Developing approaches to engage people in air pollution: What works and what doesn't?

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#### Supervised by:

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#### In collaboration with:

Andrew Grieve, Consultant, Kings College London Dr Gary Fuller, Environmental Research Group, Kings College London

- 1. Motivations for the project: Why do we need to engage the public in air pollution and encourage behaviour change?
- 2. Evidence and theory: What does the evidence tell us about how we should communicate air pollution to engage people? What can we learn from behaviour change theory?
- 3. Developing *Airwaze*: How has this evidence and theory informed the development of our app?
- 4. Future plans: What's next for the development and evaluation of Airwaze?

Woodcock et al 2009 Rojas-Rueda et al 2013











Future plans

What does the evidence tell us about how we should communicate air pollution to engage people and change their behaviours?

#### Systematic Literature Review

#### **Search Terms**

(Soci\* OR public\*OR citizen\* OR resident\* OR city OR cities OR smart cit\*)

(behav\*)

(awareness OR communicat\* OR engage\* OR participation OR perception\* OR intervention\*)

("air pollut\*" OR "air quality")



What does the evidence tell us about how we should communicate air pollution to engage people and change their behaviours?

Systematic Literature Review : findings

- 43 studies
- 25 types of behaviours
  - 1) avoidance, 2) contributing,
  - 3) supportive, 4) protective
- 22 found evidence of change
- Alerts/ advisories during high pollution episodes
- Reduce outdoor activity

#### **Current communication**

General & unspecific

Meaningless to people

Lack of harmonisation

Channels - inaccessible

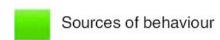
**Alarmist** 

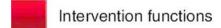
Risk of adverse consequences

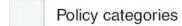
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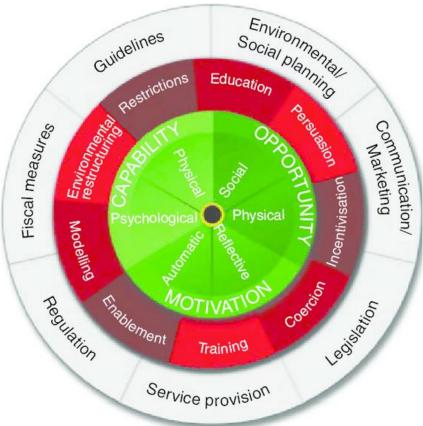
#### Systematic Literature Review: Recommendations

- 1. Personalised
- 2. Targeted
- 3. Local hotspots and pollution sources
- 4. Complexity (not too simple)
- 5. Range of actions
- 6. Supportive behaviours
- 7. Positive outcomes and co-benefits (health, environment, social, financial)
- 8. Context and relatability
- 9. Beyond data
- 10. Interdisciplinary collaboration









Michie et al 2013

#### What can we learn from behaviour change theory?

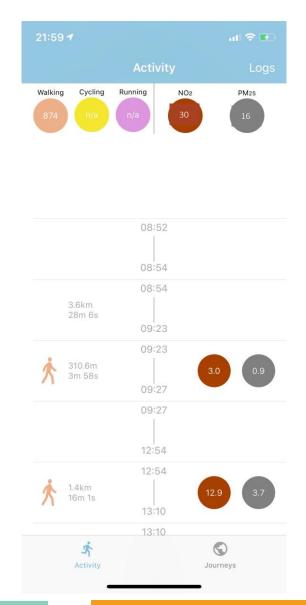
Page	Grouping and BCTs	Page	Grouping and BCTs	Page	Grouping and BCTs
1	1. Goals and planning	8	6. Comparison of behaviour	16	12. Antecedents
	1.1. Goal setting (behavior) 1.2. Problem solving 1.3. Goal setting (outcome) 1.4. Action planning 1.5. Review behavior goal(s) 1.6. Discrepancy between current		6.1. Demonstration of the behavior     6.2. Social comparison     6.3. Information about others' approval		12.1. Restructuring the physical environment 12.2. Restructuring the social environment 12.3. Avoidance/reducing exposure to cues for the behavior
	behavior and goal 1.7. Review outcome goal(s) 1.8. Behavioral contract 1.9. Commitment	9	7. Associations 7.1. Prompts/cues 7.2. Cue signalling reward 7.3. Reduce prompts/cues 7.4. Remove access to the		12.4. Distraction 12.5. Adding objects to the environment 12.6. Body changes
3	Feedback and monitoring     Seedback and monitoring     Seedback of behavior by others without feedback     Feedback on behaviour     Self-monitoring of behaviour	10	reward 7.5. Remove aversive stimulus 7.6. Satiation 7.7. Exposure 7.8. Associative learning 8. Repetition and substitution	17	13. Identity  13.1. Identification of self as role model  13.2. Framing/reframing  13.3. Incompatible beliefs  13.4. Valued self-identify  13.5. Identity associated with changed
	2.4. Self-monitoring of outcome(s) of behaviour		8.1. Behavioral practice/rehearsal		behavior
5	2.5. Monitoring of outcome(s) of behavior without feedback 2.6. Biofeedback 2.7. Feedback on outcome(s) of behavior  3. Social support		8.2. Behavior substitution 8.3. Habit formation 8.4. Habit reversal 8.5. Overcorrection 8.6. Generalisation of target behavior 8.7. Graded tasks	18	14. Scheduled consequences 14.1. Behavior cost 14.2. Punishment 14.3. Remove reward 14.4. Reward approximation 14.5. Rewarding completion 14.6. Situation-specific reward 14.7. Reward incompatible behavior
	3.1. Social support (unspecified) 3.2. Social support (practical) 3.3. Social support (emotional)	11	9. Comparison of outcomes 9.1. Credible source 9.2. Pros and cons		14.8. Reward alternative behavior 14.9. Reduce reward frequency 14.10. Remove punishment
6	4. Shaping knowledge 4.1. Instruction on how to		9.3. Comparative imagining of future outcomes	19	15. Self-belief 15.1. Verbal persuasion about
	perform the behavior 4.2. Information about Antecedents 4.3. Re-attribution 4.4. Behavioral experiments	12	10. Reward and threat 10.1. Material incentive (behavior) 10.2. Material reward (behavior) 10.3. Non-specific reward 10.4. Social reward 10.5. Social incentive		capability 15.2. Mental rehearsal of successful performance 15.3. Focus on past success 15.4. Self-talk
7	5. Natural consequences	1	10.6. Non-specific incentive	19	16. Covert learning
	5.1. Information about health consequences     5.2. Salience of consequences     5.3. Information about social and environmental consequences     5.4. Monitoring of emotional		10.7. Self-incentive 10.8. Incentive (outcome) 10.9. Self-reward 10.10. Reward (outcome) 10.11. Future punishment		16.1. Imaginary punishment 16.2. Imaginary reward 16.3. Vicarious consequences
	consequences 5.5. Anticipated regret 5.6. Information about emotional consequences	15	11. Regulation 11.1. Pharmacological support 11.2. Reduce negative emotions 11.3. Conserving mental resources 11.4. Paradoxical instructions		

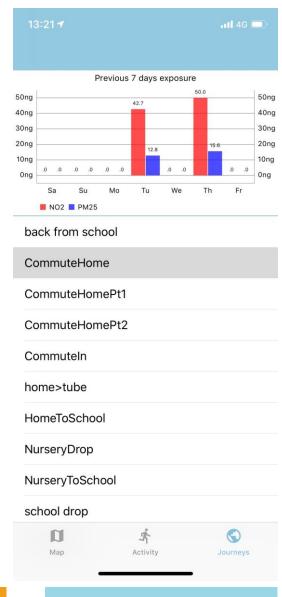
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- 1. To engage users in air pollution
- 2. To encourage active travel
- To reduce exposure during active travel





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- 2. Targeted
- 3. Range of actions
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- 6. Positive outcomes and co-benefits (health, environment, social etc)
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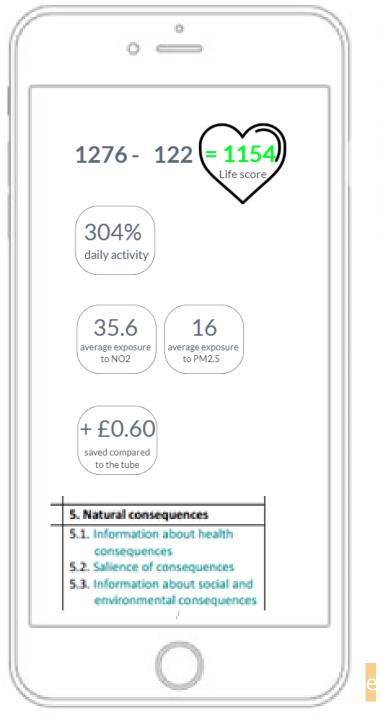
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4		-	10.5. Social incentive	<u> </u>	
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	consequences		10.8. Incentive (outcome)	1	16.2. Imagina ward
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	5.3. Information about social and	<u> </u>	10.10. Reward (outcome)		
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	5.6. Information about emotional	1	11.2. Reduce negative emotions	1	
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	consequences		11.3. Conserving mental resources		

Your life score.
We take into account the physical activity you've done and the air pollution you've breathed in Your daily physical activity target.
It is set at 30minutes

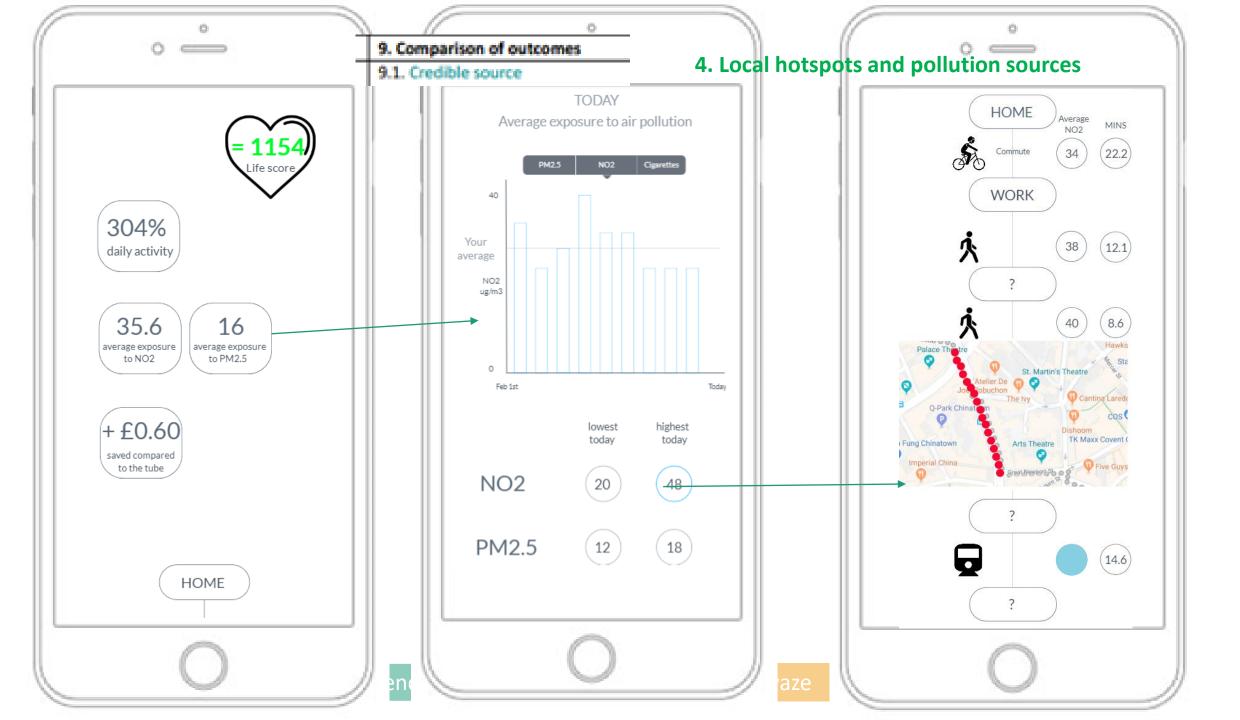
Your average exposure to air pollution during the trips you've walked, cycled and ran today

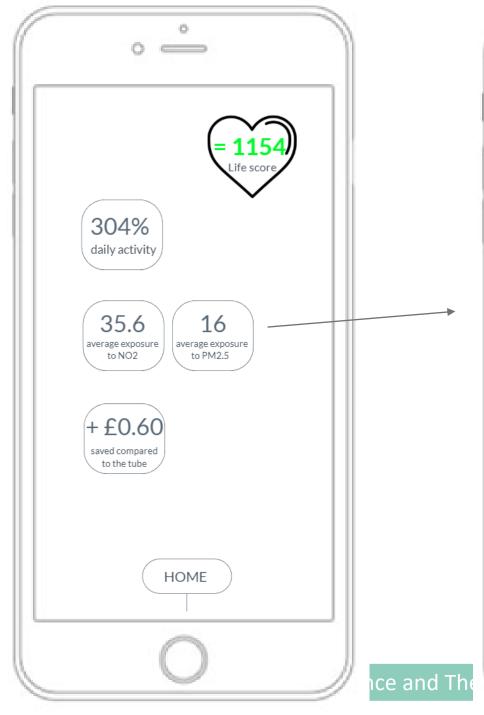
Personal financial savings compared to the tube for journeys walked

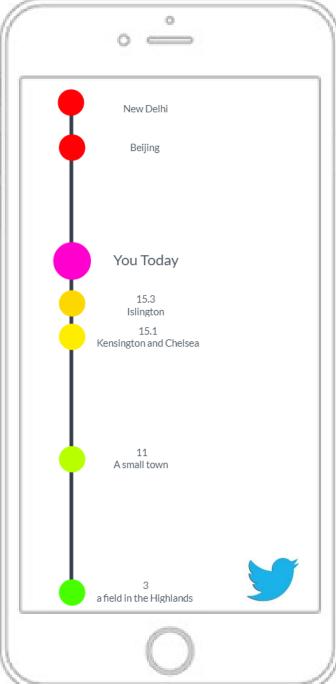
6. Positive outcomes and co-benefits (health, environment, social etc)











- 7. Supportive behaviours
- 8. Context and relatability

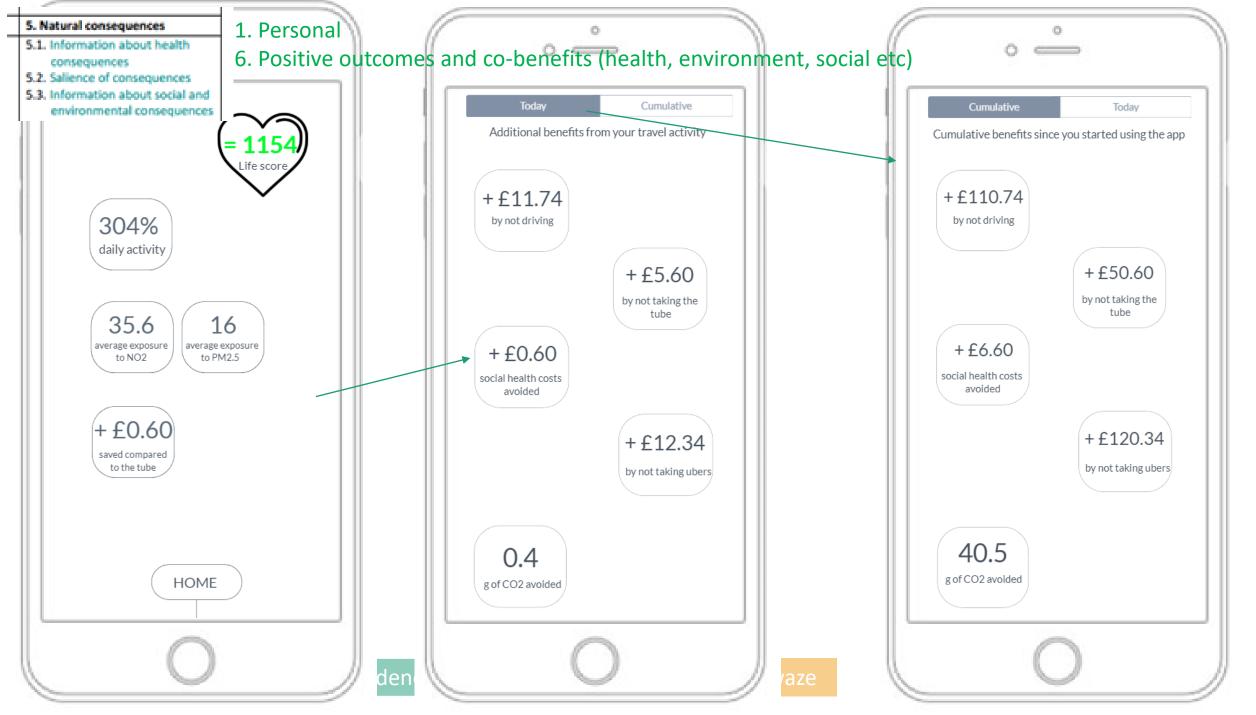
#### 6. Comparison of behaviour

- 6.1. Demonstration of the behavior
- 6.2. Social comparison

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#### 3. Social support

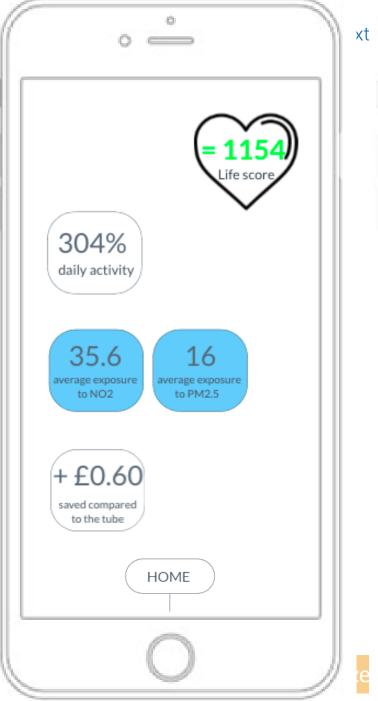
- 3.1. Social support (unspecified)
- 3.2. Social support (practical)
- 3.3. Social support (emotional)



Future plans: What's next for the development and evaluation of *Airwaze*?

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- 2. Targeted
- 3. Range of actions
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- 5. Complexity (not too simple)
- 6. Positive outcomes and co-benefits (health, environment, social etc)
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- 9. Beyond data
- 10. Interdisciplinary collaboration

Page	Grouping and BCTs	Page	Grouping and BCTs	age	Grouping and BCTs
	1. Goals and planning	8	6. Comparison of behaviour	16	12. Antec lents
	1.1. Goal setting (behavior)		6.1. Demonstration of the		12.1. Restructing the physical
	1.2. Problem solving		hobavier		envi ame.
	1.3. Goal setting (outcome)		6.2. Social comparison		12.2. Rexructuring the social
	1.4. Action planning		6.3. Information about others'	4	environment
	1.5. Review behavior goal(s)		approval		12.3. Avoidance/reducing exposure to
	1.6. Discrepancy between current		аррготаг		cues for the behavior
	behavior and goal	9	7. Associations	┪	12.4. Distraction
	1.7. Review outcome goal(s)	9	7.1 Prompts/cues	4	12.5. Adding objects to the
	1.8. Behavioral contract				environment
	1.9. Commitment		7.2. Cue signalling reward		12.6. Body changes
	1.5. Communent		7.3. Reduce prompts/cues		12.6. Body Changes
_			7.4. Remove access to the		42.11
3	2. Feedback and monitoring		reward	17	13. Ident
	2.1. Monitoring of behavior		7.5. Remove aversive stimulus		13.1. Identification of self as role
	by others without		7.6. Satiation		mode
	feedback		7.7. Exposure		13.2. Framing/reframing
	2.2. Feedback of ehaviour		7.8. Associative learning		13.3. Incompatible beliefs
	2.3. Self-moz ring of				13.4. Valued self-identify
	behav	10	8. Repetition and substitution		13.5. Identity associated with change
	2.4. Self nitoring of		8.1. Behavioral	┪	behavior
	me(s) of behaviour		proctice/reheasal		
	2.5. nitoring of outcome(s)		8.2. Behaver sy stitution	18	14. Scheduled consequences
	or behavior without		8.3. Habit for ation		14.1. Behavior
	feedback		8.4. Habit evers		14.1. Beliavi 10
	2.6. Biofeedback		8.5. Overcorrection		14.3. Remo rewa
	2.7. Feedback on outcome(s)		8.6. Generalisation of target		14.4. Reward approximation
	of behavior		behavior		14.5. Rewarding completion
			8.7. Graded tasks		14.6. Situation-specific reward
-	3. Social support		8.7. Graded tasks		14.7. Reward incompatible behavior
,	3.1. Social support (unspecified)			-	14.7. Reward incompatible behavior
		11	9. Comparison of outcomes	_	
	3.2. Social W /rt (practical)		9.1. Credible urce		14.9. Reduce reward frequency
	3.3. Social suport (emotional)		9.2. Pro cons		14.10. Remove punishment
			9.3. Comparative imagining of		
6	4. Shaping knowledge		future outcomes	19	15. Self-belief
	4.1. Instruction or low to			_	15.1. Ve al persuz on about
	perform t behavior	12	10. Reward and threat		capab
	4.2. Information about		10.1. Ma vial increave (behavior)	7	15.2. Mental covarsal of successful
	4.2. Information about		10.2. Materix ward (behavior)		per armance
	4.3. Re ibution		10.3. Non- con reward		15.3. Focus on past success
	4.4. Behavioral experiments		10.4. So, al reward		15.4. Self-talk
		_	10.5. Social incentive		
7	5. Natural consequences		10.6. Non-specific incentive	19	16. Covert learning
	5.1. Information about health		10.7. Self-incentive		16.1. Imax ary pur riment
	consequences		10.8. Incentive (outcome)		16.2. Imagina ward
	5.2. Salience of consequences		10.9. Self-reward		16.3. Vicario 3 co sequences
	5.3. Information about social and		10.10. Reward (outcome)		
	environmental consequences		10.11. Future punishment		<b>,</b> • • • • • • • • • • • • • • • • • • •
	5.4. Monitoring of emo? (al		20.22. I dedice pullishment		
	consequences	45	44 Baratatar	$\dashv$	
	5.5. Anticipated regre	15	11. Regulation	4	
	5.6. Information about emotional		11.1. Pharmacological support		
			11.2. Reduce negative emotions		
	consequences		11.3. Conserving mental resources		
			11.4. Paradoxical instructions		



**HOME** 34 4.2 **WORK** 38 (1.2) 40 0.6 ? 2.6 32 0.2 **WORK** 4.2 Commute **HOME** 

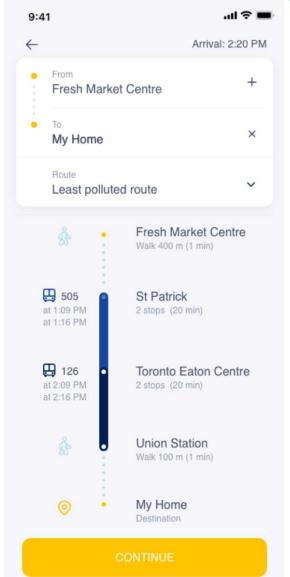
Motivations

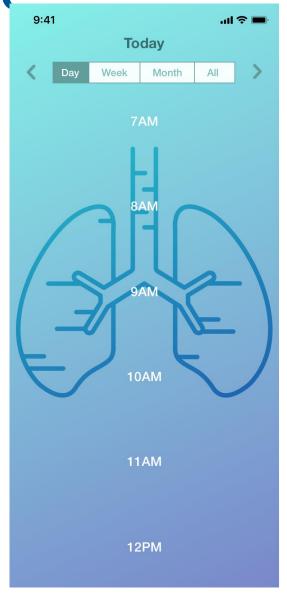
Evidence

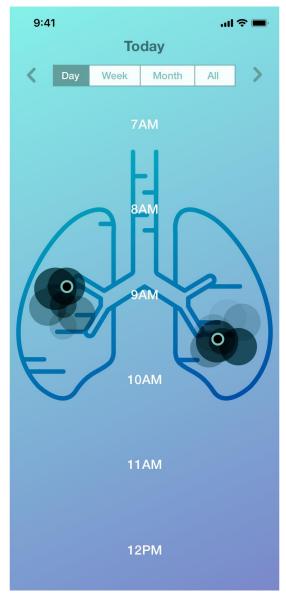
waze?

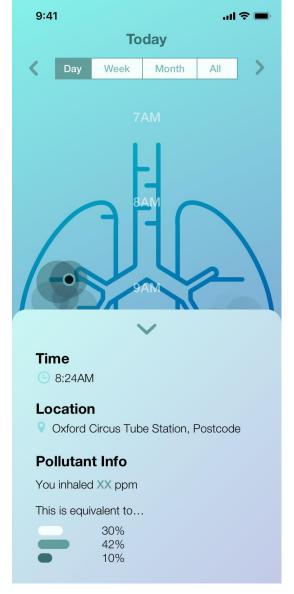
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Future plans: What's next for the development and evaluation of Airwaze?









#### Summary

- 1. Motivations for the project: Why do we need to engage the public in air pollution and encourage behaviour change?
- 2. Evidence and theory: What does the evidence tell us about how we should communicate air pollution to engage people? What can we learn from behaviour change theory?
- 3. Developing *Airwaze*: How has this evidence and theory informed the development of our app?
- 4. Future plans: What's next for the development and evaluation of Airwaze?

Future plans: What's next for the development and evaluation of *Airwaze*?

## hubbub



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• Woodcock et al. (2009), Public health benefits of strategies to reduce greenhouse-gas emissions: urban land transport, Lancet 374:1930e43.

Motivations for the project: Why do we need to engage the public in air pollution and encourage behaviour change?

Witte 1994

Severity
Susceptibility
Self-efficacy
Response efficacy

'Air pollution isn't really a problem anyway..'

'Sure, air pollution affects some people but my own health isn't affected'

'there's nothing I can do to reduce my exposure to air pollution or improve the air around me'

'Even if I did reduce the amount I drive it won't make a difference'

D'Antoni et al 2017; Bickerstaff 2004; Bickerstaff and Walker 2002