
# Behavioural Impacts of E-cycle Trials

## A Rapid Evidence Assessment

On behalf of the Department for Transport

transport for quality of life

UNIVERSITY OF WESTMINSTER

sustrans

UWE Bristol University of the West of England

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Report authors: Ian Shergold, Kiron Chatterjee (UWE Bristol).

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## Disclaimer



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# Contents

## Key Messages

- This review has found evidence of recent e-cycle trials, available from a range of countries across the world, and eighteen such trials are reviewed here.
- In most instances, participants in the trials have self-selected to be involved, suggesting perhaps that people willing to take part in a trial may already be pre-disposed to the use of an e-cycle, and later purchase of one.
- When provided with an e-cycle to use in a trial, most people do use them. This use varies from trial to trial, but can be quite significant. Shorter trials (two weeks for example) seem to foster lower levels of use than some of the longer (5-10 week) trials.
- External factors may play a role in the outcomes of a trial, with closure of cycle routes an impediment in one trial and a warmer climate a positive influence in some others.
- Limited post-trial data collection limits the report in being able to provide detailed results for post-participation e-cycle use (and purchase), but there are positive indications of future purchase and use at the end of most of the trials.
- Commuting is the target for many of the studies here. This may reflect the perceived importance of commuting per se, or it may be convenience, in that it potentially offers a destination amenable to e-cycle use (secure, and with charging facilities if needed), and a simplified recruitment process - especially with engaged employers.
- Where studies have explored behavioural issues, it seems that use of an e-cycle in a trial can also change some people's attitude towards their car, and its use.
- There is evidence to suggest that trial use can translate into both e-cycle purchase, and continuing e-cycle use for some – although in some instances the increase is in conventional cycling.
- The inverse relationship between levels of conventional cycling and interest in purchasing an e-cycle found in some studies perhaps suggests that potential target audiences for trials may be those less likely to cycle a lot at present.
- Two important potential barriers to the use of e-cycles reported in trials are cost of cycles and security, alongside the more predictable issues of road safety, infrastructure and the weather.
- Several trials successfully used financial incentives as an encouragement to participants to purchase and use an e-cycle. A study from the Netherlands provided useful insights into how ongoing e-cycle use might be incentivised.
- Overall, the literature reviewed in this short study has indicated that interventions providing the opportunity to try an e-cycle for a period of time will encourage use, leading to changed travel behaviours (around commuting at least), and decreased use of a car. This suggests that trials could be a useful tool in supporting moves to lower-carbon travel.

# 1. Introduction

This document presents the findings of a rapid literature review of evidence from trials or pilots of electrically-assisted cycles (generally referred to as e-cycles). In particular, the review looked for evidence of behavioural changes related to the opportunity to try an e-cycle without having to purchase one – with e-cycles still a relatively expensive item for most people.

DfT commissioned the review through the Local & Regional Transport Analysis - Evaluation Research Support Contract which is held by the University of the West of England (UWE Bristol) with Sustrans, Transport for Quality of Life and the University of Westminster.

DfT provided a set of research questions to be explored (see Table 2 below). The review found around forty items of literature that had some relevance, with twenty being deemed worthwhile for detailed analysis. The literature selected for analysis can be seen at Appendix 1. The results of the analysis are described below.

# 2. Methodology

The evidence reviewed was a combination of academic literature (journal articles) and project-related reports. These were sourced either from material already known to the project team, from searches of online databases or from a list of relevant material previously collected by DfT and made available to the review team.

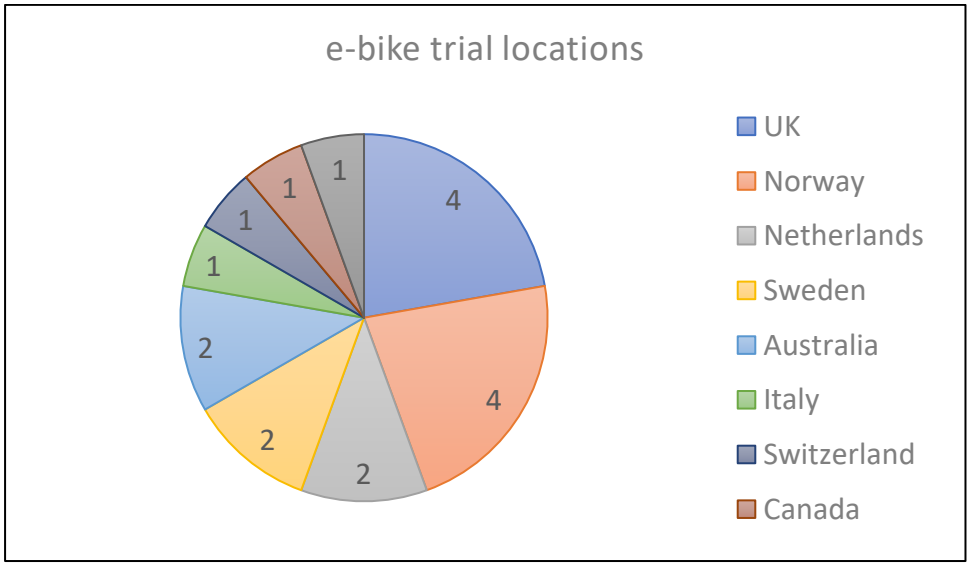
## Search strategy

Searches for additional material (primarily academic journal articles) were carried out in a range of online databases including: Scopus, Science Direct, TRID (Transportation Research Integrated Database), supplemented by searches in Google Scholar and in Google. These were conducted using search terms related to ‘e-bike pilots’, ‘e-bike trials’, and ‘e-bike substitution’. Variations on terms were used, including electric bike and bicycle to maximise search returns.

As noted, the search strategy was specifically targeted towards reports related to trials and pilots of e-cycles, and excluded material looking more broadly at use of e-cycles or cycle-share schemes. The searches resulted in evidence being found on eighteen trials or pilots. These took place across the world, with a strong representation from Europe and Scandinavia in particular (see Figure 1 below).

In total, fifteen journal articles and five research reports were reviewed. In three instances there were duplicate items looking at the same intervention (pilot or trial). In one case both papers are analysed in detail as they were exploring different aspects of the trial, and in the other two they reported similar findings.

Figure 1: Location of e-cycle trials reviewed




## Analysis strategy

All of the selected material was analysed against the research questions (see Table 2 below). In addition, consideration was given to the study methods used. The ability of the paper / report to answer the research questions and the quality of the study approach were each marked on a scale of 1-5 to give a simple ranking of the material in order to prioritise the analysis. This scoring / ranking can be seen in the list of literature at Appendix 1.

Table 1: Research Questions

| No. | Research question |
|---|---|
| 1 | Do trial schemes result in increased levels of cycling and if so, what proportion of people take up cycling after trying an e-cycle for the first time? |
| 2 | What types of trials (e.g. short-term loan, longer-term loan, retailer events) are the most popular among participants and most cost-effective at encouraging people to take-up cycling? |
| 3 | Which groups are more likely to take up cycling after trying an e-cycle? Are there any other factors that help to explain this (e.g. geography, existing cycling levels)? |
| 4 | Are there supporting measures (e.g. purchase subsidies, training and support) that can facilitate e-cycle uptake after a trial, and to what extent are these measures cost-effective? |
| 5 | What do people go on to do after trying an e-cycle for the first time? (e.g. purchase or hire an e-cycle, use or buy a standard cycle, nothing) |
| 6 | How many cycling trips are taken by people who have subsequently taken up cycling following participation in a trial? Alternatively, how many cycling trips are typically taken by e-cycle users per month? |

It was acknowledged that it might not be possible to answer all of these questions, or to answer them in full. This turned out to be the case, with some material in respect of all of the questions, but this being somewhat limited in some instances.

## Characteristics of e-cycle studies reviewed

Looking across the literature selected for review, most studies related specifically to interventions involving e-cycles only, although in two instances the e-cycles were part of a wider, shared mobility scheme (e.g. alongside electric cars for example).

The trials lasted from one week through to three years, but most were in the range five to ten weeks. The trials typically fell into three sizes, with either 10-20, 30-70, or 100-150 participants using an e-cycle (sometimes the overall cohort involved in the project was higher, but the number given access to an e-cycle relatively small). The one exception in respect of scale was the financial incentive scheme conducted in the Netherlands which attracted some 550 participants. This trial was somewhat unique in that here the participants used their own e-cycle and were not provided one by a project sponsor / funder.

Many of the trials were aimed at commuters, sometimes at specific companies or a group of companies in an area. Several of the trials were aimed at students and took place in a university context, and two papers focussed on parents of schoolchildren taking their children to school. Although many trials involved a specific purpose (such as commuting), invariably the participants were able to use the e-cycles for any purpose during their trial.

In most instances, trial participants were self-selected, albeit there might be some balancing of gender and age groups by the research teams. Several studies used GPS tracking of the cycles to provide automated usage data. Most studies collected data at the start and end of the trial, and in a few instances, there was a follow up to see what happened after the trial. One study conducted this follow-up after one year. Most studies collected survey data, some added travel diaries, whilst a few conducted interviews and focus groups with participants.

A small number of the e-cycle interventions were set up as randomised control trials (RCT), with random allocation of participants into the trial (sometimes termed ‘treatment’ group) with other participants forming a control group.

# 3. Analysis

The papers and reports reviewed have been read and analysed in respect of the research questions. This analysis is presented below against each of the research questions. Where there was little or no direct consideration of the research question topic, an attempt has been made to answer the questions based on broader behaviours reported during the trial or pilot.

Throughout the analysis section below short sections of text have been taken from the articles and reports reviewed, to illustrate both the supporting material and the analysis process itself. This text is referenced to its source. In some instances, the original text has been shortened or amended to retain its sense in isolation from its context in the original source.

The analysis has also been informed by the summaries of each study included in the Evidence Table provided at Appendix II.

## Research Question 1: Do trial schemes result in increased levels of cycling and if so, what proportion of people take up cycling after trying an e-cycle for the first time?

Most of the studies reviewed were focussed on the potential use of e-cycles for commuting, and often the trials themselves were specifically focussed on this purpose (although participants were normally advised they could use the trial e-cycles for any purpose). Thus, in most instances, the results reported applied to commuting behaviour – and in particular looked at substitution of car use by e-cycle use.

Note: most data were collected at the end of the trial or pilot period, which may have been as short in duration as two weeks, so will not necessarily reflect longer-term behaviours.

### Commuting behaviour

- Over the 10-weeks, 55% of commuting trips were solely made by e-cycle, with an additional 1% by a combination of e-cycle and public transport, and 1% by regular bicycle. This equates to a total of 57% of commuting trips involving an e-cycle or bicycle for some portion of the journey, compared to 11% before the trial (RAC, 2016).
- Overall, the number of people commuting to work by bicycle at least once per week more than doubled (28% to 59%) during the study and the same increase was seen for all trips (22% to 53%). For cyclists who were not actively cycling prior to receiving an e-cycle (n=78), about 42% started commuting by e-cycle at least once per week (MacArthur et al., 2017).
- The e-cycle-related change in absolute distance cycled is biggest for non-commute travel. However, when looking at cycling as share of total commute or

non-commute distance travelled, the effect is greatest for commute travel (Fyhri & Fearnley, 2015).

- After 6 months, car use dropped to 24% with e-cycles accounting for 73% of all commute trips. This increase in e-cycling is particularly shown in the distance range of 0–20km (de Kruijf et al., 2018).
- Participants used the e-cycles to cycle to work on average two times during the two weeks, and used the cycle for fewer than half the days that they had it (Behavioural Insights Team Ltd. 2017).
- We found that there were both direct personal benefits and organisational co-benefits of an active commute compared with passive commuting. Although the distance of our employees' commutes was manageable using a conventional cycle, employees had strong perceptions about the barriers of cycling to work, and these had deterred them from undertaking an active commute using a conventional cycle (Page & Nilsson, 2016).
- Upon returning their e-cycle, the intervention group participants were first asked about their user experiences. Most of the participants (72%) had used the cycle primarily for work commute trips (Fyhri et al., 2017).

**Analysis:** Many of the trials were directed specifically at commuting, and thus participants were actively encouraged to use the loan e-cycles for that purpose. It is perhaps not surprising that during the trials there was substantial use of the e-cycles for that purpose. The small number of longer-term studies did offer some data suggesting that the effect continued, but most trials did not conduct a longitudinal follow-up to see what happened afterwards.

## Car use

- After loaning 80 employees an e-cycle for six to eight weeks, car mileage was reduced by 20% (Cairns et al., 2017).
- Before the trial, a majority of the participants' commuting trips was made by car (61% of all trips to and from work), this reduced to an average of 32% during the trial (RAC, 2016).
- Before the trial, a majority of the participant's commuting trips were made by car, either as a driver or passenger (85% of all trips to and from work). During the trial, this reduced to 48% on average over the 10 weeks and after the trial it dropped further to 41% (RAC, 2017).
- On average, the participants conducted 4.4 trips per day during the test periods. Between M1 and M2, the treatment group decreased their number of car trips by 1 and increased their e-cycle trips by 0.6 and conventional bicycle trips by 0.3. On average, the number of car trips expressed as the share of total trips went from 74% at M1 to 53% at M2 for the treatment group but remained stable in the control group from 74% to 75%, although after their own trial period this then fell to 44%. The treatment and control groups both reduced car distance travelled and increased cycle (and e-cycle) distance travelled across the intervention period (Söderberg et al., 2015).

- After 6 months (T2), the use of e-cycles increased further, with car use dropping further to 24% and e-cycles accounting for 73% of all commute trips. The further increase in e-cycling is particularly shown in the distance range of 0–20km (de Kruijf et al., 2018).
- There were significant decreases in car use and the adoption of e-cycling for all distance ranges, but the effect tends to diminish with distance, implying that e-cycles provide the best alternative to car travel for distances less than 15 km (de Kruijf et al., 2018).
- Participants that substitute commuting by car with e-cycling are often dependent on their car for other trips like chauffeuring children or running errands. Sometimes this means activities previously chained into car commutes are now segmented into separate trip. (Dahl Wikstrøm & Bocker, 2020)

**Analysis:** Most of the trials saw reductions in car use – primarily in respect of commuting (often the focus of the trial itself). There is a small amount of evidence to suggest that the effect continues, and increases. There is also some evidence to suggest distances up to 15-20km are around the limit for journey 'substitution' by e-cycle. It is worth noting the element of caution expressed in the Dahl Wikstrøm & Bocker paper, that not all trips are achievable with the e-cycle, and potentially e-cycle use for some trips could create additional stand-alone car journeys.

## Mode shift

- During the pilot phase, e-cycle use increased significantly from 0% to 87.0% of the total number of trips in an average week. This increase occurred mostly at the cost of regular cycle-use, which went down significantly from 56.3% to 5.1%. Bus use was also significantly reduced from 20.8% to 2.3% during the pilot (Plazier et al., 2017).
- On average, the participants conducted 4.4 trips per day during the test periods. Between M1 and M2, the treatment group decreased their number of car trips by 1 and increased their e-cycle trips by 0.6 and conventional bicycle trips by 0.3. The Treatment and control groups both reduced car distance travelled and increased cycle (and e-cycle) distance travelled across the intervention period (Söderberg et al., 2015).
- Participation in the program leads to a strong modal shift. Overall, car use drops from 62% to 28%, conventional bicycle use drops from 33% to 1%, and e-cycle accounts for 68% of all commute trips after 1 month (T1). Hence, e-cycles substitute for cars and conventional cycling to about the same extent (de Kruijf et al., 2018).
- Participation in the WeBike field trial did not significantly change participants' sentiments towards various modes of transportation. Furthermore, e-cycles were rated lower than regular cycles on independence, reliability, stress-free travel, and environmental friendliness. However, e-cycles were rated higher than cars on all aspects except independence and comfort (Gorenflo et al., 2017).

**Analysis:** Several trials reported reductions in car use, and one reported reduced bus use as well. Results in respect of conventional cycling are mixed, with both increases alongside e-cycle use in some instances, and reductions in others.

## Physical activity

- 59% of the employees increased their overall physical activity (PA), (Cairns et al., 2017).
- Weekly cycling activity for transport increased more than cycling for exercise (Fyhri & Fearnley, 2015).

**Analysis:** There is little direct study or reference to the potential health or exercise benefits in the e-cycle trials, and in general it was not a focus, or something measured in the trials. Where distances travelled are recorded (through travel diaries or GPS tracking), it would potentially have been possible to measure changes in activity levels.

## Behavioural insights

- What is still unclear is the extent to which participants' motivations going into the program informed their usage during the program and their attitudes coming out of it (MacArthur et al., 2017).
- The study provides strong evidence that exchanging one's car keys for an e-cycle for just a few weeks influences long-term 'habitual associations' with car usage, and that this change persists even a year after the end of the intervention (Moser et al., 2017).
- The effect of the e-cycle increased with time, indicating a learning effect among users, and was greater for female than for male cyclists (Fyhri & Fearnley, 2015).
- E-cycle cycling trips increased from 0.9 to 1.4 per day, distance from 4.8 km to 10.3 km and, as a share of all transport, from 28% to 48%, whereas with the control group there was no increase in cycling (Fyhri & Fearnley, 2015).
- E-cycles have a greater effect on female than on male cyclists. Measured by number of trips, cycling increased considerably among female test users and significantly more than that of their male counterparts. However, the analysis identified no gender effect on cycling mileage share of all transport. This supports the existing literature which holds that females travel shorter distances and use the cycle for other purposes than men, and importantly that women commute less by bicycle than men do. It seems that the e-cycle, to a greater extent, results in newly generated trips for women than for men (Fyhri & Fearnley, 2015).
- E-cycles have similar effects in all age groups. While e-cycles tend to be more popular with older age groups, in particular where the e-cycle market is in its infancy, we recorded no difference in effect of the e-cycle intervention between age groups in our test group. The e-cycle offers advantages to cyclists of all age categories (Fyhri & Fearnley, 2015).

- Despite the relatively large substitution effect from cars to e-cycles, we need to stress that the e-cycle does not replace all types of car trips, at least in its current form. The survey results indicate that it is mainly work trips and other single-purpose trips that are considered suitable to switch for e-cycles. Trips that demand transporting goods and/or passengers are still, for the general participant, dependent on the car (Söderberg et al., 2015).
- This study finds that the participants were motivated to test (different models of) e-cycles and that doing so allowed them to acquire new knowledge and skillsets that enhanced their familiarity with e-cycling while benefiting from the structure, service, and security that the scheme offers (Dahl Wikstrøm & Bocker, 2020).
- After 6 months, the use of e-cycles increased further, with car use dropping further to 24% and e-cycles accounting for 73% of all commute trips. The further increase in e-cycling is particularly shown in the distance range of 0–20km (de Kruijf et al., 2018).
- E-cycle use is highest for the shortest distances (0–5 km: 80%) and decreases with distance, but it still accounts for 63% of trips longer than 20 km. There were significant decreases in car use and the adoption of e-cycling for all distance ranges, but the effect tends to diminish with distance, implying that e-cycles provide the best alternative to car travel for distances less than 15 km (de Kruijf et al., 2018).
- The frequency of conventional cycling at T0 has a positive effect on the number of e-cycle trips in both the total model and in the model of multimodal car commuters and at T1 and T2 (de Kruijf et al., 2018).
- Our study shows that vehicle sharing service pilot users will not start using the service because of the novelty of it, nor will they modify or redesign it to their needs. Rather, if it does not meet their needs, they will not use the service at all (Berg et al., 2019).
- Due to the high level of space-time fixity that many residents experienced, it might not matter if the vehicle sharing service (VSS) is convenient or not. In many cases a VSS cannot compete against the comfort that privately-owned cars provide (Berg et al., 2019).
- E-cycles achieved the greatest cycling amount (distance and time) for the entire trial period, with the smallest sample variability, and the intervention group reported significantly higher “intrinsic regulation” for cycling at the nine-month follow-up, compared with the control group (Bjørnarå et al., 2019).
- The results further show that many of those who used the VSS already cycle or walk as their main mode of transport but used the service during the free period since they were curious how the VSS worked (Berg et al., 2019).
- Second, we found a positive relationship between e-cycling frequency and the outcome measures; more frequent use of the e-cycle was associated with more positive affect, and more positive organisational behaviour (Page & Nilsson, 2016).

- Although the distance of our employees' commutes was manageable using a conventional cycle, employees had strong perceptions about the barriers of cycling to work, and these had deterred them from undertaking an active commute using a conventional cycle (Page & Nilsson, 2016).
- Participation in the WeBike field trial did not significantly change participants' sentiments towards various modes of transportation. Furthermore, e-cycles were rated lower than regular cycles on independence, reliability, stress-free travel, and environmental friendliness. However, e-cycles were rated higher than cars on all aspects except independence and comfort (Gorenflo et al., 2017).
- A majority (77%) stated that the e-cycle had made them cycle more often than before, and 56% said that the cycle allowed them to ride longer trips than before (Fyhri et al., 2017).

**Analysis:** There was a curiosity about using e-cycles by participants (reflected also in the fact that most studies recruited self-selected participants), and some evidence that familiarity over time increased interest in e-cycles.

There was a suggestion in one study that this effect was stronger amongst women – although gender was rarely a feature of analysis in trials, other than in descriptions of the sample. (In some trials the sample was biased towards men, and in one biased towards women).

Several studies recorded changes in attitudes towards other modes of travel, and in relationships with car use for example, with this effect still measurable one year later for one trial. Positive impacts on other domains of participants lives (e.g. more positive organisational behaviour) were also measured in one study.

There was a sense in several studies that e-cycles could overcome barriers to conventional cycling over the distances that some participants were travelling (for commuting for example). Although, as previously noted, distances of 15-20km seem to be the limit for people's willingness to use an e-cycle.

### E-cargo cycles

One paper that was found in the literature search related to the use of e-cargo cycles. Whilst not necessarily directly relevant to the research question posed here, it did detail the results of a series of trials, and perhaps merits further attention as a theme in respect of e-cycle use.

- Pilots enabled the demonstration of measurable effects in terms of reduction of CO2 emissions and energy savings in urban logistics (Nocerino et al., 2016)

The results relate to trials carried out with four delivery businesses in Italy, with very positive outcomes. The businesses that deployed e-cargo cycles in the trials continued to use them after the trial finished.

## Key findings for Research Question 1

1. There is evidence of modal shift – in three of the trials commuting by e-cycle rose to 50%-73% of commuting trips (RAC, 2016) (MacArthur et al., 2017) (de Kruijf et al., 2018).
2. There is also evidence of reduction in car use – several trials reported such reductions (for commuting) of 20%-30% (RAC 2016, 2017) (Söderberg et al., 2015) (de Kruijf et al., 2018).
3. In respect of pedal cycle substitution, the results are mixed. Some studies report a fall in conventional cycle use, and others an increase.
4. There is evidence to suggest that 15-20km is around the limit of e-cycle substitution for commuting journeys.
5. There was a curiosity about using e-cycles by participants, and some evidence that familiarity over time increased their interest in e-cycles.
6. One study suggested that this effect was stronger amongst women – although gender was rarely a feature of analysis in trials, other than in descriptions of the sample (Fyhri et al., 2017).
7. Several studies recorded changes in attitudes towards other modes of travel (positive and negative), and in relationships with car use for example, with this effect still measurable one year later for one trial (Moser et al., 2017) .
8. Other impacts – there was very limited reflection on levels of physical activity within results from trials, although one paper did record increased physical activity for 59% (Cairns et al., 2017).
9. Other impacts on participants' lives (e.g. more positive organisational behaviour) were also measured in one study (Page & Nilsson, 2016).

## Research Question 2: What types of trials (e.g. short-term loan, longer-term loan, retailer events) are the most popular among participants and most cost-effective at encouraging people to take-up cycling?

There was very limited self-analysis of trial format in any of the literature reviewed here, so the responses below are more descriptive in nature, discussing the length of the trials conducted, and the additional support given to people in the trials and afterwards to continue e-cycling.

### Trial length / purpose

- Employees were loaned an e-cycle for six to eight weeks. Participants were advised that they could use their cycles as much, or as little, as they wished, and that there was no requirement to use them for commuting (Cairns et al., 2017)
- Participants were given a 10-week loan for their commute to and from work, as well as any other trips they wished to make (RAC, 2016).
- Twenty employees from the two participating workplaces had exclusive use of an e-cycle for their commute to and from work for 10 weeks, as well as any other trips they wished to make (RAC, 2017).
- Participants from three Kaiser Permanente Northwest campuses (1 urban and 2 suburban) were issued an e-cycle for 10 weeks to use for various trip purposes, focusing on first / last-mile commuting (MacArthur et al., 2017).
- The trial was part of the annual e-cycle promotion programme in Switzerland, in which car owners can try out an e-cycle for free over a two-week period in exchange for their car keys (Moser et al., 2017).
- Each student was able to use an e-cycle for four to five weeks (Plazier et al., 2017).
- Although users were initially allowed to use the e-cycle for two or four weeks, their test periods were in practice both longer and shorter than this, ranging from 9 to 64 days. No instructions were given about how and when they were to use it (Fyhri & Fearnley, 2015).
- The treatment groups had e-cycles for five weeks. They were only instructed how to operate the e-cycle and that they could use it as much as they liked (Söderberg et al., 2015).
- Trial periods lasted for 1-2 weeks (Dahl Wikstrøm & Bocker, 2020).
- The commuting incentive scheme ran for up to 1 year (de Kruijf et al., 2018).
- Participants could undertake two-week trials of regular and e-cycles (Behavioural Insights Team Ltd. 2017).

- Participants were loaned the e-cycle for as long as they requested. The median loan period at the time for this paper was 6 weeks. Travel was not limited to commuting, the e-cycles could be used for any purpose (Page & Nilsson, 2016).
- Participants had the e-cycles for three years (Gorenflo et al., 2017).
- Participants had access to the e-cycles for one week before being interviewed (Berg et al., 2019).
- Participants had access to the e-cycles for three months (Bjørnarå et al., 2019).
- Participants had access to the e-cycles for three months (Fyhri et al., 2017).
- Long-term trials of e-cargo cycles (Nocerino et al., 2016).

**Analysis:** Trial periods ranged from one week to three years. Most were in the range of 5-10 weeks. The Swiss study is notable in that it physically removed access to a car in return for a loan e-cycle (although it was noted that most participants came from two-car households).

### Additional support / equipment provided

- Participants were provided with accessories (a helmet, lock, lights, reflective gear and pannier plus an optional child seat and child helmet). They were also required to complete (free) e-cycle training to the UK Bikeability level 3 standard, which, in most cases, comprised a two-hour on-road training session. Support was also available from a local cycle shop. (Cairns et al., 2017)
- At the shop, test persons were given brief instruction on how to operate the cycle (Fyhri & Fearnley, 2015).
- Participants were provided with related equipment, such as helmets, panniers, and locks, for free (Dahl Wikstrøm & Bocker, 2020).
- Participants were provided with free helmets, safety jackets, and locks (Behavioural Insights Team Ltd. 2017).
- Road-side cover was provided, and the e-cycles serviced midway through a loan period (Page & Nilsson, 2016).

**Analysis:** Most trials provided safety equipment (helmets etc.), and access to technical support services for servicing / repairing the e-cycle for example. Only one study required the participants to undertake any pre-trial training (Cairns et al., 2017).

### Incentives to continue using an e-cycle

- To encourage any newly established travel behaviours to be maintained after the trial, participants were also given the opportunity to purchase their e-cycles during Week 7 of the trial (RAC, 2016).

- At the end, they were offered the possibility of buying an e-cycle at a reduced price (Plazier et al., 2017).
- The commuting incentive scheme ran for up to 1 year (de Kruijf et al., 2018).
- Participants had the e-cycles for three years, and were able to keep them after the trial for their own continued use (Gorenflo et al., 2017).

**Analysis:** A small number of the trials encouraged participants to continue e-cycling by offering them the option to buy their trial cycle at a discounted price at the end of the trial (or in one case allowing them to keep the trial cycles). The commuting incentive scheme offered participants the ability to earn a maximum of 1,000 Euros in total – although this would have necessitated a full year of commuting by e-cycle.

## Key findings for Research Question 2

1. In general, most trials were over-subscribed. Trials attract those curious about e-cycles.
2. Only when the trial is in a specific context (i.e. parents of children at primary schools in Norway willing to try cycles capable of carrying their children) is recruitment harder.
3. Most trials experienced some drop-out, particularly longitudinal studies with multiple data collection points.
4. Attempts to counter some of these issues included financial incentives, discounts on e-cycles, and the ability to purchase the e-cycle trialled.
5. None of the studies examined discussed the costs of running a trial.
6. The two most effective (modal shift) trials were the Dutch incentive scheme (which addressed both existing e-cycle owners and those who bought an e-cycle to participate), and a student scheme in the Netherlands where the shift was from bicycle and bus (de Kruijf et al., 2018) (Plazier et al., 2017).

## Research Question 3: Which groups are more likely to take up cycling after trying an e-cycle? Are there any other factors that help to explain this (e.g. geography, existing cycling levels)?

The papers and reports provide descriptions of the trial participants, which in some instances provides clues to who they believe might change their behaviours and adopt e-cycling, and some limited analysis of future use (mainly based on intention to use).

### Participant selection

- In constructing the trial, the aim was to select a group of people with the potential to change their behaviour. Given initial experience, priority was given to those living within 1–10 miles of work, as being those most likely to change their behaviour (Cairns et al., 2017).
- Participants in this trial were selected based on two types of criteria. First, to try to ensure uniformity of sample, priority was given to:
  - Those who said that, if they participated, they planned to use the cycle for commuting, at least some of the time.
  - Those who were planning to use the cycle for the whole journey (although there was interest from various people who wanted to combine cycle and rail use) (Cairns et al., 2017).
- Second, given a particular interest in examining the potential for promoting e-cycle use to achieve carbon savings and major shifts in travel behaviour, priority was given to:
  - People currently driving to work and/or who were frequent car drivers.
  - People who were not currently cycling to work (particularly non-cyclists) and/or less experienced cyclists.
  - People who had relatively low levels of physical activity. (Cairns et al., 2017).
- Compared with the Swiss population, well-educated men were overrepresented among the survey participants (Moser et al., 2017).
- In addition, more than half of participants lived in households with two or more cars indicating that the programme reaches a target group with a real potential for mobility-related energy savings (Moser et al., 2017).
- The large substitution effect from cars to e-cycles should be seen in the light of the high share of car trips that were present in the sample at the baseline (Söderberg et al., 2015).
- This trial attracted mainly men, aged 35-54, with access to a car. Less than 10% were already regular cycle commuters. The majority were looking to cycle for fitness reasons (Behavioural Insights Team Ltd. 2017).

- Participants were self-selected, following an introduction to e-cycles event at their employment site, and were likely to be pre-disposed to use of an e-cycle (Page & Nilsson, 2016).
- Tourism Hires: These schemes report that the majority of riders have been from an older or less fit demographic who were also generally less experienced cyclists. Many hirers were part of a family or group which included fitter cyclists who could now ride with those unable to use standard cycles (Carplus, Bikeplus. 2016).
- Aside from visitors, the next largest rider group has been 'try before buying', again generally retired people. These riders have expressed an interest in having their own e-cycles but wanted to test them out before committing to a purchase (Carplus, Bikeplus. 2016).
- Multivariate analyses suggest that a shift to e-cycling is affected by gender, physical condition, car ownership, and household composition.
    - Participants with poor physical condition e-cycle significantly less than all other participants.
    - Having only one car in the household correlates with a higher frequency of e-cycling relative to those who have two or more.
    - Lower-income participants have a higher e-cycling frequency.
    - Single individuals e-cycle less compared to couples with children, while couples without children e-cycle more (de Kruijf et al., 2018).

**Analysis:** Many of the trials were targeted at car commuters. Only the Brighton trial reported in Cairns et al (2017) explicitly encouraged or embraced non-cyclists, and the composite UK study report (Carplus/Bikeplus, 2016) encountered such people in the 'tourist' trials. Some studies noted a bias towards male, 30-50, better educated and more wealthy participants. One study had a bias to female participants. Almost all of the studies had self-selected participants (albeit the research team may have then selected for a balanced sample), implying some degree of interest, or motivation for e-cycling before joining a trial. This is particularly true for the Dutch e-cycle incentive trial (de Kruijf et al., 2018), where participants either already owned an e-cycle or acquired one to participate and was also a factor in the tourism and try before you buy samples from the UK (CarPlus/Bikeplus, 2016)).

## Future purchase / use

- In general, when asked under which circumstances, they would consider buying an e-cycle, survey respondents mostly indicated ''when the e-cycle gets cheaper" (84%) (Plazier et al., 2017).
- Only one participant was ''for sure going to buy an e-cycle". This participant currently commuted by bus, and indicated that independency from public transit schedules would be an important motivator (Plazier et al., 2017).
- *Since our participants continued to rate regular cycles higher than e-cycles, even after using e-cycles for a sustained period of time, this suggests that perhaps e-cycles should not be marketed directly against regular cycles. Instead, e-cycle retailers may want to target populations such as seniors who*

*could benefit from the unique aspects of e-cycles such as the ability to be ridden with less physical effort (Gorenflo et al., 2017).*

- *At the time of the study, the vehicle share scheme (VSS) was new and the users were offered the opportunity to use the service for free. Whether they will continue to use it in the future, when they will have to not only share it with more residents but also pay for using it, is uncertain (Berg et al., 2019).*
- *Higher levels of intrinsic motivation for cycling may contribute to increased active travel, also in the long term (Bjørnarå et al., 2019).*
- *The highest interest for purchasing an e-cycle existed among those who cycled up to 10 km per week. The lowest interest could be found among those who had cycled more than 20 km (13% interested). Those who had not cycled at all were slightly less interested in purchasing than those who had cycled a little (Fyhri et al., 2017).*
- *The strongest predictor for interest in buying an e-cycle is knowledge about e-cycles. The second most important variable is willingness to pay (WTP) for a normal cycle, which has a negative influence on interest in buying an e-cycle; in other words, those who are willing to pay much for a normal cycle are less likely to want an e-cycle (Fyhri et al., 2017).*
- *Habit strength for cycling, having higher education, cycling a lot for transport, or exercise all contribute negatively to interest in e-cycles (Fyhri et al., 2017).*
- *Those who have intentions to drive less car in their everyday life are more inclined to want an e-cycle. Age, attitudes toward cycling, intentions for cycling more, and social norms for cycling were not significant predictors of interest in buying an e-cycle (Fyhri et al., 2017).*

**Analysis:** The studies that targeted students found that e-cycle use would likely stop at the end of the trial as purchase costs would be too high to continue use. Cost of e-cycle purchase was a recurring theme in respect of future use. Several studies suggest that committed conventional cyclists are less likely to be thinking about moving to an e-cycle. Fyhri et al (2017), carried out a more extensive investigation of WTP, and found that those most likely to be interested in purchasing an e-cycle were those who were not committed conventional cyclists, and who already had some ideas about reducing car dependency.

## Key findings for Research Question 3

1. Some studies noted a bias towards male, those aged 30-50, better educated and more wealthy participants.
2. Many of the trials were targeted at commuters, who were normally car-owners.
3. Only the Brighton Trial (Cairns et al., 2017) explicitly encouraged or embraced non-cyclists, although the ‘tourist’ trials may have also reached this group (Carplus/BikePlus, 2016)

4. Almost all of the studies had self-selected participants implying some degree of interest, or motivation for e-cycling before joining a trial.
5. Several studies suggest that committed cyclists are less likely to be thinking about moving to an e-cycle.
6. Cost of e-cycle purchase was a recurring theme in respect of future use. In a willingness to pay (WTP) study those most likely to be interested in purchasing an e-cycle were those who were not committed conventional cyclists, and who already had some ideas about reducing car dependency.
7. The studies that targeted students found that e-cycle use would likely stop at the end of the trial as purchase costs would be too high to continue use.

## Research Question 4: Are there supporting measures (e.g. purchase subsidies, training and support) that can facilitate e-cycle uptake after a trial, and to what extent are these measures cost-effective?

There is very limited analysis of these factors in the literature reviewed here, so some of the features of the trials themselves are also described, as they included factors that may also support e-cycle use for the participants beyond the trial period.

### Supporting features in the trial

- Participants were provided with accessories (a helmet, lock, lights, reflective gear and pannier plus an optional child seat and child helmet). They were also given (required to complete) free e-cycle training to the UK Bikeability level 3 standard, which, in most cases, comprised a two-hour on-road training session (Cairns et al., 2017).
- Support was also available from a local cycle shop (Cairns et al., 2017).
- At the shop, test persons were given brief instruction on how to operate the cycle (Fyhri & Fearnley, 2015).
- The participants in this study were positive towards the supporting structures of the scheme (e.g., the maintenance and repair of the e-cycle), which indicates that there might be a potential for alternatives to purchase-oriented schemes, thereby permanently enhancing the supporting structures of sustainable mobility practices (Dahl Wikstrøm & Bocker, 2020).
- The intervention was an incentive scheme paying up to 1,000 Euro maximum (de Kruijf et al., 2018).

**Analysis:** Many of the studies provided basic safety equipment – i.e. helmets, and some level of technical support for the e-cycles or recovery services. Several provided some limited training in use. The Dutch incentive trial included a potentially significant financial reward (up to a maximum of 1,000 Euros over the year) for riding the cycle for commuting purposes.

### Factors that would support future use beyond the trials

- The participant's experiences highlighted the importance of the Government investing in safe infrastructure (with a slight preference towards off-road infrastructure) (RAC, 2016).
- Providing incentives / grants to encourage employers to retrofit workplace end-of-trip facilities (RAC, 2016).
- Road user education and training (including for novice e-cycle riders) to encourage and facilitate cycling (RAC, 2016).
- Some participants also made observations about the quality of some cycle paths and investment in on-road and off-road infrastructure emerged as the

participants' top two priorities for Government investment to encourage more people to cycle (RAC, 2017).

- The majority of the participants found weather conditions as a major barrier to cycling (MacArthur et al., 2017).
- In general, when asked under which circumstances they would consider buying an e-cycle, survey respondents mostly indicated ‘‘when the e-cycle gets cheaper” (84%) and ‘‘if an appealing financing scheme is offered” (43%). Most interviewees indicated a willingness to consider leasing a cycle in the future if a maintenance service is included (Plazier et al., 2017).
- Secure parking (Söderberg et al., 2015).
- Many of the interviewees were hesitant to park their e-cycles at non-designated parking spaces, especially in urban areas, because of safety reasons, and the challenges of parking the e-cycle were frequently brought up in the interviews (Dahl Wikstrøm & Bocker, 2020).
- Several participants stressed that the e-cycle was expensive; there were also problems with cycle locks. The short cycle lock was not compatible with the design of many cycle racks, which made it difficult to park and lock the e-cycle at certain places (Dahl Wikstrøm & Bocker, 2020).
- Accordingly, the difficulties with locking and parking made some participants avoid using the e-cycle for certain trips and activities therefore, they saw a need for secure and safe parking spaces (Dahl Wikstrøm & Bocker, 2020).
- Some informants also highlighted the importance of having facilities like changing rooms and showers at their workplace. Even when using an e-cycle, many found the need to change clothes, and possibly shower, when arriving at work (Dahl Wikstrøm & Bocker, 2020).
- Schemes that are not based on individual ownership will also reduce the barrier for buying an expensive e-cycle and can reduce some of the inequitable outcomes in the form of access to e-cycles (Dahl Wikstrøm & Bocker, 2020).
- The study paid limited attention to route characteristics, which were only represented by distance. Obviously, aspects such as quality and safety of the cycling infrastructure, landscape, and aesthetics may be important factors in e-cycle use, which can be targeted in policies (de Kruijf et al., 2018).
- For instance, these characteristics may differ strongly between the Netherlands, which has an extensive cycling infrastructure, and the United Kingdom, where such infrastructure is often lacking (de Kruijf et al., 2018).
- Safer routes to travel on (there was a lot of construction work underway at Heathrow at the time), parking facilities at work destination, showers (Behavioural Insights Team Ltd. 2017).
- Weather, cycling infrastructure, road conditions etc. are noted as barriers to cycling (Page & Nilsson, 2016).

- Therefore, when designing and implementing residential VSSs, it is necessary to take the organisation of everyday life into account, which include analyses of urban planning reforms in the local area and how they increase or ease space-time fixity (Berg et al., 2019)
- Price reduction of the e-cycle (e.g. VAT exemption), spread of knowledge among the wider population, and actions to offer an e-cycle experience may therefore be effective strategies for further expansion of the e-cycle in the transport system and thereby to increase bicycle use in Norway. Price was the only hindrance to buy an e-cycle that was given any substantial mention (mean score 5.0). There was also some concern that it might be stolen (mean score 4.0) (Fyhri et al., 2017).
- Issues around initial cost and additional infrastructure to support a different approach to logistics (i.e. more / smaller / distributed warehousing) (Nocerino et al., 2016).

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**Analysis:** The key issues influencing future use include cost of e-cycles, and a range of issues familiar to cycling more generally: Cycling infrastructure, facilities for secure parking, changing and showering facilities and the weather. The issue of security when parking seems to resonate with participants in several studies – reflecting the cost of e-cycles, and in particular the value of the battery.

## Key findings for Research Question 4

1. Many studies note that they provided basic safety equipment – i.e. helmets, and some level of technical support / roadside assistance for the e-cycles. Several provided limited training.
2. Uniquely, the Dutch incentive trial included a financial reward for riding the cycle for commuting purposes.
3. The key issues influencing future use include cost of e-cycles, and a range of familiar cycling issues: Cycling infrastructure, facilities for secure parking, changing and showering facilities and the weather.
4. The issue of security when parking was important for participants in several studies – reflecting the cost of e-cycles, and strong concerns over theft.

## Research Question 5: What do people go on to do after trying an e-cycle for the first time? (e.g. purchase or hire an e-cycle, use or buy a standard cycle, nothing)

Much of the evidence here is drawn from surveys undertaken at the end of a trial, and there are only a limited number of studies that had follow-up data collection that helped to answer this question.

### Future plans in respect of e-cycling

- 38% participants expected to cycle more in the future, and at least 70% said that they would like to have an e-cycle available for use in the future, and would cycle more if this was the case (Cairns et al., 2017).
- When it comes to sustained behaviour change, a majority of participants that completed the after survey said they expected to continue cycling more often than they did before the trial (11 of which said they were extremely likely to) and over half said they were likely to drive less often (8 of which said they would drive a lot less) (RAC, 2016).
- While the proportion of commuting trips by car settled at 46% following the trial, this still represents a 15-percentage point reduction compared to before the trial despite many participants no longer having access to an e-cycle. In addition, just over a quarter of commuting trips continued to be made by e-cycle (26%) and a further 15% by regular bicycle, maintaining a high cycling mode share of 41% (RAC, 2016).
- Usage of e-cycles for commuting remained high throughout the trial, peaking at 60% in Week 1 and dropping to 28% in Week (RAC, 2017).
- After the trial an average of 43% of respondents indicated they would be more likely to cycle for certain trips, most commonly for exercise or recreation (64%). Over half of all users reported that they are more likely to take a standard cycle on at least two or more types of trips (out of five listed) (MacArthur et al., 2017).
- Over a third of respondents (33%) said they would definitely consider purchasing their own e-cycle, primarily because it is “fun” (21%), a good way to get exercise (21%), and a cost-effective form of transportation (21%). Another third said “maybe” (MacArthur et al., 2017).
- By November 2015 10% of participants (from total pool of 1854) used their coupon to buy an e-cycle (Moser et al., 2017).
- The follow-up questionnaire (after one year) asked participants if they or a member of their household had bought an e-cycle since the end of the programme. In the responses, 117 participants (39%) stated that they had not purchased an e-cycle, 50 (17%) reported that they intended to buy an e-cycle in the upcoming months and 133 (44%) indicated that they had bought an e-cycle (Moser et al., 2017).

- It is suggested that the programme had a long-term effect on participants' habitual associations with car use, regardless of whether they would go on to purchase an e-cycle (Moser et al., 2017).
- A large majority of the respondents (81%) stated that they had had a positive experience, but were not planning on buying an e-cycle yet. Six participants considered buying an e-cycle, whereas only one participant was ‘‘for sure going to buy an e-cycle” (Plazier et al., 2017).
- Participants had already purchased an e-cycle. It is not clear from the paper whether people were aware of the incentive scheme when they purchased their e-cycle, but they had obviously decided to buy the cycle with or without that incentive (de Kruijf et al., 2018).
- Of those that borrowed an e-cycle, 53% (Dahl Wikstrøm & Bocker, 2020) said they planned to continue cycling to work.
- Desire to buy an e-cycle is greatest amongst those who used the cycles regularly. In this sample the survey showed that 13% of regular riders have gone on to purchase an e-cycle and a further 17% proceeded to purchase a standard cycle. (Carplus/Bikeplus. 2016).
- Rotherham Trial: 35% of people intend to buy an electric or conventional cycle after taking an electric cycle on a “try before you buy” loan (Carplus/Bikeplus. 2016).
- The evidence supports the fact that loan schemes have a higher conversion rate of sales than visitor e-cycle hire as those engaging with the schemes are already contemplating purchase (Carplus/Bikeplus. 2016).

**Analysis:** In the studies that asked the question of participants, there was some intention to cycle, or cycle more, embracing both conventional cycling and e-cycles. Sometimes this would be caveated in respect of the cost of buying an e-cycle – i.e. if they could afford one. Where there was a financial incentive to purchase an e-cycle after the trial there was evidence of a limited effect, with 10% buying in the Moser study. There is also some evidence of reduced car use even if people are not still cycling, and a change in attitude towards car use.

### E-cargo cycles

The single e-cargo cycle study again provided evidence that the trials had encouraged the participating companies to continue their use of e-cycles beyond the trial period, and to incorporate them into their urban delivery platforms.

- Three companies decided to carry on using the e-cycles trialled during the pilots. In particular, the performances of e-cycles and of the logistics platform convinced one to expand the initiative, creating a full electric vehicles logistic platform (Nocerino et al., 2016).

## Key findings for Research Question 5

1. In the studies that asked the question of participants, there were often high levels of intention to continue to cycle, or to cycle more (i.e. 38% in Cairns et al., 2017, 43% in MacArthur et al., 2017, 53% cycling to work in Dahl Wikstrøm & Bocker, 2020), embracing both conventional cycling and e-cycles.
2. Sometimes this would be caveated in respect of the cost of buying an e-cycle – i.e. if they could afford one.
3. There were also clearly stated intentions to buy an e-cycle from participants in some studies (i.e. 33% in MacArthur, 17% in Moser) and 70% of participants in the Brighton trial (Cairns et al., 2017) said they would like an e-cycle and would use it if they had one.
4. This had translated into actual purchases of e-cycles (13% in the CarPlus/BikePlus report, 10% at the end of the trial, and 44% after one year in Moser et al., 2017).
5. There is also some evidence of reduced car use even if people are no longer cycling, and a change in attitude towards car use (RAC 2016, Moser et al., 2017).

## Research Question 6: How many cycling trips are taken by people who have subsequently taken up cycling following participation in a trial? Alternatively, how many cycling trips are typically taken by e-cycle users per month?

There is very limited analysis of post-trial activity in the papers reviewed – thus the descriptive text below sometimes relates to activity during the actual trials.

### Cycle trips post-trial

- Averaged across all participants, weekly mileage was in the order of 15–20 miles a week; time spent cycling was about 120–150 min (2–2.5 h); and number of days commuting to work by cycle was around 2 (Cairns et al., 2017).
- For those who purchased their e-cycle (17 participants), 37 per cent of their commuting trips were by car as a driver after the trial but 50 per cent continued to be made by e-cycle and 13 per cent by regular cycle (63 per cent in total) (RAC, 2016).
- This high level of cycling was also sustained following the trial, with the after-survey findings showing that 51 per cent of commuting trips continued to be made by e-cycle and an additional 6 per cent by regular bicycle (57 per cent in total). In addition, over three quarters (76 per cent) of participants reported cycling for any purpose at least one to three times per week in the after survey compared to only 25 per cent indicating they did so more than once per month before the trial (RAC, 2017).
- Although levels of cycling increased over the trial, those selected had already positively responded to a question as to whether they wanted to try an e-cycle - so were likely already familiar with cycles or were cyclists? (Fyhri & Fearnley, 2015).
- Most trips lasted less than 20 minutes and took place during spring, summer, and fall, although some participants did ride their cycles all year (Gorenflo et al., 2017).
- Half of riders in commuter settings said they are using the e-cycles at least once a month (39% once a week) and although 82% of regular riders have said they are more likely to buy only 12% have done so, so far indicating there is a role for cycle share for on-going convenient cycle hire as well as “try before you buy” (Carplus, Bikeplus. 2016).

**Analysis:** Where follow-up research has been undertaken, there does appear to be evidence that levels of cycling are maintained post-trial, with particular evidence seen in respect of commuting.

## Key findings for Research Question 6

1. There is limited evidence in the literature reviewed here to respond to this question in depth, and some relevant evidence has already been presented in response to RQ1 and RQ5.
2. The two Australian commuter studies indicate levels of cycling seen in their respective trials were maintained after the trial. For example, 50% of commuting trips by e-cycle in the first trial, and 51% in the second (RAC 2016, RAC 2017).
3. It is worth re-stating, that participants were normally self-selected, and thus interested in e-cycles, thus likely pre-disposed to ride one after the trials.

# 4. Conclusions

The short literature review conducted here found studies and reports on eighteen trials, pilots, or research programmes looking at short interventions involving e-cycles. The review did not look at the broader literature on e-cycle use or shared-use schemes.

There appear to be relatively few studies that focus specifically on the effects of a trial or pilot using e-cycles. With more time it may be that there is more material available in the form of project reports to be found, or studies in languages other than English that could be added to that reviewed here. It has been possible, however, to find material from around the world, across a range of scales (both in respect of numbers of participants and length of trial). Although limited in number, there are also examples of innovation around trial approach and purpose.

Although some studies have reported limitations (in approach, and in scale), they are generally well executed. In some instances, the authors have clearly identified that their sample is not representative of the wider population, and almost without fail participants have self-selected to be in the trial / pilot concerned. This alone is an important point to note, and perhaps offers the first key insight from this review – that people willing to take part in a trial may already be pre-disposed to the use of an e-cycle, and later purchase of one.

The second factor to note is that when provided with an e-cycle to use for a short time in a trial, most people do use them. This varies from trial to trial, but as noted above can be quite significant. The shorter trials (two weeks for example) seem to foster lower levels of use than some of the longer (5-10 week) trials, which may reflect a need for people to become used to using the e-cycles, or difficulties in re-arranging other travel behaviours around the new option. Other external factors may also play a role, with building work perhaps one of the reasons for low usage at the Heathrow trial, and a warmer climate responsible for higher levels of use in the two Australian studies. The relatively small number of studies that conducted follow-up surveys with participants limits the report in being able to provide any clear results for post-participation e-cycle use (and purchase), but there are seemingly positive indications of future use at the end of most of the trials.

Commuting is the target for many of the studies here, although in most instances participants were advised they could also use the e-cycle for any purpose. The choice of commuting for trials is in itself interesting for a number of reasons. It may reflect the perceived importance of commuting behaviour in wider transport and travel planning, or it may be convenience, in that it potentially offers a destination that can support e-cycle use (secure, and with charging facilities if needed), and a simplified recruitment process, especially with engaged employers supporting the trial. Unfortunately, these issues are not discussed directly in the papers themselves, but it does suggest that further trials or pilots may well find better traction in this context.

Where studies have explored behavioural issues, it seems that use of an e-cycle in a trial can also change some people's attitude towards their car, and its use. There is also evidence to suggest that trial use does translate into both e-cycle purchase, and

continuing e-cycle use for some. Interestingly, for some participants this increase in cycling is with conventional cycles. The inverse relationship between levels of cycling and interest in purchasing an e-cycle found in some studies is also interesting, and again perhaps suggests that potential target audiences for trials may be those less likely to cycle a lot at present.

Two important potential barriers to the use of e-cycles are cost and security, alongside the more traditional issues around road safety, infrastructure and the weather. The latter are perhaps predictable concerns and reflect wider issues within transport policy and planning around provision for cycling versus the car and public transport. The recent experience of the initial Covid-19 lockdown in the UK provided evidence of how levels of cycling (and walking) could increase when infrastructure and levels of traffic permit it. The issues of cost and security are additional barriers to e-cycle use for some, and a number of the studies reviewed here used incentives of one form or another to try and overcome this issue. In particular the study from the Netherlands provided useful insights into how e-cycle use might be incentivised, whilst the schemes in other countries that provided discounts against purchase also seemed to have some impact. It would have been insightful to understand how many people had actually purchased an e-cycle in order to take part in the Dutch incentive programme, and whether the prospect of earning rewards for use was the tipping point in the purchase. The security (from theft) aspect came across strongly in one or two studies, and as noted above may be one reason why use for commuting is a preferred model for the pilots reviewed here – although it is not explicitly cited as such in any of the studies.

There are some key gaps relating to understanding fully the role of e-cycle trials or pilots. The first is understanding how to scale up trials to achieve broader participation, moving beyond those who are already interested. Secondly, there is a need for follow-up studies of the impact of trial participation on transport mode use. Although one or two studies here looked at behaviours after six months or a year, and two trials ran for a year or more, in general the last data collection point is when people return their loan e-cycle. Longitudinal studies exploring what proportion of trial users went on to purchase an e-cycle, and what they then used it for would be helpful in understanding the long-term impacts of trial interventions. Most of the studies reviewed have looked at commuting, and whilst this is an important travel purpose it is only one element of wider travel behaviours (and a relatively small part of overall travel). It would be very helpful to understand whether other groups in society such as the older population[1] (who have been significant purchasers of e-

[1] One trial has taken place in Oxford and Reading which recruited 77 participants aged 50 or above who had not cycled for at least five years, or whose cycling had significantly declined during this period, to use an e-cycle or a pedal cycle for eight weeks (Jones et al., 2016). The 39 e-cycle participants were lent an e-cycle. The trial mainly focused on the cognitive and wellbeing impacts of using the cycles but a post-trial survey revealed that 58% of participants reported that they had cycled since the trial and intended to increase or maintain their level of cycling and 19 went on to purchase an e-cycle and 12 a pedal cycle.

Source: Jones, T., Chatterjee, K., Spinney, J., Street, E., Van Reekum, C., Spencer, B., Jones, H., Leyland, L.A., Mann, C., Williams, S. & Beale, N. (2016). cycle BOOM. Design for Lifelong Health and Wellbeing. Summary of Key Findings and Recommendations. Oxford Brookes University, UK. https://www.cycleboom.org/summary-report.

cycles in the UK), or other journey purposes (i.e. shopping, leisure, social activities) could equally be targeted through trials. Finally, it would be very useful to further examine the role of trials and pilots in encouraging greater use of e-cycles for local logistics and delivery purposes. The one study reviewed here showed very promising results in respect of emissions reductions, and that financially use of such cycles could be made to work.

Overall, the literature reviewed in this short study has indicated that interventions providing the opportunity to try an e-cycle for a period of time will encourage use. In some instances, this use can be quite significant, leading to changed travel behaviours (around commuting at least), and decreased use of a car. It is evident that in most cases those taking part in the trials already have some interest, or inclination to use or buy an e-cycle, so to an extent may be using the trial to “try before they buy”. Even so, if a trial provides that final incentive, then they appear to be a useful tool to support moves to lower-carbon travel.

## Appendix I. Literature reviewed

| No | Score | Reference |
|---|---|---|
| 1 | 24 | Cairns, S., Behrendt, F., Raffo, D., Beaumont, C. & Kiefer, C. 2017, Electrically-assisted bikes: Potential impacts on travel behaviour, Transportation research. Part A, Policy and practice, vol. 103, pp. 327-342. |
| 2 | 21 | RAC. The power of electric bikes. 2016. advocacy@rac.com.au |
| 3 | 18 | de Kruijf, J., Ettema, D., Kamphuis, C.B. and Dijst, M., 2018. Evaluation of an incentive program to stimulate the shift from car commuting to e-cycling in the Netherlands. Journal of Transport & Health, 10, pp.74-83.<br>See also: de Kruijf, J., Ettema, D. & Dijst, M. 2019;2018, "A longitudinal evaluation of satisfaction with e-cycling in daily commuting in the Netherlands", Travel, behaviour & society, vol. 16, pp. 192-200. |
| 4 | 18 | MacArthur, J., Kobel, N., Dill, & J. Mumuni, Z. 2017. Evaluation of an electric bike pilot project at three employment campuses in Portland Oregon: Final Report |
| 5 | 18 | Plazier, P.A., Weitkamp, G. & van den Berg, Agnes E 2017, The potential for e-biking among the younger population: A study of Dutch students, Travel, behaviour & society, vol. 8, pp. 37-45. |
| 6 | 18 | Söderberg f.k.a. Andersson, A., Adell, E. & Winslott Hiselius, L. 2021, What is the substitution effect of e-bikes? A randomised controlled trial, Transportation research. Part D, Transport and environment, vol. 90. |
| 7 | 17 | Fyhri, A., Fearnley, N., 2015. Effects of e-bikes on bicycle use and mode share. Transportation research. Part D, Transport and environment. 36 (0), 45–52. |
| 8 | 17 | RAC. The power of electric bikes in regional WA. 2017. advocacy@rac.com.au |
| 9 | 16 | Behavioural Insights Team Ltd. 2017. An Evaluation of Low-Cost Workplace-Based Interventions to Encourage Use of Sustainable Transport. |
| 10 | 15 | Dahl Wikstrøm, R. & Böcker, L. 2020, Changing Suburban Daily Mobilities in Response to a Mobility Intervention: A Qualitative Investigation of an E-bike Trial, Sustainability, vol. 12, no. 6, pp. 2413. |

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|---|---|---|
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# Appendix II. Evidence tables

| Reference | Trial / Study | Trial Features / Objectives | Location | Study design | Main findings |
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| Cairns, S., Behrendt, F., Raffo, D., Beaumont, C. & Kiefer, C. 2017 | • E-cycle loan scheme aimed at commuters.<br>• Literature review.<br>• 80 Participants | • The study aimed to evaluate the attractiveness of e-cycles to commuters in an urban context in the UK.<br>• Trial employees were loaned an e-cycle for 6–8 weeks.<br>• The intention was to select a group of people with the potential to change their behaviour, with the trial a proof of concept that this could occur. In practice, selection was an iterative process with a need to have a roughly even split of men and women (to ensure selection compatibility with | Brighton, UK. | • Before and after surveys with all trial participants, as well as interviews and/or focus groups.<br>• All cycles were fitted with the 'Smart E-cycles monitoring System' (SEMS) – a monitoring system requiring no intervention from trial participants, which would submit data about cycle use in real time to a remote server. (Technical issues prevented the collection of full data for all the e- | • Three-quarters of those who were loaned an e-cycle in the trial used them at least once a week.<br>• Across the whole sample, average usage was around 15–20 miles per week, with an overall reduction in car mileage of 20%.<br>• 38% of trial participants expected to cycle more in the future, and at least 70% said that they would like to have an e-cycle available for use in the future, and would cycle more if this was the case.<br>• 59% of the employees loaned an e-cycle increased their overall physical activity.<br>• Trial results are consistent with the literature review, that when e-cycles are made available, they get used; that a proportion of e- |

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| | | the fleet mix of cross-bar and step-through cycles), and representation from different age groups. | | cycles in the trial). | cycle trips typically substitutes for car use; and that many people who take part in trials become interested in future e-cycle use, or cycling more generally. |
| RAC. 2016 | • E-cycle loan scheme aimed at commuters.<br>• 40 Participants | • A trial that looked to understand the potential of e-cycles to overcome some of the barriers to cycling, through the eyes of the user.<br>• E-cycles were available for a 10-week loan for commuting to and from work, (and any other trips they wanted to make).<br>• To encourage any newly established travel behaviours to be maintained after the trial, participants were also given the opportunity to purchase their e- | Perth, Australia. | • Before and after surveys.<br>• Weekly travel diaries to record their usage and experiences | • Significant behaviour change was experienced during the trial, with usage of the e-cycles for commuting remaining high throughout the trial.<br>• The proportion of commuting trips by car settled at 46% following the trial, representing a 15% reduction compared to pre-trial despite many participants no longer having access to an e-cycle.<br>• Just over a quarter of commuting trips continued to be made by e-cycle (26%) and a further 15% by regular bicycle, maintaining a cycling mode share of 41%.<br>• A majority of those that completed the after survey |

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| | | cycles during Week 7 of the trial. | | | expected to continue cycling more often than they did before the trial. Over half expected to drive less often. |
| de Kruijf, J., Ettema, D., Kamphuis, C.B. and Dijst, M., 2018 | • A one-year e-cycling incentive program<br>• 547 Participants | • The programme was aimed at commuters, who could earn monetary incentives when using their own e-cycles.<br>• The maximum incentive that could be realised over the whole year was 1,000 Euro.<br>• Participants had already purchased an e-cycle.<br>• Note: It is not clear from the paper whether people were aware of the incentive scheme when they purchased their e-cycle, but they had already decided to buy the cycle with or | North-Brabant, the Netherlands | The study used a longitudinal design allowing to observe behaviour change and mode shifts.<br><br>The study used a combination of quantitative research methods including surveys. It also undertook longitudinal statistical analysis. | • The program appeared to be highly effective in stimulating e-cycle use.<br>• After one month the share of commute trips made by e-cycle increased from 0% to 68%, with an increase up to 73% after six months.<br>• Half of the e-cycle trips replaced car trips, the other half substituted conventional cycling trips.<br>• Distance is seen as important for adopting e-cycling. E-cycles have a larger acceptable distance than a conventional cycle, but the likelihood to use the e-cycle decreased as commuting distance increased.<br>• Multivariate analyses suggest that a shift to e-cycling is affected by age, gender, physical condition, |

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| | | without that incentive. | | | car ownership and household composition.<br>• The study found support for the hypothesis that having a strong car-commuting habit decreases the probability of mode shift to a new mode alternative, whilst multimodality may increase the likelihood of e-cycle use as a result of openness to other travel options and a more deliberate mode choice.<br>• Dissatisfaction with current travel mode positively influenced mode shift towards e-cycles.<br>• The results imply that stimulating e-cycling may be a promising way of stimulating physical activity, but that it will be most effective if targeted at specific groups who are not currently engaging in active travel. |
| MacArthur, J., Kobel, N., Dill, | • E-cycle loan scheme | • Participants from three Kaiser Permanente | Portland, USA. | • Participants were asked to | • Participants cycled more often and to a wider variety |

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| & J. Mumuni, Z. 2017 | aimed at staff and students at a US university.<br>• 155 Participants | Northwest campuses (1 urban and 2 suburban) were issued an e-cycle for 10 weeks<br>• The program's primary goal was to test user acceptance of electric-assist folding bicycles (e-cycles) as a first/last-mile commuting solution. | | complete three surveys—before, during and after using the e-cycle, to evaluate how their perceptions and levels of cycling may have changed.<br>• Responses were analysed using statistical software and a GIS. | of places than before the study.<br>• Overall, the number of people commuting to work by bicycle at least once per week more than doubled (28% to 59%) during the study and the same increase was seen for all trips (22% to 53%).<br>• For cyclists who were not actively cycling prior to receiving an e-cycle (n=78), about 42% started commuting by e-cycle at least once per week.<br>• Over a third of respondents (33%) said they would definitely consider purchasing their own e-cycle, for reasons such as: it is "fun" (21%), a good way to get exercise (21%), and a cost-effective form of transportation (21%). Another third said "maybe.<br>• Participants became more confident cyclists after the study; and cited fewer barriers to cycling when |

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| | | | | | given the opportunity to use an e-cycle, particularly for overcoming hills and reducing sweat.<br>• The study's findings support the general hypothesis that e-cycles enable users to cycle to more distant locations, cycle more frequently and allow a broader participation in cycling for certain segments of the population by reducing barriers to cycling. |
| Plazier, P.A., Weitkamp, G. & van den Berg, Agnes E 2017 | • E-cycle loan scheme aimed at Dutch students, with the option to purchase the e-cycle at reduced price<br>• 37 Participants | • This study assessed the benefits and limitations of e-cycle use for students participating in a pilot in a university town in the Netherlands.<br>• It targets a gap in the literature regarding e-cycle use in early adulthood.<br>• Each student was able to use an e-cycle for four to five | Netherlands | • Thirty-seven pilot participants completed a survey on their e-cycle experiences, and follow-up in-depth interviews were held with eight participants.<br>• The sample was small, non-representative and self- | • In general, the introduction of the e-cycle during the pilot period led to a shift from the regular cycle and bus as dominant transport modes to the e-cycle as the dominant transport mode.<br>• During the pilot phase, e-cycle use increased significantly from 0% to 87.0% of the total number of trips in an average week.<br>• This increase occurred mostly at the cost of regular cycle-use, which went down significantly from 56.3% to |

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| | | weeks. At the end, they were offered the possibility of buying an e-cycle at a reduced price. | | selected. Therefore, the findings might not be generalizable to other populations. | 5.1%. Bus use was also significantly reduced from 20.8% to 2.3% during the pilot.<br>• The positive attitudes of students suggest increased acceptance of e-cycles for everyday use, and likelihood of use in later life.<br>• Results reveal a high potential for e-cycles to substitute public transportation use, but the high purchasing price makes it difficult for the e-cycle to compete with other transport modes.<br>• The study also provides support for the method of e-cycle pilot testing in attracting new user groups.<br>• When asked under which circumstances they would consider buying an e-cycle, survey respondents mostly indicated ‘‘when the e-cycle gets cheaper” (84%). |
| Söderberg f.k.a. | • Randomised control trial | • A randomised controlled trial with GPS data from 98 | Sweden | • Baseline travel behaviour of the | • The treatment group increased cycling on average with 1 trip and 6.5 |

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| Andersson, A., Adell, E. & Winslott Hiselius, L. 2021 | with one group provided with e-cycles.<br>• 65 e-cycle Participants. | frequent drivers in Sweden was conducted to investigate the effect of the e-cycle on modal choice, the number of trips, distance, as well as perceptions of the e-cycle as a substitute for the car.<br>• The treatment groups had e-cycles for five weeks. They were only instructed how to operate the e-cycle and that they could use it as much as they liked.<br>• The sample reflects a car-oriented segment, but was self-selected, and the employees that volunteered to participate may have already had a desire to change their travel behaviour. | | treatment and control group was measured for one week (M1), before the treatment group borrowed e-cycles for five weeks.<br>• Towards the end of the trial, a new measurement was done for both groups (M2).<br>• After the treatment group had finished e-cycling, the control group were given the e-cycles for five weeks. At the end of this period, another measurement was conducted (M3).<br>• Travel behaviour data and survey | km per day and person, which led to a 25% increase in total cycling.<br>• This increase was at the expense of car use, which on average decreased by 1 trip and 14 km per person and day, a decrease in car mileage of 37%.<br>• On average, the number of car trips expressed as the share of total trips went from 74% at M1 to 53% at M2 for the treatment group but remained stable in the control group from 74% to 75%. After their five-week trial this fell to 44%.<br>• The Treatment and control groups both reduced car distance travelled and increased cycle (and e-cycle) distance travelled across the intervention period.<br>• The survey results indicate that it is mainly work trips and other single-purpose trips that are considered suitable to switch for e- |

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| | | | | answers were collected via TravelVu, a smartphone application specialized in detecting trip characteristics.<br>• Note: The trial was impacted by Covid, which also affected travel to work. | cycles, whilst trips that transport goods and/or passengers are still, for the general participant, dependent on the car. |
| Fyhri, A., Fearnley, N., 2015 | • E-cycle loan scheme<br>• 61 e-cycle Participants | • From a survey sent to 30,000 members of the Norwegian Automobile Federation, which received 5500 responses, sixty-six participants were randomly selected to use an e-cycle for two or four weeks.<br>• Results were compared with those of a control group (N=160) also drawn from the survey. | Norway | • Surveys before and after trial. The control group had no e-cycle, but also completed surveys.<br>• Note: The authors highlight that the characteristics of the test-users differed from the control group (better gender balance, lower income and more | • E-cycles increase the amount of cycling; both expressed as number of trips and as distance cycled. Trips increased from 0.9 to 1.4 per day, distance from 4.8 km to 10.3 km and, as a share of all transport, from 28% to 48%, whereas with the control group there was no increase in cycling.<br>• The effect of the e-cycle increased with time, indicating a learning effect among users.<br>• It was greater for female than for male cyclists, |

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| | | • Although users were initially allowed to use the e-cycle for two or four weeks, their test periods were in practice both longer and shorter than this, ranging from 9 to 64 days. | | cycling in the former), and that most of the participants only had access to an e-cycle for two weeks. | resulting in more newly generated trips for women than for men. There were no differences with age.<br>• The e-cycle-related change in absolute distance cycled is biggest for non-commute travel. However, when looking at cycling as share of total commute or non-commute distance travelled, the effect is greatest for commute travel.<br>• Weekly cycling activity for transport increased more than cycling for exercise.<br>• Overall, the results suggest that the e-cycle is indeed practical for everyday travel. |
| RAC. 2017 | • E-cycle loan scheme<br>• 17 Participants | • Trial aimed at increasing awareness and usage of e-cycles, and to boost cycling in Western Australia's (WA) regional cities and towns.<br>• For this study employees were | Albany, Western Australia | Before and after surveys | • Over the 10 weeks, on average, almost half of all commuting trips were solely made by e-cycle - None of the participants had reported cycling to and from work before the trial and 40 per cent noted that they never cycled for any purpose. |

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| | | provided exclusive use of an e-cycle for 10 weeks to facilitate their commute as well as any other trips they wished to make. | | | • Usage of e-cycles for commuting remained high throughout the trial, peaking at 60% in Week 1 and dropping to 28% in Week 9.<br>• Before the trial, a majority of the participant's commuting trips were made by car, either as a driver or passenger (85% of all trips to and from work). During the trial, this reduced to 48% on average over the 10 weeks and after the trial it dropped further to 41%.<br>• High levels of cycling were sustained following the trial, with the after-survey findings showing that 51% of commuting trips continued to be made by e-cycle and an additional 6% by regular bicycle (57% in total). In addition, over three quarters (76%) of participants reported cycling for any purpose at least one to three times per week in the after survey compared to only 25% indicating they |

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| | | | | | did so more than once per month before the trial. |
| Behavioural Insights Team Ltd. 2017 | • Part of wider travel behaviour change programme at the airport.<br>• 21 Participants in the e-cycle trial | Study of a two-week try-a-cycle scheme at Heathrow Airport. (The scheme included both e-cycles and traditional cycles) | Heathrow Airport, UK | • Pre and post-trial surveys (one month after cycles returned).<br>• The trial mainly attracted men, aged 35-54, with access to a car. Less than 10% were already regular cycle commuters. The majority were looking to cycle for fitness reasons.<br>• Extensive construction work (meaning some cycle lanes were closed), and e-cycles not being part of the airport financial incentive scheme for more sustainable | • E-cycles did encourage some people to cycle, or to cycle more. Participants with e-cycles used them to cycle to work on average two times during the two weeks. They used the cycle for fewer than half the days that they had it.<br>• Of those that borrowed an e-cycle, around half said they planned to continue cycling to work |

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| | | | | mobility will have all likely impacted on the attractiveness of the study, and potentially on the use of the e-cycles. | |
| Dahl Wikstrøm, R. & Böcker, L. 2020 | • E-cycle loan scheme<br>• 21 Participants | • A qualitative study of an intervention offering e-cycles to suburban commuters in Norway.<br>• Trial periods were 1-2 weeks, and cycles were loaned with related equipment, such as helmets, panniers, and locks. | Norway | • The paper draws on the staging mobilities framework and conceptualizes situational mobilities as involving the dimensions of embodiment, social interaction, and materiality.<br>• This study explores the potential of combining mobile methods (GPS-tracking), qualitative GIS, and visual methods (photo- and map- | • This study finds that the participants were motivated to test (different models of) e-cycles and that doing so allowed them to acquire new knowledge and skillsets that enhanced their familiarity with e-cycling while benefiting from the structure, service, and security that the scheme offers.<br>• Participants that substitute commuting by car with e-cycling are often dependent on their car for other trips like chauffeuring children or running errands. Sometimes this means activities previously chained into car commutes are now |

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| | | | | elicitation) in interviews, and participant observations.<br>• Details of journeys made during the trial are not reported here, instead this paper explores the role the e-cycles could play in the participants (mobility) life. | segmented into separate trips. |
| Fyhri, A., Heinen, E., Fearnley, N. & Sundfør, H.B. 2017 | • E-cycle loan scheme.<br>• 66 Participants | • Adds 'willingness to pay' (WTP) outcomes to Fyhri (2015) above.<br>• Most participants (72%) used the loan e-cycle primarily for work commute trips | Norway | • Stage 1 of the study was an internet questionnaire, asking for perceptions about cycling, everyday transport habits, as well as recruitment questions.<br>• Stage 2 was an intervention study, in which | • The results of the intervention study showed a large increase in participants' WTP for an e-cycle after having had access to use it for some weeks compared to the control group.<br>• The highest interest for purchasing an e-cycle existed among those who cycled up to 10 km per week. The lowest interest could be found among those who had cycled more than |

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| | | | | some respondents were offered temporary e-cycle use in order to determine the effect of using e-cycles on willingness to pay (among other things). This was followed by a post-intervention survey.<br>• The control group was given a survey at the same time. | 20 km (only 13% interested).<br>• Those who had not cycled at all were slightly less interested in purchasing than those who had cycled a little.<br>• The strongest predictor for interest in buying an e-cycle is knowledge about e-cycles. The second most important variable is WTP for a normal cycle, which has a negative influence on interest in buying an e-cycle; in other words, those who are willing to pay much for a normal cycle are less likely to want an e-cycle.<br>• Habit strength for cycling, having higher education, cycling a lot for transport, or exercise all contribute negatively to interest in e-cycles.<br>• Those who have intentions to drive less car in their everyday life are more inclined to want an e-cycle. |

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| | | | | | • Age, attitudes toward cycling, intentions for cycling more, and social norms for cycling were not significant. |
| Moser, C., Blumer, Y. & Hille, S.L. 2017;2018 | • E-cycle loan scheme.<br>• 144 Participants borrowed an e-cycle | • Annual e-cycle promotion programme in Switzerland, in which car owners can try out an e-cycle for free over a two-week period in exchange for their car keys.<br>• A longitudinal survey was used to measure the long-term effects of the trial on mobility-related habitual associations. | Switzerland | • Questionnaires before the intervention, and again after one year.<br>• Sample: Compared with the Swiss population well-educated men were overrepresented among the survey participants.<br>• More than half of participants lived in households with two or more cars indicating that the programme reaches a target group with a real potential for | • The study provides strong evidence that exchanging one's car keys for an e-cycle for just a few weeks influences long-term 'habitual associations' with car usage, and that this change persists even a year after the end of the intervention.<br>• This finding was valid both for participants who bought an e-cycle after the trial and those who did not. We conclude that an e-cycle trial has the potential to break mobility habits and motivate car owners to use more sustainable means of transport.<br>• By November 2015 10% of participants (from total pool of 1854) used their coupon to buy an e-cycle.<br>• It is suggested that the programme had a long-term |

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| | | | | mobility-related energy savings.<br>• Participants' actual travel behaviour was not tracked in this study, although the authors acknowledge this is important for future research (e.g. using tracking devices and travel diaries). | effect regardless of whether participants go on to purchase an e-cycle. |
| Berg, Henriksson & Ihlström 2019 | • Shared vehicle scheme that incorporates e-cars and e-cycles<br>• 11 Participants used the shared e-cycles | • The aim of the study was to explore to what extent a vehicle-sharing system (VSS) that includes electric bicycles and cars, connected to a block of apartments in a middle-sized city in Sweden, could cater for individuals' everyday mobility needs and reduce | Jönköping, Sweden | • This study was based on a qualitative research approach with data collected through interviews with individuals living in a newly built neighbourhood.<br>• E-cycles were only part of this small-scale | • Results show a reluctance to voluntarily sacrifice comfort regarding everyday energy use. Owning and using a private car is to a high degree interpreted as convenient.<br>• The results also suggest that a VSS has the potential to satisfy mobility needs for people living in urban areas. However, in order for it to be successful, both in terms of satisfying mobility needs as |

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| | | the need to own a car. | | scheme, but were used by all participants. Data was collected after one week only - so did not include post-study use | well as being regarded as an attractive alternative to private car ownership, we argue that reconfiguration of modal choice and accessibility on different sociotechnical levels is a necessity. Interventions such as satisfactory public transport and better infrastructure for cycling and walking are suggested, as well as stricter parking regulations, banning cars in certain areas and making car use and ownership more expensive. In other words, the deployment of both soft and hard measures in combination is necessary.<br>• Our study shows that vehicle sharing service pilot users will not start using the service because of the novelty of it, nor will they modify or redesign it to their needs. Rather, if it does not meet their needs, they will not use the service at all. |

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| | | | | | • At the time of the study, the VSS was new and the users were offered the opportunity to use the service for free. Whether they will continue to use it when they will have to share it with more residents and also pay for using it, is uncertain.<br>• The results further show that many of those who used the VSS already cycle or walk as their main mode of transport but used the service during the free period since they were curious how the VSS worked. |
| Gorenflo, C., Rios, I., Golab, L. & Keshav, S. 2017 | • Long-term E-cycle loan scheme.<br>• 31 Participants | • This paper presents an analysis of data collected through the Waterloo WeBike project: a field trial in which over 30 sensor-equipped electric bicycles (e-cycles) were given to members of the University of | Canada | • The study focusses strongly on data collection from the cycles around usage and charging - data includes trips and battery charging sessions | • Findings are that the primary purpose of the e-cycles in the trial was for commuting, with most trips lasting less than 20 minutes and most trips taking place in the summer months.<br>• There was no evidence of range anxiety, and little correlation between anticipated and actual use. |

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| | | Waterloo for personal use.<br>• Participants had the e-cycles for three years, and were able to keep them after the trial for their own continued use. | | spanning nearly three years. As a consequence, it is more a study of usage patterns of e-cycle users.<br>• The e-cycles were not exclusively pedal-assist, they could also operate in pure electric mode.<br>• Pre-trial participants completed a survey regarding current modes of transportation and attitudes towards e-cycles.<br>• 31 out of over 100 prospective participants were selected for the field trial and received their own e-cycle to use as they wished. | • Participants rated regular bicycles higher than e-cycles even after becoming familiar with e-cycles through the field trial.<br>• Participation in the WeBike field trial did not significantly change participants' sentiments towards various modes of transportation. Furthermore, e-cycles were rated lower than regular cycles on independence, reliability, stress-free travel, and environmental friendliness. However, e-cycles were rated higher than cars on all aspects except independence and comfort.<br>• It is concluded that the general population in Canada is still unaware of e-cycles and their potential, and that e-cycle manufacturers should target sales to non-cycle users, such as seniors, rather than trying to displace sales of regular bicycles. |

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| Bjørnarå, H.B., Berntsen, S., J te Velde, S., Fyhri, A., Deforche, B., Andersen, L.B. & Bere, E. 2019 | • Cycle (including e-cycle) loan scheme.<br>• 36 participants (18 e-cycle users in total, 18 control) | • The primary objective of the study was to assess the feasibility and effect of an intervention providing access to:<br>○ an e-cycle including a trailer for child transportation,<br>○ a cargo (longtail) cycle, and a<br>○ traditional cycle with a trailer<br>• Cycles were available for three months<br>• The study considered transportation habits (weekly frequency of cycling and driving to the workplace, the kindergarten and the grocery store) and total cycling (distance and time).<br>• Separate conclusions are | Norway | • Participants answered a web-based questionnaire when signing up, and a questionnaire assessing transportation habits, intrinsic motivation, barriers and facilitators for cycling, as well as psychological constructs (attitudes, subjective norms, perceived behavioural control and intentions) and habit strength related to car use at baseline and after each intervention arm, in total four times. | • Access to different cycle types for parents with children attending kindergarten resulted in overall increased cycling, decreased car use and higher intrinsic motivation for cycling.<br>• E-cycles achieved the greatest cycling amount (distance and time) for the entire trial period, with the smallest sample variability, and the intervention group reported significantly higher “intrinsic regulation” for cycling at the nine-month follow-up, compared with the control group.<br>• Hence, providing parents with children in kindergarten with access to e-cycles might result in increased and sustained cycling, even during the winter season. |

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| | | drawn about e-cycle use, and comparisons made to the other models. | | • Intrinsic motivation for cycling was assessed with the Intrinsic Motivation Inventory and the Behavioural Regulation in Exercise Questionnaire 2.<br>• The most substantial study limitation was that the sample size did not allow for regression analyses, and thus not for the adjustment of confounders. | |
| Page, N.C. & Nilsson, V.O. 2016;2017 | • E-cycle loan scheme.<br>• 31 Participants | • Employees of a UK-based organization participated in a workplace travel behaviour change intervention and used e-cycles as an active commuting mode; this was a | UK | • Participants were self-selected, following an introduction to e-cycles event at their employment site, and were likely to be pre- | • Employees who changed their behaviour to active commuting reported more positive affect, better physical health and more productive organisational behaviour outcomes compared to passive commuters. |

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| | | change to their usual passive commuting behaviour.<br>• Participants were loaned the e-cycle for as long as they requested. The median loan period (at the time of the paper) was 6 weeks. The e-cycles could be used for any purpose. Road-side cover was provided, and the e-cycles serviced midway through a loan period.<br>• Focus of study was on non-travel outcomes of an active commute. To develop employee well-being and organisational behaviour for improved business success. | | disposed to use of an e-cycle.<br>• Data were collected at the individual (employee) level pre-intervention, during the intervention phase, and post-intervention, via online monthly questionnaires and weekly diaries. | • There was an interactive effect of commuting mode and commuting distance: a more frequent active commute was positively associated with more productive organisational behaviour and stronger overall positive employee well-being whereas a longer passive commute was associated with poorer well-being, although there was no impact on organisational behaviour.<br>• This research provides emerging evidence of the value of an innovative workplace health promotion initiative focused on active commuting in protecting and improving employee well-being and organisational behaviour for stronger business performance.<br>• It considers the significant opportunities for organizations pursuing improved workforce well-being, both in terms of |

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| | | • The personal benefits and organisational co-benefits of active commuting were compared to a control group who did not change their behaviour (and continued non-active commutes). | | | employee health, and for improved organisational behaviour and business success. |
| Carplus Bikeplus. 2016 | • Mainly shared-use e-cycle hire schemes, with a small number of trials and tourism schemes.<br>• 2667 Participants | • Analysis of eleven e-cycle interventions in the UK.<br>• Most schemes are shared-use, only two appear to be 'trial' as such and another 2-3 tourism schemes. | UK - various | • The report covers the first year of data collected across a programme of e-cycle sharing and trial scheme interventions. Data specifically related to the latter is minimal, and most results relate broadly to the use of e-cycles in general.<br>• There were two survey strategies: firstly, | • Shared e-cycles can attract new riders to cycling, E-cycles can provide health and wellbeing benefits, enable new types of trips to be made as cycling trips, enable people to reduce their car use and shared e-cycles can offer affordable and convenient access to new opportunities. E-cycle hire supports a “try before you buy” model.<br>• Desire to buy an e-cycle is greatest amongst those who used the cycles regularly. In this sample the survey showed that 13% of regular riders have gone on to |

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| | | | | for one off (mainly tourism projects) and secondly regular riders (mainly urban commuter projects).<br>• GPS trackers were fitted to all cycles to capture specific trip data.<br>• In total 535 respondents completed at least one survey just under 20% response rate).<br>• Results reflect the nature of the local projects where response rates were highest: Compass Bikes, Journey Matters and Plymouth Bike Hire | purchase an e-cycle and a further 17% proceeded to purchase a standard cycle.<br>• In the Rotherham Trial: 35% of people said they intended to buy an electric or conventional cycle after taking an e-cycle loan.<br>• The evidence supports the fact that loan schemes have a higher conversion rate of sales than visitor e-cycle hire as those engaging with the schemes are already contemplating purchase.<br>• Half of riders in commuter settings said they were using the e-cycles at least once a month (39% once a week) and although 82% of regular riders have said they are more likely to buy only 12% have done so, so far indicating there is a role for cycle share for on-going convenient cycle hire as well as “try before you buy”.<br>• Despite relatively small sample sizes, the programme has given |

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| | | | | | strong indications that e-cycles and cycle share can make significant contributions to widening the appeal of cycling to those who don't wish to, or cannot ride a conventional cycle.<br>• The programme has also highlighted the potential for e-cycles to enable: new trips to be converted to cycling, and faster, hillier and longer journeys to be made by cycle.<br>• Evidence from the interventions shows that e-cycles can support a transition from car trips and contribute to a range of social and environmental policy areas. By creating a network of shared e-cycles where people live, work, study and visit, many of the barriers to cycling are removed for a wider range of types of people. |
| Nocerino, R., Colorni, A., Lia, | • 39 companies | • The study explores the results of four | Italy | EU-funded trial with extensive | • Pilots enabled the demonstration of |

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| F. & Luè, A. 2016 | across the programme, with four trials in Italy | Italian pilots in Pro-E-Bike, an EU funded project (Intelligent Energy Europe programme www.pro-e-bike.org).<br>• The project analyses the performance of electric bicycles and electric scooters for the delivering of goods in urban areas and tests the use of these vehicles in seven European countries with thirty-nine companies.<br>• The Italian pilots were located in Genoa (three) and Milan (one).<br>• Trials were specifically focussed on urban logistics / delivery companies | | monitoring and evaluation activity. | measurable effects in terms of reduction of CO2 emissions and energy savings in urban logistics.<br>• Three companies decided to carry on using the e-cycles after the pilots.<br>• The performances of e-cycles and of the logistics platform convinced one to expand the initiative, creating a full electric vehicles logistic platform. |