Toward feminist geographies of cycling

Léa Ravensbergen | Ron Buliung | Nicole Laliberté

Department of Geography and Programs in Environment, University of Toronto Mississauga, Canada

Correspondence
Léa Ravensbergen, Department of Geography and Programs in Environment, University of Toronto Mississauga, Room 3211 Davis Building, 3359 Mississauga Rd. N., Mississauga, ON L5L 1C6, Canada.
Email: lea.ravensbergen@mail.utoronto.ca

Funding information
Social Sciences and Humanities Research Council of Canada

Abstract

Using a systematic search strategy, this paper reviews the literature about gender and cycling and critically assesses existing approaches to study the topic. Most studies use a binary conceptualization of gender, a cross-sectional research design, and quantitative analysis to examine male–female differences in cycling behaviours, stated concerns, correlates, and barriers. The two hypotheses at the centre of most of this work are (1) that women cycle less than men due to greater safety concerns and (2) that women cycle less, or at least use bicycles differently than men, because of their more complex travel patterns that arise from greater household responsibilities. While the literature draws attention toward travel characteristics, it often relies on a simple binary conceptualization of gender. In doing so, it identifies differences in male–female cycling patterns, but it rarely sheds light on the gendered processes underlying these differences. In this paper, we argue that research into cycling as a form of mobility could be strengthened by engaging with feminist theories such as performativity, intersectionality, and embodiment to advance a more nuanced understanding of how gender and other axes of identity are intertwined with cycling.

KEYWORDS
cycling, embodiment, feminist geography, gender, intersectionality, literature review, performativity
Received: 9 October 2018 Revised: 24 May 2019 Accepted: 5 June 2019
DOI: 10.1111/gec3.12461

1 | INTRODUCTION

In the late 1970s, transportation research and planning were critiqued for being gender-blind: for ignoring genderbased differences in mobility and accessibility to urban space (Giuliano, 1979; Rosenbloom, 1978). While this critique resulted in a surge of interest and publications on the topic, the geographer Robin Law argued in her 1999 review paper that the issues and theoretical frameworks used to study gender and transport remained limited in scope. Specifically, she demonstrated that the field remained largely concerned with travel behaviour and policy, and the debate about the shorter commutes of female workers tended to overshadow other research questions. Law (1999) proposed an alternative approach to the study of gender and transport, one that would use a more systematic theory of gender as a category in social life.

Eleven years following Law's critique, Hanson (2010) reviewed research on gender and mobility to question how the then-current knowledge of these topics could inform development of sustainable mobility policies. Hanson (2010) identified two strands of thinking about gender and mobility in the academic literature that remained largely discrete and disconnected from each other. One of the two strands of thinking concerned how gender shapes mobility, studies that measure mobility or travel in great detail, generally through the use of large, national secondary datasets or activity-travel diaries, but tend to take a simplified view of gender as the male/female sex binary. This body of work is characterized by issues pointed out by Law (1999) in that it identifies patterns but does not delve deeply into the gendered processes underlying such patterns (Hanson, 2010). The second stream of research Hanson (2010) identified is concerned with how mobility shapes gender, in which the social constructions of gender are thoroughly examined but travel characteristics are not deeply considered. These studies usually make use of qualitative methods that pay close attention to context, emphasize the social environment, and focus on women's lived experience (Hanson, 2010). Hanson (2010) urged future researchers to integrate these two strands of thinking in order to pursue sustainable transport outcomes.

In this paper, we conduct a systematic review of transportation literature on gender, with a focus on cycling, in the two decades since Law's (1999) critique and the 9 years since Hanson's (2010) work. We focus on cycling in this

paper because the conversation about cycling and gender is as old as the bicycle itself (Garvey, 1995; Strange & Brown, 2002). Social historians and scholars working in other disciplines have studied how cycles acted as a disruptive force, "threatening" the normative framing of gender identities and roles as early as the late 18th century (Garvey, 1995; Mackintosh & Norcliffe, 2007; Strange & Brown, 2002). In addition, cycling is gaining attention in contemporary research due to its potential to play a key role in sustainable urban mobility. Furthermore, this contemporary research focusing on urban regions in Canada, the United States, the United Kingdom, and Australia has identified a "gender gap" in this sustainable mode of transport whereby men have been found to cycle more for both recreation and transport than women (Emond, Tang, & Handy, 2009). In some cases, data suggest that as many as two thirds of commuter cyclists are male in these places (Emond et al., 2009). The gender gap appears to exist mainly in cities with low cycling rates, while in cities with high cycling rates, an equal proportion of men and women cycle for transportation (Emond et al., 2009).[1] This gender-based mode share gap has been engaged within policy and advocacy as well. As an example, consider the Copenhagenize Bicycle Friendly City Index, an inventory and ranking of bicycle-friendly cities, which includes a "gender split" parameter that awards cities points for exhibiting a small gender gap in cycling (see http://copenhagenizeindex.eu/criteria.html). While the bicycle is often discussed in relation to gender and sustainable mobility, the ways in which the recent academic literature has approached this topic, and more specifically whether it has incorporated thinking by scholars such as Law (1999) and Hanson (2010), have yet to be examined.

The paper begins with a description of the systematic search strategy used to assemble the reviewed studies. Then, the literature on gender and cycling is summarized, and methodological approaches are reviewed. We found that many of the problems identified through Hanson and Law's earlier analyses of the literature persist today. We argue for more research on cycling that considers gender deeply, as well as research that integrates extensive analysis of mobility and intensive analysis of gender. To enable a feminist geography of cycling, Section 5 begins to describe a project of working through and with three theoretical concepts used in feminist geography, namely, performativity, intersectionality, and embodiment. The paper concludes by outlining the implications for cycling research and policy of framing gender and, more broadly identity, using feminist theory that has informed geographic scholarship.

2 | REVIEW PROCESS

A systematic search and review process was used to identify peer-reviewed articles on gender and transport cycling. This type of review process aims to employ an exhaustive, comprehensive search strategy, followed by a critical review of the identified literature (Grant & Booth, 2009). The lead author developed the search protocol with input from a reference librarian at the University of Toronto's Robarts Library. Searches for the following three terms in conjunction (using the "AND" operator) were applied to titles and abstracts of five multidisciplinary databases (IBSS (International Bibliography of the Social Sciences), Sociological Abstracts, Geobase, ASSIA (Applied Social Sciences Index and Abstracts), and MEDLINE):

1 Cycling: bike* OR bicycl* OR cycl*

2 Gender: sex* OR gender* OR m?n OR wom?n OR male* OR female* OR girl* OR boy* OR masculin* OR feminin*

3 Transport: travel* OR transport* OR commut* OR utilitarian OR "non-motori?ed mode*" OR "non-motori?ed transport*"

Searches took place in September 2018. Because our aim was to assess academic work published since Hanson's (2010) and Law's (1999) publications, articles also had to be published since 2000 and be peer-reviewed. No geographical restrictions were applied. All identified articles were written in the English language, which may have produced bias toward research performed in English-speaking places. The initial search produced 1,466 publications across five databases. The five databases did not include papers from the *Transport Research Record* (TRR), *Journal of the Transportation Research Board*. An adapted search protocol was used to engage directly with the TRR. The third search term "transport" was removed as all articles published in this journal relate to transport and as the terms gender and cycling were only applied to article titles. This was done because the TRR's database does not include an abstract search function. A total of eight articles were identified through theTRR search.

A multi-step screening process was used to distinguish articles relevant to the topic of gender and transport cycling (Figure 1). Duplicates were removed, and then titles and abstracts were reviewed for relevance. Many papers were excluded during the title and abstract review process due to their clear focus on biomedical cycles, rather than bicycling (e.g., menstrual cycles and hormonal cycles). The full texts of the 125 remaining articles were assessed for eligibility. Articles that discussed cycling, but not in relation to gender, were excluded. For example, some examined gender differences in active travel but did not discuss cycling separately from walking. Articles that reported male–female discrepancies in cycling behaviours without interpretation were also excluded. A total of 64 articles were excluded, producing 61 articles (57 from the five databases and four from the TRR) for review.

3 | RESULTS

Most studies (n = 49) used quantitative methods to compare how cycling behaviours, correlates, barriers, or concerns

varied between male and female respondents. A further seven articles used qualitative methods, three used mixed methods, and two were literature reviews. Most articles originated from the United States (n = 14), the United

Kingdom (n = 9) or other European countries (n = 12), and Australia (n = 9). Twenty articles were primarily concerned with examining gender and cycling, while 41 did so as a secondary focus. Two hypotheses were frequently discussed to explain the gender gap in cycling: women's greater concern over safety and male–female differences in trip characteristics, often in relation to women's greater responsibility for household labour. In fact, 36 articles discussed the "risk-aversion" hypothesis, while 14 articles considered male/female differences in trip characteristics. Six of these articles discussed both themes. A summary of all studies included is presented in Appendix A.

3.1 | Concern over safety

The majority of articles that examined gendered risk arrived at this conclusion by comparing male and female responses (ascertained through self-identification) to travel survey questions (n = 15). Female respondents identified safety indicators as greater barriers to cycling than did male respondents (Delmelle & Delmelle, 2012; Dickinson, Kingham, Copsey, & Pearlman Hougie, 2003; Troped et al., 2001; Van Bekkum, Williams, & Morris, 2011; Wittman, Savan, Ledsham, Liu, & Lay, 2015), perceived roads or existing infrastructure as less safe or satisfactory than did male respondents (Manton, Rau, Fahy, Sheahan, & Clifford, 2016; Nelson & Woods, 2010; Stronegger, Titze, & Oja, 2010), or described greater concern over safety indicators (e.g., vehicular traffic and lack of bicycle infrastructure) than did male respondents (Akar, Fisher, & Namgung, 2013; Twaddle, Hall, & Bracic, 2010). Other survey-based studies found that safety indicators were statistically stronger correlates of bicycling behaviour for women than men (Akar et al., 2013; Emond et al., 2009; Mitra & Nash, 2018; Orstad, McDonough, Klenosky, Mattson, & Troped, 2016; Van Cauwenberg et al., 2012). Furthermore, Alveano-Aguerrebere, Ayvar-Campos, Farvid, and Lusk (2017) and Van Holle et al. (2014) found evidence for women's greater concern over safety by asking respondents to rate possible cycling commute environments.
FIGURE 1 Overview of the systematic review process

Four observational studies found evidence for the risk-aversion hypothesis (Beechman & Wood, 2014; Garrard, Rose, & Kai Lo, 2008; Parker, Gustat, & Rice, 2011; Zanotto & Winters, 2017). Studies also found support for the safety hypothesis through reported behaviour (i.e., women reported cycling more frequently off-road while men reported doing so more frequently on-road) (Heesch, Sahlqvist, & Garrard, 2012) or stated preference for greater separation from traffic (Aldred, Elliot, Woodcock, & Goodman, 2017). Women indicated greater concerns over safety than did men in two articles using qualitative methods as well (Karkie & Tao, 2016; Mosquera et al., 2012). For example, in Mosquera et al.'s (2012) qualitative study, female interviewees and focus group participants stated that they felt more vulnerable to personal attacks, injuries, and theft while cycling than did men. Four articles examined the effects of gendered parental perceptions of safety on children's cycling behaviours (Carver et al., 2005; Hsu & Saphores, 2014; Nevelsteen, Steenberghen, Van Rompaey, & Uyttersprot, 2012; Trapp et al., 2011). Finally, some studies did not provide empirical evidence for the safety hypothesis but cited literature on gendered concern over safety (Bell, Garrard, & Swinburn, 2006; Fishman, 2016; Ji et al., 2017; Noyes et al., 2014; Tayhan, Cornish, Boyd, Joshi, & Macleod, 2016; Teschke, Koehoorn, Shen, & Dennis, 2017; Wang, Akar, & Guldmann, 2015).
Concern over safety frequently refers to concern of physical injury due to collisions or accidents, often in relation to infrastructure presence (Akar et al., 2013; Damant-Sirois & El Geneidy, 2015; Manton et al., 2016). Sometimes, however, stated safety concerns related to fear for personal safety (e.g., crime, attacks, and assault) (Van Cauwenberg et al., 2012), or to both injury and personal safety (Mosquera et al., 2012). In one article, women's greater concern over safety was discussed in relation to air pollution and related illnesses (Zhao, Shengxiao, Peilin, Liu, & Long, 2018). At other times, the source of this concern remained unspecified (Troped et al., 2001). Males also tended to have safety concerns or a preference for cycling infrastructure but appeared to raise such issues less often, or to a lesser extent, than did females (Aldred et al., 2017; Heesch et al., 2012).

3.2 | Trip characteristics

The second frequently discussed theme concerned male–female differences in trip characteristics. Eight articles found that men and women use bicycles for different activities (e.g., Beecham & Wood, 2014; Brey, Castillo-Manzano, & Castro-Nuno, 2017; Damant-Sirois & El Geneidy, 2015; Fyhri & Fearnley, 2015; Goodman & Cheshire, 2014; Ji et al., 2017; Nehme, Perez, Ranjit, Amick, & Kohl, 2016b; Sahlqvist & Heesch, 2012). These gendered differences in cycling activity-travel or trip characteristics are frequently discussed in relation to the unequal distribution of household labour. Women today still tend to hold greater responsibility household tasks such as grocery shopping, chauffeuring children, and running errands (Scheiner & Holz-Rau, 2017). When this is the case, women tend to organize their daily trips into efficient trip-chains: i.e., making one or more stops on the way to the final destination (e.g., dropping off children during the commute to work) in order to balance employment, household, and caregiving work (Scheiner & Holz-Rau, 2017). Three articles examined how complex and gendered activity-travel or trip characteristics influenced cycling behaviours (Brey et al., 2017; Eye & Ferreira, 2015; Zhao, Wang, & Deng, 2015).

Two articles argued that women cycle less than men, rather than exhibit different cycling trip characteristics, because some of the activities associated with household labour may be more difficult to complete by bicycle than using other modes (Delmelle & Delmelle, 2012; Dickinson et al., 2003). Furthermore, Prati (2018) examined the relationship between women's participation in transport cycling and measures of gender equality in European Union states. The "time" domain of the Gender Equality Index (i.e., the gendered division of time spent on household duties) was positively associated with women's cycling, suggesting that women's greater role in household responsibilities may act as a barrier to participating in transport cycling. Two articles did not report male–female discrepancies in trip characteristics but cited literature on the topic (Emond et al., 2009; Wang et al., 2015).

While the risk-aversion and trip-chaining hypotheses were most frequently discussed, other gender differences in male–female bicycle behaviour were also considered. Two articles argued that females are more motivated to cycle due to environmental concerns than are males (Sardianou & Nioza, 2015; Sigurdardottir, Kaplan, Moller, & Teasdale, 2013). Furthermore, participants in Mosquera et al.'s (2012) study also commented on potential barriers women may face when trying to maintain a "feminine" appearance while cycling (e.g., difficulty wearing high heels or skirts). Some articles examined gender and cycling without focusing on the dichotomy between men's and women's experiences. For example, Ferguson (2017) explored the experiences of female bike messengers with a focus on restroom access in two American cities.

4 | DISCUSSION

Findings from this review indicate that cycling research where gender is considered tends to focus on identifying male–female differences in behaviours, stated concerns, correlates, and barriers. Quantitative studies are conducted more frequently, and in most of these studies, great attention is given to travel demand metrics such as trip purpose, trip type (recreational or transport, and commute or non-commute), trip mode (private or public bicycle), or other characteristics (e.g., travel alone or with other, location, and time). In these studies, however, less attention is given to the conceptualization of gender. Gender is typically treated using a male/female binary, with data arising through self-report travel surveys. Much of the extant research on gender and cycling therefore falls under one of the two streams of inquiry identified by Hanson (2010): studies that examine how gender shapes transport using a simplified view of gender and data describing travel demand.

This focus on how gender shapes mobility produces a cycling literature characterized by the same issues identified by Law (1999): male–female patterns are identified, but the underlying gendered processes that may produce observed outcomes such as risk-aversion or trip-chain travel characteristics in the first place are not adequately or deeply considered. For example, in their article on bicycle path preference across the sexes, Garrard et al. (2008) stated that some population groups, such as women, have "greater sensitivity to adverse traffic conditions" (p. 56) and a "preference for less strenuous forms of physical activity" (p. 57). At no point do the authors attempt to explain why men's and women's behaviour may be different in this regard. Furthermore, in Heesch et al.'s (2012) research on cycling patterns, motivators, and constraints, they explain how men may cycle more frequently because "women are more likely than men to trip chain as part of their commute, given their responsibilities for transporting children and other household members and to do the household shopping." (p. 2). The authors, however, do not question why women experience additional labour and unpaid work in the first place. The reviewed studies are brimming with similar examples.

Taken together, in the two decades since Law's (1999) article, her call for transport research that engages fully with gender as a social category has yet to be broadly taken up by transport scholars engaged in cycling research. Current cycling research remains focused on only one of the two stands of studies identified by Hanson (2010), research that consider travel in great detail, but tends to take a simplified view of gender. Concentrating on how gender shapes mobility without considering how mobility shapes gender is problematic because it can result in studies that ignore the power relations that exist between these social categories. Furthermore, failing to do so can contribute to gender-based inequalities. For example, it can encourage harmful gender stereotypes (e.g., "*girls don't bike because they are scared*"), inhibit people from fully expressing themselves (e.g., "I can't admit I find cycling dangerous because I will be called a sissy"), or justify the status quo (e.g., "women will never bike as much as men because they are more fearful"). We therefore argue for more geographically and historically situated research that accounts for the contested nature of identity—cycling research that asks how mobility shapes gender—as a way to complement the work of other scholars whose interests are more squarely focused on gendered patterns of transport outcomes. One way forward is to frame cycling with theories commonly engaged with by feminist geographers. Doing so could allow for more avenues for research and could also result in more context-specific options for policy intervention. The remainder of this paper plots ways to advance toward feminist geographies of cycling by folding feminist theories used in geography into research and policy on gender and cycling.

5 | WAYS FORWARD

Given the scope and variety of feminist theories, there are many ways in which the cycling literature could engage with this field to produce more sophisticated and nuanced understandings of gender, identity, and cycling. In this section, three contributions from feminist theory that have had significant impact in the field of geography and may

help scholars think about gender and biking differently are considered: performativity, intersectionality, and embodiment. It is important to note that the scope of this paper only allows for introductory engagement with these concepts; therefore, we recommend that readers refer directly to the vast feminist literature in order to properly engage with the complexity of these—and other—feminist theories.

5.1 | Performativity, intersectionality, and embodiment

The philosopher Judith Butler developed performativity as a concept to explain how gender is socially constructed, and not based on biology. At the time of Butler's (1990) writing, there was agreement amongst feminist thinkers that sex (a biological category based on of one's reproductive system) and gender (a social construct based on of one's sex) were separate categories. However, Butler (1990) argued against this reinforcement of the sex/gender, and nature/culture binaries and disputed that sex is a biological category because the sexual organs we are born with are used to regulate individuals into masculine or feminine comportments and are therefore understood via cultural interpretations. To Butler, gender is a normative ideal, largely constituted of regulatory practices of gender formation throughout the life course. Our performances of gender go unnoticed because these "repeated stylization[s] of the body" (p. 43) are normalized; we are constantly performing our identity and reading, and reacting to, the performance of others. Butler's work has had a significant impact in many sub-fields of geography where it has been used to examine gender, sexuality, space, and place (e.g., Bell, Binnie, Cream, & Valentine, 1994; Valentine, 1996).

Performativity might be helpful in cycling research to understand how the bicycle fits into the identity performances of some people, and not others. It may be difficult for some people to perform the identity of a "cyclist" or to perform their own identity while they cycle. For instance, many could feel uncomfortable cycling in contexts where it is seen as a hypermasculine adrenaline sport. Informal regulatory practices may be used to encourage some bodies to cycle while discouraging others. There is some evidence of this occurrence in the literature (Bonham & Wilson, 2012; Cavill & Watkins, 2007; Frater & Kinghman, 2018; Osborne & Grant-Smith, 2017; Steinbach, Green, Datta, & Edwards, 2011), though there is still much room for further analysis. For example, in Cavill and Watkins's (2007) study on the use of a multipurpose trail in Liverpool, many young girl-identifying[2] participants stated they refused to cycle because it has an "image problem." Participants expressed that cycling was an appropriate behaviour amongst young boys, while they described the indignity of cycling themselves. These participant views demonstrate how, in this context, cycling is seen as performing masculinity and is regulated through social pressures for girls.

Another useful concept is intersectionality, which is based on the theory that forms of oppression, associated with axes of identity (gender, class, race, ability, etc.), do not exist independently (Crenshaw, 1991). Few articles in this review considered difference amongst "women" or "men" (exceptions include Bonham & Wilson, 2012; Singleton & Goddard, 2016, and Steinbach et al., 2011). Instead, it is often assumed, implicitly or otherwise, that the "woman's experience" or the "man's experience" of cycling is the same for all, regardless of ethnicity, age, ability, class, or sexuality. Many feminist geographers have warned against discussing gender without considering the role of difference (Hopkins, 2017; Valentine, 2007). When difference is not incorporated into our study of women's experiences, the women's voices we do hear tend to be from White, middle-class, heterosexual, women (Lugones & Spelman, 1983).

Many articles that engage with theories of gender performativity do so in an intersectional manner. As an example, consider Bonham and Wilson's (2012) research that identified key life-course moments in which women either started or stopped cycling in Adelaide, South Australia. The first moment was learning to ride as a child: a time when cycling was associated with freedom, socializing, and enjoyment. Most women gave up cycling in high school for one or more of the following reasons: increased demands (e.g., homework and new activities), the physical and spatial dimensions of secondary school (e.g., longer trip to school and need to carry more things), or a feeling that cycling wasn't "cool" anymore. Some women started cycling again when they had children, or even grandchildren, so that they could participate in this activity together. Here, contradictory feelings emerged when it came to cycling and performing "good motherhood." Some women viewed cycling with their children as performing "good motherhood" as they were modelling healthy behaviour and spending time with their children. Others expressed that safely chauffeuring their children around to many different opportunities by car made them feel like a "good mother."

In this article, Bonham and Wilson (2012) engage with performativity by demonstrating how in certain contexts it can be challenging to perform "cool" female adolescence or "good mothering" while cycling. The article also begins to grapple with an intersectional approach by considering both gender and age. By engaging with both concepts, Bonham and Wilson (2012) are able to provide a more complete understanding of the dynamic barriers to cycling that women might face. The authors demonstrate the many ways in which context-specific gender roles can influence the decision to bike. Furthermore, they contribute to policy in a unique way because they are able to point out key moments in women's lives when they are more likely to either take up or give up cycling. Armed with these findings, policy makers can craft interventions that target these identified barriers at these specific life-course moments.

Finally, we turn to the utility of embodiment theory in exploring gendered differences in cycling. While some historical work has unpacked gendered bodily comportment while cycling (e.g., Garvey, 1995), present-day cycling

research has yet to fully engage with embodiment. Contemporary geographers have engaged with embodiment in a multitude of ways (for example, see Cresswell, 1999; Longhurst, 2001), and we argue that Young's (2005) work on feminine bodily experience could shed light on the underpinnings of the present-day gendered "risk-aversion" hypothesis. Young (2005) critiqued the ways in which mainstream American discourse interprets differences in male–female bodily movements. She observed that women generally are not as open with their bodies as they walk, sit, throw, or carry things as men—i.e., their legs stay closer together, they take smaller strides, they hold things close, and they move the entire body less. This way of moving is frequently interpreted as a biological, natural, difference between the genders, but Young (2005) interpreted it as a way in which patriarchy influences mobility at the scale of the body. She argued that feminine movement displays an ambiguous transcendence (i.e., women's bodies being lived as a burden), an inhibited intentionality (i.e., holding back while also committing to a task), and a discontinuous unity with its surroundings (i.e., the disunity between the parts of the body that commit to the task and the part that do remain immobile). These gendered experiences of mobility are internalized and result from the situation of women in a patriarchal society. According to Young's analysis, in mainstream American culture, some women in comparison to men are not encouraged to use their full bodily capacities and to develop specific bodily skills. Young girls can acquire many "subtle habits of feminine body comportment" (p. 43) that they conform to throughout the life course in order to perform their sex/gender. These gender processes outlined by Young (2005) may contribute to some women's tendency to have less confidence in their cycling abilities, a factor which may be voiced as greater concern over safety.

Embodiment also intersects with the theories of performativity and intersectionality. For example, some girls may receive less encouragement to ride a bicycle than their male counterparts throughout their lives. This could be due to gender performativity (e.g., regulating this "masculine" activity by calling a girl who cycles a "tom boy"). When girls are discouraged from cycling, they may be prevented from fully developing this bodily skill. This could produce less confidence in their riding abilities, something that could be expressed as a greater concern over safety. Regardless of gender, lack of experience could result in lower confidence in one's cycling abilities. However, as Young (2005) discussed, women are more likely to be prevented from fully developing these bodily skills than

men in patriarchal societies because cycling is at odds with performing some forms of femininity. Furthermore, as Crenshaw's (1991) work on intersectionality reminds us, one must also consider the race, age, sexuality, and the other axes of identity experienced by the girl in this example to fully understand her experience with cycling. These examples demonstrate how framing cycling with a feminist geographical lens could move the field toward deeper understandings of gendered differences in cycling behaviours that consider power relations and the contested nature of identity.

6 | CONCLUSION

The bicycle not only has the potential to play a key role in a more sustainable transportation future, but it is also a clear example of how gender and mobility "are completely bound up with each other" (Hanson, 2010, p. 6). In this article, a systematic search strategy is used to identify the academic literature on gender and cycling. Results indicate that the bulk of this research was quantitative and explored gendered differences in cycling behaviours, barriers, concerns, and correlates. Two themes emerged: (1) women may cycle less than men due to their greater concern over safety, and (2) women may cycle less than men, or may have differing trip characteristics than men, due to their greater responsibility for household labour. Reflecting on this literature in relation to the gender and mobility critiques by Law (1999) and Hanson (2010), we have demonstrated that most articles examined how gender influences mobility, one of the two streams of gender and mobility studies identified by Hanson (2010). These studies make use of multiple travel demand metrics and rely on simple binary conceptualizations of gender. In relying on normative male/female binary metrics, the societal processes behind why women are associated with childcare, household responsibilities, and concern over safety are not adequately or deeply considered in the current literature. These findings indicate that Law's (1999) critical review of transport research is still relevant to the study of cycling today. There is a need for more research on identity and cycling that moves beyond identifying male/female differences and considers the underlying social, political, economic, and historical reasons of such differences. This research would fall under the "how does mobility influence gender" stream of research identified by Hanson (2010).

A question that remains to be answered is why the current literature has skewed toward one of the two strands of research identified by Hanson (2010) and has not incorporated the critiques made by Law (1999) two decades ago. One possible reason for this lack of engagement is the multidisciplinary nature of cycling studies; some cycling researchers may not be aware of contributions by geographers such as Law and Hanson. Furthermore, this review demonstrated how the bulk of current research uses quantitative methods, objectivist ontology, and positivist epistemology. It is admittedly easier to engage with the feminist theories discussed above using qualitative methods, constructivist ontologies, and interpretivist epistemologies that can delve into the nuance of individual experiences. We therefore call for feminist geographies of cycling research to broaden possibilities for both research and policy.

The subject area of much of the research identified in this review was restricted to gendered behavioural differences. Using feminist geography frameworks could broaden the scope of cycling studies, and transport research more broadly, as scholars not are only free to explore the many societal reasons behind the observed genderbased patterns identified in the current literature but can also examine how intersecting axes of identity influence experiences of cycling. To do so, they can ask different questions or use different methods or epistemological and ontological approaches to produce context-specific research. We call for such research on the topic, and we put forth in this paper just three concepts that could move the field forward: performativity, intersectionality, and embodiment.

Furthermore, while these feminist concepts were discussed in relation to gender in this paper, these theories can also be applied to the study of racialization, sexuality, class, and other axes of identity. Some articles in this review begin to engage with these topics; however, these examples remain rare. More research that draws on these theories, as well as the intersections of these theories, is needed. We call for such research not just to move the academic field forward but also because of the potential interventions this proposed research could identity. Contextspecific research that embraces feminist theory and feminist geography could help in the development of specific policies or programmes to encourage cycling for everyone. For example, if future research finds that some women are less confident in their embodied cycling abilities due to lack of encouragement in childhood, bike-to-school programmes that emphasize girls' participation can be created.

While Hanson (2010) argued for research that thinks deeply about gender and considers complex travel metrics, feminist geographies of cycling holds the potential to engage with these and other geographic framings of concepts such as mobility and place. While this paper focused on cycling as one specific type of mobility, transportation, future work could examine whether the field could benefit from cycling being framed within the broader social and cultural geographies of mobility, an approach that has been used to study other travel modes (e.g., Bissell, Vannini, & Jensen, 2017), and gendered mobility (e.g., Clement & Waitt, 2018). A second concept that may warrant further investigation is place. In fact, while many of the articles in this review examined the relationship between cycling and built form (e.g., Trapp et al., 2011; Van Holle et al., 2014), few examined the social, political, historical context of places. Mobility and place are also implicated in the construction of gender (Massey, 1994). The potential for transportation scholarship to engage with the dynamic relationship between gender, mobility, and place has yet to be fully realized.

ACKNOWLEDGEMENT

Léa Ravensbergen received the Joseph-Armand Bombardier Graduate Scholarship from the Social Sciences and Humanities Research Council of Canada (SSHRC).

ENDNOTES

1It is important to note that this literature is predominantly Western-focused; therefore, these trends may differ in other contexts.

2We continue to use the terms “women,” “men,” “girl,” and “boy” in this paper because the people in question self-identify with these terms. However, we wish to highlight the many ways in which one can experience and express these identities.

ORCID

Léa Ravensbergen https://orcid.org/0000-0003-3259-6673

REFERENCES

Akar, G., Fisher, N., & Namgung, M. (2013). Bicycling choice and gender case study: The Ohio State University. *International Journal of Sustainable Transportation*, *7*, 347–365.

Aldred, R., Elliot, B., Woodcock, J., & Goodman, A. (2017). Cycling provision separated from motor traffic: A systematic review exploring whether stated preferences vary by gender and age. *Transport Reviews*, *37*(1), 29–55. https://doi.org/10.1080/01441647.2016.1200156

Aldred, R., Woodcock, J., & Goodman, A. (2016). Does more cycling mean more diversity in cycling? *Transport Reviews*, *6*(1), 28–44.

Alveano-Aguerrebere, I., Ayvar-Campos, F. J., Farvid, M., & Lusk, A. (2017). Bicycle facilities that address safety, crime, and economic development: Perceptions from Morelia, Mexico. *International Journal of Environmental Research and Public Health*, *15*(1), 1–22. https://doi.org/10.3390/ijer

Beecham, R., & Wood, J. (2014). Exploring gendered cycling behaviours within a large-scale behavioural data-set. *Transportation Planning and Technology*, *37*(1), 83–97.

Beechman, R., & Wood, J. (2014). Characterising group-cycling journeys using interactive graphics. *Transportation Research Part C*, *47*, 194–206.

Bell, A. C., Garrard, J., & Swinburn, B. A. (2006). Active transport to work in Australia: Is it all downhill from here? *Asia-Pacific Journal of Public Health*, *18*(1), 62–68. https://doi.org/10.1177/10105395060180011001

Bell, D., Binnie, J., Cream, J., & Valentine, G. (1994). All hyped up and no place to go. *Gender, Place and Culture*, *1*(1), 31–47. https://doi.org/10.1080/09663699408721199

Bhat, C. R., Astroza, S., & Hamdi, A. S. (2017). A spatial generalized ordered-response model with skew normal kernel error terms with an application to bicycling frequency. *Transport Research Part B*, *95*, 126–148. https://doi.org/10.1016/j.trb.2016.10.014
Bissell, D., Vannini, P., & Jensen, O. B. (2017). Intensities of mobility: Kinetic energy, commotion and qualities of supercommuting. *Mobilities*, *12*(6), 795–812. https://doi.org/10.1080/17450101.2016.1243935
Bonham, J., & Wilson, A. (2012). Bicycling and the life course: The start–stop–start experiences of women cycling. *International Journal of Sustainable Transportation*, *6*, 195–213.
Brey, R., Castillo-Manzano, J., & Castro-Nuno, M. (2017). 'I want to ride my bicycle': Delimiting cyclist typologies. *Applied Economics Letters*, *24*(8), 549–552. https://doi.org/10.1080/13504851.2016.1210760
Butler, J. (1990). *Gender trouble: Feminism and the subversion of identity*. New York, NY: Routledge.
Carver, A., Salmon, J., Campbell, K., Baur, L., Garnett, S., & Crawford, D. (2005). How do perceptions of local neighborhood relate to adolescents' walking and cycling? *American Journal of Health Promotion*, *20*(2), 139–147. https://doi.org/10.4278/0890-1171-20.2.139
Cavill, N., & Watkins, F. (2007). Cycling and health: An exploratory study of views about cycling in an area of North Liverpool, UK. *Health Education*, *107*(5), 404–420. https://doi.org/10.1108/09654280710778556
Clement, S., & Waitt, G. (2018). Pram mobilities: Affordances and atmospheres that assemble childhood and motherhood on-the-move. *Children's Geographies*, *16*(3), 252–265.
Crenshaw, K. (1991). Mapping the margins: Intersectionality, identity politics, and violence against women of color. *Stanford Law Review*, *43*(6), 1241–1299. https://doi.org/10.2307/1229039
Cresswell, T. (1999). Embodiment, power and the politics of mobility: The case of female tramps and hobos. *Transactions of the Institute of British Geographers*, *24*(2), 175–192. https://doi.org/10.1111/j.0020-2754.1999.00175.x
Damant-Sirois & El Geneidy (2015). Who cycles more? Determining cycling frequency through a segmentation approach in Montreal, Canada. *Transportation Research Part a*, *77*, 113–125.
Delmelle, E. M., & Delmelle, E. C. (2012). Exploring spatio-temporal commuting patterns in a university environment. *Transport Policy*, *21*, 1–9. https://doi.org/10.1016/j.tranpol.2011.12.007
Dickinson, J. E., Kingham, S., Copsey, S., & Pearlman Hougie, D. J. (2003). Employer travel plans, cycling and gender: Will travel plan measures improve the outlook for cycling to work in the UK? *Transportation Research Part D*, *8*, 53–67. https://doi.org/10.1016/S1361-9209(02)00018-4
Emond, C., Tang, W. & Handy, S. (2009). Explaining gender difference in bicycling behavior. *Transportation Research Record: Journal of the Transportation Research Board*, No. 2125, Transportation Research Board of the National Academies, Washington, D.C., pp. 16–25.
Eye, A., & Ferreira, A. (2015). Taking the tyke on a bike: Mothers' and childless women's space–time geographies in Amsterdam compared. *Environment and Planning a*, *47*, 691–708.
Ferguson, J. (2017). Discreet to excrete in the concrete jungle: Women bike messengers and their inventive urban strategies in three US cities. *Gender, Place & Culture*, *24*(1), 85–96. https://doi.org/10.1080/0966369X.2016.1263602
Fishman, E. (2016). Bikeshare: A review of the recent literature. *Transport Reviews*, *36*(1), 92–113. https://doi.org/10.1080/01441647.2015.1033036
Frater, J., & Kinghman, S. (2018). Gender equity in health and the influence of intrapersonal factors on adolescent girls' decisions to bicycle to school. *Journal of Transport Geography*, *71*, 130–138. https://doi.org/10.1016/j.jtrangeo.2018.07.011
Fyhri, A., & Fearnley, N. (2015). Effects of e-bikes on bicycle use and mode share. *Transport Research Part D*, *36*, 45–52. https://doi.org/10.1016/j.trd.2015.02.005
Garrard, J., Rose, G., & Kai Lo, S. (2008). Promoting transportation cycling for women: The role of bicycle infrastructure. *Preventive Medicine*, *46*, 55–59. https://doi.org/10.1016/j.ypmed.2007.07.010
Garvey, E. G. (1995). Reframing the bicycle: Advertising-supported magazines and scorching women. *American Quarterly*, *47*(1), 66–101. https://doi.org/10.2307/2713325
Giuliano, G. (1979). Public transportation and the travel needs of women. *Traffic Quarterly*, *33*, 607–616.
Goodman, A., & Cheshire, J. (2014). Inequalities in the London bicycle sharing system revisited: Impacts of extending the scheme to poorer areas but then doubling prices. *Journal of Transport Geography*, *41*, 272–279. https://doi.org/10.1016/j.jtrangeo.2014.04.004
Grant, M. J., & Booth, A. (2009). A typology of reviews: An analysis of 14 review types and associated methodologies. *Health Information and Libraries Journal*, *26*, 91–108.

Habib, K. N., Mann, J., Mahmoud, M., & Weiss, A. (2014). Synopsis of bicycle demand in the City of Toronto: Investigating the effects of perception, consciousness and comfortability on the purpose of biking and bike ownership. *Transport Research Part a*, *70*, 67–80.
Hanson, S. (2010). Gender and mobility: New approaches for informing sustainability. *Gender, Place & Culture: A Journal of Feminist Geography*, *17*(1), 5–23.
Heesch, K., Sahlqvist, S., & Garrard, J. (2012). Gender differences in recreational and transport cycling: A cross-sectional mixed-methods comparison of cycling patterns, motivators, and constraints. *International Journal of Behavioral Nutrition and Physical Activity*, *9*(106), 1–12.
Hopkins, P. (2017). Social geography I: Intersectionality. *Progress in Human Geography*, 1–11.
Hsu, H. P., & Saphores, J. D. (2014). Impacts of parental gender and attitudes on children's school travel mode and parental chauffeuring behavior: Results for California based on the 2009 National Household Travel Survey. *Transportation*, *41*, 543–565.
Ji, Y., Fan, Y., Ermagun, A., Cao, X., Wang, W., & Das, K. (2017). Public bicycle as a feeder mode to rail transit in China: The

role of gender, age, income, trip purpose, and bicycle theft experience. *International Journal of Sustainable Transportation*, *11*(4), 308–317. https://doi.org/10.1080/15568318.2016.1253802
Karkie, T. K., & Tao, L. (2016). How accessible and convenient are the public bicycle sharing programs in China? Experiences from Suzhou city. *Habitat International*, *53*, 188–194.
Kienteka, M., Reis, R. S., & Rech, C. R. (2014). Personal and behavioral factors associated with bicycling in adults from Curitiba, Paraná State, Brazil. *Cad. Saúde Pública, Rio de Janeiro*, *30*(1), 79–87.
Law, R. (1999). Beyond 'women and transport': Towards new geographies of gender and daily mobility. *Progress in Human Geography*, *23*(4), 567–588.
Longhurst, R. (2001). *Bodies: Exploring fluid boundaries*. London: Routledge.
Lugones, M., & Spelman, E. (1983). Section 5: Have we got a theory for you! Feminist theory, cultural imperialism and the demand for "the woman's voice". In W. K. Kolmar, & F. Bartkowski (Eds.), *Feminist theory*. New York, NY: McGraw-Hill.
Mackintosh, P. G., & Norcliffe, G. (2007). Men, women and the bicycle: gender and social geography of cycling in the late nineteenth-century. In *Cycling and society* (pp. 153–177).
Manton, R., Rau, H., Fahy, F., Sheahan, J., & Clifford, E. (2016). Using mental mapping to unpack perceived cycling risk. *Accident Analysis and Prevention*, *88*, 138–149.
Massey, D. (1994). *Space, place, and gender*. Minneapolis, MN: University of Minnesota Press.
Mitra, R., & Nash, S. (2018). Can the built environment explain gender gap in cycling? An exploration of university students' travel behavior in Toronto, Canada. *International Journal of Sustainable Transportation*, *0*(0), 1–10.
Mosquera, J., Parra, D. C., Gomez, L. F., Sarmiento, O., Schmid, T., & Jacoby, E. (2012). An inside look at active transportation in Bogotá: A qualitative study. *Journal of Physical Activity and Health*, *9*, 776–785.
Nehme, E. K., Perez, A., Ranjit, N., Amick, B. C., & Kohl, H. W. (2016a). Behavioral theory and transportation cycling research: Application of diffusion of innovations. *Journal of Transport & Health*, *3*, 346–356.
Nehme, E. K., Perez, A., Ranjit, N., Amick, B. C., & Kohl, H. W. (2016b). Sociodemographic factors, population density, and bicycling for transportation in the United States. *Journal of Physical Activity and Health*, *13*, 36–43.
Nelson, N. M., & Woods, C. B. (2010). Neighborhood perceptions and active commuting to school among adolescent boys and girls. *Journal of Physical Activity and Health*, *7*, 257–266.
Nevelsteen, K., Steenberghen, T., Van Rompaey, A., & Uyttersprot, L. (2012). Controlling factors of the parental safety perception on children's travel mode choice. *Accident; Analysis and Prevention*, *45*, 39–49.
Noyes, P., Fung, L., Lee, K. K., Grimshaw, V. E., Karpati, A., & DiGrande, L. (2014). Cycling in the city: An in-depth examination of bicycle lane use in a low-income urban neighborhood. *Journal of Physical Activity and Health*, *11*, 1–9.
Orstad, M. H., McDonough, M., Klenosky, D. B., Mattson, M., & Troped, P. J. (2016). Correlates of trail use for recreation and transportation on 5 Massachusetts trails. *Journal of Physical Activity and Health*, *13*, 845–853.
Osborne, N., & Grant-Smith, D. (2017). Constructing the cycling citizen: A critical analysis of policy imagery in Brisbane, Australia. *Journal of Transport Geography*, *64*, 44–53.
Parker, K. M., Gustat, J., & Rice, J. C. (2011). Installation of bicycle lanes and increased ridership in an urban, mixed-income setting in New Orleans, Louisiana. *Journal of Physical Activity and Health*, *8*(1), S98–S102.
Prati, G. (2018). Gender equality and women's participation in transport cycling. *Journal of Transport Geography*, *66*, 369–375.
Rosenbloom, S. (1978). Editorial: The need for study of women's travel issues. *Transportation*, *7*, 347–350.
Sahlqvist, S. L., & Heesch, K. C. (2012). Characteristics of utility cyclists in Queensland, Australia: An Examination of the associations between individual, social, and environmental factors and utility cycling. *Journal of Physical Activity and Health*, *9*, 818–828.
Sardianou, E., & Nioza, E. (2015). Who are the eco-bicyclists? *Transportation Research Part D*, *34*, 161–167.

Scheiner, J., & Holz-Rau, C. (2017). Women's complex daily lives: A gendered look at trip chaining and activity pattern entropy in Germany. *Transportation*, *44*, 117–138. https://doi.org/10.1007/s11116-015-9627-9
Sigurdardottir, S. B., Kaplan, S., Moller, M., & Teasdale, T. W. (2013). Understanding adolescents' intentions to commute by car or bicycle as adults. *Transportation Research Part D*, *24*, 1–9.
Singleton, P., & Goddard, T. (2016). Cycling by choice or necessity? Exploring the gender gap in bicycling in Oregon. *Transportation Research Record: Journal of the Transportation Research Board*, No. 2598, Transportation Research Board, Washington, D.C., 110–118. https://doi.org/10.3141/2598-13
Steinbach, R., Green, J., Datta, J., & Edwards, P. (2011). Cycling and the city: A case study of how gendered, ethnic and class identities can shape healthy transport choices. *Social Science and Medicine*, *72*(7), 1123–1130.
Strange, L. S., & Brown, R. (2002). The bicycle, women's rights, and Elizabeth Cady Stanton. *Women's Studies*, *31*, 609–626.
Stronegger, W. J., Titze, S., & Oja, P. (2010). Perceived characteristics of the neighborhood and its association with physical activity behavior and self-rated health. *Health & Place*, *16*, 736–743.
Tayhan, A., Cornish, R., Boyd, A., Joshi, M. S., & Macleod, J. (2016). The impact of cycle proficiency training on cycle-related behaviours and accidents in adolescence: Findings from ALSPAC, a UK longitudinal cohort. *BMC Public Health*, *16*(469), 1–10.
Teschke, K., Koehoorn, M., Shen, H., & Dennis, J. (2017). Bicycling injury hospitalisation rates in Canadian jurisdictions: Analyses examining associations with helmet legislation and mode share. *BMJ Open*, *5*, 1–13.
Trapp, G., Giles-Corti, B., Christian, H. E., Bulsara, M., Timperio, A. F., McCormack, G. R., & Villaneuva, K. P. (2011). On your bike! A cross-sectional study of the individual, social and environmental correlates of cycling to school. *International Journal of Behavioral Nutrition and Physical Activity*, *8*(123), 1–9.
Troped, P. J., Saunders, R. P., Pate, R. R., Reininger, B., Ureda, J. R., & Thompson, S. J. (2001). Associations between selfreported

and objective physical environmental factors and use of a community rail-trail. *Preventive Medicine*, *32*, 191–200.
Twaddle, H. & Hall, F. & Bracic, B. (2010). Latent bicycle commuting demand and effects of gender on commuter cycling and accident rates. *Transportation Research Record: Journal of the Transportation Research Board*, No. 2190, Transportation Research Board of the National Academies, Washington, D.C., pp. 28–36.
Valentine, G. (1996). (Re)negotiating the heterosexual street. In N. Duncan (Ed.), *Bodyspace: Destabilizing geographies of gender and sexuality*. London: Routledge.
Valentine, G. (2007). Theorizing and researching intersectionality: A challenge for feminist geography. *The Professional Geographer*, *59*(1), 10–21.
Van Bekkum, J., Williams, J. M., & Morris, P. (2011). Cycle commuting and perceptions of barriers: Stages of change, gender and occupation. *Health Education*, *111*(6), 476–497.
Van Cauwenberg, J., Clarys, P., De Bourdeaudhuij, I., Van Holle, V., Verte, D., De Witte, N., … Deforche, B. (2012). Physical environmental factors related to walking and cycling in older adults: The Belgian aging studies. *BMC Public Health*, *12*(142), 1–13.
Van Holle, V., Van Cauwenberg, J., Deforche, B., Goubert, L., Maes, L., Nasar, J., … De Boureaudhuij, I. (2014). Environmental invitingness for transport-related cycling in middle-aged adults: A proof of concept study using photographs. *Transportation Research Part A*, *69*, 432–446.
Wang, C. H., Akar, G., & Guldmann, J. M. (2015). Do your neighbors affect your bicycling choice? A spatial probit model for bicycling to The Ohio State University. *Journal of Transport Geography*, *42*, 122–130.
Wati, K., & Tranter, P. J. (2015). Spatial and socio-demographic determinants of South East Queensland students' school cycling. *Journal of Transport Geography*, *47*, 23–36.
Wittman, K., Savan, B., Ledsham, T., Liu G., Lay, J. (2015). Cycling to high school in Toronto, Ontario, Canada: Exploration of school travel patterns and attitudes by gender. *Transportation Research Record: Journal of the Transportation Research Board*, No. 2500, Transportation Research Board, Washington, D.C., pp. 9–16. DOI: https://doi.org/10.3141/2500-02.
Young, I. M. (2005). Chapter 2: Throwing like a girl: A phenomenology of feminine body comportment, motility, and spatiality. In *On female body experience: Throwing like a girl and other essays*. New York, NY: Oxford University Press.
Zanotto, M., & Winters, M. (2017). Helmet use among personal bicycle riders and bike share users in Vancouver, BC. *American Journal of Preventive Medicine*, *53*(4), 465–472.
Zhao, J., Wang, J., & Deng, W. (2015). Exploring bikesharing travel time and trip chain by gender and day of the week. *Transportation Research Part C*, *58*, 251–264.
Zhao, P., Shengxiao, L., Peilin, L., Liu, J., & Long, K. (2018). How does air pollution influence cycling behaviour? Evidence from Beijing. *Transportation Research Part D*, *63*, 826–838.

AUTHOR BIOGRAPHIES

Léa Ravensbergen is a PhD candidate at the University of Toronto Mississauga, where she holds a Joseph-Armand Bombardier Canada Graduate Scholarship from the Social Sciences and Humanities Research Council of Canada. Her research interests lie at the inter section of transportation, health, and social geographies. Her current doctoral project engages with theories from feminist geography to examine the gender gap in cycling in Toronto.
Ron Buliung is a professor in the Department of Geography and Programs in Environment at the University of Toronto Mississauga. His research is primarily focused on child and youth transportation and health. His most recent work examines the possibilities and limitations of childhood disability and urban living.
Nicole Laliberté is an assistant professor, teaching stream, in the Department of Geography and Programs in Environment at the University of Toronto Mississauga. Her research is located at the inter?section of geography, feminist theory, and critical human rights studies. Her most recent work focuses on anti-oppression pedagogies and a feminist geopolitics of education.

How to cite this article: Ravensbergen xxxL, Buliung R, Laliberté N. Toward feminist geographies of cycling. *Geography Compass*. 2019;e12461. https://doi.org/10.1111/gec3.12461