Bicycling campaigns promoting health versus campaigns promoting safety: A randomized controlled online study of 'dangerization'

Tim Gamble*

Ian Walker

Aleksandra Laketa

Department of Psychology, University of Bath, Bath BA2 7AY, UK

*Corresponding author. +44 (0) 1225 385283, t.gamble@bath.ac.uk

Abstract

This study tested the idea that promoting bicycle safety might inadvertently discourage bicycling by having negative effects on how the activity is perceived. It also tested the idea that stressing the health benefits of bicycling would have a positive effect on perceptions and intentions to cycle. Two-hundred and twenty-eight adults were randomly allocated to read safety-focused, health-focused, or control publicity materials and their immediate influences on bicycling perceptions were measured. Health-focused materials significantly increased bicycling's perceived health benefits amongst non-bicyclists and had no influence on perceived risk; the safety-focused campaign had no effect on either perceived risks or health benefits for either group. Neither campaign measurably changed intentions to bicycle nor the perceived enjoyment of bicycling, both of which were clearly higher amongst bicyclists than non-bicyclists. The study suggests that safety-focused campaigns are unlikely to have any immediate effect on people's perceptions and intentions to cycle, whether positive or negative; health-focused campaigns, on the other hand, make bicycling appear more beneficial to those who do not currently do it. In addition, although the possibility exists that current bicyclists are a qualitatively different sub-population, able to enjoy bicycling in non-conducive environments, their rating bicycling as more enjoyable than non-bicyclists hints that new campaigns might usefully emphasize the enjoyment of bicycling to encourage its uptake.

Keywords: bicycling, cycling, risk perception, enjoyment, health benefits, public health

Bicycling campaigns promoting health versus campaigns promoting safety: A randomized controlled online study of 'dangerization'

1. Introduction

Bicycling levels in most parts of the United Kingdom, like in many parts of the world, are stagnating or even declining (Department for Transport, 2013). This is unfortunate, given the social benefits more utility bicycling – that is, riding to accomplish tasks such as shopping and commuting – would bring (Andersen et al, 2000; Blair, 2009; Cavill & Davis, 2007; Crawford & Lovelace, 2015; Künzli et al., 2000; Teschke et al., 2012; Woodcock et al., 2009, 2014) and the number of short, motorized journeys that could feasibly be transitioned to the bicycle. Of late, transport mode-choice research has started to turn away from rational-choice benefit:cost interpretations (Graham-Rowe, Skippon, Gardner & Abraham, 2011) towards considering the role of emotion (Horton, 2007; Steg, 2005). In the case of bicycling, it is suggested that safety fears play a central role in people's decisions about whether or not to use this mode (Dill & McNeil, 2013; Fraser & Lock, 2011; Pank, 2012; Sanders, 2015; Winters et al., 2011). However, as Sanders (2015) recently noted, "little research has investigated this topic beyond the general notion that perceived traffic risk deters cycling" (p. 27).

Here, we approach the issue of perceived fear using the tools of health psychology, which has long dealt with the links between emotion and behaviour. The starting point for this analysis is that bicycling does carry some real risk of injury. In part, this risk arises because bicycling is often, at the policy level, constructed not as a means of transport but as an essentially frivolous leisure activity (Aldred, 2014). This means that in countries like the UK and USA it does not receive laws and infrastructure to promote safety (Pucher & Buehler, 2008; Pucher & Dijkstra, 2003; Teschke et al., 2012) and instead must compete for space with motor vehicles (Adams, 1995; Davis, 1993; Sheller & Urry, 2003). As it happens, the risks that arise from sharing space with motorists are overshadowed by bicycling's long-term health benefits (Andersen et al., 2000; British Medical Association, 1992; Cavill & Davis, 2007; De Hartog, Boogard, Nijland & Hoek, 2010; Oja et al., 2011; Rojas-Rueda, de Nazelle, Tainio, & Nieuwenhuijsen, 2011; Woodcock et al., 2009). But, as noted above, people's travel decisions might have emotional perceptions at their core, which is why it is so important to understand their risk perceptions. In this paper, we are interested in the possible role of public communications in shaping these risk perceptions.

Various campaigns have attempted to communicate the risks of bicycling to bicyclists and potential bicyclists. Sometimes explicitly, but more often implicitly, these campaigns are based on models of behaviour like the Health Belief Model, which suggest that the way to make people protect themselves from risk is to make that risk more salient (Harrison, Mullen, & Green, 1992; Rosenstock, 1974; Rothman & Salovey, 1997). This approach has certainly worked in 'classic' health settings where, for example, framing and information provision have been found to increase the perceived risks of breast cancer and thereby motivate protective behaviours such as breast self-examination and mammography screening (Banks et al., 1995; Basen-Engquist & Parcel, 1992; Sedigheh, Hasani, Aghamolaei, Zare, & Gregory, 2009; Tenkorang, 2013; Umeh & Jones, 2010; Walsh & Lehane, 2011; Zighaimat et al., 2010). In the case of bicycling, campaigns often promote wearing protective equipment such as hi-visibility clothing and helmets (e.g., cycle-smart.org in the UK and the Bicycle

Helmet Safety Institute in the US). As it happens, the assumption that this equipment will make bicycling safer is hotly debated by the research community (e.g., Curnow, 2005; Elvik, 2013; Fyhri, Bjørnskau & Backer-Grøndahl, 2012; Fyhri & Phillips, 2013; Goldacre & Spiegelhalter, 2013; Hagel & Pless, 2006; Olivier & Walter, 2013; Rissel, 2012; Robinson, 2007; Walker, 2007; Walker, Garrard & Jowitt, 2014; Walker & Robinson, submitted). But whilst interesting, that debate is not pertinent to our current focus. Rather, we look here at a more general idea, which is that promoting prophylactic behaviours for bicyclists – particularly with campaigns targeted at novice riders or non-riders – might fail to appreciate that people can also reduce the risk of bicycling injury simply by avoiding the activity altogether (Rothman, Salovey, Antone, Keough, & Martin, 1993). Given bicycling's considerable social benefits, the idea that people might deal with perceived risks simply by not bicycling is a particular concern in cultural contexts where bicycling might already be seen as a minority activity that is easily avoided (e.g., Aldred & Jungnickel, 2014).

So there are a priori grounds for suggesting that bicycle safety campaigns might inadvertently 'dangerize' bicycling – increasing fear of the activity and thereby reducing participation levels. However, to the best of our knowledge, there is as yet no empirical test of this suggestion. This study therefore tested the idea that bicycle safety campaigns might increase the perceived risk of bicycling and affect intentions to travel by bicycle. At the same time, we were also interested in the related idea that campaigns framing bicycling in more positive ways might encourage participation. It is well known that perceived benefits, as well as perceived risks, play a crucial role in motivating a variety of behaviours (Harrison, Mullen, & Green, 1992; Rosenstock, 1974; Rothman & Salovey, 1997; Sarafino & Smith, 2011). In the case of physical activity, research suggests that two types of perceived benefits seem to play a central role: perceived health benefits and perceived enjoyment (Dishman et al., 2005; Hagberg, Lindahl, Nyberg, & Hellenius, 2009; Thomas, Walker & Musselwhite, 2014). Hence, it is possible that bicycle safety campaigns might discourage people from bicycling by reducing perceived health benefits and/or reducing perceived enjoyment of this activity, in addition to increasing perceived risk. Therefore, this study used both safety-focused materials, which covered risks and protective behaviours, and health-focused materials, which stressed the physical and mental health benefits of bicycling. For both types of material, we measured possible shifts in both positive and negative perceptions of bicycling.

Finally, we also considered the factor of personal engagement. Research suggests that people who are personally engaged in a certain behaviour, thanks to greater knowledge and stronger attitudes, process relevant information about this behaviour in more detail compared to people who are not personally engaged (Petty, Cacioppo, & Schumann, 1983). With this in mind, it is reasonable to assume that whether or not a person currently travels by bicycle might play a role in how different messages about bicycling are processed and perceived (Daley & Rissel, 2011; Rissel, Campbell, Ashley & Jackson, 2002). We therefore assessed each participant's level of bicycle use and used this as an independent variable.

In summary, then, this study aimed to examine the effects of safety-focused and health-focused bicycling campaigns on perceived risks, health benefits and enjoyment of bicycling, and intentions to bicycle in the future. It also aimed to examine whether any effects would be different in

people who currently do and do not ride bicycles. As these issues have not been examined in this way before, the study focused specifically on short-term ‘first impressions’ of bicycling campaign materials, leaving it for future research to consider longer-term exposure to such messages.

2. Material and Methods

2.1. Design

A 3 × 2 × 2 mixed factorial design manipulated the independent-samples factors of Condition (safety-focused information, health-focused information, or control) and Bicycling Status (bicyclists and non-bicyclists), as well as the repeated-measures factor of Time (measures were taken before and after the information provision). The 4 outcome measures were (1) perceived risks of bicycling, (2) perceived health benefits of bicycling, (3) perceived enjoyment of bicycling, and (4) intention to bicycle.

2.2. Participants

This study was conducted using Bristol Online Surveys. The sample consisted of 228 people (127 male, 101 female) aged from 18 to 61 (M = 32.27, SD = 10.87). Sixty-nine participants were non-bicyclists and 159 were bicyclists, with a bicyclist defined here as somebody who had ridden a bicycle at least once in the past two weeks. Respondents were recruited opportunistically through social media (Facebook and Twitter), and on the University of Bath homepage and electronic Noticeboard. There were no rewards for taking part in the study.

2.3. Bicycling perceptions

Perceived risk of bicycling was measured using seven items from the Bicycle Helmet Attitudes Scale (BHAS), specifically the *Perceived Danger Of Cycling* subscale (Ross, Ross, Rahman, & Cataldo, 2011). Given that our sample included bicyclists and non-bicyclists, the original BHAS items were rephrased in order to make them applicable for both groups of participants. In addition, two items were reversed, so as to reduce the original negative focus (Rattray & Jones, 2005). For example, the item "*Generally speaking, I believe that cycling in the street is dangerous*" was reversed to "*Generally speaking, I believe that cycling in the street is safe*". The items were scored on a seven-point Likert scale, with responses ranging from "Strongly Disagree" to "Strongly Agree".

Perceived health benefits of cycling were measured using items from the Exercise Benefits/Barriers Scale (EBBS – Grubbs & Carter, 2002; Jones, 1996; Sechrist, Walker, & Pender, 1987). To make the scale more relevant to bicycling behaviour, and to both bicyclists and non-bicyclists, the original items were slightly modified. For instance, "*I will prevent heart attacks by exercising*" was modified into "*I believe that cycling can prevent heart attacks*". The scale again consisted of seven items, scored the same as the perceived risk scale.

Perceived enjoyment of bicycling was measured using items from the Physical Activity Enjoyment Scale (PACES – Crocker, Bouffard, & Gessaroli, 1995; Kendzierski & DeCarlo, 1991; Motl et al., 2001). This scale has already been used for measuring perceived enjoyment of bicycling, so it was assumed that the items would be relevant to this form of activity. However, since the original PACES aimed to assess perceived enjoyment at the very moment of completing the activity, the items were modified to make them applicable for measuring perceived enjoyment of bicycling in general, and for both bicyclists and non-bicyclists. Again there were seven items in the scale, five of which had a positive focus (e.g. "*I believe that cycling is pleasurable*") and two of which had a negative focus (e.g.

"*I believe that cycling is depressing*") and which were later reverse-scored. The responses and scoring for this scale were the same as for the two previous scales.

The 21 questions just described (see Appendix for a full list) were mixed together and presented to each participant in random order. At the beginning of these questions, non-bicyclists were instructed to answer the items based on what they thought was true about bicycling in general. It could be argued that this made some of the questions hypothetical for non-bicyclists. However, hypothetical questions are still reliable and valid when measuring people's perceptions, since perceptions are a hypothetical construct that cannot be observed directly (Rattray & Jones, 2005).

Finally, intentions to bicycle were assessed with two items: *"I want to cycle in the near future"* and *"I actually intend to cycle in the near future".* The reason for including both items was based on the reasoning that some people might not have the resources to actually cycle. Therefore, the first item was added as a measure of people's willingness to cycle, thereby minimizing the effect of external barriers on behavioural intentions. The items were again scored on a seven-point Likert scale from "Strongly Disagree" to "Strongly Agree".

2.4. Information leaflets and the experimental manipulation

Three leaflets were generated for this study (see Figure 1). All three leaflets were one-sided and had the exact same layout: a picture at the top, followed by five bullet points. Both the health-focused and the safety-focused leaflets were created using imagery from real UK bicycling campaigns. The image for the safety-focused leaflet was taken from the 2002 THINK! CycleSense campaign in the UK, and an image from the City of Bristol's 2011 Better By Bike campaign was used for the health-focused leaflet. The control leaflet was intended to convey no emotional tone and so contained neutral, objective facts about bicycling with a picture of a bicycle at the top. A University of Bath logo was added at the bottom of the leaflets, because a credible and trustworthy source is important for information processing (Hu & Sundar, 2010). Particular care was given to ensure that all three versions of the leaflets provided the same quantity of information, as well as had the same background colour, letter font and size.

Health-focused Safety-focused Control

Figure 1: The three information leaflets used in this study

2.5. Procedure

There was an online consent form and a participant information sheet on the very first page of the survey. Participants were allowed to continue only if they consented to take part. At this stage, participants were told that the purpose of the study was to examine people's perceptions of bicycling; the nature of the manipulation was not revealed at this point, to avoid biased responses. The respondents were told about the actual aim of the research in the debrief page. After consenting, the participants were randomly allocated by the survey software to one of the three conditions of the study.

Each participant first provided basic demographic information, including their age, gender, and how many times they had bicycled in the past two weeks, with answers ranging from "0 = Never" to "5 = Five times or more". Everyone who had bicycled at least once was classed as a cyclist, and everyone who had not bicycled was classed as a non-bicyclist. Then participants completed the bicycling perception scales and reported their intentions to cycle. The order of the 21 bicycling perception items was randomized, so as to avoid order effects. This also helped avoid primacy or recency effects when the same questions were asked the second time.

After completing the pre-intervention bicycling perceptions scale, participants were shown the relevant information leaflet for their condition (Figure 1). They were asked to study this and, once they had read and fully understood the information, to press a button to continue. After the leaflet, there was a personality questionnaire, which was added as a distractor between baseline and post-manipulation measures of bicycling perceptions and intentions. This questionnaire was expected to divert people's attention from the information leaflet and from the topic of bicycling more generally. After this, participants again completed the bicycling perceptions and intentions scales before seeing the final debrief page.

3. Results

Perceived risks, health benefits and enjoyment of bicycling were each measured with 7 questions at two time points. The questions were reverse-coded where necessary and then collapsed to produce a single pre- and post-intervention score, ranging from 1 to 7, for each person for each of the three measures. Collapsing the 7 scores in each measure was justified given Chronbach's alpha ratings of between .77 and .89 across the 6 scales (mean = .83). Missing scores were replaced with mean values where necessary when calculating these scale scores.[1] These risk, health benefits and enjoyment scores were then each analysed in a 3 (Condition) × 2 (Bicycling Status) × 2 (Time) split-plot analysis of variance. A similar analysis was also applied to the data on intentions to bicycle in the future.

3.1. Perceived health benefits

Mean ratings for perceived health benefits of bicycling are shown in Figure 2. Analysis of these data showed a significant three-way Bicycling Status × Condition × Time interaction, Wilks's $\lambda = .96$, $F(2,222) = 4.60$, $p = .01$, showing that bicyclists and non-bicyclists responded differently to the three interventions. The nature of the three-way interaction is clear from Figure 2: in the health-focused condition, bicyclists did not change their estimates of the health benefits after the intervention ($t(37) = 1.86$, $p = .42$) whereas the non-bicyclists' estimates of the health benefits increased significantly ($t(28) = 4.52$, $p = .0006$). In the Control condition, neither bicyclists' ($t(54) = 1.39$, $p = 1.00$) nor non-bicyclists' ($t(22) = 1.48$, $p = .90$) estimates of the benefits changed significantly after intervention, and the same lack of any change was found in the Safety-focused condition ($t(65) = 1.39$, $p = 1.00$ and $t(16) = 1.23$, $p = 1.00$ respectively). All these paired *t*-tests are corrected for multiple comparisons using the Bonferroni method.

In addition to the three-way interaction there were significant main effects of Bicycling Status, Wilks's $\lambda = .89$, $F(1,222) = 27.04$, $p < .001$, reflecting how bicyclists generally saw more health benefits than non-bicyclists, and of Time, Wilks's $\lambda = .98$, $F(1,222) = 4.34$, $p = .04$, reflecting the general tendency to give slightly higher ratings after intervention (Mean = 5.86, SD = 0.77) compared to before intervention (Mean = 5.73, SD = 0.79). There was no overall main effect of Condition, Wilks's $\lambda = .99$, $F(2,222) = 1.29$, $p = .28$. There was a significant interaction between Condition and Time, Wilks's $\lambda = .95$, $F(2,222) = 6.10$, $p = .002$, suggesting the three interventions altered health benefit assessments differently.

In summary, then, the only clear effect here was that the health-focused leaflet significantly increased non-bicyclists' ratings of bicycling's health benefits.

[1] As a check on this procedure, we also tried omitting participants with missing data, but this made no qualitative change to the overall pattern of results.

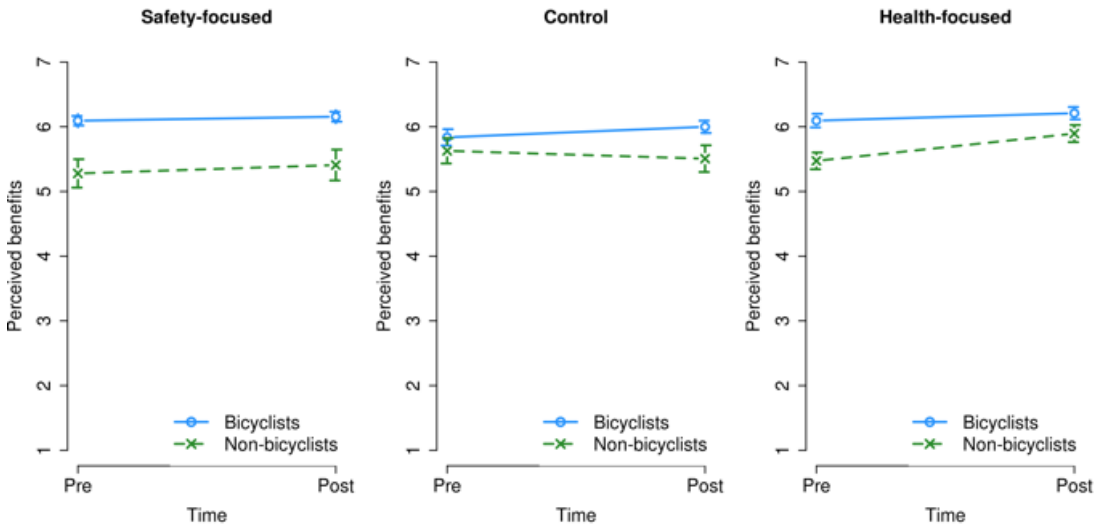

Figure 2: Mean ratings of the health benefits of bicycling as a function of Bicycling Status, Message Condition and Pre/Post intervention status. Error bars show standard errors.

3.2. Perceived enjoyment

Mean ratings for the perceived enjoyment of bicycling are shown in Figure 3. Unsurprisingly, given the essentially parallel lines on each plot, the only significant effect in the analysis of variance was a main effect of Bicycling Status, Wilks's $\lambda = .81$, $F(1,222) = 52.83$, $p < .001$. All other effects were non-significant: Condition, Wilks's $\lambda = .99$, $F(2,222) = 1.62$, $p = .19$, Time, Wilks's $\lambda = 1.00$, $F(1,222) = 0.00$, $p = .95$, Bicycling Status × Condition, Wilks's $\lambda = .99$, $F(2,222) = 0.76$, $p = .47$, Bicycling Status × Time, Wilks's $\lambda = 1.00$, $F(1,222) = 0.32$, $p = .58$, Condition × Time, Wilks's $\lambda = 1.00$, $F(2,222) = 0.20$, $p = .82$, and the three-way interaction, Wilks's $\lambda = 1.00$, $F(2,222) = 0.45$, $p = .64$. Overall, then, bicyclists rate bicycling as more enjoyable than non-bicyclists regardless of intervention.

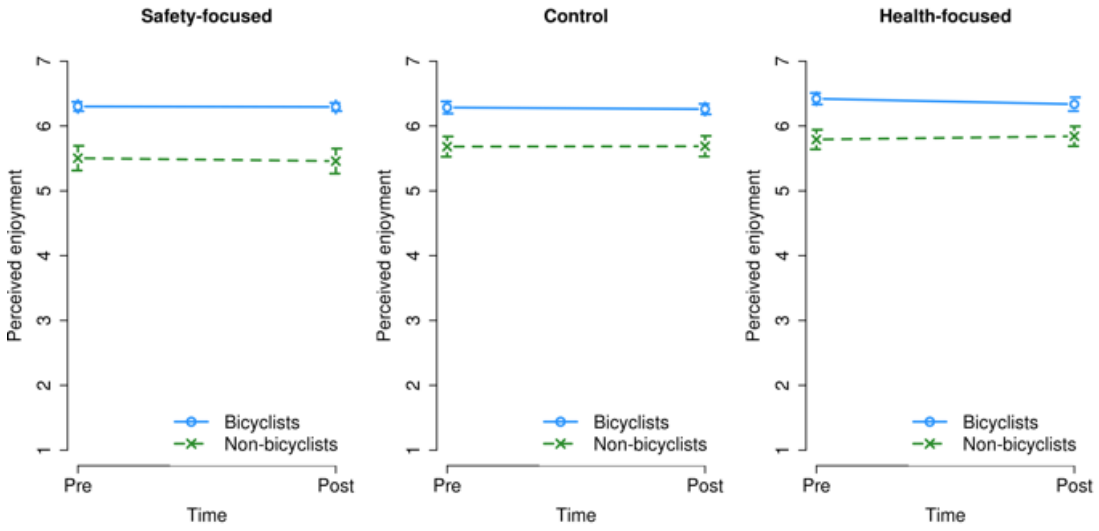

Figure 3: Mean ratings of bicycling enjoyment as a function of Bicycling Status, Message Condition and Pre/Post intervention status. Error bars show standard errors.

3.3. Perceived risks

Mean ratings for perceived risks are shown in Figure 4. Analysis of variance showed significant main effects of Bicycling Status, Wilks's $\lambda = .94$, $F(1,222) = 14.23$, $p = .0002$, thanks to non-bicyclists generally rating risk as higher than bicyclists. But there were no main effects of Time, Wilks's $\lambda = .98$, $F(1,222) = 3.89$, $p = .05$, nor Condition, Wilks's $\lambda = .99$, $F(2,222) = 1.06$, $p = .35$. The only significant interaction was between Bicycling Status and Time, Wilks's $\lambda = .97$, $F(1,222) = 7.27$, $p = .008$, reflecting how, regardless of which intervention they received, the difference in risk ratings between bicyclists and non-bicyclists tended to get slightly larger between pre-test ($d = .45$, $t(226) = 3.11$, $p = .004$) and post-test ($d = .62$, $t(226) = 4.26$, $p < .001$). Bonferroni-corrected *t*-tests showed that the interaction appears to be caused by the difference between bicyclists' and non-bicyclists' risk perceptions simply becoming slightly greater after ($d = .61$, $t(226) = 4.26$, $p < .001$), compared to before ($d = .45$, $t(226) = 3.11$, $p = .004$), the intervention. However, the differences are perhaps too slight to mean much as in two corrected paired *t*-tests neither bicyclists' ($t(158) = 1.68$, $p = .18$) nor non-bicyclists' ($t(68) = 1.55$, $p = .25$) risk perceptions changed significantly over the course of the intervention. All other interactions were non-significant: Bicycling Status × Condition, Wilks's $\lambda = .98$, $F(2,222) = 2.22$, $p = .11$, Condition × Time, Wilks's $\lambda = .99$, $F(2,222) = 1.47$, $p = .23$, and Bicycling Status × Condition × Time, Wilks's $\lambda = 1.00$, $F(2,222) = 0.20$, $p = .82$.

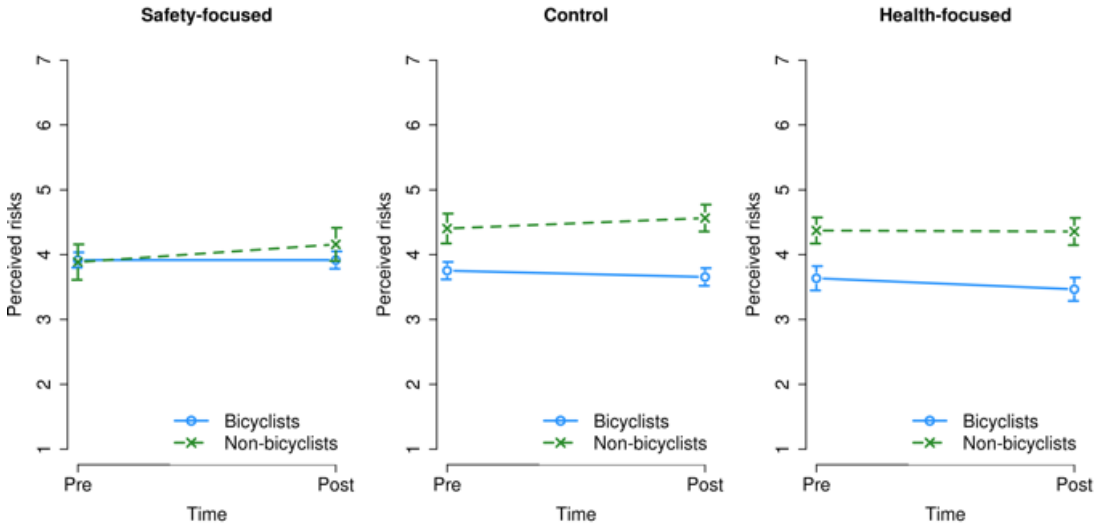

Figure 4: Mean ratings of bicycling risks as a function of Bicycling Status, Message Condition and Pre/Post intervention status. Error bars show standard errors.

3.4. Intention to bicycle

The mean intention scores are shown in Figure 5. Perhaps unsurprisingly, people who have recently ridden a bicycle have substantially higher intentions to bicycle in the future, as reflected in the main effect of Bicycling Status, Wilks's $\lambda = .49$, $F(1,210) = 218.02$, $p < .001$. Every other term in the analysis of variance was non-significant: Condition, Wilks's $\lambda = .98$, $F(2,210) = 1.79$, $p = .17$, Time, Wilks's $\lambda = 1.00$, $F(1,210) = 0.19$, $p = .67$, Bicycling Status × Condition, Wilks's $\lambda = .99$, $F(2,210) = 1.40$, $p = .25$, Bicycling Status × Time, Wilks's $\lambda = 1.00$, $F(1,210) = 0.10$, $p = .76$, Condition × Time, Wilks's $\lambda = .99$, $F(2,210) = 0.56$, $p = .57$, and the three-way interaction, Wilks's $\lambda = .98$, $F(2,210) = 1.67$, $p = .19$.

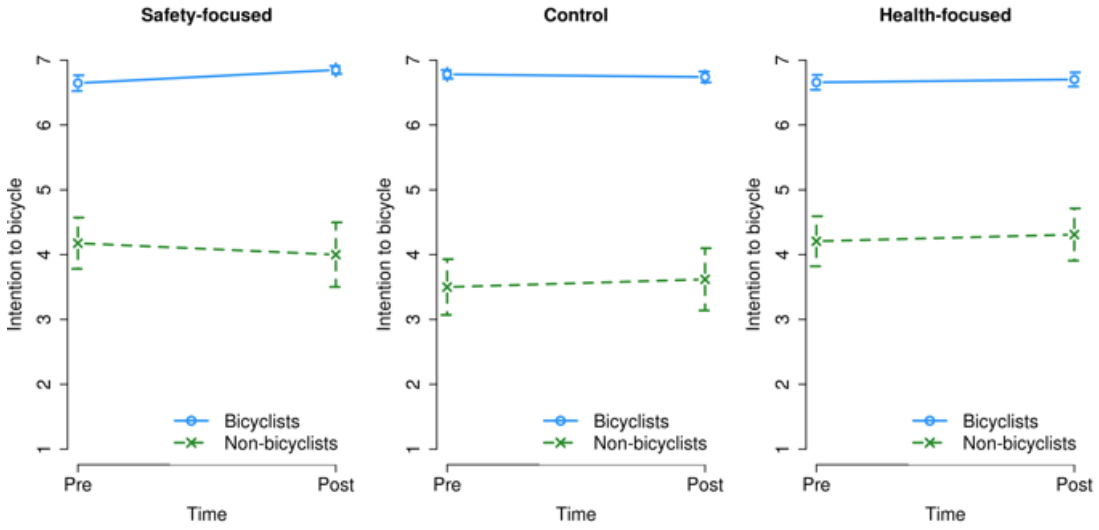

Figure 5: Mean intention to bicycle as a function of Bicycling Status, Message Condition and Pre/Post intervention status. Error bars show standard errors.

4. Discussion

This was the first study to our knowledge that experimentally tested the effects of bicycling campaign materials on both positive and negative perceptions of bicycling. The main aim was to examine the effects of safety-focused and health-focused campaigns on bicycling perceptions (risk, health benefits, enjoyment and intention to bicycle in the future), and to examine whether any effects were different in bicyclists and non-bicyclists. For non-bicyclists, perceptions of health benefits increased after the health-focused message and there was no corresponding change in perceived risks from seeing the safety-focused message. As such, it appears these two types of message are not ends of a continuum but rather separately influence perceptions about bicycling. Contrary to our *a priori* prediction, messages about safety did not 'dangerize' bicycling for non-bicyclists but messages about health did make the activity look more beneficial.

People who were already riding bicycles, on the other hand, were unaffected by all the messages, and remained throughout more positive about how enjoyable bicycling is and the extent to which they intended to use a bicycle in the future. It is interesting to note there were no signs of bicyclists feeling reinforced or validated by reading positive messages about their existing activity.

Overall, then, the results suggest that, at least over the sort of short time courses studied here, messages to existing bicyclists are unlikely to have any immediate effect on perceptions about bicycling or intention to carry out the activity; messages to non-bicyclists might be more likely to influence perceptions of bicycling, and to influence these more positively, if they emphasize health benefits rather than safety precautions.

This point about the study's short-term nature is an important one, and it is not yet possible to say how messages like these might plant ideas that are acted upon later (particularly if message exposure might have a cumulative effect over time). Although none of the materials here led to a change in non-bicyclists' immediate intentions to ride – and, frankly, if seeing a poster were all it took to make people immediately want to become bicyclists we would probably already know this – the messages used here did increase non-riders' perceptions of how healthy bicycling is. As such, it is possible such changes in perceptions might translate into intention or action over a longer time course than in this study. Verplanken, Walker, Davis and Jurasek (2008) and Walker, Thomas and Verplanken (2015) showed that a disruptive event like moving home, which forces people explicitly to reconsider their travel behaviour, is an opportunity for habitual actions to fall back into line with attitudes and beliefs. So if publicity materials really can change attitudes to bicycling in non-riders, such that they perceive it as more healthy (particularly through repeated exposure to such messages, as through a concerted advertising campaign), this might plant the seed for a future behaviour that will emerge following a disruptive event like a residential relocation or the appearance of new bicycle infrastructure.

In contrast to the health-related message, the safety-focused message did not significantly alter bicyclists' or non-bicyclists' risk perceptions nor their intentions to ride a bicycle in the short term. This implies that, even though fear of bicycling might frequently be cited as a barrier to the activity (Dill & McNeil, 2013; Fraser & Lock, 2011; Pank, 2012; Sanders, 2015; Winters et al., 2011), it is unlikely this fear is influenced by bicycle safety campaigns as we hypothesized it might be. One possible explanation for this focuses on the nature of the fear and risk. Specifically, as most fears are complex and multifaceted (Plutchik, 2001), fear of bicycling might go beyond simply the fear of being injured in a collision (Harrison, 2001; Sanders, 2015). For example, some people might fear bicycling on the road not because of possible collisions but because of possible harassment or violence from strangers (BBC, 2013; Harrison, 2001; Ravenscroft, 2004; Ravenscroft, Uzzell & Leach, 2002). Gatersleben, Murtagh and White (2013), using a range of methods, recently showed how travel mode might even shape such fears in a self-perpetuating way, such that travelling by car makes urban spaces feel more threatening than they do for people travelling actively or by public transport – thereby potentially decreasing the likelihood of drivers using non-car modes in the future. If fear of bicycling really does lie in part with fear of people rather than fear of collision, bicycle safety campaigns, which focus on collisions, helmets and visibility aids, would indeed be expected to have little or no effect on people's risk perceptions.

These above issues could moreover be intertwined with issues of bicyclist subgroups. Van Holle et al. (2012), in a review of the European literature, segregated recreational from transportation bicycling and suggested that, whilst riding for pleasure is discouraged by collision risk, such that there

is less recreational bicycling in higher-traffic areas, utility bicycling is unrelated to traffic risk. (Both forms of riding were unrelated to crime-related safety in that review.) In the present study, we did not assess the type of riding done by our participants and, although our interest is primarily in bicycling for transportation, it is possible that we inadvertently mixed riders with very different motives with regard to safety. Indeed, as one of the reviewers of this paper noted, there must exist a subset of off-road extreme-sport riders for whom the presence of some risk is a positive attraction!

A qualitatively different explanation for our safety-related message having no effect on risk perceptions or intentions to ride could be that when people say they fear bicycling, this is not really a statement about perceptions of risk at all. Fear of bicycling might be more personal, related to issues of social norms and identity (Horton, 2007). That is, in many nations (like the UK and USA), there is arguably some stigma around bicycling for transportation purposes, with commuter bicycling in particular frequently viewed as the "poor man's vehicle" (Aldred, 2013; ScienceDaily, 2013), especially by people lower in socio-economic status (Thornton, Evans, Bunt, Simon, King & Webster, 2011). In such contexts, it is possible that statements of fear are a socially acceptable means through which people decline participation in what is seen as a non-normative and non-aspirational activity. If this idea is correct, communications about collision risk and prophylactic measures would, again, be expected to play no role in shaping people's stated fear. Given these possible issues of fear of crime and fear of stigma, the extent to which fear of things other than traffic plays a role in people's willingness to bicycle is a potentially useful avenue for future research.

Finally, we note that perceived enjoyment of bicycling in this study was not affected by any of the materials, whether for bicyclists or non-bicyclists. However, there was a significant main effect of bicycling status on perceived enjoyment, such that regardless of time and condition, current bicyclists saw bicycling as more enjoyable. Given that perceived enjoyment is linked to engagement in physical activity, particularly for bicycling (Jones, 2005; Spinney, 2009; Van der Horst, Paw, Twisk, & Van Mechelen, 2007), it is useful to see that current riders' perceptions of enjoyment were not significantly reduced by the safety-focused campaign. This implies that campaigns to promote bicycle safety are unlikely to decrease people's perceived enjoyment of bicycling – further evidence against our earlier suggestion that such campaigns might 'dangerize' bicycling. Taking this further, it would be particularly interesting for future research to explore whether messages promoting enjoyment might be even more promising than health messages for encouraging bicycling uptake (with these campaigns, ideally, tied to a disruptive life event that forces travel mode reconsideration – Verplanken et al., 2008; Walker et al., 2015). The data here suggest that people currently bicycling do indeed perceive the activity as enjoyable, supporting the idea that focusing on enjoyment might be important for encouraging the activity. On the other hand, though, we might argue that people currently bicycling in a country like the UK are unrepresentative of most people, as they are able to find enjoyment when riding in an environment which, as noted earlier, is often designed and legislated more for the needs of the motorist than the bicyclist (Adams, 1995; Davis, 1993; Pucher & Buehler, 2008; Pucher & Dijkstra, 2003; Sheller & Urry, 2003; Teschke et al., 2012). It is possible that the enjoyment experienced by current bicyclists would not be shared by people new to the activity in such an environment, and efforts to promote bicycling through enjoyment-focused messages could potentially be undermined if people

were to try the activity only to find the experience subjectively unpleasant and far from what they were promised.

At the policy and practice level, the findings here suggest that bicycling campaigns ought in future to be viewed as very different things depending on whether they target current riders or potential riders, as the needs and likely reactions of these groups are so different. Subject to the earlier proviso that the benefits of bicycle safety aids are not established at the population level, it looks as though it might be possible to recommend these to a current rider without changing their immediate perceptions of how safe or enjoyable bicycling is (although it is not known how long-term exposure to repeated messages implying that one's transport mode is dangerous might affect people, nor how such messages might support a culture of shifting responsibility for bicyclists' safety from the motorists who create the risk to the bicyclists who receive it – Walker & Robinson, submitted). The non-rider, however, cannot have their bicycle journeys made any safer by using equipment, as those journeys do not currently exist. Promotion efforts for this (much larger) group therefore need to be about creating bicycle journeys in the first place. The data presented here suggest that for this group, a focus on the health benefits, or perhaps the enjoyment of bicycling, is a more promising avenue than introducing the topic of safety equipment, the topic of which at best has no effect at all on their perceptions.

This study had several strengths, not least the close comparability of its publicity materials and its randomized controlled nature. However, there were some methodological limitations that could be avoided in future research. First, as noted, the time interval between measuring baseline and post-manipulation bicycling perceptions and intentions was short (in the order of minutes). This could have affected the findings in two important ways. First, the participants could have become aware of the real purpose of the study when they saw the perception scales for the second time in succession, resulting in biased answers in the post-manipulation measures. Second, it could be that the short time interval did not allow for the information provided on the leaflet to be processed sufficiently to affect people's perceptions. It is known that, in some circumstances, the effect of new information cannot be observed in people straight away (Nabi, 1999; Stiff, 1986). For these reasons, future studies would benefit from including one or more follow-ups some time after the manipulation, as well as potentially repeating information provision to simulate the nature of a more concerted advertising campaign.

The second limitation we wish to highlight is that there was no assessment of whether participants understood the information provided on the leaflet. Therefore, we cannot rule out the idea that the participants did not read the information, or did not read it carefully enough. A certain level of systematic processing is needed for a message to produce any real change in cognitions (Van Assema, Martens, Ruiter, & Brug, 2001). This limitation is a particular concern given our study was conducted online where participants could not be monitored. On the other hand, our finding an effect on non-bicyclists' health perceptions even when participants' engagement with the materials might be imperfect means the effect should be the same or even larger in more propitious circumstances.

Third, we noted earlier that our participants might have been different 'types' of rider: we possibly had recreational riders, who pay more attention to safety, mixed with utility riders who are less concerned about this issue (Van Holle et al., 2012). Similarly, the broad age range of our participants (18 to 61) means we might have had people at different life stages with different motives

for, and influences on, their perceptions of bicycling. Arguably, such variety amongst our participants could have diluted the strength of any effect of the safety-related message in our data. In response to this suggestion we would note that campaigns from governments and special interest groups frequently broadcast a single message to an entire population. If our sample *did* contain a mixture of rider types and/or a mixture of people at different life stages, then this heterogeneity is perhaps desirable as a reflection of the broad range of people that would be targeted by any real bicycle-related campaign in the future.

Finally, there might be questions about the non-bicyclist group used here. As well as issues of the sample overall being self-selected, perfectly operationalizing the concept of 'non-bicyclist' is essentially impossible: the term could be defined as somebody who has never ridden a bicycle, somebody who does not identify with the label 'bicyclist', or somebody who has not used a bicycle for a certain length of time. All of these definitions can be faulted, but any researcher hoping to study the concept of non-bicyclists is forced to choose one definition for their study. It is possible that, had we chosen a different definition, our results would have been different, and it might have been preferable to collect data on all the possible definitions to test the effects of moving from one to another. But these concerns notwithstanding, the very strong differences seen in intentions to bicycle in the near future (Figure 5: $\lambda = .49$, $p < .001$) suggest that there might indeed be some validity to what we called bicyclists and non-bicyclists here.

5. Conclusions

A bicycling campaign poster that promoted the health benefits of bicycling increased non-bicyclists' perceptions of how healthy the activity was. There was no evidence of a safety-focused poster 'dangerizing' bicycling and making it feel less safe, at least over the sort of short time courses studied here. Neither the health nor the safety message had any influence on stated intentions to bicycle in the near future. These results suggest health-focused and safety-focused campaigns target separate constructs, rather than lying at opposite ends of a continuum, and that thereby the two could in principle co-exist. Finally, whilst bicycling's ease and convenience will likely be the prime determinants of future ridership levels, there are signs in this study that shifting the focus away from both health and safety towards messages about the enjoyment of bicycling might be useful in future cycling campaigns and interventions aimed at non-bicyclists. Promoting bicycling as enjoyable – ideally coupled with a legal and infrastructural framework to ensure it really is pleasant – might be the best approach for achieving long-term adherence to bicycling, and thereby benefiting public health and well-being.

References

Adams, J. (1995). *Risk.* London: Routledge.

Aldred, R. (2013). Incompetent or too competent? Negotiating everyday cycling identities in a motor dominated society. *Mobilities, 8*, 252-265.

Aldred, R. (2014). A matter of utility? Rationalising Cycling, Cycling Rationalities. *Mobilities,* doi:10.1080/17450101.2014.935149

Aldred, R., & Jungnickel, K. (2014). Why culture matters for transport policy: The case of cycling in the UK. *Journal of Transport Geography, 34*, 78-87.

Andersen, L. B., Schnohr, P., Schroll, M., & Hein, H. O. (2000). All-cause mortality associated with physical activity during leisure time, work, sports, and cycling to work. Archives of Internal Medicine, 160, 1621-1628.

Banks, S. M., Salovey, P., Greener, S., Rothman, A. J., Moyer, A., Beauvais, J., & Epel, E. (1995). The effects of message framing on mammography utilization. *Health Psychology, 14*, 178-84.

Basen-Engquist, K., & Parcel, G. S. (1992). Attitudes, norms, and self-efficacy: a model of adolescents' HIV-related sexual risk behavior. *Health Education Quarterly, 19*, 263-277.

BBC (2013). Cyclists on the dangers of motorists' punishment pass. Retrieved 7 April 2015 from http://www.bbc.co.uk/news/uk-scotland-24225932

Blair, S. N. (2009). Physical inactivity: the biggest public health problem of the 21st century. *British Journal of Sports Medicine, 43*, 1-2.

British Medical Association (1992). *Cycling: Towards Health and Safety*. Oxford, UK: Oxford University Press.

Cavill, N., & Davis, A. (2007). *Cycling and health: what's the evidence?* London: Cycling England.

Crawford, F., & Lovelace, R. (2015). *The Benefits of Getting England Cycling*. Retrieved 7 April 2015 from http://www.ctc.org.uk/sites/default/files/1501_fcrawford-rlovelace_economic-cycle-reformatted.pdf

Crocker, P. R., Bouffard, M., & Gessaroli, M. E. (1995). Measuring enjoyment in youth sport settings: A confirmatory factor analysis of the Physical Activity Enjoyment Scale. *Journal of Sport & Exercise Psychology, 17*, 200-205.

Curnow, W.J. (2005). The Cochrane Collaboration and bicycle helmets. Accident Analysis and Prevention, 37, 569-573.

Daley, M., & Rissel, C. (2011). Perspectives and images of cycling as a barrier or facilitator of cycling. *Transport Policy, 18*, 211-216.

Davis, R. (1993). *Death on the streets: cars and the mythology of road safety*. Hawes, North Yorkshire: Leading Edge.

De Hartog, J. J., Boogaard, H., Nijland, H., & Hoek, G. (2010). Do the health benefits of cycling outweigh the risks? *Environmental Health Perspectives, 118*, 1109-1113.

Department for Transport. (2013). *Walking and Cycling Statistics*. [Series]. Retrieved from: https://www.gov.uk/government/organisations/department-for-transport/series/walking-and-cycling-statistics

Dill, J., & McNeil, N. (2013). Four types of cyclists? *Journal of the Transportation Research Board, 2387*, 129-138.

Dishman, R. K., Motl, R. W., Sallis, J. F., Dunn, A. L., Birnbaum, A. S., Welk, G. J., Bedimo-Rung, A.L., Voorhees, C.C., & Jobe, J. B. (2005). Self-management strategies mediate self-efficacy and physical activity. *American Journal of Preventive Medicine, 29*, 10-18.

Elvik, R. (2013). Corrigendum to: "Publication bias and time-trend bias in meta-analysis of bicycle helmet efficacy: A re-analysis of Attewell, Glase and McFadden, 2001" [Accid. Anal. Prev. 43 (2011) 1245–1251]. *Accident Analysis and Prevention, 60*, 245-253.

Fraser, S. D., & Lock, K. (2011). Cycling for transport and public health: a systematic review of the effect of the environment on cycling. *The European Journal of Public Health, 21*, 738-743.

Fyhri, A., Bjørnskau, T., & Backer-Grøndahl, A. (2012). Bicycle helmets – A case of risk compensation? *Transportation Research Part F: Traffic Psychology and Behaviour, 15*, 612-624.

Fyhri, A., & Phillips, R.O. (2013). Emotional reactions to bicycle helmet use. *Accident Analysis and Prevention, 50*, 59-63.

Gatersleben, B., Murtagh, N., & White, E. (2013). Hoody, goody or buddy? How travel mode affects social perceptions in urban neighbourhoods. *Transportation Research Part F: Traffic Psychology and Behaviour, 21*, 219-230.

Goldacre, B., & Spiegelhalter, D. (2013). Bicycle helmets and the law. *BMJ*, 346:f3817.

Graham-Rowe, E., Skippon, S., Gardner, B., & Abraham, C. (2011). Can we reduce car use and, if so, how? A review of available evidence. *Transportation Research Part A: Policy and Practice, 45*, 401-418.

Grubbs, L., & Carter, J. (2002). The relationship of perceived benefits and barriers to reported exercise behaviors in college undergraduates. *Family & Community Health, 25*, 76-84.

Hagberg, L. A., Lindahl, B., Nyberg, L., & Hellénius, M. L. (2009). Importance of enjoyment when promoting physical exercise. *Scandinavian Journal of Medicine & Science in Sports, 19*, 740-747.

Hagel, B.E., & Pless, I.B. (2006). A critical examination of arguments against bicycle helmet use ad legislation. *Accident Analysis and Prevention, 38*, 277-278.

Harrison, J. (2001). Planning for more cycling: the York experience bucks the trend. *World Transport Policy & Practice, 7*, 21-7.

Harrison, J. A., Mullen, P. D., & Green, L. W. (1992). A meta-analysis of studies of the Health Belief Model. *Health Education Research, 7*, 107-116.

Horton, D. (2007). Fear of Cycling. In: D. Horton, P. Rosen, P. Cox (Eds), *Cycling and Society*. Hampshire, England: Ashgate. pp. 134–152.

Hu, Y., & Sundar, S. S. (2010). Effects of online health sources on credibility and behavioral intentions. *Communication Research, 37*, 105-132.

Jones, M. (1996). The relationship of perceived benefits of and barriers to reported exercise in older African American women. *Public Health Nursing, 13*, 151-158.

Jones, P. (2005). Performing the city: A body and a bicycle take on Birmingham, UK. *Social and Cultural Geography, 6*, 813-830.

Kendzierski, D., & DeCarlo, K. J. (1991). Physical Activity Enjoyment Scale: two validation studies. *Journal of Sport & Exercise Psychology, 13*, 50-64.

Künzli, N., Kaiser, R., Medina, S., Studnicka, M., Chanel, O., Filliger, P., Herry, M., Horack, F., Puybonnieux-Texier, V., Quenel, P., Schneider, J., Seethaler, R., Vergnaud, J.-C., & Sommer, H. (2000). Public-health impact of outdoor and traffic-related air pollution: a European assessment. *The Lancet, 356*, 795-801.

Motl, R. W., Dishman, R. K., Saunders, R. P., Dowda, M., Felton, G., Ward, D. S., & Pate, R. R. (2002). Examining social-cognitive determinants of intention and physical activity among black and white adolescent girls using structural equation modelling. *Health Psychology, 21*, 459.

Nabi, R. L. (1999). A cognitive- functional model for the effects of discrete negative emotions on information processing, attitude change, and recall. *Communication Theory, 9*, 292-320.

Oja, P., Titze, S., Bauman, A., De Geus, B., Krenn, P., Reger- Nash, B., & Kohlberger, T. (2011). Health benefits of cycling: a systematic review. *Scandinavian Journal of Medicine & Science in Sports, 21*, 496-509.

Olivier, J., & Walter, S.R. (2013). Bicycle helmet wearing is not associated with close motor vehicle passing: A re-analysis of Walker, 2007. *PLOS ONE, 8*, e75424. doi:10.1371/journal.pone.0075424

Pank, P. (2012). Potential cyclists 'too scared' to ride, says Transport Minister [Article]. *The Times.* Retrieved from: http://www.thetimes.co.uk/tto/public/cyclesafety/article3548232.ece

Petty, R. E., Cacioppo, J. T., & Schumann, D. (1983). Central and peripheral routes to advertising effectiveness: the moderating role of involvement. *Journal of Consumer Research, 10*, 135-144.

Plutchik, R. (2001). The Nature of Emotions: human emotions have deep evolutionary roots, a fact that may explain their complexity and provide tools for clinical practice. *American Scientist, 89*, 344-350.

Pucher, J., & Buehler, R. (2008). Making cycling irresistible: Lessons from The Netherlands, Denmark and Germany. *Transport Reviews, 28*, 495-528.

Pucher, J., & Dijkstra, L. (2003). Promoting safe walking and cycling to improve public health: lessons from the Netherlands and Germany. *American Journal of Public Health, 93*, 1509-1516.

Rattray, J., & Jones, M. C. (2005). Essential elements of questionnaire design and development. *Journal of Clinical Nursing, 16*, 234-243.

Ravenscroft, N. (2004). Tales from the tracks: discourses of constraint in the use of mixed cycle and walking routes. *International Review for the Sociology of Sport, 39*, 27-44.

Ravenscroft, N., Uzzell, D., & Leach, R. (2002). Danger ahead? The impact of fear of crime on people's recreational use of non-motorised shared-use routes. *Government & Policy, 20*, 741-756.

Rissel, C. (2012). The impact of compulsory cycle helmet legislation on cyclist head injuries in New South Wales, Australia: A rejoinder. *Accident Analysis and Prevention, 45*, 107-109.

Rissel, C., Campbell, F., Ashley, B., & Jackson, L. (2002). Driver road rule knowledge and attitudes towards cyclists. *Australian Journal of Primary Health, 8*, 66-69.

Robinson, D.L. (2007). Bicycle helmet legislation: Can we reach a consensus? *Accident Analysis and Prevention, 41*, 375-380.

Rojas-Rueda, D., de Nazelle, A., Tainio, M., & Nieuwenhuijsen, M. J. (2011). The health risks and benefits of cycling in urban environments compared with car use: health impact assessment study. *BMJ, 343*, 4521-4536.

Rosenstock, I. M. (1974). Historical origins of the health belief model. *Health Education Monographs, 2*, 328-335.

Ross, T. P., Ross, L. T., Rahman, A., & Cataldo, S. (2010). The bicycle helmet attitudes scale: using the health belief model to predict helmet use among undergraduates. *Journal of American College Health, 59*, 29-36.

Rothman, A. J., & Salovey, P. (1997). Shaping perceptions to motivate healthy behavior: the role of message framing. *Psychological Bulletin, 121*, 3-19.

Rothman, A. J., Salovey, P., Antone, C., Keough, K., & Martin, C. D. (1993). The influence of message framing on intentions to perform health behaviors. *Journal of Experimental Social Psychology, 29*, 408-433.

Sanders, R.L. (2015). Perceived traffic risks for cyclists: The impact of near miss and collision experiences. *Accident Analysis and Prevention, 75*, 26-34.

Sarafino, E. P., & Smith, T. W. (2011). *Health psychology: biopsychosocial interactions (7th ed.).* USA: John Wiley & Sons, Inc.

ScienceDaily. (2013). A Stigma too far? Research looks at how cyclists are perceived in a car-dominated society [Online Article]. Retrieved from: http://www.sciencedaily.com /releases/2013/06/130618113721.htm

Sechrist, K. R., Walker, S. N., & Pender, N. J. (1987). Development and psychometric evaluation of the exercise benefits/barriers scale. *Research in Nursing & Health, 10*, 357-365.

Sedigheh, S. T., Hasani, L., Aghamolaei, T., Zare, S., & Gregory, D. (2009). Prediction of breast self-examination in a sample of Iranian women: an application of the Health Belief Model. *BMC Women's Health, 9*, 1-7.

Sheller, M., & Urry, J. (2003). The City and the Car, in A. Root (Ed.), *Delivering Sustainable Transport: A Social Science Perspective.* Oxford: Elsevier. pp.171-89.

Spinney, J. (2009). Cycling in the city: Movement, meaning and method. *Geography Compass, 3*, 817-835.

Steg, L. (2005). Car use: Lust and Must. Instrumental, symbolic and affective motives for car use. *Transportation Research Part A: Policy and Practice, 39*, 147-162.

Stiff, J. B. (1986). Cognitive processing of persuasive message cues: a meta analytic review of the effects of supporting information on attitudes. *Communication Monographs, 53*, 75-89.

Tenkorang, E. Y. (2013). Myths and misconceptions about HIV transmission in Ghana: what are the drivers? *Culture, Health & Sexuality, 15*, 296-310.

Teschke, K., Reynolds, C. C., Riesc, F. J., Gouge, B., & Winters, M. (2012). Bicycling: health risk or benefit*? UBCMJ, 3*, 6-11.

Thomas, G., Walker, I., & Musselwhite, C. (2014). Grounded Theory analysis of commuters discussing a workplace carbon-reduction target: Autonomy, satisfaction, and willingness to change behaviour in drivers, pedestrians, bicyclists, motorcyclists, and bus users. *Transportation Research Part F: Traffic Psychology and Behaviour, 26*, 72-81.

Thornton, A., Evans, L., Bunt, K., Simon, A., King, S., & Webster, T. (2011). *Climate Change and Transport Choices: Segmentation model – A framework for Reducing CO2 Emissions from Personal Travel*. Department for Transport report retrieved 7 April 2015 from https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/49971/climate-change-transport-choices-full.pdf

Umeh, K., & Jones, L. (2010). Mutually dependent health beliefs associated with breast self-examination in British female university students. *Journal of American College Health, 59*, 126-131.

Van Assema P., Martens, M., Ruiter, R. A., & Brug, J. (2001). Framing of nutrition education messages in persuading consumers of the advantages of a healthy diet. *Journal of Human Nutrition & Dietetics, 14*, 435-42.

Van der Horst, K., Paw, M. J. C. A., Twisk, J. W., & Van Mechelen, W. (2007). A brief review on correlates of physical activity and sedentariness in youth. *Medicine and science in Sports and Exercise, 39*, 1241-1255.

Van Holle, V., Deforche, B., Van Cauwenberg, J., Goubert, L., Maes, L., Van der Weghe, N., De Bourdeeaudhuij, I. (2012). Relationship between the physical environment and different domains of physical activity in European adults: a systematic review. *BMC Public Health, 12*:807

Verplanken, B., Walker, I., Davis, A., & Jurasek, M. (2008). Context change and travel mode choice: Combining the habit discontinuity and self-activation hypotheses. *Journal of Environmental Psychology, 28*, 121-127.

Walker, I. (2007). Drivers overtaking bicyclists: objective data on the effects of riding position, helmet use, vehicle type and apparent gender. *Accident Analysis and Prevention, 39*, 417-425.

Walker, I., Garrard, I., & Jowitt, F. (2014). The influence of a bicycle commuter's appearance on drivers' overtaking proximities: An on-road test of bicyclist stereotypes, high-visibility clothing and safety aids in the United Kingdom. *Accident Analysis and Prevention, 64*, 69-77.

Walker, I., Thomas, G.O., & Verplanken, B. (2015). Old habits die hard: Travel habit formation and decay during an office relocation. *Environment & Behavior*. Published online before print September 15, 2014, doi:10.1177/0013916514549619

Walsh, E., & Lehane, E. (2011). An exploration of the relationship between adherence with dietary sodium restrictions and health beliefs regarding these restrictions in Irish patients receiving haemodialysis for end- stage renal disease. *Journal of Clinical Nursing, 20*, 331-340.

Winters, M., Davidson, G., Kao, D., & Teschke, K. (2011). Motivators and deterrents of bicycling: Comparing influences on decisions to ride. *Transportation, 38*, 153-168.

Woodcock, J., Edwards, P., Tonne, C., Armstrong, B. G., Ashiru, O., Banister, D., & Roberts, I. (2009). Public health benefits of strategies to reduce greenhouse-gas emissions: urban land transport. *The Lancet, 374*, 1930-1943.

Woodcock, J., Tainio, M., Cheshire, J., O'Brien, O., & Goodman, A. (2014). Health effects of the London bicycle sharing system: health impact modelling study. *BMJ, 348*:g425.

Zighaimat, F., Ebadi, A., Karimi-Zarchi, A. A., Moradi, N., Hajiamini, Z., & Mehdizadeh, S. (2010). The effect of education based on health belief model on dietary behavior of Coronary Artery Bypass Graft patients. *Iran Journal of Nursing, 23*, 50-60.

Appendix: Bicycling perceptions and intentions scale

Note that the 21 risk, benefits and enjoyment items below were presented to each person mixed together in random order.

Perceived risk

1. I believe that there is a high risk of being injured by motor vehicles when cycling.
2. I believe that cyclists are at greater risk of being injured on the street, as compared to pedestrians and motorcyclists.
3. Generally speaking, I am afraid of cycling on the road.
4. Generally speaking, I believe that cycling on the street is dangerous.
5. I believe that a cycling accident could result in life-threatening injuries.
6. Generally speaking, I believe that cycling on the street is safe.*
7. I believe that there is a slim chance of getting hurt while riding a bike.*

Perceived health benefits

1. I believe that cycling improves mental health.
2. I believe that cycling can help prevent heart attacks.
3. I believe that cycling can help prevent high blood pressure.
4. I believe that cycling increases levels of physical fitness.
5. I believe that cycling increases longevity.
6. I believe that cycling improves overall body functioning.
7. I believe that cycling improves the way your body looks.

Perceived enjoyment

1. I believe that cycling is fun.
2. I believe that cycling is a relaxing activity.
3. I believe that cycling is energizing.
4. I believe that cycling is pleasurable.
5. I believe that cycling is boring.*
6. I believe that cycling is refreshing.
7. I believe that cycling is depressing.*

* = reversed

Bicycling Intentions

1. I want to cycle in the nearest future.
2. I actually intend to cycle in the nearest future.