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Commuting and wellbeing: a critical overview of the literature with implications for policy and future research

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ABSTRACT

This review provides a critical overview of what has been learnt about commuting's impact on subjective wellbeing (SWB). It is structured around a conceptual model which assumes commuting can affect SWB over three time horizons: (i) during the journey; (ii) immediately after the journey; and (iii) over the longer term. Our assessment of the evidence shows that mood is lower during the commute than other daily activities and stress can be induced by congestion, crowding and unpredictability. People who walk or cycle to work are generally more satisfied with their commute than those who travel by car and especially those who use public transport. Satisfaction decreases with duration of commute, regardless of mode used, and increases when travelling with company. After the journey, evidence shows that the commute experience "spills over" into how people feel and perform at work and home. However, a consistent link between commuting and life satisfaction overall has not been established. The evidence suggests that commuters are generally successful in trading off the drawbacks of longer and more arduous commute journeys against the benefits they bring in relation to overall life satisfaction, but further research is required to understand the decision making involved. The evidence review points to six areas that warrant policy action and research: (i) enhancing the commute experience; (ii) increasing commute satisfaction; (iii) reducing the impacts of long duration commutes; (iv) meeting commuter preferences; (v) recognising flexibility and constraints in commuting routines and (vi) accounting for SWB impacts of commuting in policy making and appraisal.

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1. Introduction

The overall goal of public policies is to improve the welfare of the population. In transport, welfare has traditionally been assessed by considering objective impacts of the transport system such as travel times and costs, crashes, and environmental degradation. However, the subjective experience of transport, including how it contributes to overall happiness, is of growing interest (Mokhtarian, 2019). This has coincided with concern about the limits of GDP as a measure of economic performance and social progress and global interest in measuring and improving people's wellbeing (OECD, 2011).

Wellbeing is a multidimensional concept that may be measured both objectively and subjectively. This review focuses on what we know about the impact of commuting on subjective wellbeing (SWB). SWB is aimed at capturing wellbeing as perceived by individuals based on the view that "people are the best judges of how their life is going" (OECD, 2011, p. 265). This does not dismiss the importance of objective dimensions of wellbeing (such as income and health). SWB is defined formally by the OECD as "Good mental states, including all of the various evaluations, positive and negative, that people make of their lives, and the affective reactions of people to their experiences" (OECD, 2013, p. 10). SWB can be measured (Tinkler & Hicks, 2011) in terms of evaluative wellbeing (how satisfied individuals are with different domains of their life and with life overall) and experiential wellbeing (how often individuals experience positive and negative emotions). Both of these are a type of hedonic wellbeing and relate to the presence of pleasure and absence of pain. SWB can also be measured in terms of eudaimonic wellbeing which relates to the achievement of a higher purpose or meaning in life.

Various papers have recently reviewed theoretical relationships between transport, personal travel, and wellbeing, and assessed what is known from the literature about the relationships (De Vos, Schwanen, Van Acker, & Witlox, 2013; Delbosc, 2012; Ettema, Gärling, Olsson, & Friman, 2010; Mokhtarian, 2019; Nordbakke & Schwanen, 2014; Reardon & Abdallah, 2013). These papers look at the role of travel in general and do not specifically focus on commuting, even though research on the subjective experience of commuting has a long tradition with studies on commuting stress dating back to the 1970s (e.g. Novaco, Stokols, Campbell, & Stokols, 1979).

A review of research on commuting and SWB is justified in its own right. The relationship between commuting and SWB is likely to be quite different from that of other travel (e.g. leisure travel) for many reasons. It is a regular, unavoidable activity which absorbs substantial personal time and resources and may be a dominant feature in people's lives for many years. National Travel Survey data for England indicates that the average one-way commute duration is 31 min (DfT, 2018a) and one in seven commuters (14%) have commutes of 60 min or more (DfT, 2018b). Workers in England therefore spend an average of one hour per day commuting and one in seven spend at least two hours commuting. A comparison of one-way commuting times across Europe in 2015 suggests even longer commutes with a 53 min average for the UK and 42 min average across the European Union 28 countries (Eurostat, 2019).[1] American Community Survey data for 2012–2016 indicates the average one-way commute is 26 min in the United States (USCB, 2017).

Studies of commuting and SWB have been conducted across various disciplines (e.g. economics, psychology, health, transport) and are highly heterogeneous in terms of the aspects of SWB considered, the characteristics of commuting considered, and the

methodological approaches used. This presents a challenge in comparing and contrasting studies, critically evaluating findings and drawing conclusions. The authors of this paper took on the challenge following a symposium on "Commuting and Wellbeing" which was held in Bristol in June 2017 and brought together international researchers working in this field. We concluded that it would be valuable to the research community and to policy makers to review the diverse body of research, synthesise findings and identify implications for policy and future research.

We did not attempt to carry out a systematic review, as our goal was to understand the development of the field over time rather than summarise results from the set of studies that meet specific criteria. The review thus takes the form of a critical review (Grant & Booth, 2009) which aims at extensively researching the literature, identifying significant items and critically evaluating their contributions. It is written as a narrative, moving from one conceptual area to another, reflecting on the overall development of theoretical and empirical understanding.

The paper starts (in section 2) with a conceptual model of the relationship between commuting and SWB, identifying different areas that have been investigated in the literature. It then builds up a picture (in section 3) of what has been learnt to date, based on the expert knowledge of the authors in each area. It finishes with recommendations for policy and future research (in section 4).

2. Conceptualisation of the relationship between commuting and SWB

Our conceptualisation of the relationship between commuting and SWB is shown in Figure 1. It is partly based on the conceptual model of the relationship between travel and wellbeing of Ettema et al. (2010), which highlights that travel may affect different aspects of SWB, and of De Vos et al. (2013), which differentiates impacts of travel in the short-term and long-term. However, our model applies specifically to commuting.

People's commute journeys are influenced by their life situation (an objective factor as indicated by the rectangular outline) and personal traits (a subjective factor as indicated by

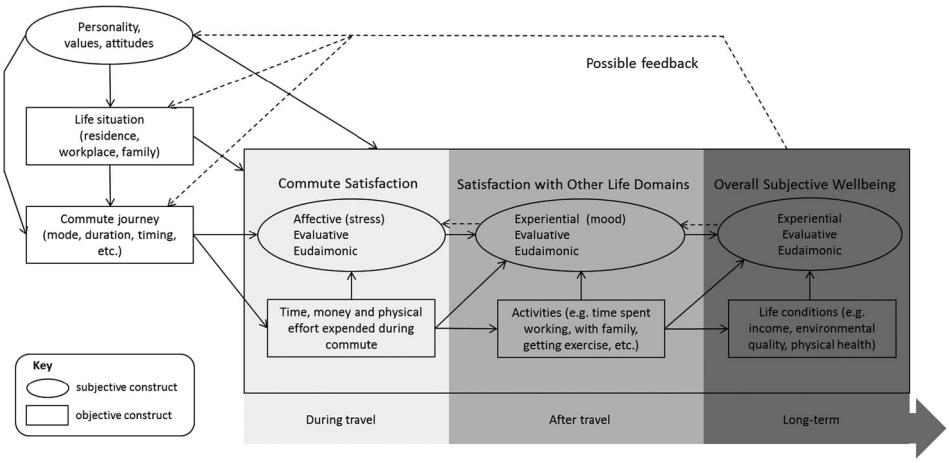

Figure 1. Conceptual model for the relationship between commuting and SWB.

the oval outline). The commute journey has potential objective impacts and subjective impacts on the commuter during their journey,[2] after their journey and in the long-term. People's wellbeing is also influenced by the broader interaction between their life situation and personal traits as shown by the arrows from these to the wellbeing box. Our review is organised with respect to this conceptualisation.

Commuting has objective effects on those that undertake it, for example, in terms of expenditure of time, money and physical effort and possible injuries sustained or exposure to pollutants. Our focus, however, is on how the commute journey is experienced subjectively.

The review starts with studies that have looked at *affective experiences of commuting* during travel (section 3.1). It then considers studies which have assessed *satisfaction with the commute* (section 3.2). Section 3.3 explores whether there are *spill-over effects from the commute to other life domains*. It is well established that physical health is a primary factor influencing overall SWB (e.g. Dolan, Peasgood, & White, 2008), hence in section 3.4 we summarise evidence for *commuting impacts on physical health*.

In section 3.5 we identify what has been learnt from studies that have focused directly on the *relationship between commuting and overall SWB*. These provide core evidence on whether there is any effect of commuting on people's overall lives. In some cases, studies have sought to explain the *mechanisms underlying observed relationships between commuting and overall SWB*. Their findings are reported in section 3.6. The final area of consideration in section 3.7 is *feedback effects between SWB and decisions that workers make relating to commuting*, for example, whereby unhappy commuters alter how they make their journey to work or the journey itself (e.g. through a workplace or residential location change).

3. Evidence review

3.1. Affective experiences of commuting

Affective experiences of commuting refer to "feelings evoked by travelling, such as stress, excitement, pleasure, boredom and control" (Anable & Gatersleben, 2005, p. 164). According to Russell's circumplex model of affect (Russell, 1980), an environment is automatically experienced in terms of two dimensions: valence (degree of pleasantness) and arousal (degree of intensity). For instance, "stress" is a combination of intense arousal and unpleasantness. Most research into affective experiences of commuting has focused on stress.

3.1.1. Commute stress

As early as the 1970s, researchers have documented the personal stress associated with commuting to work. The factors influencing commute stress are only partly clear. Early studies focused on impedance, defined as the difficulty commuters experience in moving from home to work and back (Schaeffer, Street, Singer, & Baum, 1988). Researchers initially measured impedance as travel distance or time (e.g. Novaco et al., 1979) but soon focused on travel speed to capture the effect of congestion (e.g. Schaeffer et al., 1988). Novaco, Stokols, and Milanesi (1990) differentiated between physical impedance (e.g. speed) and subjective impedance measured as drivers' perceptions about inability to

avoid traffic, speed reductions due to traffic jams, exposure to traffic control devices and other characteristics of the commute.

It has been theorised that impedance contributes to stress through the mechanism of perceived control: higher impedance causes commuters to feel less control and thus more stress. One study found control to be "the most powerful predictor of commuting stress" (Sposato, Röderer, & Cervinka, 2012, p. 581). Control can be operationalised in a variety of ways. Schaeffer et al. (1988), in comparing stress for commuters driving alone versus carpooling, differentiated between control over the internal environment of the car (e.g. controlling the radio) and control over the route taken to work. Lucas and Heady (2002) showed for workers in Atlanta, Georgia, that flexi-time work schedules, which give commuters control over when they commute, are associated with reduced commute stress. The concept of choice is closely related to the concept of control (Kluger, 1998; White & Rotton, 1998), but some argue that choice has an ambiguous effect on stress, particularly if the choices available are not seen as favourable ones (Koslowsky, Kluger, & Reich, 2013). Others have operationalised control as the predictability or, conversely, the variability of the commute. While Novaco and Gonzalez (2009) argued that variability is a moderator of the effect of impedance (i.e. variability magnifies the effect of impedance) on stress, Kluger (1998, pp. 160–161) concluded that "commute variability may be the main commuting stressor".

Most studies of commute stress have focused on car users, but studies of public transport users show some similarities and some differences. An early study showed that stress increased as crowding on trains in Stockholm increased (Lundberg, 1976). Another study of commuters to New York City showed that predictability is associated with reduced stress for rail commuters, as it is for driving, possibly because predictability offers a form of cognitive control in situations where commuters do not have behavioural control (Evans, Wener, & Phillips, 2002). A third study showed that improvements in service quality reduced stress for rail commuters to New York City by reducing travel times and increasing predictability (Wener, Evans, & Boately, 2005).

Recent studies have compared commute stress between users of different modes and found the lowest stress among those that walk or cycle to work and highest stress amongst those that drive (Gatersleben & Uzzell, 2007, for university employees at the University of Surrey, UK; Legrain, Eluru, & El-Geneidy, 2015, for university employees at McGill University, Canada). For pedestrians, it has been found that feelings of comfort and safety from traffic are associated with reduced commute stress (Legrain et al., 2015). It has also been found from a study in Rotterdam that the emotional state of active commuters is more sensitive to weather (temperatures, clouds, precipitation and wind) than other commuters (Böcker, Dijst, & Faber, 2016). The concept of bicycling level of traffic stress, measured as a function of road characteristics and traffic levels (Furth, Mekuria, & Nixon, 2016), is popular among transport planners but has not yet been validated to be an indicator of cycle commuting stress.

Commute stress also depends on personal characteristics. Women have been found to experience greater commute stress than men and some studies show that women are more sensitive to stress factors (Wener et al., 2005). The reasons for this gender effect have not been explored in depth, but it may be related to greater time urgency for women who often have more pressing responsibilities outside of work (e.g. childcare, housework) (Novaco, Kliewer, & Broquet, 1991).

The evidence to date on factors contributing to commute stress is convincing, although stronger evidence of causal relationships is needed. Most studies use cross-sectional, observational designs, although one study used an experimental design where college students were randomly allocated to use different commute modes and stress levels compared (White & Rotton, 1998). The studies are mostly from the United States and Europe, and their applicability to other parts of the world are uncertain.

3.1.2. Other affective responses to the commute experience

Whilst stress has been the main focus, some cross-sectional studies in the United States and Europe have explored other affective responses to the commute. One study of university employees at the University of Surrey, UK, obtained appraisals by commuters of the extent to which their journeys were stressful, exciting, boring, relaxing, pleasant and depressing (Gatersleben & Uzzell, 2007). Car users found their commutes to be relatively unpleasant and arousing, public transport users unpleasant and not arousing, cyclists pleasant and arousing and walkers pleasant and not arousing. Delays were the most important factors contributing to unpleasant experiences of car and public transport users. For walkers and cyclists it was traffic danger and quality of route provision.

Studies comparing commuting with other daily activities have found commuting to be the activity rated with the least positive affect scores and with one of the most negative affect scores (Kahneman, Krueger, Schkade, Schwarz, & Stone, 2004, for female, American workers; Mokhtarian, Papon, Goulard, & Diana, 2015, for French workers; Lancée, Veenhoven, & Burger, 2017, for Dutch workers). Analysis of data from the American Time Use Survey has shown that total affect (aggregated combination of positive and negative affect scores) is lower during work-related travel than other activities with this pattern more pronounced when commuting by bus and less pronounced when driving and cycling or interacting with another person while travelling (Morris & Guerra, 2015a). Increased commute duration is associated with lower total affect, particularly due to higher stress (Morris & Guerra, 2015b).

Some studies have focused on the factors that enable travellers to experience their journeys positively. They have used the concept of "liking" both for travel in general and for modes specifically (Ory & Mokhtarian, 2005). It has been shown for commuters in San Francisco that finding the commute less stressful is associated with greater liking of the commute (Ory et al., 2004). Greater understandings of positive affective experiences of commuting, their causal factors, and their relationships with commute stress are needed.

3.2. Satisfaction with the commute

Whereas affect during commuting concerns travellers' emotional state, commute satisfaction has a broader definition. In particular, it is assumed that travel satisfaction can be regarded as a sub-domain of overall SWB (as per family life, working life, etc.), and commuting is a sub-domain in its own right given that it consumes a large amount of time for many workers (Ettema et al., 2010). Ettema et al. (2011) proposed a measurement scale for travel satisfaction (which has frequently been applied in studies of commuting travel), which includes both cognitive and affective components. However, other authors measure travel satisfaction using only a cognitive measurement scale (e.g.

Susilo & Cats, 2014), or as a composite of evaluations of specific aspects of the trip (e.g. St-Louis, Manaugh, van Lierop, & El-Geneidy, 2014). Some studies have measured satisfaction with a particular commute trip (e.g. today's or yesterday's commute: Mao, Ettema, & Dijst, 2016) and others with a typical commute trip (e.g. Olsson, Gärling, Ettema, Friman, & Fujii, 2013).

Given that commute satisfaction reflects commuters' evaluations beyond their affective experiences implies that a broader set of factors influences commute satisfaction. First and foremost, travel mode has been found to be strongly associated with commute satisfaction. Commuters using active travel modes report the highest levels of commute satisfaction, whereas public transport users report the lowest levels (e.g. St-Louis et al., 2014, for university employees at McGill University, Canada; Friman, Gärling, Ettema, & Olsson, 2017, for urban commuters in Sweden; Ye & Titheridge, 2017, for workers in Xi'an, China). As most studies of commute satisfaction control for trip characteristics such as trip duration, this suggests that different travel modes have specific properties that make them more or less satisfying. For active travel, it is reported that the physical activity involved is associated with a more positive mood, which translates into higher satisfaction (Ekkekakis, Backhouse, Gray, & Lind, 2008). For car use, it is argued that aspects such as independence, mastery, joy and prestige play a role in the relatively high satisfaction with car use (Bergstad et al., 2011). For public transport commuting, two North American studies have found that rail commuters are more satisfied with their commute than bus commuters (Handy & Thigpen, 2019; St-Louis et al., 2014), but a study in Sweden found higher satisfaction among bus commuters than rail commuters (Ettema, Friman, Gärling, Olsson, & Fujii, 2012).

Longer commute durations are associated with reduced satisfaction with commutes made by all modes (Ettema et al., 2012; Ettema, Gärling, Olsson, Friman, & Moerdijk, 2013; Manaugh & El-Geneidy, 2013; Mao et al., 2016; St-Louis et al., 2014). For car commuters in the Netherlands, it has been found that congestion and perceived lack of safety are associated negatively with commute satisfaction (Ettema et al., 2013). For public transport users in Sweden, Ettema et al. (2012) report that travelling in the peak, use of ICTs and engaging in relaxation and entertainment activities are negatively associated with commute satisfaction. Having company, however, is associated positively with commute satisfaction. The authors suggest that the use of ICTs and engaging in relaxation and entertainment activities can be interpreted as coping mechanisms for responding to negative de-activation during the commute. This highlights the caution required when interpreting results from cross-sectional studies.

Some studies have investigated the role of built environment characteristics. Mostly, the residential location is used as a proxy of the environment in which commuting takes place, although in fact most of the commuting will take place beyond this area. As a result, outcomes are often inconclusive. Ettema et al. (2012) did not find significant differences between Swedish cities of different size. Mao et al. (2016) found that in denser areas of Beijing, using the subway or bicycle are associated with higher commute satisfaction. Ye and Titheridge (2017) did not find significant associations between access to public transport, green areas or car-oriented design and commute satisfaction in the Chinese city of Xi'an. Other studies have investigated whether perceptions of the travel route and the surrounding landscape influence travel satisfaction. Böcker et al. (2016) found that the percentage of green space on the route is positively associated with commute satisfaction for cycle commuters in Rotterdam.

Mao et al. (2016) found that commuters in Beijing with more flexibility in their mode choice had higher commute satisfaction, presumably because they can choose their preferred travel mode. Surprisingly, this study also found that those without any flexibility in mode choice had a relatively high commute satisfaction, which was attributed to less experience with competing modes and processes of rationalisation. Handy and Thigpen (2019) also found higher satisfaction among those with mode constraints in the context of Davis, California.

Some studies have shown that commute satisfaction is linked to travel-related attitudes. According to De Vos, Mokhtarian, Schwanen, Van Acker, and Witlox (2016) and St-Louis et al. (2014), a positive stance towards a certain travel mode has positive implications for travel satisfaction when using that mode. For instance, a liking of one's usual commute mode is associated with higher commute satisfaction (Handy & Thigpen, 2019). Ye and Titheridge (2019) found lower income commuters in Xi'an had lower levels of commuting satisfaction and this is related to a mismatch between commuting mode choice and travel attitudes. Besides travel-related attitudes, other types of attitudes might also impact travel satisfaction. Manaugh and El-Geneidy (2013) suggest that satisfaction with walking trips is more likely for people who value exercise and who are environmentally aware. It has also been shown that people with a positive stance towards travel in general are more satisfied with trips compared to people who dislike travel (De Vos & Witlox, 2016; Ye & Titheridge, 2017). On the other hand, it is also plausible that travel satisfaction affects travel-related attitudes; a satisfying trip with a certain travel mode might result in a more positive stance towards the used mode. In a conceptual paper, De Vos (2019) argues that travel satisfaction might influence attitudes (and also travel mode choice) more than vice versa. However, the effect of commute satisfaction on attitudes has not yet been empirically analysed.

Nearly all the results reported above have been based on cross-sectional studies and hence there can be doubts about direction of causality. A longitudinal evaluation of an e-cycling stimulation programme in the province of North-Brabant, the Netherlands, found that the commute satisfaction of car commuters increases over time after taking up e-cycling to work (De Kruijf, Ettema, & Dijst, 2019). Residential or job moves resulting in shorter commute distances and more active travel have been found to result in higher levels of commute satisfaction (De Vos, Ettema, & Witlox, 2019, for movers to Ghent, Belgium, and Schneider & Willman, 2019, for employees at the University of Wisconsin-Milwaukee). This shows that changes to commuting can influence commute satisfaction.

The role of various contextual factors that potentially could impact on commute satisfaction and be subject to influence by policy interventions remains unexplored. For car commuting, this includes road design and, parking availability. For public transport factors such as seat availability, vehicle functionalities (e.g. Wi-Fi) and design of stations merit investigation. For active travel modes, more insight is needed on the impact of landscape, road design, surface quality and workplace facilities. This research should extend to emerging new technological and organisational innovations in transportation such as electric cars, automated vehicles, bike sharing, car sharing and ride hailing platforms.

It should be noted that travel can also have a direct impact on eudaimonic wellbeing – since feelings of security, confidence and autonomy can be affected by how people

(perceive) travel. Singleton (2019) refers to these eudaimonic aspects of travel as travel eudaimonia. We are not aware of empirical research that has considered eudaimonic aspects of commuting.

3.3. Commuting spill-over effects to other life domains

This section first considers objective effects of commuting on time spent on other activities and then subjective effects on mood subsequent to the commute and satisfaction with other life domains.

There is evidence from different countries on how time spent commuting affects time allocation to other activities. A study using the American Time Use Survey found longer commute durations are associated with less time spent with spouse, children and friends for men and less time spent with friends for women (Christian, 2012). An analysis of data for car commuters from Statistics Canada's General Social Survey showed long commute durations associated with reduced time spent in physically active leisure and social leisure, but not work (Hilbrecht, Smale, & Mock, 2014). In contrast, results obtained from the China Family Panel Studies showed that longer duration commutes are associated with reduced time working and sleeping, but no difference in time spent caring for family, in physical activity and social activity (Nie & Sousa-Poza, 2018). A study of how commuting affects social capital in southern Sweden found commuting by car associated with reduced social participation and less trust compared with active commuting, and the strength of these associations increased with duration of the commute (Mattisson, Håkansson, & Jakobsson, 2015).

Another potential effect of commuting is a spill-over of mood to subsequent activities. An analysis of American Time Use Survey data found that longer commute durations are associated with lower positive affect at work, but no difference in sense of meaning during work (an indicator of eudaimonic wellbeing) (Morris & Zhou, 2018). A study in Sweden asked commuters to report on their smartphones their mood before and directly after their commute and later at the workplace (Friman, Olsson, Ståhl, Ettema, & Gärling, 2017). Analysis of the data showed that longer duration commutes are associated with worsened mood later in the workplace, although not immediately after the commute. Two studies of commuters in Montreal (Canada) have compared mood at work of users of different modes. A survey of McGill University staff and students found that cyclists are more likely to be energised when they arrive at work than users of other modes (Loong, van Lierop, & El-Geneidy, 2017). A comparison of IT workers arriving to work by car, public transport and cycling, however, found no difference in mood between the different mode users in the initial period of working (Brutus, Javadian, & Panaccio, 2017).

Looking at impacts of the commute on people's daily lives more broadly, analysis of data from public health surveys in southern Sweden showed that car and public transport commutes exceeding 30 min are associated with increased everyday stress, lower vitality and perceived poor sleep quality (Hansson, Mattisson, Björk, Östergren, & Jakobsson, 2011). There is one example of a longitudinal study which has evaluated the impact of an intervention and found that commuters who switched to an improved train service in New York experienced reduced commute stress and also reduced job strain but no change in stress at home (Wener et al., 2005).

Some studies have considered the relationship between commuting and satisfaction with different life domains. For example, two studies have shown that longer commute durations are associated with decreased satisfaction with social contacts (Delmelle, Haslauer, & Prinz, 2013, for workers in Vienna; Kroesen, 2014, for workers in Netherlands), while a study of British workers found longer commute durations are associated with lower leisure time satisfaction for men but not for women (Wheatley, 2014). When workers are satisfied with their commutes it has been found they have greater satisfaction with their jobs (Abou-Zeid & Ben-Akiva, 2011, for an international sample of commuters) and with work-family balance (Denstedli, Julsrud, & Christiansen, 2017, for knowledge workers in Oslo).

In summary, the evidence suggests that longer commutes are associated with reduced time spent in social and leisure activities (at least in a North American and European context) and this is felt by commuters in terms of satisfaction with social/leisure participation and work-family balance. Studies also indicate spill-over effects from the commute to mood at work and job satisfaction. As previously, the evidence is almost entirely based on cross-sectional survey data and caution is required in inferring causal relationships.

3.4. Commuting and physical health

Physical health is a primary factor influencing overall SWB (e.g. Dolan et al., 2008), hence the impact of commuting on physical health is an important potential pathway for commuting affecting overall SWB. First, higher levels of physical activity have been observed amongst commuters who walk (Audrey, Procter, & Cooper, 2014), cycle (Donaire-Gonzalez, de Nazelle, & Cole-Hunter, 2015) or use public transport (MacDonald, Stokes, & Cohen, 2010), when compared to drivers (Wanner, Götschi, Martin-Diener, Kahlmeier, & Martin, 2012). It is important to understand if increased (or decreased) physical activity from mode changes are offset by corresponding decreased (or increased) physical activity in other activity domains. A longitudinal study exploring this in English towns identified a modest, positive relationship between change in the amount of active travel for work and change in overall physical activity (Sahlqvist, Goodman, Cooper, & Ogilvie, 2013).

Other determinants of health, alongside those arising from physical activity, should be considered to fully understand the impact of commuting on physical health. Whilst commuting duration, unsurprisingly, is positively associated with inhalation of air pollutants amongst active commuters, one analysis has estimated that the physical activity benefits, compared to staying at home, exceeded the potential harm from air pollution for people who cycle up to 3.5 h daily (Tainio et al., 2016). Longer commuting durations have been shown to be related to fatigue symptoms (Kageyama, Nishikido, Kobayashi, Kurokawa, & Kaneko, 1998, for male workers in Tokyo) and poor sleep (Walsleben et al., 1999, for rail commuters in New York), which can induce cardiovascular abnormalities and dysfunction related to the onset of heart disease.

Turning to objective indicators of physical health itself, various cross-sectional (e.g. Flint & Cummins, 2016) and longitudinal (e.g. Martin, Panter, Suhrcke, & Ogilvie, 2015) studies have found public transport users and active commuters reporting lower Body Mass Index (BMI) and/or body fat (indicators of overweight and obesity) than car commuters. However, other studies have shown mixed results on the relationship between

commute distance or duration and BMI (Hoehner, Barlow, Allen, & Schootman, 2012; Kroesen, 2014; Künn-Nelen, 2015). Further studies have also examined waist circumference, systolic and diastolic blood pressure and musculoskeletal disorders (Koslowsky et al., 2013). Typically effect sizes observed in these studies are of small (clinical) significance and the longer-term impacts are under-researched.

Results on the relationship between commuting and self-reported measures of physical health have not produced clear results. Lower frequency of sickness absence has been observed amongst employees in the Netherlands who cycled to work, particularly those cycling longer distances (Hendriksen, Simons, Garre, & Hildebrandt, 2010). A study of commuting in Cambridge (UK) found more time spent in active commuting associated with better physical wellbeing (Humphreys, Goodman, & Ogilvie, 2013), but changes over time in active commuting not associated with changes in physical wellbeing (Mytton, Panter, & Ogilvie, 2016). Two studies have examined the relationship between commute duration and perceived health based on repeated observations from panel data. Künn-Nelen (2015) found from 1991–2008 data for British workers a small negative association between commute duration and self-reported health and more substantial negative association with health satisfaction, both of which are more pronounced for car commuters and for women. Clark, Chatterjee, Martin, and Davis (2019) found no association between commute duration and self-reported health for workers in England from data for 2009/2010–2013/2014. They found no longitudinal association between commute mode and self-reported health but did find a positive cross-sectional association between cycling to work and self-reported health and a negative cross-sectional association for bus commuting. This can be interpreted as showing that people with better health cycle to work and people with worse health use the bus – it does not suggest a causal effect of commute mode on health.

In summary, considerable heterogeneity exists across studies in this area, particularly in study designs and measures of physical health. Evidence suggests that active commuting may decrease overweight/obesity to a small degree, but not that it makes a substantial difference to perceived health. Nevertheless, in section 3.6.1, we assess whether there is any evidence that physical health effects of commuting have an impact on overall SWB.

3.5. Relationship between commuting and overall SWB

This section and the next one (section 3.6) present findings from studies that have directly examined the relationship between commuting and overall SWB. Some studies have used cross-sectional data while others have used panel data. Table 1 provides summary details of the studies reported in sections 3.5 and 3.6 to allow the reader to compare characteristics of the studies.

3.5.1. Cross-sectional studies

Cross-sectional studies have consistently found a negative relationship between commute duration and SWB, including studies in Sweden (Hansson et al., 2011), United States (Choi, Coughlin, & D'Ambrosio, 2013), Canada (Hilbrecht et al., 2014), Great Britain (ONS, 2014), and China (Nie & Sousa-Poza, 2018). One of these studies reported that the largest negative association occurs for one-way commutes between 61 and 90 min (ONS, 2014). Possible explanations for this are that those with commutes exceeding 90 min travel to work

Table 1. Studies of the relationship between commuting and overall SWB.

Study	Data	SWB indicator(s)	Methods of analysis	Main findings
Cross-sectional studies				
Hansson et al. (2011)	Public health surveys in southern Sweden in 2004 & 2008 (n = 21,088)	1. Self-rated health: "How do you feel right now, physically and psychologically, considering your health and your wellbeing?" (7-point scale) 2. Mental health (36-point scale based on General Health Questionnaire (GHQ12))	Binary logistic regression	Car commutes up to 60 min one-way associated with lower self-rated health relative to active commuting (at 95% significance level). No statistically significant associations between longer duration commutes by car or public transport with mental health.
Choi et al. (2013)	*Gallup–Healthways survey* (US) data collected in 2008–2011 (n = 338,000)	1. Gallup–Healthways wellbeing index (WBI) – a composite measure on 100-point scale based on questions about six domains (life evaluation, emotional health, physical health, healthy behaviour, work environment, basic access) 2. Experienced happiness yesterday (yes/no)	Linear (OLS) regression and binary logistic regression	Longer commute duration associated with reduced WBI score and reduced probability of being happy yesterday (at 99% significance level).
Humphreys et al. (2013)	*Commuting and Health in Cambridge Study* data collected in 2009 (n = 989)	Mental and physical wellbeing derived from responses to Medical Outcomes Study Short Form (SF-8) question	Linear (OLS) regression	More time spent actively commuting not associated with better mental wellbeing (but associated with better physical wellbeing).
Olsson et al. (2013)	Survey of commuters in three largest urban areas of Sweden (n = 713)	1. Satisfaction with life scale (SWLS) 5-item measure of life satisfaction 2. Affect-balance index based on six positive and six negative emotions	Linear (OLS) regression	Satisfaction with travel decreases with commute duration and is higher for walking/biking (both at 99% significance level). Lower satisfaction with travel associated with lower satisfaction with life (SWLS) and affect balance (both at 99% significance level).
Hilbrecht et al. (2014)	*Statistics Canada's General Social Survey* data collected in 2010 (n = 3409 car commuters)	1. Life satisfaction 2. Time pressure (both measured on 10-point scale)	Linear (OLS) regression	Longer car commute duration associated with lower life satisfaction (at 99% significance level) and increased time pressure (at 95% significance level). Negative association between commute duration and life satisfaction is mediated by reduced time spent in physically active leisure and greater perceived experience of traffic congestion but not time spent for social leisure.
Kroesen (2014)	*Longitudinal Internet Studies for the Social Sciences* data collected in 2009 (n = 1429 Dutch workers)	"Taking all things together, how happy would you say you are?" (11-point scale)	Mediation structural equation model	Longer commute duration associated with lower SWB via satisfaction with social contacts (at 95% significance level) both for car and bicycle commuters.
ONS (2014)	*Annual Population Survey* (GB) data collected in 2012–2013 (n = 60,200)	1. Life satisfaction 2. Daily activities worthwhile 3. Happy yesterday	Linear (OLS) regression	Longer commute duration associated with lower SWB for all four measures (at 95% significance level). Commuting by bus for over 30 min one-way

		4. Anxious yesterday (all measured on 10-point scale)		and by walking for 16–30 min one = way associated with lower SWB (for all four measures) than commuting by any mode for 1–15 min one-way.
Chng et al. (2016)	*Understanding Society* study data collected in 2010/11 (n = 3630 London workers)	1. "How dissatisfied or satisfied are you with your life overall" (7-point scale) 2. Mental health (36-point scale based on General Health Questionnaire (GHQ12))	Linear (OLS) regression	Walking commutes associated with higher life satisfaction than car commutes (at 99% significance level) but not with better mental health.
Crane et al. (2016)	*Sydney Travel and Health Study* data collected in 2013 (*n* = 846)	"How would you rate your quality of life?" (5 point-scale)	Multilevel ordinal logistic regression	Bicycle commuting associated with higher quality of life than other commute modes (at 99% significance level).
Nie and Sousa-Poza (2018)	*China Family Panel Studies* data collected in 2010 (*n* = 4117)	1. "How satisfied are you with your life?" 2. "How happy are you?" (both measured on 5-point scale)	Ordered probit regression plus mediation analysis	Longer commute duration associated with decreased life satisfaction and happiness (at 90% significance level). Commutes of at least one hour one-way associated with lower happiness but not life satisfaction. No clear differences in life satisfaction or happiness found for different commute modes. Longer commute duration associated with SWB via time spent sleeping.
Ruger et al. (2017)	*German Federal Foreign Office survey* data collected in 2011 (*n* = 1928)	Health-related quality of life (4-point scale)	Mediation structural equation model	Longer commute duration associated with lower health-related quality of life via perceived stress (at 95% significance level).
Longitudinal studies				
Stutzer and Frey (2008)	*German Socio-Economic Panel* data collected in 1985–2003 (*n* = 19,088 individuals)	"How satisfied are you with your life, all things considered?" (11-point scale)	Fixed-effects (FE) linear regression	Longer commute duration associated with decreased life satisfaction (across all commute modes) (at 99% significance level). Longer commute duration also associated with decreased satisfaction with health, job and spare time, but not decreased satisfaction with dwelling and environment.
Roberts et al. (2011)	*British Household Panel Survey (BHPS)* data collected in 1991–2004 (*n* = 7761 women and 7316 men)	Mental health (36-point scale based on General Health Questionnaire (GHQ12))	Fixed-effects (FE) linear regression	Longer commute durations associated with decreased mental health for women (at 99% significance level) but not men. Adverse effect lower for bus users and car passengers.
Dickerson et al. (2014)	*British Household Panel Survey (BHPS)* data collected in 1996–2008 (*n* = 9900 individuals)	1. "How dissatisfied or satisfied are you with your life overall" (7-point scale) 2. Mental health (36-point scale based on General Health Questionnaire (GHQ12))	Fixed-effects (FE) ordered logit regression	Longer commuting duration not associated with decreased life satisfaction. Commute duration interactions with mode tested and non-significant. Longer commute duration associated with worse mental health for women but not men.

(*Continued*)

Table 1. Continued.

Study	Data	SWB indicator(s)	Methods of analysis	Main findings
Martin et al. (2014)	*British Household Panel Survey (BHPS) data* collected in 1991–2008 (n = 17,895 individuals)	Mental health (36-point scale based on General Health Questionnaire (GHQ12))	Fixed-effects (FE) linear regression	Walking (at 99% significance level) and bus commuting (at 95% significance level) associated with better mental health compared to commuting by car. The longer the duration of the walk to work the larger the increase in mental health (with the opposite effect for car commute duration).
Mytton et al. (2016)	*Commuting and Health in Cambridge Study* data collected in 2009 and 2012 (*n* = 801)	Mental and physical wellbeing derived from responses to Medical Outcomes Study Short Form (SF-8) questions.	Difference in mental wellbeing score	Higher mental wellbeing score at time point 2 (at 95% significance level) for those continuing to cycle to work than those who do not cycle to work (but not higher physical wellbeing). No significant association found for those who started cycling to work or for walking.
Lorenz (2018)	*German Socio-Economic Panel* data collected in 2007–2013 (n = not stated)	1. "How satisfied are you today with the following areas of your life?: (a) health, (b) job, (c) household income, (d) personal income, (e) dwelling, (f) leisure time, (g) family life" and "How satisfied are you with your life, all things considered?" (all measured on 11-point scale). 2. "How often have you felt (i) angry, (ii) worried, (iii) happy, (iv) sad?" (5-point scale).	Fixed-effects (FE) linear regression plus mediation analysis	Longer commute distance associated with lower satisfaction with leisure time (at 99% significance level) and family life (at 95% significance level) but not satisfaction with other life domains or life overall. No associations with affective wellbeing. Association between commute distance and satisfaction with leisure time and family life is found to be partly explained by less time for care-giving, spare time activities and sleeping.
Ingenfeld et al. (2018)	*German Socio-Economic Panel* data collected in 1998–2013 (*n* = 25,422)	1. "How satisfied are you with your life, all things considered?" (11-point scale). 2. "In the last 4 weeks, how often have you felt angry, happy, worried or sad?" (5-point scale)	Fixed-effects (FE) linear regression plus mediation analysis	Longer commute distance associated with decreased life satisfaction (at 95% significance level) but no association with affective wellbeing. When commuting distance specified as categorical variable, commute distance over 80 kms associated with decreased life satisfaction (at 99% significance level). Satisfaction with leisure time is a mediator of the non-linear association.
Clark et al. (2019) and Chatterjee et al. (2017)	*Understanding Society* panel data collected in 2009/10 and 2014/15 (*n* = 26,000 English workers)	1. "How dissatisfied or satisfied are you with your life overall?" (7-point scale) 2. "How dissatisfied or satisfied are you with your job?" (7-point scale) 3. "How dissatisfied or satisfied are you with the amount of leisure time you have?" (7-point scale) 4. Mental health (36-point scale based on General Health Questionnaire (GHQ12)) 5. "Have you recently felt constantly under strain?" (4-point scale)	Fixed-effects (FE) linear regression plus mediation analysis	Longer commute duration associated with increased strain in people's lives (at 95% significance level), reduced mental health (at 95% significance level), reduced job satisfaction (at 99% significance level) and reduced leisure time satisfaction (at 99% significance level), but no difference in life satisfaction. Walking to work associated with decreased strain in people's lives (at 95% significance level).

less frequently than other workers or may have more comfortable travelling conditions. No association between use of different commute modes and SWB was found for Chinese commuters (Nie & Sousa-Poza, 2018). Walking to work and commuting by bus have been found to be associated with lower SWB compared to driving for British workers (ONS, 2014).

Studies in specific locations can help to understand how context affects the relationship between commuting and SWB. Walking to work is associated with higher life satisfaction in London (after controlling for commute distance), indicating that walking may be beneficial in large cities (Chng, White, Abraham, & Skippon, 2016). However, walking was not found to be associated with better mental health. Humphreys et al. (2013) also found no association between the amount of time spent actively commuting and mental wellbeing for commuters in Cambridge (UK). Cycling to work in Sydney is associated with higher self-rated quality of life (which can be regarded as an indicator of SWB) compared to other forms of commuting (Crane, Rissel, Greaves, & Gebel, 2016). This was argued to be due to the moderately intense physical activity involved in cycling.

3.5.2. Panel studies

With concern that associations between commuting and SWB based on cross-sectional data may be spurious, researchers have used panel data to control for potential confounders. They have analysed the data using fixed-effects regression modelling which identifies the within-individual relationship between commuting behaviour and SWB based on multiple observations per individual.

The first example of such a study used eight waves of data from the *German Socio-Economic Panel (GSOEP)* to find that longer duration commutes are associated with lower life satisfaction (Stutzer & Frey, 2008). An 18 min increase in commute duration is associated with a lower life satisfaction equivalent of one-eighth of the effect of being unemployed. The relationship holds for different commute modes. The possibility that partners of long duration commuters receive a compensatory benefit was tested and rejected. The authors referred to their finding as the "commuting paradox", since economic theory would suggest that people with longer commutes will not have lower than average SWB, since they would be compensated by better jobs or housing**.** Their explanation was that people incorrectly estimate the effects of commuting and their ability to adapt to it.

In contrast, longer duration commutes are not found to be associated with lower life satisfaction based on a fixed-effects regression analysis of *British Household Panel Survey (BHPS)* data (Dickerson, Hole, & Munford, 2014). A previous analysis of the same *BHPS* data set found that longer duration commutes are associated with worse *mental health* for women but not men (Roberts, Hodgson, & Dolan, 2011). This was interpreted as showing that women's greater household responsibilities meant longer commute durations were unfavourable to them.

Another study used *BHPS* data and fixed-effects regression modelling with the primary aim of assessing whether there are differences in SWB associated with commute mode (Martin, Goryakin, & Suhrcke, 2014). It found walking and bus commuting are associated with better mental health than commuting by car and the longer the duration of the walk to work the larger the improvement in mental health (with the opposite effect for

car commute duration). The relationship between active commuting and mental well-being has been assessed for commuters in Cambridge based on repeated surveys in 2009 and 2012. Those who maintained cycling to work reported improved mental well-being scores over time compared to those who did not cycle to work, although there was no significant association with mental wellbeing for those who started cycling to work or for those maintaining or starting walking to work (Mytton et al., 2016).

Three recent studies have explored how the relationship between commuting and SWB differs depending on the measure of SWB considered. With fixed-effects regression modelling on six waves of U*nderstanding Society* data for workers in England it was found that longer commute durations are not associated with decreased life satisfaction, although they are associated with increased strain, worse mental health, reduced job satisfaction and reduced leisure time satisfaction (Clark et al., 2019). Only limited differences in SWB were found for using different commute modes. Walking to work is associated with decreased strain in people's lives and increased leisure time satisfaction. Lorenz (2018) analysed the relationship between commuting distance (rather than duration) and various measures of SWB based on *GSOEP* data. She found no association between commute distance and overall SWB, whether experiential or evaluative. Ingenfeld, Wolbring, and Bless (2018) analysed *GSOEP* data over a longer period and found a negative association between commute distance and life satisfaction when commute distance is specified as a continuous variable but that the negative association is only strongly significant for commute distances over 80 kms when commute distance is specified as a categorical variable. This suggests greater attention should be given to non-linear effects in future research.

The lack of a negative within-individual association between commute duration and life satisfaction was interpreted by Clark et al. (2019) as arising because workers are acting rationally and only take on longer commutes if there are compensating benefits (income and satisfactory housing/employment) which contribute to life goals. With their data, they noted that those workers who moved from short commutes (up to 15 min one-way) to long commutes (over 45 min one-way) increased their income more than those who continued to have a short commute (Chatterjee, Clark, Martin, & Davis, 2017). They also found that those workers who persisted with long commutes had consistently lower life satisfaction than other workers. This could be due to unobserved factors unrelated to the commute (e.g. being more pessimistic), or quite plausibly due to these workers accepting the situation and being unwilling or unable to change it. This would support the commuting paradox hypothesis. Further investigation is warranted about why long duration commuters persist with their commutes.

3.6. Mechanisms underlying relationship between commuting and overall SWB

The results reported in section 3.5 identify relationships between commuting and overall SWB without revealing explanations why they might arise. In this section we assess evidence on mechanisms responsible for these relationships.

Two studies have considered how time spent commuting affects time spent on other activities and hence overall SWB. The first for Canadian car commuters found that a negative association between commute duration and life satisfaction was mediated by reduced time spent in physically active leisure and greater experience of traffic congestion but not

time spent for social leisure (Hilbrecht et al., 2014). The second for Chinese workers found no evidence for mediation via a reduction in time for caring for family, work, physical activity and social activity but evidence to support part mediation via a reduction in time spent sleeping (Nie & Sousa-Poza, 2018).

The impact of commuting on overall SWB through its effect on satisfaction with different life domains has been another focus of investigation. Satisfaction with the *commute* has been shown to be positively associated with affect balance (experiential wellbeing) and life satisfaction (evaluative wellbeing) for Swedish commuters (Olsson et al., 2013). Given that satisfaction with the commute is positively associated with walking or cycling to work and negatively associated with commute duration this implies active commuting and shorter duration commutes are beneficial not only to domain-specific commute satisfaction but to overall SWB. These results are based on cross-sectional data and we cannot be certain about the direction of causality. It is conceivable that happier and healthier people are more likely to report greater satisfaction with daily activities and to take up active commuting. The relationship could also be bi-directional where happier people take up active commuting and this further increases their happiness. As noted in section 3.2, however, the recent longitudinal study by De Kruijf et al. (2019) found that the commute satisfaction of car commuters increases over time after taking up e-cycling and this represents some evidence of the main direction of causality theorised in Figure 1.

A path analysis based on cross-sectional data for car and bicycle commuters in the Netherlands found that increased commute duration is associated with decreased satisfaction with social contacts which in turn has a negative association with happiness (Kroesen, 2014). However there was no association between commute duration and other tested mediators, namely: BMI, perceived health and job satisfaction. A path analysis for one wave of *Understanding Society* data for workers in England revealed that longer commute journeys are associated with decreased leisure time satisfaction, decreased job satisfaction and increased strain (Chatterjee et al., 2017). These factors in turn are associated with reduced life satisfaction. Leisure time satisfaction is the most dominant of the factors and accounts for 80% of the negative association between commute duration and life satisfaction. In neither of these studies is there an indication that longer commuter durations impact on overall SWB via worse physical health.

The role of stress was investigated by Ruger, Pfaff, Weishaar, and Wiernik (2017) who found that perceived stress has a mediating role in the negative association between commute duration and health-related quality of life based on a survey of expatriate workers of the German Foreign Office. The mediating role is particularly prominent among parents, suggesting reduced time availability from long commutes is particularly felt by this group.

The results reported above suggest longer commute durations influence overall SWB negatively via decreased satisfaction with social participation/leisure time, loss of sleep and increased stress. They suggest active commuting influences overall SWB positively via greater satisfaction with commuting. It is recommended that further investigations of mediating relationships are carried out based on longitudinal data to provide stronger evidence on causality.

3.7. Feedback effects between SWB and decisions that workers make relating to commuting

The possibility that commuters respond to SWB effects of commuting by altering how they make their journey to work or the journey itself (e.g. through a workplace or residential location change) needs to be considered. Recent studies suggest that people choose to live in a neighbourhood which enables them to have satisfying trips (Cao & Ettema, 2014, for residents of Minneapolis-Saint Paul; De Vos & Witlox, 2016, for residents of Ghent, Belgium). This can be achieved by living in neighbourhoods facilitating use of a preferred travel mode, but also by living in a neighbourhood that permits a preferred commute length (De Vos & Witlox, 2017). Analysis of panel data for workers in England shows that those with commutes over 45 min one-way (who tend to have lower life satisfaction than other workers) have an increased likelihood of changing jobs by the following year of around 25% (Chatterjee et al., 2017). People might also change their travel choices (e.g. mode choice, departure time) in response to dissatisfying commute trips. However, due to the mostly fixed work and house locations and working hours, changing travel choices (e.g. not travelling by car or travelling outside peak hours) might often not be feasible. In general, more research is needed on how commuters respond to dissatisfying commutes.

4. Policy and research recommendations

4.1. Summary of the evidence

The body of evidence reviewed in section 3 suggests commuting has an impact on multiple dimensions of SWB, both during and after the journey to work. During the journey, stress can be induced by a lack of control, associated with congestion, crowding and unpredictability, and mood is found to be generally lower than during other daily activities. People who walk or cycle to work are generally more satisfied with their commute than those who travel by car and especially those who use public transport. Satisfaction decreases with duration of commute, regardless of mode used, and increases when travelling with company. After the journey, there is evidence that the commute experience "spills over" into how people feel and perform at work and home. However, a consistent link between commuting and life satisfaction overall has not been established. The evidence suggests that commuters are generally successful in trading off the drawbacks of longer and more arduous commute journeys against the benefits they bring in relation to overall life satisfaction, but further research is required to understand the decision making involved.

4.2. Policy context for acting upon the evidence

There is a fertile policy environment for utilising the growing evidence on the links between commuting and SWB given the high prominence of the wellbeing agenda in many countries at present. One important dimension of the wellbeing agenda is measurement. For example, the OECD's Better Life Index measures wellbeing in each OECD country across 11 domains – housing; income; jobs; community; education; environment; civic engagement; health; life satisfaction; safety; and work-life balance. At the national level,

wellbeing measurement programmes, such as those in the UK, Canada and Australia, have dashboards of wellbeing indicators with domains similar to that of the OECD (Kroll, 2011). However, while transport is linked in various ways to many of these domains of wellbeing (Delbosc, 2012; Reardon & Abdallah, 2013), including through the commute, transport is largely absent from these indicator sets. For example, in the UK Measuring National Wellbeing Programme, the only transport specific indicator relates to accessibility to services; measured as the average minimum travel time by public transport or walking to eight main services (including hospitals and schools).

One of the ways in which the wellbeing agenda differs from others before it, such as the sustainability agenda, is its emphasis on subjective indicators. Advocates for the use of SWB in policy argue that the practice of asking people directly about their wellbeing, rather than relying on objective proxies, democratises the basis upon which policy is made. A key concern, however, with using subjective indicators is the possibility of the "happy poor" where those who are in disadvantaged positions adapt to their circumstances and therefore subjectively may be happy and consider themselves satisfied with their life, while objectively are experiencing poor wellbeing (for example, below average life expectancy and housing conditions) and thus there is a risk of undermining legitimate claims for state intervention to support these groups. Conversely, there are risks that those with the highest wellbeing by objective measures will be the least satisfied subjectively – the "worried well" – and resources are directed from the people who need them most in objective terms. The current policy consensus is that subjective indicators should be used as a complement to, rather than replacement for, existing objective data on wellbeing (Bache, Reardon, & Anand, 2016).

There is therefore potential for evidence on wellbeing and its links to the commute to inform government policy in many ways. For example, the UK Airports Commission undertook a Quality of Life Assessment as part of its assessment of future airport capacity needs. The Commission assessed the links between SWB and four aviation factors (proximity to airports, aviation noise, working in airports and being at airports). It argued that "the ability to value the impact of airports on subjective wellbeing … provides an important potential input to understanding the scale of any mitigation that might be required before an airport scheme is attractive, especially in terms of non-market impacts" (Airports Commission, 2014, p. 50). It follows, therefore, that evidence on the links between commuting and SWB could also be used to inform policy interventions. For example, understanding more the links between commuting, SWB and productivity at work, could lead to work-placed interventions that help to mitigate the impact of the commute; not only for the benefit of employers but for individuals and society too.

4.3. Policy and research recommendations

We now consider recommendations for policy actions and research priorities which follow on from our understanding of the evidence base. These recommendations were collaboratively developed by the authors. Table 2 summarises the recommendations, which are organised by six policy aims. The policy actions have been partly informed by the literature reviewed and partly based on the personal knowledge of the authors. Many of them have been applied in parts of the world, for other aims than improving the SWB of commuters, but we hope this review may provide an added impetus to adopt them.

Table 2. Policy and research recommendations.

Policy aim	Evidence	Potential policy actions	Delivery agents	Evidence gaps	Research priorities
Enhancing the commute experience	Lack of control over journey leads to commute stress (see section 3.1.1). Traffic danger and poor quality route provision leads to unpleasant commutes for walkers and cyclists (see section 3.1.2).	Measures to increase predictability & control: • Real-time information for public transport • Guaranteed ride home programmes for car poolers and public transport riders Measures to increase enjoyment: • Wi-fi on public transport • Reduced crowding on public transport • Green routes for walking/cycling separated from motorised transport	- Land use planners and developers - Highway authorities - Public transport agencies - Employers	Limited knowledge about factors influencing commute enjoyment (in particular design and environmental factors).	1. Monitoring of affective experiences before, during and after commute journeys (e.g. using passive methods (smartphones) and active methods (ethnography)) to identify influencing factors (design and environmental factors). 2. Evaluation of interventions aimed at improving commute experience (including new transport alternatives such as commute shuttles).
Increasing commute satisfaction	Higher level of satisfaction with active commuting compared to driving and lower satisfaction with public transport commuting than driving (see section 3.2). Satisfaction decreased by congestion/crowding and perceived lack of safety and increased by interacting with other travellers (see section 3.2).	Measures to enable a shift to active commuting: • Land use policies (compact and mixed land uses) • Infrastructure investment (e.g. green routes) • Financial incentives (e.g. parking cash-out, tax-free bicycle purchase) • Information and support Measures to improve quality of provision and image of public transport: • Priority over private motorised transport	- Land use planners and developers - Transport planners - Highway authorities Public transport agencies - Employers	Limited understanding of transport design and environmental factors that influence commute satisfaction. Limited understanding of how commute satisfaction varies across the socio-economic status distribution (Ye & Titheridge, 2019, being a recent exception).	1. Understanding of variation in commute satisfaction by socio-economic status. 2. Design of methods to measure design and environmental factors and comparison of commutes to identify how design and environmental factors influence commute. satisfaction. 3. Longitudinal studies to evaluate how changes to commutes (due to personal events or external interventions) influence commute satisfaction. 4. Cost effectiveness analyses of interventions aimed at improving commute satisfaction.

		• Cleanliness, comfort, staff passenger care, punctuality and frequency of public transport			
Reducing negative SWB impacts of long duration commutes	Longer duration commutes associated with lower satisfaction with job and with social and leisure participation and greater strain in people's lives (see sections 3.3–3.6).	Policies to lessen need for long duration commuting: • Employer assistance with local housing • Flexible working practices (including working from home) Measures to reduce commute journey times: • Congestion management (e.g. pricing) • Improved public transport (rapid transit, greater coverage, better integration between services) Measures to "compress" commute journey times (make them pass more quickly): • See Watts and Lyons (2010) for ideas on how commuters can equip themselves for long commute journeys	- Employers - Local gov't - Public transport agencies	Compensations and coping mechanisms for long duration commutes not well understood.	1. Qualitative research to better understand how long duration commutes affect different workers (according to life situation, type of employment and work conditions) 2. Investigating longer term effects of commute (dis)satisfaction on SWB and health. 3. Evaluation of employer commute assistance programmes.
Meeting commuter preferences	Mismatch between travel preferences and behaviour can lead to dissatisfaction with commute and residential location greater strain in people's lives (see sections 3.2 and 3.7).	Policies to encourage greater range of housing, job and transport options: • Land use policies to provide balanced housing and employment provision • Co-working offices in residential neighbourhoods	- National gov't (planning, housing, employment, transport departments) - Local gov't (departments as above)	No specific research on how commute dissatisfaction influences residential relocation	1. Understanding better how travel attitudes and preferences influence commuting satisfaction. 2. Investigating how commuting affects home and job satisfaction and decisions to relocate.

(*Continued*)

Table 2. Continued.

Policy aim	Evidence	Potential policy actions	Delivery agents	Evidence gaps	Research priorities
		• Support for innovation in transport service provision (which reduces travel barriers and increases options)			
Recognising flexibility and constraints in commuting routines	Indications that negative SWB impacts of commuting are higher for those more constrained and women in particular (see sections 3.2 and 3.5).	Measures to increase commute flexibility: • Transport pricing that suits commuters who do not travel to work every day and/or do not wish to use the same mode every day / Withdrawal of season-ticket discounts for frequent rail commuters • Withdrawal of discounts for frequent users of car parks • Promotional activities to encourage workers to try new commute options	- Public transport agencies and new transport service providers - Employers	Limited dimensions of commuting have been considered in studies to date (mostly duration and mode) and it has been assumed that workers have the same commute each day.	1. Collecting commuting diaries to examine role of commuting flexibility and constraints in wellbeing. 2. Research to explore barriers to using commuting alternatives.
Accounting for wellbeing impacts of commuting in policy making	Appraisal of transport investment decisions does not account for "experienced utility" of travel (see section 4.2).	Taking account of wellbeing impacts of commuting in: • Transport appraisal procedures • Monitoring of place-based wellbeing/quality of life • Monitoring of wellbeing at work by employers	- National gov't - Employers		1. Including measurement of commute satisfaction in evaluations of transport interventions. 2. Developing method for converting commute satisfaction into standardised wellbeing metric.

The first policy aim is "Enhancing the commute experience" and draws upon the findings reported in section 3.1. Policy actions are identified to avoid commute stress by increasing the predictability and control of commute journeys and to increase positive affect by providing an environment which enables commuting to be enjoyable. Research recommendations focus on getting better knowledge on how features of the commute influence affect and evaluating how interventions can influence this.

The second policy aim is "Increasing commute satisfaction" which builds on the first policy aim but concerns overall satisfaction with the commute and draws upon the findings reported in section 3.2. Policy actions focus on measures to increase active commuting (for which there is strong evidence of higher commute satisfaction) and measures to reduce dissatisfaction associated with public transport use (since public transport is unavoidable for many commuters). Research recommendations focus on understanding differences amongst the working population in commute satisfaction and how this is affected by their commute contexts (design and environmental factors) and also evaluating how changes in people's lives and the transport system influence this. It is also suggested that cost-effectiveness analyses be carried out to better understand which policy actions would deliver desired outcomes for the lowest possible cost, as well as to help potentially understand the return on public (or private) investment.

The third policy aim is "Reducing negative wellbeing impacts of long duration commutes" which draws upon the findings reported in sections 3.3–3.6. Policy actions focus on reducing the need for long duration commutes, reducing commute journey times across different transport modes and making journey times feel shorter. Research is recommended to understand in what circumstances long duration commutes are most damaging to SWB and whether benefits connected to jobs distant from where people live can be maintained when people live closer to their work. It is also important to understand longer term effects of commute dissatisfaction on SWB as virtually no evidence is available on this. Evaluations would be valuable to assess the outcomes of interventions aimed at reducing long duration commuting. There is a question of who bears responsibility for this issue. If workers choose situations involving long commutes should they not be the ones that bear the costs (SWB impacts) of this? This needs careful consideration of whether long commutes are a result of personal preferences or failures of markets and planning and whether they are unevenly distributed across the population and thus potentially contributing to inequality (in terms of accessibility, job prospects and so on), and thus whether they are an appropriate sphere for public intervention.

The fourth policy aim is "Meeting commuter preferences" which draws upon the findings reported in sections 3.2 and 3.7. This has policy recommendations to stimulate initiatives which offer the public more options regarding housing, jobs and commuting. Research is recommended to better understand how travel-related attitudes influence commuting satisfaction and to consider the competing issues that people face regarding their home, job and commuting choices and how they resolve them. This would enable better understanding of preferences and how they can be met.

The fifth policy aim is "Recognising flexibility and constraints in commuting routines" which draws upon the findings reported in sections 3.2 and 3.5. Studies have tended to assume that commuting is a repeated activity one working day to the next, but we know that commuting is changing as a result of more flexible working practices and greater provision of information to commuters on travel conditions and options. For

example, while the average commute duration has increased from 27 min to 31 min in England between 2002 and 2017 (DfT, 2018a), this has been counteracted by the trend for workers to travel to their workplace less often (379 commute trips per year on average for those full-time employed in England in 2002 and 331 in 2017 [DfT, 2018c]). Furthermore, the proportion of people in employment working from home has increased (DfT, 2016). Policy recommendations focus on further increasing commuting flexibility. However, there will remain workers who have less discretion about how often and when they travel to work and these are likely to be those from lower socio-economic groups who also experience lower SWB for other reasons than commuting. It is important that the impacts of commuting on SWB are considered across the social gradient. Regarding research, we recommend in-depth studies investigating how commuting flexibility and constraints affect SWB and investigating the barriers which prevent workers from modifying their commutes.

The sixth and final policy aim is "Accounting for wellbeing impacts of commuting in policy making". The systems used to appraise transport investment decisions consider the decision utility of travellers (for example, based on their willingness to trade off time for money) but we argue that experienced utility in the form of SWB impacts is neglected and may not closely coincide with decision utility. We advocate that procedures are developed to account for SWB impacts of transport and other public policy interventions that affect commuting and that research supports this by collecting the necessary evidence. We also advocate that SWB related to travel (i.e. commute satisfaction) is more routinely included in monitoring of the wellbeing and quality of life of the workforce and communities.

We finish with some observations about the policy process itself. The evidence presented in this paper is robust enough to highlight some key links between commuting and SWB (even if stronger evidence is needed to demonstrate cause and effect and many aspects need further research). Our view is that the evidence is not strong enough to be directly applied in project appraisal currently but can be incorporated into evidence-informed policy making. We believe the evidence is strong enough to provide a clear narrative (see section 4.1) to policy makers, the business sector and the public of the links between commuting and SWB. In turn, policy needs to use more measures of objective wellbeing and subjective wellbeing in project and performance evaluation in order to close the gaps in the evidence base and strengthen it going forward.

To conclude, the research reviewed in this paper has made an important contribution in enabling SWB, an outcome of transportation that has been largely neglected, to be brought into decision making and specific measures to be taken which can improve people's lives. It offers a helpful new perspective on and impetus for transport policies and interventions, beyond the traditional goals of facilitating movement and managing "objective" negative externalities such as pollution and injuries.

Notes

1. This data was collected by the European Foundation for the Improvement of Living and Working Conditions (EuroFound) and the methodology used is not described. Our view is that the National Travel Survey results are more reliable.

2. Potentially, commuting might elicit affective responses before the commute, for example, in preparation or anticipation of travel but this has not been investigated in studies to date.

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