileage (in km)

income group	non-migr. male	migr. male	non-migr. female	migr. female
1	17	18	15	16
2	22	22	17	16
3	23	21	18	17
4	32	28	25	20
5	34	25	26	21

Table 7: Median time spent (in min)

income group	non-migr. male	migr. male	non-migr. female	migr. female
1	70	80	70	80
2	80	75	74	70
3	80	80	75	75
4	88	85	80	80
5	95	85	85	90

Table 8: Median number of trips

income group	non-migr. male	migr. male	non-migr. female	migr. female
1	3	2	3	3
2	3	3	4	3
3	4	3	4	3
4	4	3	4	3
5	4	4	4	3

Product: All-time car access

92 % of all individuals report to own at least one household car. As Table 9 demonstrates, all-time car access is closely associated to household income in all subgroups. A sizeable gap based on migration status exists yet narrows down for men as income increases. The share of households reporting all-time car access only for one partner shrinks as income increases (Table 10). The share of households where the man reports all-time car access and the woman

does not is higher than the reverse case but the gap also decreases in income.

Table 9: All-time access to car (in %)

income group	non-migr. male	migr. male	non-migr. female	migr. female
1	70.0	51.0	68.0	55.8
2	83.0	70.1	75.9	64.5
3	90.1	80.7	84.5	69.7
4	92.1	87.4	90.3	81.3
5	93.5	88.3	92.0	80.2

Table 10: All-time car access (intra-household subsample, in %)

income group	m=yes|f=no	m=no|f=yes
1	12.0	9.4
2	11.3	6.8
3	9.1	5.0
4	6.7	4.8
5	5.4	4.1

Overall, the data provides descriptive evidence for gendered inequalities along the satisfier chain with respect to transport. In particular, I document a sustained gendered division of paid and unpaid labor (1^{st} order) which translates into gendered activity patterns in terms of care trips (2^{nd} order), especially for parents. While gendered inequalities exist on average across all satisfier orders, higher household income and absence of migration biography mitigate the respective gender gaps at the lower orders to some extent.

The descriptive evidence suggests that gendered power relations in the provisioning system as outlined in section 2.2 indeed reverberate as gendered inequalities across the satisfier chain. This result may have implications for need satisfaction and thus, ultimately, for justice. Yet from a welfare theoretical perspective, injustice cannot be directly inferred from inequality. Descriptively exposing inequalities amounts to "limited claim making" which lacks normative content about justice (Walker 2012). Limited claim-making assumes "that evidence of spatial-distributional inequalities can be simply equated with injustice, (...) without needing

to explain for what reason(s)" (Walker 2012, 13). Based on the need satisfier escalation framework, claiming injustice due to lower-order inequalities presupposes the carbon-intensive satisfier chain to be necessary for need satisfaction. This, however, is not inevitable due to contextual and malleable nature of satisfiers. Moreover, observed disparities may result from both want and need satisfaction while only needs are relevant for justice. Hence, the descriptive evidence on gendered inequalities along the satisfier chain is substantiated with a normative account of justice in the following section.

4 Reconceptualizing Justice

This section develops the normative implications of gendered power relations for justice in need satisfaction in general and transport decarbonization in particular. I first elaborate the account of justice implied by the need satisfier escalation framework and characterize it in welfare theoretical terms. Building on feminist welfare theorist Susan Okin (1989), I integrate gendered power relations into the account of justice in need satisfaction and derive conditions for satisfier de-escalation in transport.

While not being a fully specified theory of justice, the need satisfier escalation framework conceptualizes justice as inter- and intragenerational equality in need satiation. With needs as a threshold concept, justice refers to end-states of whether or not needs are satiated. Since needs are attributed to individuals, the implied account of justice is ethically individualistic (Robeyns 2003): While needs need not necessarily be ontologically individualistic, the individual is the only relevant unit for the normative judgement of justice. At the same time, following the eudaimonic school, the individual is understood as part of a social system. Individual need satisfaction is sought within the socio-technical provisioning system which is intervowen with and constituted upon social systems and arrangements (Miller, Richter, and O'Leary 2015; Kivimaa and Kern 2016; Bayliss and Fine 2020).

Recognizing the individual as embedded into a social system, however, directs attention to inter-personal relations. The SoP acknowledges that the provisioning system within which need satisfaction operates is "constituted upon and, in turn, constitute and reproduce relations of class, gender, race, caste, etc, contingent upon who exercises power" (Bayliss and Fine 2020, 57). Recognizing that social relations are characterized by power and are, among others, distinctly gendered reveals that gender relations are not be symmetric but "hierarchical, patriarchal and asymmetric" (Knobloch 2014).

Given their asymmetry, I argue that integrating gender relations into the conception of justice is in fact necessary for an account which takes the individual as its normative basis

to be accurate. Both instrumental and intrinsic reasons can be asserted. Instrumentally, asymmetric gendered power relations may affect the individual condition for need satisfaction. For both material and immaterial needs, asymmetric social relations may cause systematic inter-individual heterogeneity in whether or not needs can be fully satiated and are thus instrumentally relevant for equality in need satiation. Even more so, for immaterial needs with procedural character satisfaction inherently depends on social relations.[22] For this type of need, satiation may be impossible if the social relations in which need satisfaction is sought are asymmetric. Hence, procedural needs necessitate justice in the social relations as a precondition for equality in need satisfaction to be achievable. In addition, even if asymmetry in the social relations are not causally linked to injustice in end-states, asymmetric gendered power relations, by their very nature, are to be considered as a question of justice (Knobloch 2014). Accordingly, it is possible that needs are universally satisfied but injustice remains as long as need satisfaction is established in asymmetric social relations.

In view of gender structure, Okin (1989) argues that any satisfactory theory of justice needs to (i) theorize the household as one cardinal point where gender power relations materializes as well as (ii) include the equality of opportunity (Okin 1989, 171:14). Applying these conditions to justice in need satisfaction, as I will argue, extends justice from the end-states of whether or not needs are satisfied to also include justice in inputs disposable for and conversion rates faced in need satisfaction processes.

Building on Okin (1989), I develop the implications of gendered power relations for justice in need satisfaction. *Firstly*, the intra-household division of labor required for need satisfaction has to be chosen freely. This proposition refers to the intra-household division of labor and time inputs for need satisfaction as well as to the process of how the division comes about. It highlights the need to account for the interconnected dimension of need satisfaction processes at the household level in a conception of justice. While needs do not ontologically exist at the household level, individuals may not complete the required tasks atomistically but organize task division among cohabitants for needs where a division of labor is possible. An intra-household division of labor for need satisfaction is most evident for the more material needs like subsistence (Max-Neef 1991) which requires both monetary income as well as care labor. Yet it may also apply to immaterial needs like mental health, understanding or significant primary relations (Doyal and Gough 1991) since they, too, crucially depend on care and emotional labor which may be divided unequally. Gender structure implies that task sharing often runs across a distinctly gendered line. Given the asymmetry of gender

[22]Immaterial needs with procedural character are affiliation and play in Nussbaum (2003), participation, understanding and affection in Max-Neef (1991) and participation and significant primary relationships as proposed by Doyal and Gough (1991).

power relations and culturally constructed gender roles, choosing the intra-household division of labor freely can be considered a minimum requirement for justice without invoking a particular theory of justice. Since also same-sex households tend to engage into systematic division of labor between partners based on gender roles (Schneebaum 2013, 2020), the proposition is not limited to a particular household type.

Secondly, justice requires equality in opportunity to achieve full need satiation. Equality in opportunity is a function of disposable inputs and conversion rates faced in the process of need satisfaction. As a result of gender structure, both may be distinctly gendered. The division of labor both at the intra-household and societal level contributes to disparities in the available inputs for need satisfaction, including material resources but also time inputs available for one's own need satisfaction. For instance, being heavily burdened with household labor may constrain the time needed to entertain significant primary relationships or to exercise opportunities to participate which Doyal and Gough (1991) list as universal needs. Moreover, as in the case of transport, androcentric biases in the built environment imply that lower levels of need satisfaction are retrievable ceteris paribus on input for care trips relative to journeys from and to the workplace. As demonstrated in Section 2.2, care trips continue to be predominantly carried out by women. Consequently, androcentric biases in the built environment imply gendered conversion rates. Thus, equal opportunity for need satisfaction requires the equalization of conversion rates in the built environment.

Finally, I apply the justice implications of gendered power relations to car dependence and transport decarbonization. I have demonstrated that the built environment generates gendered conversion rates which constrain equality of opportunity to satisfy needs. This result has implications for justice in transport decarbonization. The need satisfier escalation framework has already established that transport decarbonization needs to suspend car dependence to solve the dilemma between inter- and intragenerational need satisfaction. Yet as Greed (2005b) has pointed out early on, a more sustainable city is not automatically less sexist (also see Dengler 2020 in a similar vein). Taking gendered power relations into account, justice additionally requires the equalization of conversion rates. Consequently, transport decarbonization needs to couple equality in need satiation with equality of opportunity to satisfy needs to be just. Technically, interventions into infrastructure and urban structure need to equalize conversion rates for care relative to paid employment and commuting *while* de-escalating need satisfier carbon intensity. When designing de-escalation interventions, only those discontinuing car dependence while enabling short-distance, low-carbon travel for care can be considered just and should be preferred.

Depending on whether or not transport decarbonization policy it is linked to a societal

reorganization of labor, equalizing conversion rates for care relative to commuting will be affirmative or transformative (Fraser 1995). Transport de-escalation can be classified as affirmative if it redresses barriers to care labor in the built environment but does not interfere with the gendered division of labor. In this case, while transport will be low-carbon and care trips easy to complete, gendered differences in activities and the resulting disparity in travel patterns persist. By contrast, transport de-escalation seeks a transformative approach to justice if linked to policies which disrupt gender structure. Policies aiming at the reorganization and revaluation of labor diminish systematic gendered differences in activities as gender roles dissolve.

5 Conclusion

In this paper, I develop the implications of gendered power relations for justice in transport decarbonization. I build on the need satisfier escalation framework developed by Mattioli (2016) and Brand-Correa et al. (2020) and its conception of justice as equality in need satiation. Accordingly, decarbonization needs to establishing universal need satisfaction without overshooting planetary boundaries in the aggregate to be just. Besides prioritizing needs over wants, justice in need satisfaction requires to reverse the escalating trend of need satisfier carbon intensity by intervening in the satisfier chain. The satisfier chain consists of four hierarchical orders. In transport, the car is a product (4^{th} order) which provides the service of mobility (3^{rd} order) which in turn is necessary to perform activities (2^{nd} order). All lower satisfier orders operate within the provisioning system (1^{st} order), which includes both physical infrastructure and urban structure and social arrangements like institutions and power.

Drawing on feminist geography and welfare theory, I demonstrate how the provisioning system is deeply gendered and develop the implications for justice in transport decarbonization. At the level of the provisioning system, gendered power relations manifest as a significant gendered division and valuation of labor which also translates into androcentric biases in the built environment. Descriptive empirical evidence suggests that gendered power relations reverberate as gendered inequalities along the entire satisfier chain yet intersect considerably with household income and migration status in the lower orders. Since descriptive inequalities cannot directly be equated with injustice, I develop the implications of gender structure for justice in need satisfaction. I argue that a conception of justice recognizant of asymmetric gendered power relations extends justice to inputs for and conversion rates faced in the process of need satisfaction. Building on Susan Okin (1989), I establish two propositions for

justice which act as necessary complement to equality in need satiation as long as gender structure persists. Firstly, the intra-household division of labor for need satisfaction needs to be chosen freely. This propositions refers to the intra-household division of labor and time inputs for need satisfaction when contributions can be split among cohabitants and to how their division comes about. Secondly, justice demands equality in opportunity to satiate needs. Since androcentric biases in the built environment create gendered conversion rates, they ultimately constrain equality of opportunity for need satisfaction. Consequently, need satisfier de-escalation must couple equality in need satiation with equality of opportunity to satisfy needs to be just. For the particular case of transport, the result implies that decarbonization needs to equalize conversion rates for care relative to paid employment *while* de-escalating need satisfier carbon intensity.

This result may serve as a basis to design just de-escalation strategies. It also resonates with calls for gender mainstreaming of transport policy which have been advocated at the EU level (Christensen, Poulsen, and Oldrup 2007; Madariaga 2013). In particular, the framework proposed by Madariaga (2016) may serve to build the conceptual links between a mobility of care and the requirements deep decarbonization poses for transport policy. Moreover, recent evidence on the growth potential of cycling has demonstrated the benefits of integrating a gender equity lense into low-carbon infrastructure planning. Goel et al. (2021) suggest that equalizing conversion rates for care relative to commuting when expanding cycling infrastructure is necessary to unlock the full potential of cyling as a low-carbon travel mode. In a cross-country analysis, the authors evidence that women are under-represented when cycling levels are low and that they may suppress demand the most. However, female representation is (over-)proportional when infrastructure encourages cycling. In this case, non-work trips also account for a similar or higher share of trips taken by bike as commuting to work. The authors conclude that catering cycling infrastructure to care trips is crucially important for cycling growth to be equitable but also for its maximum growth potential to unfold. As a result, equalizing conversion rates in cycling infrastructure expansion translates to focusing attention on cycling lanes to schools and supply sites and making neighborhoods cycling-friendly in addition to building fast lanes for efficient commuting. Further research is needed, however, to substantiate our understanding of how gender justice and de-escalation interventions interact and to trace the implications for the optimal design of transport policies. As these results suggest, integrating gendered power relations into climate policy design has the potential to attenuate car dependence and gender injustice at the same time.

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Appendix

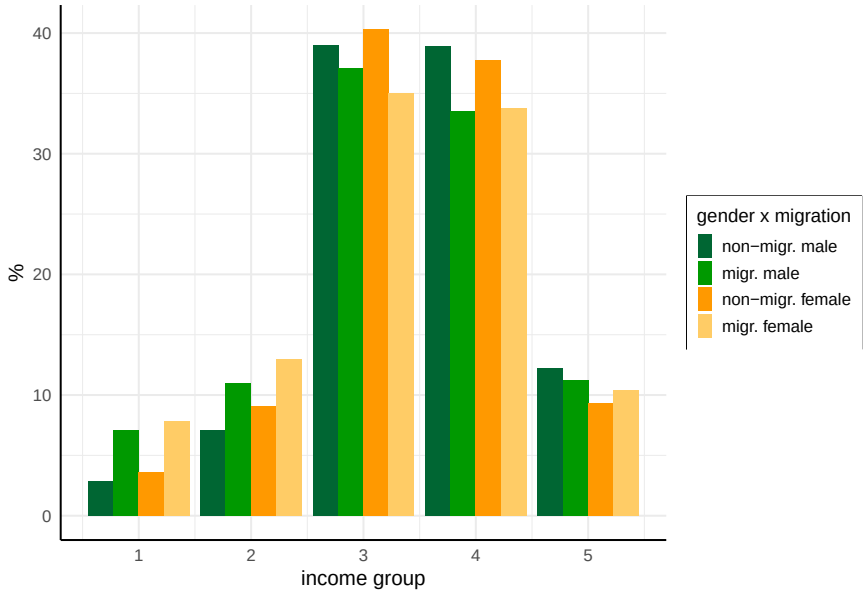

Figure 2: Income group by Gender and Migration Status

Table 11: Median number of care trips

income group	non-migr. male	migr. male	non-migr. female	migr. female
1	0	0	0	0
2	0	0	1	0
3	0	0	0	0

income group	non-migr. male	migr. male	non-migr. female	migr. female
4	0	0	0	0
5	0	0	0	0

All boxplots excluding outliers.

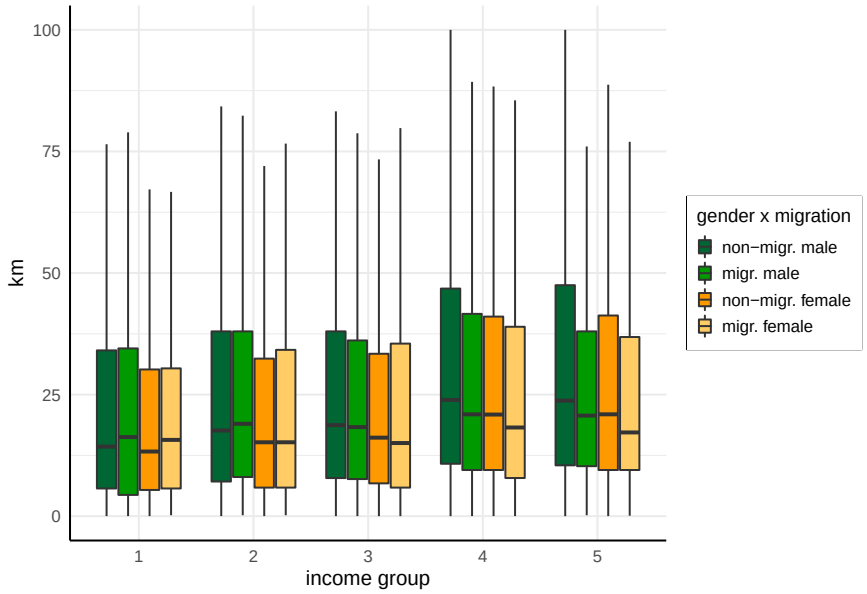

Figure 3: Record-day mileage

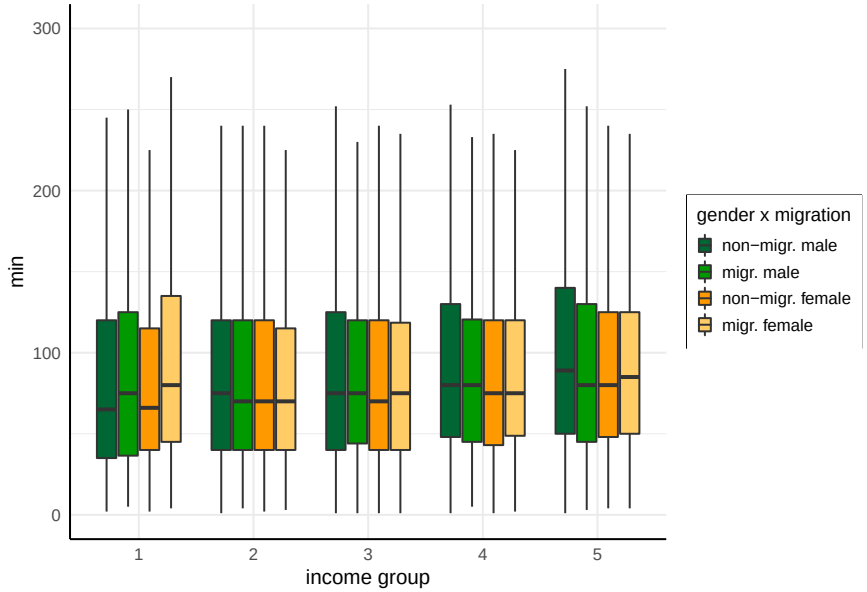

Figure 4: Time spent travelling

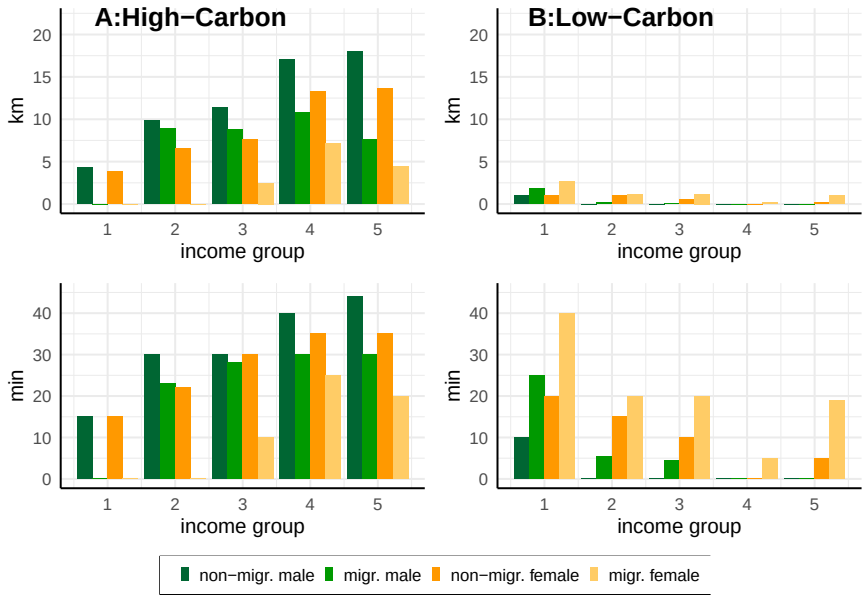

Figure 5: Median distance and time by means of transport

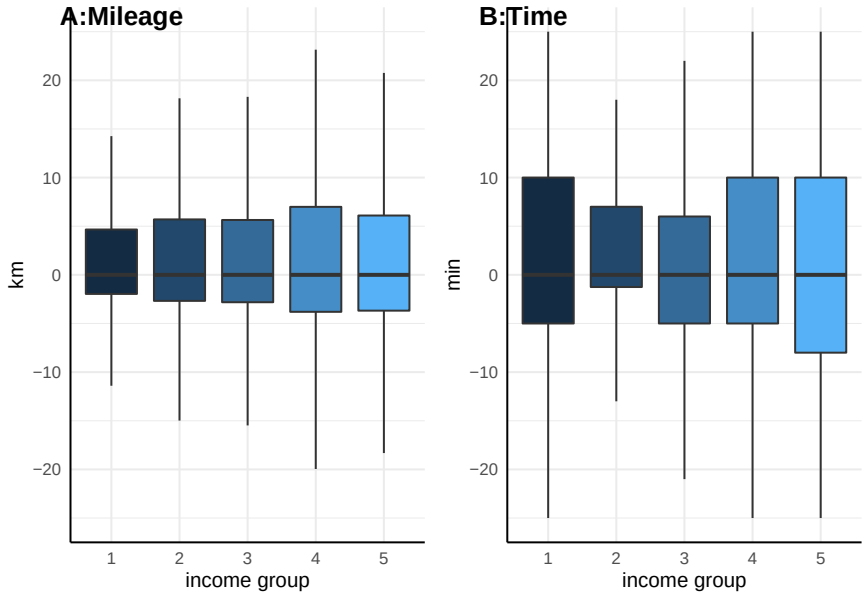

Figure 6: Intra-household difference in mobility

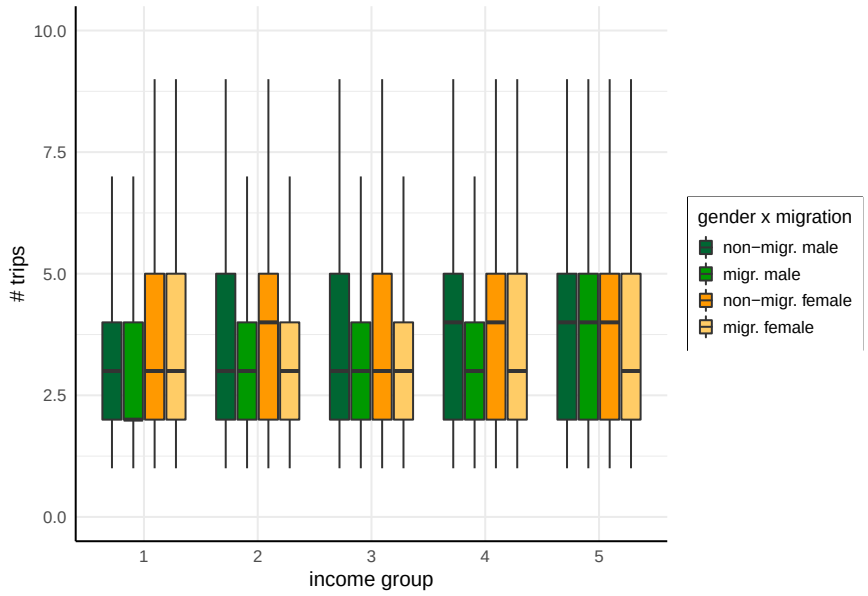

Figure 7: Number of trips

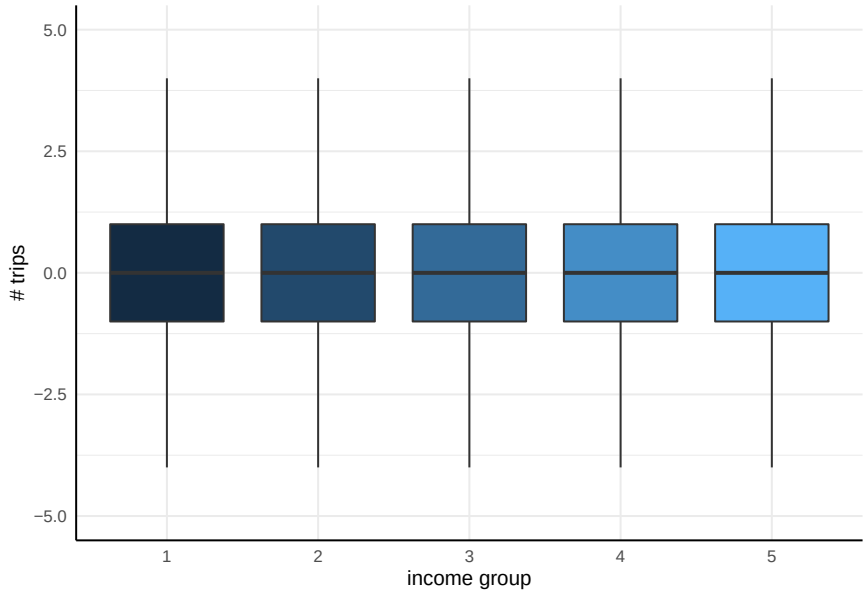

Figure 8: Intra-household trip difference

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