DETERMINANTS OF CONFIDENCE IN AUTOMATED CARS AND TRAINS

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TfL/UCL

[redacted]

Academic project conducted by UCL of interest to TfL

Research objectives outlined in briefing document

1. Explore customers feeling about automated cars and trains
2. Understand degree of trust (defined as safety, reliability and security) in automated cars and trains
3. Explore related concerns that undermine trust in automated trains
4. Identify specific factors that would address concerns

Sample structure

4 x extended (120 Minute) discussion groups

	London (Viewed)		London (Non-Viewed)	
Technology Attitude	Pioneers	Followers	Pioneers	Followers
Age	Under 40	Over 40	Over 40	Over 40
Date	18th July	18th July	20th July	20th July

- All BC1C2
- Mix of genders
- All use London Underground
- Spread of lines across the sample

Overview of Key Insights

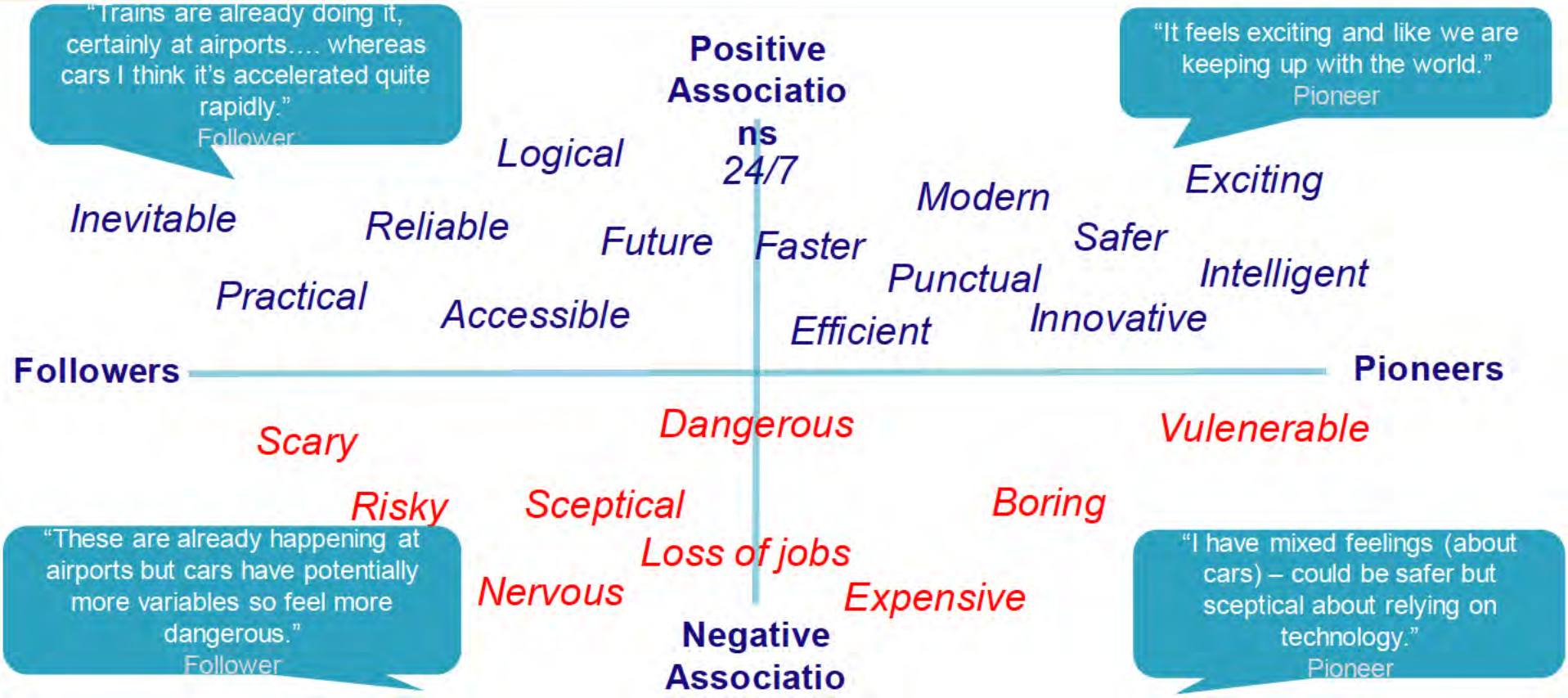
Key Insights

1	Automated vehicles are becoming more mainstream; definitely seen as part of the short term future for road and rail
2	Distinct difference in response to automated cars and automated trains. Less confidence in automated cars than automated trains
3	DLR is a strong point of reference for automated trains for London Underground users
4	Focus for users of London Underground is about getting from A-B safely, quickly and reliably – they pay limited attention to how that is fulfilled
5	Even the most confident feel more comfortable on an automated sub surface vs. automated tube train
6	Biggest concerns relate to lack of human presence – virtual voice/reassurance can overcome fears
7	Provision of relevant and evidence based information increases acceptability of unattended automated tube trains

Ki1

Automated vehicles are becoming more mainstream; definitely seen as part of the short term future for road and rail

Across 'Follower' and 'Pioneer' types, there is an understanding and acceptance that automated vehicles are the future



Customers using ‘driverless’ terminology and relate it to DLR and automated cars

“Innovative…***Driverless***, is that a word?”
Pioneer

“***Driverless*** cars is just a cheaper version to a taxi?”
Follower

“That’s not a bad point actually, because if it’s ***driverless*** then yeah why can’t they run 24 hours.”
Pioneer

“Its quite normal. The DLR is automated. The DLR has always been ***driverless***?”
Follower

“I think just like this gentleman said, if it was all ***driverless*** cars on one road then I don't think I'd have a problem with it. But it's a mixture of both and the unpredictability of humans that would worry me.”
Pioneer

“I know that Google and other companies are trialling completely ***driverless*** cars, but other car companies out there are all in it. I've already mentioned the parking.”
Follower

Ki2

Distinct difference in response to automated cars and automated trains with less confidence in automated cars than automated trains

‘Pioneers’ marginally more informed about automated cars than ‘Followers’

	London (Viewed)		London (Non-Viewed)	
Group Type	***Pioneers***	***Followers***	***Pioneers***	***Followers***
2.A.1 – To what extent would you consider yourself well informed…..	**5.1**	**4.4**	**3.5**	**3.3**

Sources of Information

- National press
- Top Gear
- Personal experience e.g. new BMW driverless parking, Mitsubishi Advent sensor cruise control
- Publicity of Google driverless car

“I've seen the car where it parks it for you and all that; it's brilliant if it parks it for you.”
Pioneer

“Just because is it the Telstra car that's around at the moment and someone got killed last week.”
Pioneer

“They're testing them already in Sweden, America. I think they're planning on testing them on British roads by 2020 I've read somewhere.”
Pioneer

Less confidence and trust in automated cars vs. trains

Safety is the critical variable that drives the low scores

	London (Viewed)		London (Non-Viewed)	
Group Type	*Pioneers*	*Followers*	*Pioneers*	*Followers*
2.A.2 – To what extent would you feel confidence in the safety, reliability, security…..	**5.0 (7.4)**	**4.0 (5.9)**	**4.6 (4.6)**	**3.8 (7.8)**

* Confidence in train

Reliability
- Not a concern
- Traffic may be more efficient if all cars were automated

Security
- Mild concern
- Potential for someone to hack into driverless software
- Likelihood low

Safety
- Major concern
- Multiple variables

"The 3 combined, it's slightly awkward. I don't think there is any reason to think that reliability and security, in fact they're going to be really good with an automated car because a computer is obviously going to be great for reliability and security and it's bringing up the safety mark which I would have thought would be a bit lower."
Follower

"Immediately when I think about the first thought was panic because I was thinking when you're driving, at least you are in control somehow. For example you know what's going to happen ahead of you in the road."
Follower

"Yeah I'd say a lot more positive on the trains than cars…because the automated trains, the DLR, touch wood, there's never been any problems with."
Pioneer

"I thought safety came to mind first and safety for trains I thought was feasible and had already been done and safety for cars I wasn't so keen on."
Follower

"I think train would be an easier transition from driver to driverless than car."
Follower

"I just think it's risky. I can understand with trains because it's on a track but there's so much like….I can understand it on a motorway."
Pioneer

"No I don't like it at all. I think we're getting big, fat and lazy, this country is. Everyone's walking about on the phones like this."
Pioneer

Multiple variables associated with cars elevates degree of risk and dislike

Practical, emotional and financial concerns emerge relating to

Practical	Emotional	Financial
Ease of use Potential for software error Mix of auto/non-auto vehicles Pedestrians Complexity of roads/traffic Temporary roadworks/lane closures Negotiating bikes/motorbikes	Risk of collision Fear of other driver behaviour Can't replicate human instinct Technology taking over Laziness Relinquishing control behind the wheel Boring	Cost of vehicles Cost of updating software Insurance claims

"There's lots more variables to take into consideration whereas a train runs on a track."
Follower

"It is already happening but for cars. I just think there's too many variables for cars."
Follower

"The boredom of sitting in a 30mph robot."
Pioneer

"I don't actually like the idea, I think it could be very dangerous."
Pioneer

"It's a silly idea – safety being the factor."
Pioneer

Some positives identified which could make automated cars appealing in the future for motorway driving

Allows me to do other things

Gives me gift of time

Sleep
Read
Work
Meeting with colleagues

"I put productive on my thing because you can do other things while you're not driving. Not just saying on the phone, but I'm just saying you might be able to do a bit of work"
Pioneer

Increase safety

Eliminates human error

Bad drivers
Reduces number of cars
No speeding
Operate within law

"If you had 1,000 of them and if they're all one road and they're all obeying the speed limit, that would be a really good thing because what's crazy not only is the amount of traffic, it's the way everyone drives"
Follower

Increases accessibility

Enables people to drive

Elderly
Disabled
Blind

"I put people who might otherwise not be able to drive like elderly or disabled, can get out and about"
Pioneer

Ki3

DLR is a strong point of reference for automated trains for London Underground users

Generally people feel more informed about automated trains vs. automated cars – more direct experience and greater visibility

	London (Viewed)		London (Non-Viewed)	
Group Type	***Pioneers***	***Followers***	***Pioneers***	***Followers***
2.B.1 – To what extent would you consider yourself well informed about automated trains	**5.4 (5.1)**	**5.0 (4.4)**	**4.8 (3.5)**	**5.0 (3.3)**

* Informed about automated cars

Sources of Information

- Automated trains are part of the transport system
- Other London trains e.g. DLR, Heathrow, Airport terminals
- International experience e.g. Japan, Berlin, Prague

"Just that I've been on one like the DLR. What's the Heathrow one as well?"
Pioneer

"I think because I've travelled a lot and it's already in a lot of cities like Tokyo and Dubai, the big major cities so I've seen it already so I'm quite comfortable."
Pioneer

"Yeah it might be Gatwick yeah but they haven't got drivers either. Yeah just been on them, and they seem to work so efficiently, had no problems. Seems a lot more simpler task to get them all running in sync.?"
Pioneer

High degree of comfort with the DLR

Most understand that DLR are 'driverless' but have a member of staff on board

Attended automated trains	Starting and stopping are automated but a train attendant operates the doors and drives the train in case of emergencies	
Unattended or "fully" automated trains	Starting and stopping, operation of doors and handling of emergencies are fully automated. No train staff are on board. Mobile and control centre staff respond in case of emergencies	

Attended automated trains *(DLR) seen to be efficient, safe and exciting and offer benefits of increased reliability and improved service with reassurance of having a staff member of staff on board – visible presence, sense of authority, uniform*

"Automated trains….its quite normal. The DLR is automated. The DLR has always been driverless."
Follower

"I think the DLR in Stratford, that's automated; I don't particularly have a problem with it. I think because I always seem to be travelling rush hour so I don't think of it."
Pioneer

"Every time I've been on the DLR, I've never had an issue. But the safety thing that's always a buffer is you know that it's a guard/driver as well."
Pioneer

"I think it's already started with DLR but I think apart from the DLR, I think it's happened elsewhere but I don't know ."
Pioneer

"Just because I think the only train that I know that drives itself is the DLR. I don't really know any other one that does, but I don't feel unsafe when I'm on it."
Follower

No issues with reliability. Safety becomes less of a concern vs cars but security is more of a concern

	London (Viewed)		London (Non-Viewed)	
Group Type	***Pioneers***	***Followers***	***Pioneers***	***Followers***
2.B.2 – To what extent would you feel confidence in the safety, reliability and security of an *unattended automated train*	**7.4**	**5.9**	**4.6**	**7.8**

Reliability

- Not a concern
- Unattended automated likely to increase reliability
- Not reliant on ANY staff
- Improve efficiency and timetable

Security

- Moderate concern
- London Underground is an obvious target
- Not sure whether unattended automated makes this more or less risky

Safety

- Moderate concern
- Less of a concern that with cars
- One track system
- Immediate response to people falling/jumping under trains

Respond to unattended automated trains on two levels

Negative emotional response initially occurs with fully unattended automated trains

Primary response
is highly emotional and cautious

What if the train breaks down in the tunnel?
What if there is anti social behaviour on the train?
What if I'm under threat?
What if there is a terrorist attack?

Concerns:
Fear
Being abandoned
Being alone
Without guidance

Secondary response
is more logical, considered and positive

What do the train drivers do in these cases anyway?
Drivers don't get actually get out of their cabin
Reassure via intercom
Radio ahead for help
Would help evacuate in emergency

Benefits:
Safer
Increased efficiency
Increased reliability/delays
They move on tracks
Not reliant on train staff
Reduce strikes
24/7 service
Modern service/London image
Airy and spacious

"We've already talked about reduce the amount of accidents which are caused by human error."
Follower

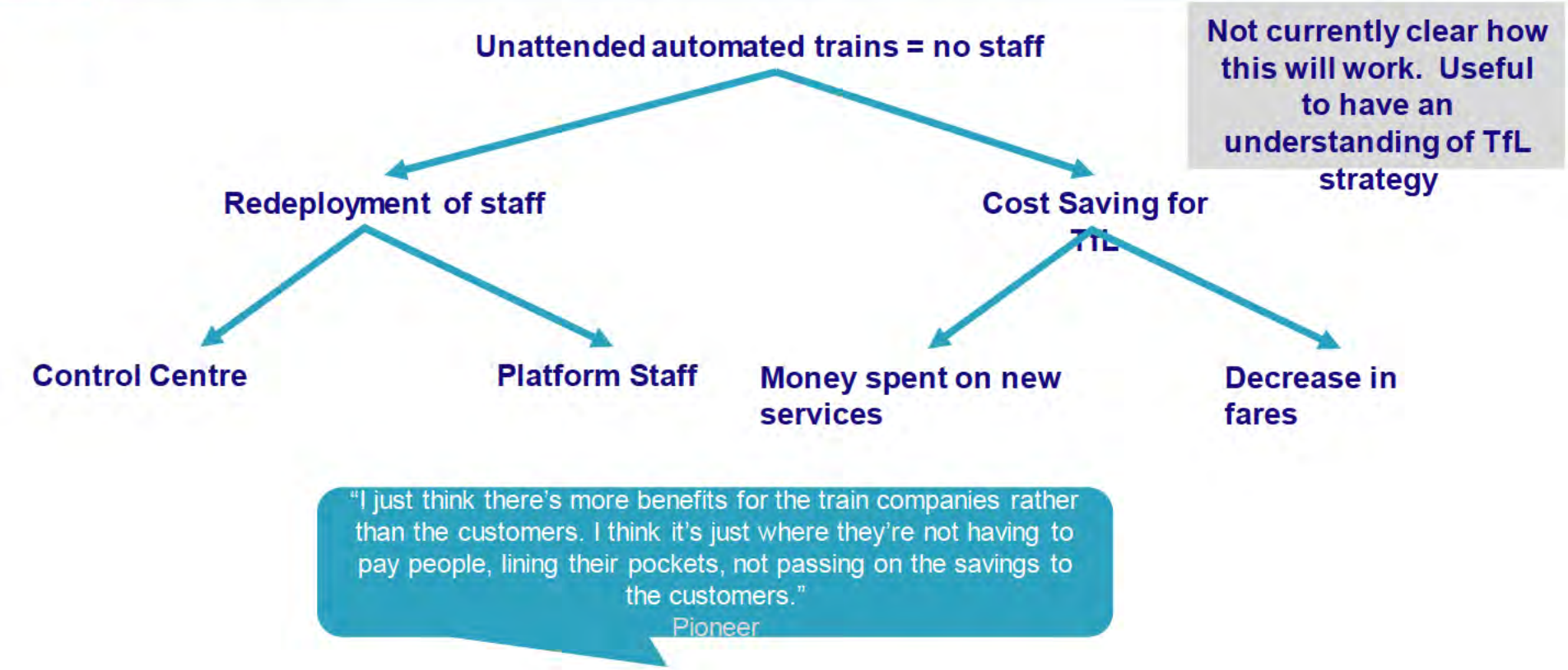
"More predictable running times because trains are always being delayed; it's a major problem for everybody"
Follower

"As soon as they get rid of the people driving the trains, it's better for me; I don't like being held to ransom to come to work."
Pioneer

"It makes London more of a modern city – like Japan already has driverless trains"
Pioneer

"I'm different on the trains here (vs Car). I think it's logical. I actually think it might even be quite practical. There are some, thinking of some of the shocking train disasters of the last couple of decades, they had humans taking care of them and it was actually system failures that caused the accidents"
Follower

Important that benefits are noticed by customers

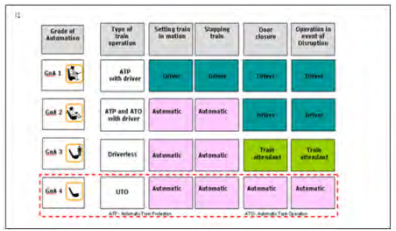


Ki4

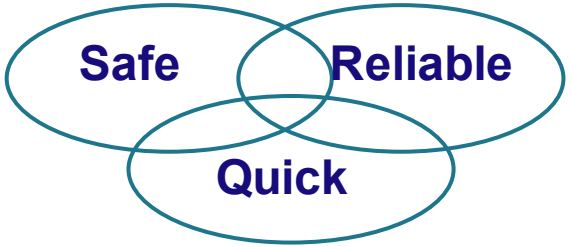
Focus for users of London Underground is about getting from A-B – they pay limited attention to how that is fulfilled

Degree of surprise when reveal that some of London Underground trains are already partially automated

Not a concern that parts of the current network are automated



Focus on end benefit vs. operational issues



If fully automated services can fulfil that then limited barriers exist

"Actually I'm rushing to work so I'm not really thinking no-one is driving that train."
Pioneer

"I just felt like in our day to day lives catching the Tube, we don't ever think about whether there's a driver on the train."
Pioneer

Ki5

Even most confident feel more comfortable on an automated sub surface vs. automated tube train

Recognise difference in size of trains that currently operate on London Underground

Language of 'deep tube' reinforces sense on discomfort as it reinforces how far you are underground

Generally less comfortable

Loss of senses e.g. can't see

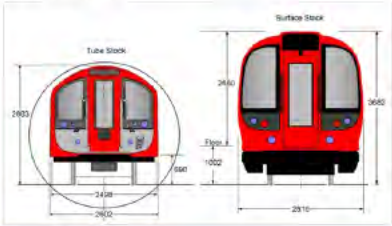
Harder to evacuate

No air

There are two different sizes trains on London Underground

The larger trains operate on what are called the 'Sub-Surface' lines- the Metropolitan, District, Circle and Hammersmith and City lines. These trains go above ground and though wide tunnels which are close to the surface

The smaller trains operate on what are called the 'Deep Tube' lines- the Bakerloo, Central, Victoria, Waterloo and City, Jubilee, Northern and Piccadilly lines. These trains go above ground and through small, 'tube' tunnels which are deeper than on the sub-surface lines



Greater sense of comfort associated with sub-surface trains

Less claustrophobic

Visual reassurance

Easier to evacuate

Fresh air

"If something goes wrong and you can see the fields and the streets outside..if you fancied your chances you'd think, well, I can get out of this. But if you're completely underground - no, seriously you're…"
Pioneer

"It's the deep tunnels and all of that, it's the dirtiness and dark, dinginess of it all that is the weird bit about it."
Follower

Many recognise that comments are fear based and irrational – worth thinking about the language used

Confidence in travelling on unattended automated tube trains feels high

	London (Viewed)		London (Non-Viewed)	
Group Type	***Pioneers***	***Followers***	***Pioneers***	***Followers***
2.D.1 – Confidence in travelling on unattended automated tube train	**8.1**	**7.4**	**5.9**	**8.1**

"Breakdown on the train. What happens if people jump under the tracks? All these scenarios haven't been thought about, couldn't have been thought about by them, because the software is not going to get out of the train and get the body off the track"
Pioneer

- Diverse group
- Range of scores 3-9
- General concerns over 'tube trains' e.g. air conditioning, antisocial behaviour
- Worried about the dark
- Worried about breakdown
- Limited reassurance in emergency situations

Phased introduction of unattended automated on sub-surface network first would be preferred

Ki6

Biggest concerns relate to lack of human presence – virtual voice/reassurance can overcome fears

Concerns and mitigation (1)

	Customer Concern	Specific mitigation proposed	Considerations
1	The train stops while in the tunnel and its dark *"Being trapped in a tunnel without a driver on board- I feel a sense of panic, isolation and not knowing how to get out of the train to a place of safety"*	Human contact from the control room to immediately reassure Ensure full wifi so customer can get real time information Help button Visual reassurance outside the train (lights, pictures) Visual reference inside the carriage that shows distance to next station	High risk of this happening on everyday journeys Impact low for short delays Language doesn't have to be as extreme as 'being trapped' Emotive language like panic and isolation is unnecessary People feel anxious as soon as the train stops
2	Somebody could hack the software and there could be a terrorist attack Rogue controllers *"Fear that the technology could be compromised by hacking or some other cyber-security attack- resulting in deaths or injuries"*	Confidence in technology Closed system Explain that this operates in other countries and never been hacked	Security threats are top of mind Recognise that the tube is a target regardless Low risk but high impact Don't need 'death or injuries' – people know the impact of a terrorist attack They don't want TfL to publish safety and security operations They are not just looking for Norton anti virus reassurance!

Concerns and mitigation (2)

	Customer Concern	Specific mitigation proposed	Considerations
3	Something getting stuck in the doors e.g. bag or coat *"Being dragged along the platform or under the automated train because there is no driver to check it is safe before closing the doors and departing from the station"*	Platform Edge Doors e.g. Jubilee line Sensor on the doors No gap between doors and platform Staff on the platform	Real everyday threat during rush hour Platforms are crowded Concerns about impact on reliability / efficiency of sensor doors Not sure what 'Gap Fillers' are Need to give examples e.g. like Jubilee line
4	Passengers display anti social or threatening behaviour e.g. drinking, rowdy *"Not being able to call someone for help in the event of being attacked or being subject to some other type of crime"*	'Eyes on the train' CCTV Help button Signs on the train to explain BTP will be called immediately Control centre to make an announcement to demonstrate these people can be seen	High risk of this occurring Definitely needs some process for BTP to be contacted Most recognise that this is unrelated to automation and can happen now without driver intervention

Concerns and mitigation (3)

	Customer Concern	Specific mitigation proposed	Considerations
5	The software breaks down and all the trains stop or get diverted somewhere else	Back up technology Contingency plans Regulate crowding Stops people coming on to platforms	Need some degree of frequency or explanation that this is low risk
6	Broken wheel/broken screen *"What happens if something unexpected happens like a broken rail- I don't think the system would account for this and the train would crash"*	Obstacle detection technology Possible introduction of deep machine learning algorithms of the type used in driverless cars	Perceived low risk of this happening What would happen now? How can driver avoid?
7	*"I suffer from claustrophobia and not having any staff on the train would make me feel worse- I think I would panic if the train stopped, and the dark enclosed space of the tunnel just makes things worse when it gets hot and its too crowded"*	Visual and audio announcements – next station is… Open gangway train (which feels more spacious) Air cooling	Too general vs. specific concern Lack of tolerance of claustrophobia Doesn't add anything by mentioning this specifically

Ki7

Provision of relevant and ‘evidence based’ information increases acceptability of unattended automated tube trains

Shift in confidence after exposure to information about safety, security, reliability

	London (Viewed)		London (Non-Viewed)	
Group Type	*Pioneers*	*Followers*	*Pioneers*	*Followers*
2.D.1 – Confidence in travelling on unattended automated tube train	8.1	7.4	5.9	8.1
5.A.1 – Confidence in travelling on unattended automated tube train	8.5	8.4	8.5	8.1

Impact of group affect on change in attitude towards safety is an additional consideration

Strongest shifts relate to direct evidence from proven examples where unattended automated tube trains work

Other countries

Europe	North America	Asia
Lyon	New York	Singapore
Paris	Detroit	Hong Kong
Barcelona	Vancouver	Dubai
Copenhagen	Las Vegas	Kuala Lumpur
Torino	Miami	Taipei
Lille	Jacksonville	Osaka
Tolouse		Kobe
Rennes		Nagoya
Lausanne		Yokohama
		Tokyo

- ***Information increases confidence levels***
- Examples are busy, aspirational cities
- Known for efficiency
- No negative reports
- No poor PR

Glasgow 2021

- ***Information increases acceptance levels***
- Glasgow is well known city
- Some rivalry with London – London should be leading
- Safety measures must have been explored

Projected forecasts

SAFETY - "Based on current projections the number of equivalent fatalities per year will be about a tenth compared to what they are now."

RELIABILITY - "For the Central Line, forecasts for unattended automated tube trains result in about a tenth of the delays compared to now"

SECURITY - "There is no projected change in security with unattended automated tube trains compared to the current situation on London Underground"

- ***Limited impact on confidence levels***
- Lack of credibility of TfL projections
- What are the figures based on?
- If taken from other countries then helpful

Role of Automation

Automation has changed the following:

- Lift attendants – no longer required to operate lifts
- Train guards – because of the development of in-cab CCTV cameras that can see the whole length of the platform
- Bus conductors – because improved payment technology has made fare evasion more difficult

- ***Limited impact on confidence levels***
- Focuses people on loss of jobs argument

Overall sense that automated trains could work in London in the future providing specific concerns are mitigated and sufficient information; much more sceptical about automated cars in congested London roads

Next steps

Reminder of Key Insights

1	Automated vehicles are becoming more mainstream; definitely seen as part of the short term future for road and rail
2	Distinct difference in response to automated cars and automated trains with less confidence in automated cars than automated trains
3	DLR is a strong point of reference for automated trains for London Underground users
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Next Steps

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