MOOD DURING COMMUTE IN THE NETHERLANDS
What way of travel feels best for what kind of people?

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ABSTRACT

Question: How happy we are depends partly on how we live our life and part of our way of life is the commute between home and work. In this context we are faced with the question of how much time spent on commuting is optimal happiness wise, and what means of transportation. Since our personal experience is limited, it is helpful to draw on the experience of other people, of people like us in particular.

Earlier research: Several cross-sectional studies have found lower subjective wellbeing among long-distance commuters and among users of public transportation. Yet these differences could be due to selection effects, such as unhappy people ending up more often in distant jobs without having a car. Still another limitation is that earlier research has focused on the average effect of commuting, rather than specifying what is optimal for whom.

Method: Data of the Dutch 'GeluksWijzer' (Happiness Indicator) study were analyzed, in the context of which 5000 participants recorded both what they had done in the previous day and how happy they had felt during these activities. This data allows comparison between how the same person feels at home and during their commute. The number of participants is large enough to allow a split-up between different kinds of people, in particular among the many well-educated women who participated in this study.

Results: People feel typically less well when commuting than at home, and this negative difference is largest when commuting using public transportation and smallest when commuting by bike. It is not per se the commuting time that depresses mood, but specific combinations of commuting time and commuting mode. Increasing commuting times can even lead to an uplift of mood when the commute is by bike or foot.

Split-up by different kinds of people shows considerable differences, especially with regard to the different modes and company when travelling. Optimal ways of commuting for different kinds of people are presented in a summary table, from which individuals can read what will fit them best. The differences illustrate that research focusing on averages will not help individuals to make a more informed choice with respect to commuting mode.

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1. INTRODUCTION

The last few decades have seen a rising interest in subjective wellbeing. This topic has been around since antiquity in Western society and has been much debated ever since; once an object of theoretical speculation, now it is an object of empirical research in the social sciences and increasingly in economics (Layard, 2005; Frey and Stutzer, 2002). The rise of scientific interest in subjective wellbeing is part of a wider cultural change, in which 'quality of life' gains prominence relative to traditional values such as religious devotion and social success (Veenhoven, 2016).

Empirical research on subjective wellbeing has shown that most people are happy, at least in contemporary developed nations (Veenhoven, 2015a). Research in modern societies has also shown that greater wellbeing is possible for most people and that an individual's happiness depends to a considerable degree on the choices that one makes in life (Lyubomirsky, 2008). As people typically want to live a happy life, there is a demand for information on the effects of choices on happiness. This information demand reflects in soaring sales of 'how to be happy books' and increasing numbers of life-coaching businesses. Although much of this advice is based on folk-wisdom, empirical happiness research is increasingly used to support the informed pursuit of happiness (Veenhoven, 2015b).

One of the choices we make is how we travel between work and home, an important aspect of modern life and one which accounts for a considerable part of daily time spent. Even in a small country like the Netherlands, commuting is a time-consuming activity with an average commuting time of 34.5 minutes one way. Time spent commuting and distances commuted have increased considerably over the past decades (Van Wee et al., 2006; Susilo and Maat, 2007). To make a well-informed choice on this matter, it is helpful to know how different aspects of commuting affect the subjective well-being of other people in general and of people like us in particular.

Research questions
Hence, the question addressed in this exploratory paper is '*What does optimal commuting look like to enhance subjective well-being for whom?*' To answer this question, three related sub-questions need to be answered.

1. Does commuting affect subjective well-being? If so, how much?
2. Which aspects of commuting influence subjective well-being most and least?
3. How different are these effects across persons and situations?

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In particular, we focus on one specific aspect of subjective wellbeing, namely the mood level during commuting.[2]

Link with the life-oriented approach

This article is part of a special issue on the life-oriented approach, which argues that behaviors in different life domains are interdependent and that travel results from life choices, while travel decisions also affect other choices in life (Zhang 2017). That approach focuses on determinants of choice he first place, while this study is about the consequences of choice, that is, on the effects on mood of chosen ways of commuting. This affective experience is likely to influence later travel decisions and a main aim of our study is to enhance that effect, making the consequence of commuting better visible and thus enabling choice that is more informed. More informed choice on commuting is likely to influence choice in other domains of life, such as where to live and work. We also followed the life-oriented approach in that we did not considered mood during commute in isolation, but studied it in the context of wider life, comparing with average mood during other activities of the day.

Plan of this paper

The remainder of this paper is organized as follows. Previous research on commuting and subjective wellbeing and lacunas in this literature are discussed in section 2. The data and methodology of our study are introduced in section 3 and the empirical findings are presented in section 4, followed by discussion and conclusions in sections 5 and 6.
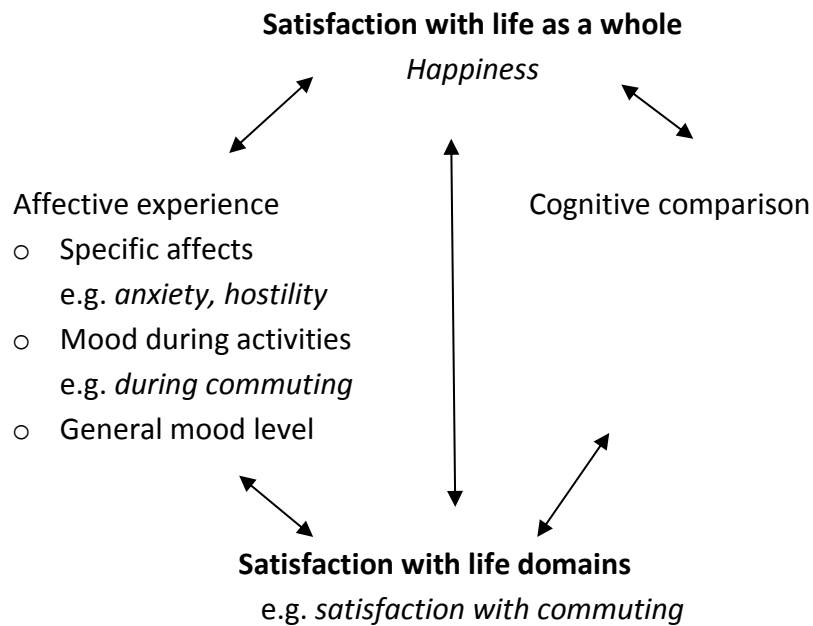
2. PREVIOUS RESEARCH

The earlier studies have considered different kinds of subjective wellbeing and different aspects of commuting.

2.1 Aspects of subjective wellbeing

Subjective wellbeing is about the self-appreciation of one's personal condition. This appreciation can concern aspects of life or life-as-a-whole. 'Appreciation' is typically based on both affective experience and cognitive comparison (e.g. Diener et al., 1999; Veenhoven, 2000), the relative weights of which vary (Veenhoven 2009). The different variants of subjective wellbeing are summarized in Figure 1 with the variants used in research on commuting printed in *italics*.

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[2] Following the happiness studies literature, happiness is a combination of affective experiences and cognitive comparisons. Hence, subjective well-being encompasses satisfaction with life in general and frequency of positive and negative mood, also known as affect (Diener et al., 1999). This is further explained in Section 2 and 3.

Figure 1
Variants of subjective well-being

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Satisfaction with life as a whole
Happiness

Affective experience
  o Specific affects
     e.g. *anxiety, hostility*
  o Mood during activities
     e.g. *during commuting*
  o General mood level

Cognitive comparison

Satisfaction with life domains
e.g. *satisfaction with commuting*

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Several studies have focused on the experience of commuting and assessed how people feel during commuting (e.g. Kahneman et al 2003; White and Dolan, 2009) or how satisfied they are with commuting (e.g. Ettema et al 2012; Friman et al., 2013). Next there are studies that consider subsequent wider effects of commuting, such as on particular feelings (e.g. Koslovsky et al 1995 on anxiety and hostility), overall mood (Morris and Guerra, 2015a) or on satisfaction with life as a whole (e.g. Stutzer and Frey, 2008). An elaborate overview of these studies is provided by DeVos et al. (2013). In the empirical part of this article, we will focus on mood during commuting, while controlling for mood during the rest of the day.

Studies that have examined the relationship between commuting and subjective wellbeing have produced mixed results. Commuting is one of the least appreciated activities during the day, in that respondents report the lowest mood levels during travel to and from work (Kahneman et al., 2003; White and Dolan, 2009; Zuzanek and Zuzanek, 2015). In addition, longer commuting times reduce life satisfaction levels (Stutzer and Frey, 2008; Studer and Winkelmann, 2011) and commuting is disliked more compared to other types of travel (Morris and Guerra, 2015a). Important negative aspects of commuting would be stress (Koslowsky et al., 1995; Novaco and Gonzales, 2009), boredom (Gatersleben and Uzzell, 2007) and increased social isolation (Putnam, 2000), which leads to decreased levels of subjective wellbeing. Conversely, some studies indicate that feelings about commuting and during commuting are generally positive or neutral (Mohktarian and Solomon, 2001; Olsson et al., 2013), while Ory et al. (2004) link commuting to higher levels of life satisfaction.

There are several reasons for these mixed results. One reason is that commuting can work out differently on the different kinds of subjective wellbeing discussed above. For instance, mood of the moment may be low when commuting, while commuting still adds to greater satisfaction with working life, because jobs at a distance are better than jobs close to one's home. Another reason is that commuting may be experienced differently by people depending on personal and commuting characteristics; in other words, the relationship between commuting and subjective wellbeing can be considered heterogeneous. Both issues will be addressed in this article; we focus on mood of the moment and assess what kinds of people feel best in what ways of commuting.

2.2 Aspects of commuting

Commuting duration
Stutzer and Frey (2008) have assessed the effects of commuting on subjective well-being in Germany. They found that longer commuting time is associated with lower life satisfaction. Studer and Winkelmann (2011), and Choi et al. (2013) obtained similar results. In addition, commute duration is negatively associated with satisfaction with the commute (Ory et al., 2004; Olsson et al., 2013; Morris and Guerra, 2015b). At the same time, some studies have indicated that the relationship between commuting time and subjective well-being is non-linear. Research by the Office for National Statistics (ONS) in the United Kingdom also indicates that each successive minute of travel decreases the level of life satisfaction. Average mood levels significantly drop after 15 minutes of commuting and life satisfaction after 45 minutes of commuting. In general, commuting times between 60 and 90 minutes are most detrimental to subjective wellbeing levels (ONS, 2014). Likewise, Wielers and VanderMeer (2013) found that moderate commuting times especially reduce wellbeing.

Commuting mode
Research on commuting mode and subjective wellbeing has generally found that cycling and walking to work contribute to higher levels of subjective wellbeing compared to motorized travel (Duarte et al., 2010; Friman et al., 2013; Olsson et al., 2013; Ettema and Smajic, 2014; Morris and Guerra, 2015; Chng et al., 2016). In particular, Ettema and Smajic (2014) found that the level of physical activity involved in walking increases mental health and enhances the mood, indicating that commuting modes involving physical activity might have a lower negative or even positive effect on happiness. On a different note, several studies have reported that commuting by car generates higher levels of subjective wellbeing than commuting by public transportation or transit (Mokhtarian and Solomon, 2001; Ettema et al., 2011; Abou-Zeid et al., 2012; Morris and Guerra, 2015a; Olsson et al., 2013). As pointed out by Morris and Guerra (2015a), the difference in subjective wellbeing of car and public transport commuters can be explained by factors such as prestige, self-esteem, convenience, comfort, reliability, and greater control over one's environment.

To work or back home

Ettema et al. (2012) examined the difference between commuting to work and from work on satisfaction with travel. It appears that commuters have different mindsets when travelling to and from work. While commuters on the way to work prepare themselves for a working day, on the way home the prospect of private time enables them to be more open to enjoying the commute. This is also shown for ICT use in public transport, which has a negative effect on well-being on the way to work when ICT use is possibly work related, whereas it has a positive effect on well-being on the way home when ICT is possibly used to coordinate private time (Ettema et al., 2012). This indicates that the experienced happiness when commuting may also be different to and from work, see also Olsson et al. (2013). In contrast, Koslowsky et al. (1995) found that commuting always leads to a bad temper when either arriving at work or at home.

Rush hour

Commuting can be a major cause of stress due to its unpredictability and perceived loss of control (Roberts et al., 2011). When people do not have control over certain factors that can occur during driving, commuting is experienced as more stressful and leads to lower reports of well-being. Drivers generally experience a lesser feeling of control during rush hours when environmental stressors are the highest and the driver needs a higher level of concentration to focus on the task. In this regard, Morris and Hirsch (2015) found that drivers in the largest cities are in a less positive mood during rush hour.

Travelling alone or together

According to Ettema et al. (2012) the strongest positive effect on satisfaction with travel is talking to others during the journey. This indicates how travelling alone or together can influence the commuters' happiness. These findings are in line with the work of Morris and Guerra (2015a), who found that social interaction positively contributes to mood during commuting. Their conclusions are based on the findings that (1) car passengers are among the happiest commuters and (2) when controlling for the pleasure derived from social interaction car drivers are at least as happy as car passengers. Likewise, Olsson et al. (2013) report that for longer commuting trips, social activities can increase positive emotions and counteract boredom and stress.

Heterogeneous effects of commuting

Roberts et al. (2011) mainly looked into gender differences in the effects of commuting on psychological health and found that although women tend to commute less, they are more influenced by the negative effects of commuting than men. It is argued that this is because women have a greater responsibility for the household. Within their wide variety of tasks besides work, commuting is another competing demand on a woman's time and thus a greater psychological burden. Other scholars have examined to what extent the relationship between commuting and subjective wellbeing is moderated by psychological dispositions. In this regard, Studer and Winkelmann (2011) found that very satisfied people are less affected

by an increasing commuting time than people who are dissatisfied with their life. In addition, social comparison plays a role: favorable comparisons of one's commute to that of others, e.g. commuting distance, time or comfort increase overall satisfaction with commuting (Abou-Zeid and Ben-Akiva, 2011).

2.3   Limitations

Although the existing literature has produced a rich body of knowledge on subjective well-being and transportation, several issues have remained unaddressed in this literature. First, selection effects are often not well-covered. For example, several cross-sectional studies found lower subjective wellbeing among long-distance commuters and among users of public transportation, however, these differences could be due to selection effects, such as unsuccessful unhappy workers settling more often for a job far away. Another point not taken into account is that people have different determined set-points (Lykken & Tellegen, 1996) and personality traits (Furnham & Cheng, 1997; Lucas & Fujita, 2000) that largely affect their mood level.[3]

Another limitation is that earlier research has focused on the average effect of commuting, rather than addressing the heterogeneous relationship between commuting and well-being and specifying what is optimal for whom. Commuting is likely to work out differently for different people and the question is rather how relations differ in subgroups of the general population. For example, where for some people travelling by car can be conducive to their level of affect, for other types of people more active transport modes such as biking or walking have a positive impact on well-being. This is worth knowing, not only for individual commuters, but also for policy makers in the field of transportation.

In our exploratory analysis, we address both selection effects and the heterogeneous relationship between commuting and well-being, where we also examine what way of travel feels best for what kind of people.

3.   APPROACH OF THIS STUDY

In this study we focus on mood during commuting. We assess what modes of commuting make people feel better or worse and look for differences in effects across different kinds of people. We use a diary technique, which allows us to address some of the above-mentioned limitations of earlier research.

3.1   Data Collection: Day Reconstruction Method (DRM)

The data for this study was gathered using the Day Reconstruction Method (DRM), a tool developed by Kahneman et al. (2004). Respondents first 'reconstruct' the previous day, listing

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[3] For an exception see Morris and Guerra (2015a).

all the activities that they engaged in and record with whom they did these activities and where. Subsequently they rate how well they felt during each of these activities. Accordingly, DRM is a combination of time-use study and a mood diary. Contrary to traditional survey research, DRM captures momentary experience rather than global memories and provides a comprehensive view of the day. Hence, we focus on the affective component of happiness, depicted on the left in Figure 1, instead of the cognitive evaluation of life, positioned on the right in Figure 1. As we have seen in Section 2, earlier research has largely been concerned with the cognitive component of happiness in the context of commuting.

The DRM is an appropriate tool to measure mood over the course of one day by combining features of time-budget measurement and experience sampling.[4] The virtue of this method is that it makes possible comparisons between moods associated with different activities including commuting during a day. DRM has been used previously in work that has addressed commuting and subjective wellbeing (e.g., Kahneman et al., 2004; White and Dolan, 2009; Morris and Guerra 2015a).

Since respondents reflect on their mood on the previous day, DRM can be more vulnerable for recall bias compared to other multi-moment measurement methods such as the Experience Sampling Method (ESM), where mood is instantly measured. However, comparison studies have found overall little difference between mood measured with DRM and ESM Methods, especially with regard to the average mood during the day (Kahneman et al., 2004; Dockray et al., 2010; Bylsma et al., 2011; Diener and Tay, 2014; Tweten et. al. 2016). At the same time, differences in evaluations of mood between the DRM and ESM are larger when looking at specific time points, future research still has to assess to what extent these differences can be attributed to recall biases (Diener and Tay, 2014).

3.3   Data and Main Variables of Interest

The data for this study was collected through a website called 'Happiness Indicator', in Dutch 'GeluksWijzer'[5] (Burger & Veenhoven 2016). This *Happiness Indicator* is a combination of a long-term follow up study on happiness and a self-help website where people can learn how to get happier.

Participants were recruited using various channels, including different types of customer communications from the health insurer VGZ, social media (Facebook, LinkedIn, Twitter) and Dutch popular magazines (see also Bakker et al., 2015). So we used a convenience sample of people interested improving their happiness, which is not a probability sample of the general population in the Netherlands. Though not representative for the general public, participants do stand for the kind of consciously living people who are

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[4] Time-budget studies assess how people spend their time and typically uses diaries (e.g. Juster & Stafford, 1991). Experience sampling techniques capture mood of the moment and (nowadays) often use cell phones for that purpose (e.g. Csikszentmihalyi and Hunter, 2003).

[5] Available at http:// www.gelukswijzer.nl. The English language version is the Happiness Indicator, which is available at http://www.happinessindicator.com

likely to use the information generated by this project.

Upon visiting the website for the first time, the participants create an account and complete a profile questionnaire. They receive an e-mail on a regular basis with a link to their personal page, where they complete a short questionnaire and, if desired, fill in the *Happiness Diary* (in Dutch 'Geluksdagboek'), which we use in this study.

The *Happiness Diary* comprises an internet application of the DRM. After having listed the activities of the previous day, participants rated how well they had felt during each of these activities, using a 0-10 rating scale as shown in Figures 2 and 3. After completing the diary, participants can compare their experienced happiness during different activities with others 'like them' (Figure 4). The average affect scores for all activities on a particular day represents the average daily mood. The *Happiness Diary* generates an at-a-glance overview that shows the activities during which the participant felt the least and most comfortable. This overview can help participants allocate their time optimally. The comparison with similar others can help the participant in making choices, for example when deciding on commuting mode and time.

Between January 2011 and December 2014, 9,091 people filled out the *Happiness Diary* 18,622 times, where each diary entry consisted, on average, of 12 activities during the day.[6] Most of the respondents in our study (86%) used the *Happiness Diary* only once.

The *Happiness Diary* classifies activities during the day in 14 primary categories, such as 'eating', 'sleeping', 'working' and 'leisure. One of these primary categories in the diary is 'in transit'. When that activity took place before or after work we assumed it was 'commuting'; we excluded the 'in transit' episodes where the activity before and after the episode was 'work'. Respondents indicated, at what time of the day they commuted, which transport mode they used, i.e. walking, bicycle, scooter, car, public transport, or other, and with whom, alone or with other(s). The hours of their commute revealed if this was in or out of rush hour (06:30-09:00 and 16:00-18:30 ANWB, 2015 & NS, 2015) and if they were commuting to work (before work) or back from work (after work).

In this study, we draw on the 2,720 diaries from 1,450 different respondents in which we could identify one or more commuting episodes during the day. In total, the database consisted of 33,465 different episodes.

The data set is described in more detail in Bakker et al. (2015) and on the website www.happinessindicator.com

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[6] We discarded diary entries with fewer than 4 activities.

Figure 2:
Example of a Happiness Diary

Figure 3:
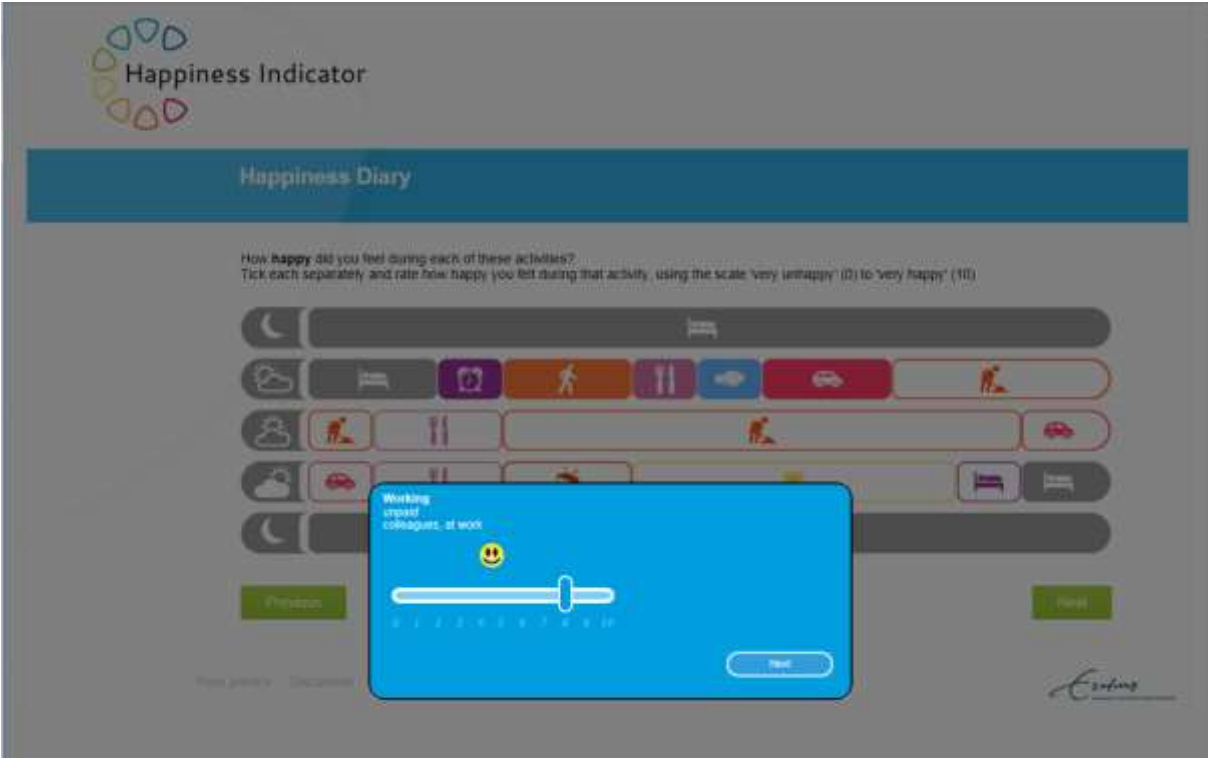**Rating of happiness during daily activities**

Figure 4:

Comparison of an individual's mood during activities with the average of similar people

3.5 Descriptive Statistics

Demographics

The demographic characteristics of the respondents are shown in Table 1. Most of the participants were female (82%), had paid employment (87%), and were highly educated (62%). In terms of living situation 24% of them lived alone and 38% had children living at home. On average, the participants worked 4.13 days or 30.7 hours per week. The majority of the participants was active in the non-profit sector.

Obviously, the participants are not representative of Dutch society and the results of this study can therefore not be generalized to the general population in the Netherlands. We do not see this as a major problem, since the goal of this study was to generate information *on particular people, for particular people*, namely those who would like to improve their happiness through a self-help website. Representativeness for the general population was therefore not required; what was required is exemplification of a specific goal-group.

Table 1:

Demographic characteristics of respondents

Variable	N	Mean %	S.D.	Min.	Max.
Gender (1=male, 2=female)	1,328	1.82	0.38	1	2

Age	1,323	39.60	12.16	15	71
Education					
Low-level (ISCED 1997 1-2)	1,328	7%		0	1
Medium-level (ISCED 1997 3-4)	1,328	31%		0	1
High-level (ISCED 1997 5-6)	1,328	62%		0	1
Family income					
Below average	1,327	24%		0	1
Average	1,327	37%		0	1
Above average	1,327	39%		0	1
Living situation					
Alone	1,328	28%		0	1
Together	1,328	27%		0	1
Two parent family with children	1,328	23%		0	1
One parent family with children	1,328	9%		0	1
Other	1,328	13%		0	1
Chronic disease	1,328	22%		0	1
Paid work	1,316	87%		0	1
Sector of employment					
Government	1,145	12%		0	1
Education and culture	1,145	18%		0	1
Healthcare	1,145	28%		0	1
Business and financial services	1,145	16%		0	1
Retail	1,145	5%		0	1
Other	1,145	21%		0	1
Working days	1,158	4.13	1.11	1	7
Working hours	1,159	30.69	10.39	1	70

Commuting time and mode

The frequencies for all the commuting aspects are given in Table 2. The participants
commuted on average 45 minutes one way, with a standard deviation of 27 minutes. Most
participants indicated that they commuted for approximately 30 minutes. The car (48%) and
bike (27%) were the most used transport modes, followed by public transport (13%). The
category 'Other/Multimodal' represents commuting using other or multiple transportation
modes. The most often mentioned commuting modes that fell into this category were
combinations of the active modes of commuting and public transportation (77%). Over half
of the commuting trips (58%) took place during rush hours, while most respondents (89%)
travelled alone to work.

Table 2:
Aspects of Commuting Trips

Variable	% of total number of episodes or diary entries (N = 4800)
Commuting mode	
Walking	2%
Bicycle	27%
Car	48%
Public Transportation	13%
Other/Multimodal	10%
Travelling to work	53%
Commuting Time	
Short (30 minutes or less)	64%
Medium-length (30-60 minutes)	26%
Long (more than 60 minutes)	10%
Commuting during rush hour	58%
Commuting with someone	11%

Mood

The descriptive statistics for the well-being variables are given in Table 3. The average daily mood of respondents at the first time of participation was a 6.7, which is slightly below average affect scores around 7.0 reported in Dutch surveys (see Veenhoven 2015b). During 37% of the activities the mood level was rated 6 or lower. This indicates that the *Happiness Indicator* website particularly attracts individuals who are less happy than the average citizen is and probably therefore would like to work on their happiness.

Participants feel mostly happier during other times of the day than while commuting. On average, average affect during commuting was rated a 6.5, which is lower than the 'average mood at home'.

The mean affect level for the main different activities during the working day is shown in Figure 5. From the graph it becomes clear that commuting is, on average, disliked more than other activities, particularly leisure and eating. Likewise, travel for other purposes is evaluated more positively than commuting. At the same time, the average mood level for commuting indicates that most people do not have the most terrible time when commuting.
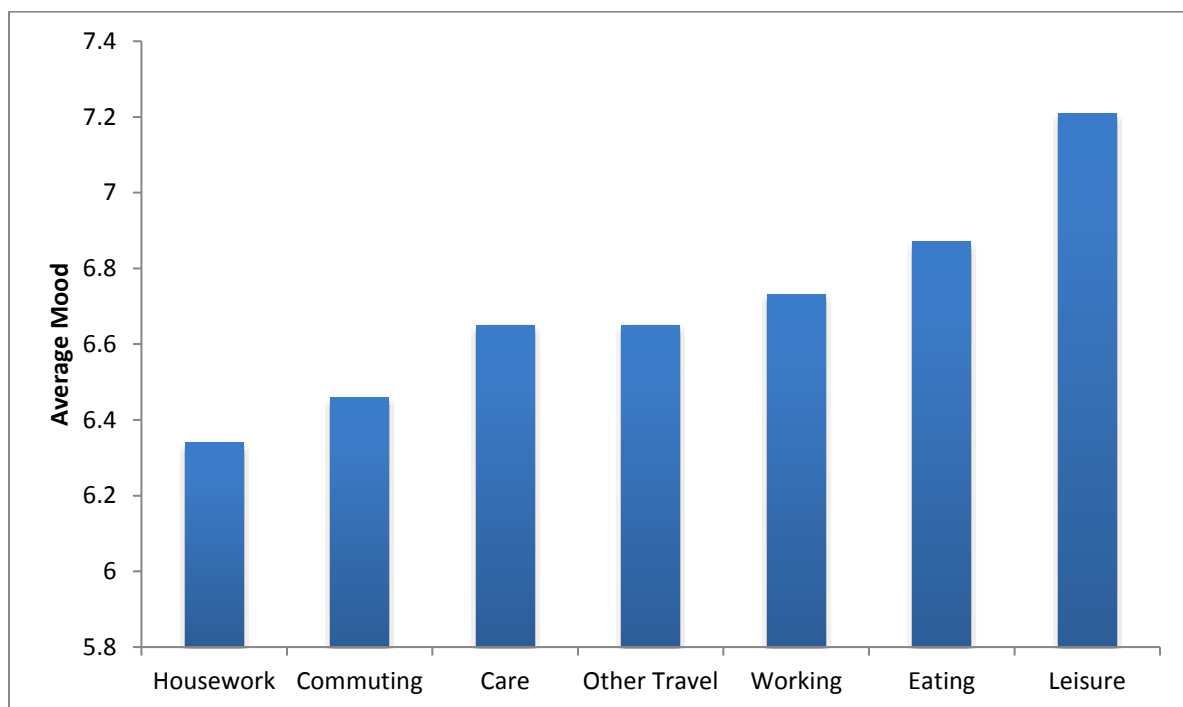
Table 3
Descriptive statistics for happiness variables

Variable	*N*	Mean	Median	Min.	Max.	S.d.

Average daily mood	33281	7.69	7.88	1	11	1.22
Mood during commute	4345	7.45	8.00	1	11	1.56
Average mood at home	33281	7.65	7.88	1	11	1.30
Difference in mood during commute and at home	4345	-.20	-.14	-7.09	5.21	1.21

N= 33,281

Figure 5:

Average affect levels during main activities of the working day

3.5 Econometric model

In this study, we focused on the affect level during commuting. To test the effect of commuting on mood, a standard reduced-form happiness model was estimated (see Morris and Guerra, 2015a):

$$M_{jit} = \Sigma\ COMMUTING_{jit} + \varepsilon_{ij} + \lambda_t + \mu_{jit}. \tag{1}$$

where M is the self-reported mood level of respondent *j* on day *i* at time point *t*; *COMMUTING* is a set of variables capturing commuting activity and the various aspects of commuting; ε_{ij} is a vector of respondent-day fixed effects to control not only for time-invariant participant characteristics, such as gender, marital status, income, and level of

education, but also for the average mood during the day'; λ_t are the time point random effects, while μ_{jit} represents the residual error.

Please note that we used a within-person design, where we look at variation of mood within persons within in a day and not between persons. By focusing on *within-person* differences we avoid the limitations inherent to common analysis of *between-person* differences noted in section 2.3.

The within-person analysis is particularly helpful to avoid distortion by general life satisfaction. The arrows in figure 1 indicate bi-directional effects among the different aspects of subjective wellbeing and this means that mood during commuting not only adds to satisfaction with life-as-a-whole (bottom-up effect), but that general life-satisfaction also effects mood during commute (top-down effect; Headey et al. 1991). Since we want to know how commuting effects mood, we needed to get rid of this top-down effect, and we did this using the difference commuting makes on mood, rather than the absolute mood level during commuting. For example, the average mood during commute of very happy people may be 7 and for unhappy people 5, while the happy feel worse when commuting, average 8 over other activities during the day, and the unhappy actually better, their average mood during the rest of the day being 4.

4   RESULTS

The main question of this paper is*: What does optimal commuting look like to enhance happiness for whom?*' and this question was broken down into the following sub-questions:
1) Does commuting affect mood during commuting? If so, how much?
2) Which aspects of commuting influence mood most and least?
3) How different are these effects across persons and situations?
What answers to these questions do our data allow?

4.1   Does commuting affect happiness? If so how much?
Our fixed effects estimations of the influence of commuting on mood are shown in Table 4. Compared to other activities and in line with our descriptive statistics, commuting is significantly associated with lower levels of affect than the average of all other activities. On average, mood during commuting is 0.28 points lower compared to average mood during the day.

Table 4:
Fixed-effects estimation of the influence on commuting on mood

	(1)	(2)	(3)
		Interaction	Interaction
	Baseline	Working Days	Working Days
Commuting	- 0.276***	- 0.266***	- 0.264***
	(0.019)	(0.021)	(0.021)
Commuting*working days		- 0.037*	

		(0.020)	
Commuting*working hours			- 0.005**
			(0.002)
R^2	0.003	0.003	0.003
Rho	0.481	0.473	0.474
Person-Days	2,752	2,228	2,225
Observations	33,259	26,809	26,791

Bootstrapped standard errors in parentheses; The interaction terms are demeaned.
*** p<0.01, ** p<0.05, * p<0.10

At the same time not everyone's mood was equally affected by commuting. When exploring to what extent the effect of commuting on mood differed across people, we found that commuting was especially associated with lower levels of affect when the participant had relatively long working weeks (see Table 4, column 2 and 3). At the same time, we observed little or no differences across gender, age, income levels, education levels, occupational classes, living situation, and health status.[7]

4.2 Which aspects of commuting influence happiness most and least?

The average affect levels presented in Figure 6 show that public transport users report the lowest levels of affect during commuting. Commuting by car involves a much smaller loss of happiness and commute by bike and walking the least. This is in line with the existing literature on commuting and subjective well-being.

Mood when commuting with someone is, on average, 0.2 higher compared to mood when commuting alone.

People report a higher mood when commuting to work than when commuting from work, while commutes longer than 60 minutes especially seem to be detrimental to mood. These findings were confirmed when a fixed effects panel model was estimated (Table 5).

Figure 6:
Average affect levels and aspects of commuting
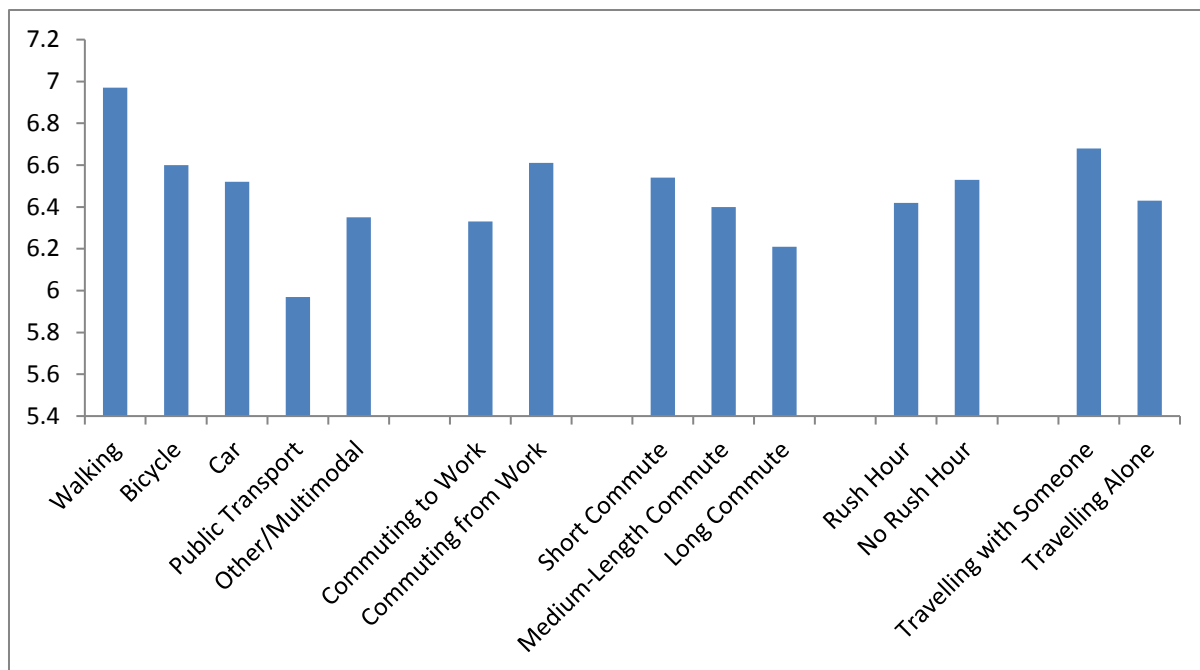
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[7] These results are available upon request.

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6.8
6.6
6.4
6.2
6
5.8
5.6
5.4

Walking, Bicycle, Car, Public Transport, Other/Multimodal, Commuting to Work, Commuting from Work, Short Commute, Medium-Length Commute, Long Commute, Rush Hour, No Rush Hour, Travelling with Someone, Travelling Alone

Table 5:

Fixed-effects estimation of the influence on aspects of commuting on affect level

	(1)	(2)	(3)	(4)	(5)	(6)
	Mode	Direction	Length	Timing	Company	Full Model
Commuting		- 0.131***	- 0.231***	- 0.244***	- 0.320***	
		(0.025)	(0.022)	(0.028)	(0.021)	
Walking	- 0.024					0.064
	(0.135)					(0.136)
Bicycle	- 0.113***					- 0.015
	(0.036)					(0.044)
Car	- 0.300***					- 0.193***
	(0.026)					(0.035)
Public Transport	- 0.578***					-0.441***
	(0.058)					(0.067)
Other/Multimodal	- 0.263***					- 0.112*
	(0.058)					(0.066)
Travelling to Work		- 0.272***				- 0.284***
		(0.028)				(0.030)
Duration 30-60 Minutes			- 0.083**			- 0.048
			(0.040)			(0.042)
Duration >60 Minutes			-0.241***			- 0.143**
			(0.066)			(0.070)
Commuting during rush hour				- 0.055		0.039
				(0.034)		(0.035)
Commuting with someone					0.294***	0.292***
					(0.048)	(0.049)
R²	0.005	0.004		0.003	0.003	0.006
Rho	0.481	0.481		0.481	0.481	0.481
Person-Days	2,752	2,752		2,752	2,752	2,752

| Observations | 33,259 | 33,259 | | 33,259 | 33,259 | 33,259 |

Configurations

We also examined potential interaction effects between the different aspects of commuting. Here we found that travelling with someone especially increases affect during a commute using public transportation. In addition, commuting with someone particularly raises mood for medium-term commutes, however, irrespective of commuting mode and length, travelling with someone is generally associated with a more positive mood than travelling alone.

In addition, the effect of commuting modes on mood is dependent on commuting length: for car commutes especially affect is lower for longer commutes. For public transport and multimodal commutes, the differences in mood between long and short commutes are considerably smaller, while affect during commute is higher for longer commutes by bicycle. An explanation for the latter finding is that longer bicycle commutes might be perceived as a substitute for exercising.

4.3 What way of commuting is optimal for whom?

Average effects of commuting on happiness may obscure substantial differences across kinds of people. In other words, the relationship between aspects of commuting and affect during commuting is heterogeneous. Since we aim at tailored advice we split-up our data into subgroups along socio-demographic lines. Specifically, we focus on: gender, age, income levels, education levels, living situation, and work situation. The differences in the effects of aspects of commuting on mood for different subgroups in society are shown in Table 6, here we report the deviation from the average daily mood by re-estimating models 1-5 in Table 5 for the different subgroups.

The most striking differences between groups can be found for the different commuting modes. While for men, older, higher-income and higher-educated people the active modes appear to be conducive for mood, this does not hold for the women, young, lower-income and lower-educated; the active modes (walking and biking) do not boost the mood of these latter people. These differences can be explained by differences in lifestyle and location of residence, which need further examination.

Travelling with someone has less effect on the mood of people with children. Apparently when children are the ones on board, e.g., they are being brought to school on a multipurpose commuting trip, travelling with someone is less satisfying than when travelling with partner, colleagues or friends.

However, heterogeneous effects of commuting length and timing appear to be rather limited.

Table 6:

The optimal commute for sub-groups: Affect during commute vs. average affect during the day

Sub-group	2. Men	3. Women	4. Age: younger than 35 Years	5. Age: 35-50 years	6. Age: older than 50 years	7. Single without children	8. Single with children	9. Partner without children	10. Partner with children	11. Below average family income	12. Average family income	13. Above average family income	14. Lower-educated	15. High-educated	16. Working part time	17. Working full time
Number Observations	5777	25170	10168	14521	6142	7686	3651	8136	7808	7606	10933	12396	10918	20029	10294	16497
Number Person-Days	493	2070	884	1169	502	646	282	696	614	613	917	1032	902	1661	826	1399
Mode																
Walking or Bicycle	0.09	-0.13	-0.32	0.01	-0.01	-0.15	-0.12	-0.14	0.04	-0.22	-0.13	0.01	-0.27	0.03	-0.12	-0.05
Car	-0.34	-0.28	-0.24	-0.31	-0.31	-0.23	-0.28	-0.31	-0.34	-0.17	-0.25	-0.37	-0.25	-0.30	-0.18	-0.34
Public transport	-0.52	-0.60	-0.60	-0.56	-0.58	-0.66	-1.29	-0.44	-0.30	-0.66	-0.37	-0.70	-0.91	-0.47	-0.67	-0.53
Other/multimodal	-0.06	-0.28	-0.32	-0.21	-0.05	0.15	-0.22	-0.47	-0.32	-0.07	-0.31	-0.30	-0.13	-0.28	-0.21	-0.27
Length																
Short commute	-0.11	-0.26	-0.28	-0.23	-0.19	-0.20	-0.29	-0.24	-0.19	-0.23	-0.25	-0.22	-0.28	-0.20	-0.20	-0.24
Medium-length commute	-0.35	-0.28	-0.38	-0.19	-0.39	-0.31	-0.49	-0.31	-0.13	-0.34	-0.22	-0.33	-0.36	-0.27	-0.25	-0.31
Long commute	-0.61	-0.42	-0.55	-0.49	-0.21	-0.47	0.06	-0.51	-0.62	-0.44	-0.29	-0.59	-0.54	-0.44	-0.58	-0.46
Timing																
During rush hour	-0.28	-0.29	-0.41	-0.23	-0.25	-0.31	-0.32	-0.30	-0.16	-0.33	-0.25	-0.30	-0.35	-0.26	-0.31	-0.27
Outside rush hour	-0.19	-0.25	-0.23	-0.25	-0.21	-0.17	-0.29	-0.30	-0.26	-0.20	-0.22	-0.30	-0.28	-0.22	-0.14	-0.29
With whom																
With someone	-0.07	-0.04	-0.04	-0.08	0.05	-0.06	-0.21	0.10	-0.40	0.06	-0.02	-0.12	-0.12	-0.02	0.04	-0.07
Alone	-0.27	-0.32	-0.37	-0.28	-0.27	-0.27	-0.31	-0.30	-0.29	-0.32	-0.27	-0.32	-0.34	-0.29	-0.27	-0.32

Note: Given the limited number of observations for the only walking commuting mode, walking and bicycle are here joined into one mode. Dark-gray highlighted columns: significant at 5% level; Light-gray columns: significant at 10% level

5. DISCUSSION and CONCLUSION

5.1 Main findings

Using a new method, this study replicated several findings from earlier research. It also brought some new pattern to the light:

Confirmation of earlier findings

o People tend to feel less well when commuting

o In particular when using public transportation and on the way to work

o Commuting by active transportation modes (biking, walking) feels best

New results

o The average mood during commute is 0.2-0.3 point lower (on scale 0-10) compared to other activities during the day

o Mood during commute is lower after a long working day

o Mood is lower when traveling alone than when traveling together, in particular when using public transportation on a medium distance

o The effects of commuting on mood are largely similar across socio-demographic categories

5.2 Agenda for further research

This exploratory study does not allow generalization of the results, not even to highly educated women, overrepresented in this study, and certainly not to the general population in the Netherlands. The next the step is to replicate this study using probability samples, be it probability samples of the general population in a nation or specific publics, such as high-educated women. Testing of hypothesis and assessing statistical significance will be useful in this context, but was not apt for an exploratory study.

The data did not allow us to explore the several aspects of commuting intensively. Most notably, it was not possible to make a distinction between different means of public transportation. The results show that some types of highly educated women did better travelling out of rush hour, while others did better in the rush hour. This raises the question of why travelling in rush hour enhances happiness for certain kinds of highly educated women. Previous research has not answered this question and our data did not allow us to explore this matter further.

Many studies in this field has focused on general tendencies and has tried to assess the relationship between transportation and happiness with the aim of defining a 'best-

practice' applicable to all. This approach serves the information demand of policy makers who aim at greater happiness for the greatest number of citizens through improvements in the transportation system. However, as demonstrated in this study, there are no such general pattern. The effects of commuting are typically heterogeneous, causing the effects to be different for different kinds of people. There is no one best way for everybody. This is why specification across different kinds of people should be more central to future research. That information will serve individual citizens in the first place and can be used in traveler education. In addition, the information can help policymakers to improve the well-being for specific groups of citizens. The information is also applicable in marketing, in particular because it sheds a new light on market segmentation. The travel sector will profit, since happy travelers tend to be better customers.

In this study we assessed the causal effect of particular ways of commuting on mood, comparing how the same persons feel during travel and the rest of the day. Still we cannot rule out reversed causality entirely; when in a bad mood people may be more inclined to use public transportation rather than take the bike. Experiments could rule out such effects, for instance when people are made switch from using a car to public transportation. However the required randomization will be difficult to achieve.

5.3 Conclusion

Analysis of the *Happiness Indicator* dataset confirmed earlier studies that observed a negative effect of commuting on subjective wellbeing. The analysis also revealed that the effect of different ways of commuting differ across situations, especially with regards to commuting mode. There is no one way of commuting that is optimal for everybody.

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