

Examining the links between  
Customer Satisfaction and  
Performance  
East Coast  
Passenger Focus

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**APPENDIX A Detailed NPS to Bugle Matching Methodology**

**APPENDIX B Additional Analysis**

# Examining the links between Customer Satisfaction and Performance East Coast Passenger Focus

## Executive Summary

Evidence from a wide range of research, including that of Passenger Focus, has highlighted that punctuality and reliability of train services is one of the key determinants of each Train Operating Company's (TOC) National Passenger Survey (NPS) customer satisfaction score. However there is frequently a disparity between PPM (Public Performance Measure) and satisfaction levels.

This study examines the links between train performance and NPS customer satisfaction for East Coast (EC) Trains by taking over 9,000 NPS results for the four and a bit years from Spring 2006 to Spring 2010, matching each NPS respondent to the actual train they used and from this identifying the lateness they experienced on each occasion and how the precise level of punctuality affected their recorded levels of satisfaction.

Our key findings are:

- Satisfaction with punctuality is the largest influencing factor on overall satisfaction, therefore improving satisfaction with punctuality will improve overall satisfaction
- On average, passenger satisfaction with punctuality falls by 2% for every additional minute of lateness (the gradient) and Overall Satisfaction falls by between 0.5% and 1%
- The rate of change at which passenger satisfaction with punctuality varies with lateness is not constant. There appears to be a series of 'tipping points' at 2-4, 5-6 and 8-10 minutes of lateness suffered
- Perception of delay varies by frequency of travel and more frequent travellers are generally less satisfied and more sensitive to delay than those who don't travel as often. This largely explains why commuters and shorter distance travellers appear less satisfied than longer-distance passengers for the same level of delay.
- Not all passengers say they are satisfied with punctuality even when their service arrives on time or early (RTE) (the 'intercept'). Only 89% of passengers are satisfied (both overall and with punctuality) at RTE, and for frequent travellers this might be influenced by their previous (but recent) experience of delay.
- The overall satisfaction of frequent travellers is driven by satisfaction with punctuality
- Passengers travelling to intermediate (through) stations experience higher levels of small delays than those travelling to stations at which the train terminates. However, this variation is not reflected in passenger satisfaction, where passengers travelling to terminating stations are less satisfied than those travelling to through stations.
- Overall satisfaction, satisfaction with journey time, frequency, connections and ticket buying facilities falls as punctuality falls (lateness increases) and therefore there is a Halo effect associated punctuality for some (but not all) service attributes.

## **Introduction**

### **1.1 Background**

Passenger Focus is the independent national consumer watchdog charged with representing the views of passengers within the UK rail industry and a mission of 'getting the best deal for rail passengers'. Amongst other objectives, Passenger Focus seeks to understand the needs and experiences of rail passengers and to secure tangible and measurable improvements for rail passengers. To support these objectives, Passenger Focus commissions and publishes the twice-yearly National Passenger Survey (NPS), which is the benchmark measure of changes in customer attitude towards all elements of UK train travel, including train services and stations.

Evidence from a wide range of research, including that of Passenger Focus, has highlighted that punctuality and reliability of train services is one of the key determinants of each Train Operating Company's (TOC) NPS customer satisfaction score. However there is frequently a disparity between performance improvements achieved by a TOC (as measured by the Public Performance Measure or PPM; for East Coast, this is the proportion of trains that arrive within 10 minutes of the timetabled time) and the corresponding customer NPS satisfaction result. There may be many possible reasons for this, such as: time lags between improved performance and changes in public perception, differences in the distribution of delays that are not reflected in average performance measures, and the impact of cancellations.

This is the fourth report in a series; so far TOCs that have been examined are National Express East Anglia (NXEA), Cross Country (XC) and Northern. This study has built on the previous experience of the others and the approach taken this time has been to concentrate on examining how actual lateness experienced by NPS respondents affects their recorded levels of satisfaction.

This report provides the results of a study examining the links between train performance and NPS customer satisfaction for the long distance operator, East Coast (EC) Trains.

### **1.2 Current East Coast NPS and PPM Performance**

When examining the performance of national operators in relation to their PPM<sup>1</sup> measure and comparing it to their customer satisfaction scores for punctuality from the NPS survey <sup>2</sup>it can be seen from the table below that there can be a high degree of variation.

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<sup>1</sup> Based on ORR National Rail Trends – Chart 2.1b - 2010-11 Q1

<sup>2</sup> From Spring 2010 NPS Survey

Franchise Operator	Satisfaction	Satisfaction Rank	PPM	PPM Rank	Difference between Satisfaction Rank and PPM Rank
Merseyrail	95%	1	96.3	2	-1
c2c	94%	2	96.8	1	1
Chiltern Railways	93%	3	95.1	5	-2
Arriva Trains Wales	89%	4	95.6	4	0
Virgin Trains	89%	5	89.5	18	-13
East Coast	89%	6	87.5	19	-13
South West Trains	88%	7	95.9	3	4
First Scotrail	88%	8	94.5	7	1
Cross Country	88%	9	90.0	17	-8
East Midlands Trains	84%	10	94.3	8	2
TransPennine Express	84%	11	94.3	9	2
Northern	83%	12	93.6	10	2
First Great Western	83%	13	92.6	12	1
London Midland	81%	14	92.2	15	-1
Southern	79%	15	93.5	11	4
Southeastern	77%	16	92.2	14	2
National Express East Anglia	76%	17	92.0	16	1
First Capital Connect	73%	18	92.3	13	5
London Overground	63%	19	95.0	6	13

Looking at this information it can be seen that passengers are happier with long distance operators' performance (East Coast, Virgin and Cross Country) than their ranking of PPM suggests they should be. By comparison, London Overground's measured performance of PPM is far better than is suggested by their passengers' satisfaction.

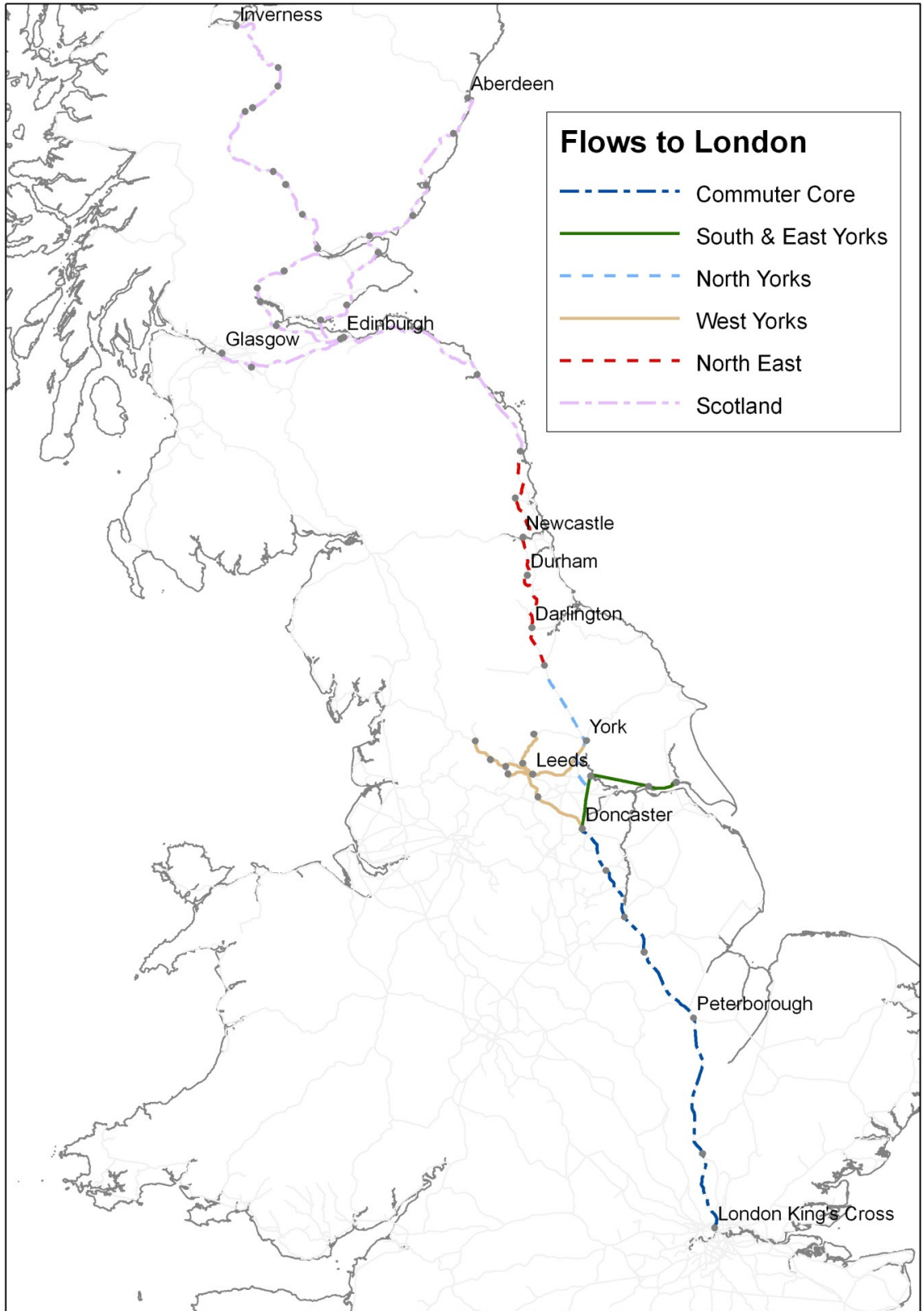
### 1.3 Geographical Scope of Analysis

In consultation with Passenger Focus and EC, it was decided to use the flows that are already established within EC. These are scoped out below:

- London <> Commuter Core
- London <> North East
- London <> North Yorkshire
- London <> Scotland
- London <> South & East Yorkshire
- London <> West Yorkshire
- Non - London North (Northern flows)
- Non – London South (Other flows)

It should be noted that when weekend engineering works have occurred some (London <> Scotland) trains have been rescheduled and diverted to run via Carlisle.

A route map displaying the routes geographically is shown in Map 1 below:



Map 1

## **1.4 Overview of Data Used**

### **1.4.1 NPS Records**

Passenger Focus conducts an NPS in the Spring and Autumn each year. Our analysis is based on data from the last nine waves (waves 14 to 22), covering a period of four years from Spring 2006 to Spring 2010 and providing over 9,000 individual observations.

### **1.4.2 Train Performance Records**

Data on actual performance of every EC service which calls at a station within the geographical scope of the study over the past four years has been derived from the TOC's Bugle<sup>3</sup> records. This gives details of the punctuality of all scheduled trains on arrival at each EC stations. This dataset also includes details of trains which were cancelled (or part cancelled for some of their route).

Throughout this analysis, trains arriving early have been treated as arriving on time (i.e. no benefit is assumed for trains arriving before their scheduled time), they are described as 'right time or early' (RTE).

### **1.4.3 Dates**

Different sources of data use different terminology in the definition of date.

Each NPS survey is referred to as a "wave"; the Spring wave is carried out over a period of ten weeks between January and April, to fit in before Easter, and the Autumn wave over ten weeks from September to November. This may be important in comparing satisfaction to performance, since the Autumn wave includes periods of traditionally low levels of performance due to leaf-fall, and Spring may include periods affected by severe weather, such as snow, whilst the summer months are not surveyed.

The railway industry divides the year into 13 four-week periods, starting on the 1<sup>st</sup> of April each year. In terms of labelling, the year is taken as the year ending, thus the period ending in March 2008 is the thirteenth period of the 2007/08 year and referred to as 2008/P13, whilst the following period starting in April 2008 is the first period of the 2008/9 year and is referred to as 2009/P01. In this report, data may be aggregated into calendar quarters, with the first quarter covering periods P11 to P13 (i.e. January to March), and whilst these do not exactly match to NPS waves, a reasonable match may be used for comparison and this is shown below.

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<sup>3</sup> Bugle is the system which TOCs use to generate details of train performance, in terms of the lateness of every train at each monitoring location on each day

Wave	Season	Year	Months	RSP Periods	Calendar Quarter	Timetable Name
Wave 14	Spring	2006	Jan-April	2006/P11-2007/P1	2005/6 Q1	December 2005
Wave 15	Autumn	2006	Sept-Nov	2007/P06-2007/P09	2006/7 Q4	June 2006
Wave 16	Spring	2007	Jan-April	2007/P11-2008/P1	2006/7 Q1	December 2006
Wave 17	Autumn	2007	Sept-Nov	2008/P06-2008/P09	2007/8 Q4	May 2007
Wave 18	Spring	2008	Jan-April	2008/P11-2009/P1	2007/8 Q1	December 2007
Wave 19	Autumn	2008	Sept-Nov	2009/P06-2009/P09	2008/9 Q4	May 2008
Wave 20	Spring	2009	Jan-April	2009/P11-2010/P1	2008/9 Q1	December 2008
Wave 21	Autumn	2009	Sept-Nov	2010/P06-2010/P09	2009/10 Q4	May 2009
Wave 22	Spring	2010	Jan-April	2009/P11-2010/P2	2009/10 Q1	December 2009

Along with the need to remember that NPS is a sample, and therefore will have a degree of sampling error, the above table shows that NPS does not continuously survey passengers through the year, and therefore changes in performance during some periods may not be specifically reflected in results. That said, comparing published annual PPM results with the punctuality experienced by the NPS sample shows only a small variation:

Year	Published PPM	PPM of NPS Sample
2006/7	82.7	83.9
2007/8	82.6	82.6
2008/9	86.9	87.7
2009/10	87.4	88.0



## 2 NPS Data

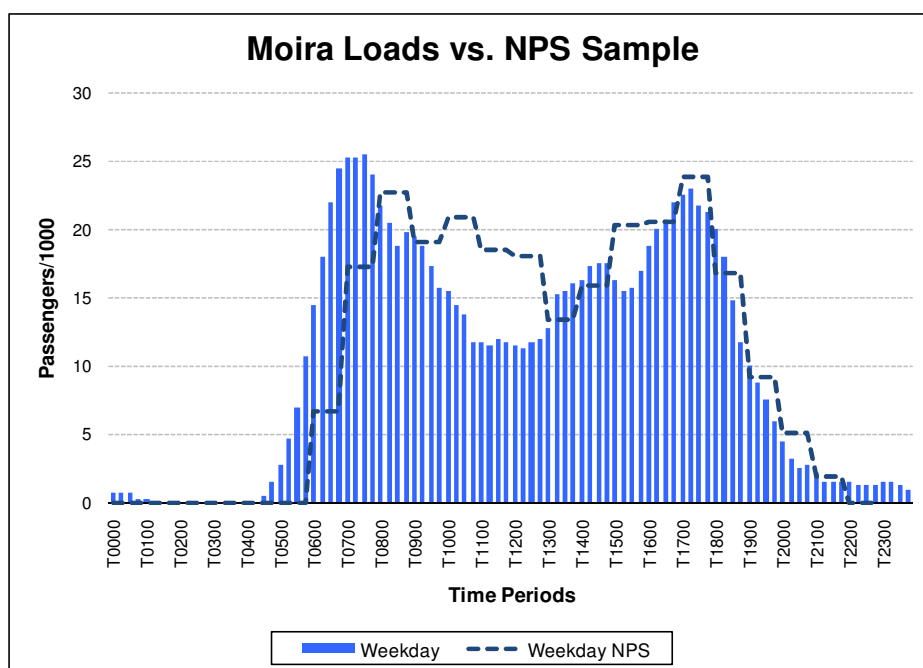
### 2.1 Data Used in Analysis

There are a total of 9863 NPS records for East Coast services over the nine waves analysed (waves 14 – 22), of this 95% have been matched to Bugle (i.e. the actual train service used, and its lateness at each monitoring point is known), leaving 9406 NPS records to be used in the analysis. They are split by wave as shown below:

NPS Wave	NPS Records	NPS Records %
Spring '06	1041	11%
Autumn '06	985	10%
Spring '07	1055	11%
Autumn '07	1127	12%
Spring '08	1003	11%
Autumn '08	1104	12%
Spring '09	1029	11%
Autumn '09	954	10%
Spring '10	1108	12%
<b>Total</b>	<b>9406</b>	<b>100%</b>

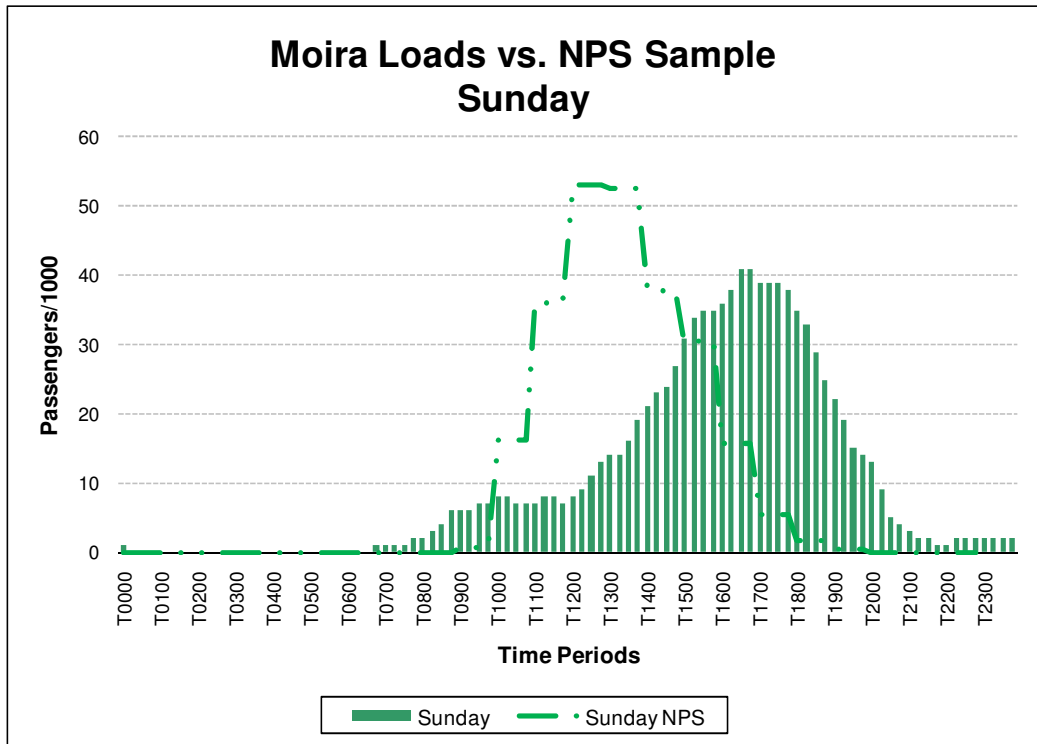
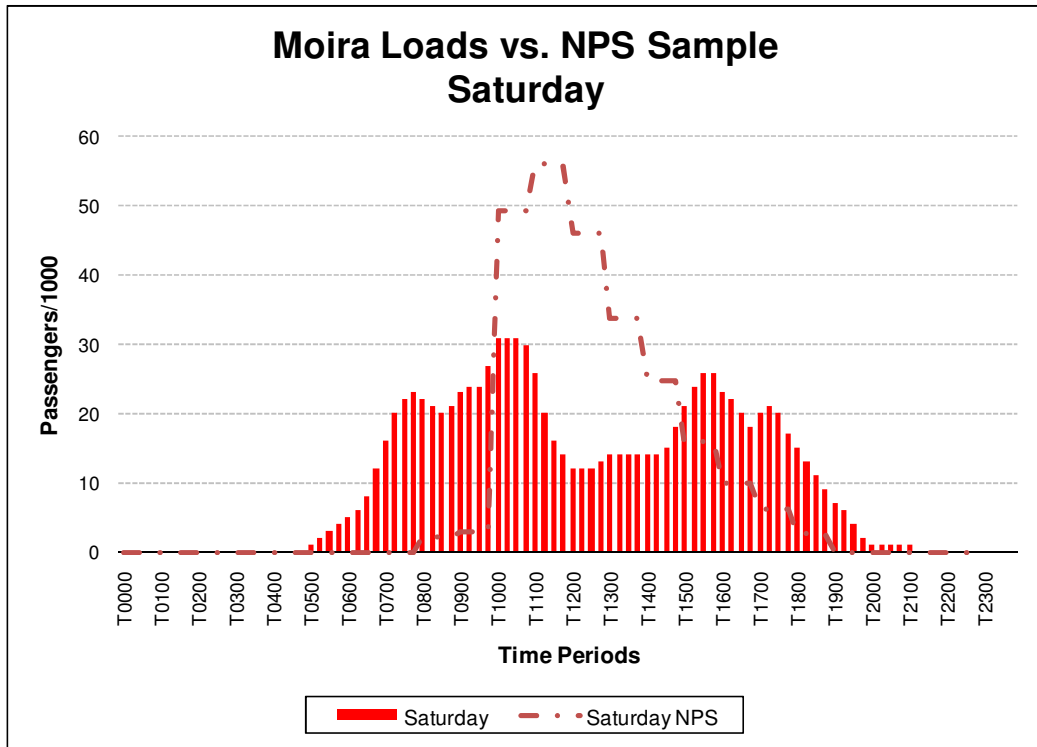
### 2.2 Time of Day and Day of Week

To ensure that the NPS sample used is representative of peak and off peak loadings we have checked the distribution of NPS respondents over the time of day and day of week. Expected demand profiles have been taken from the standard industry timetable tool, MOIRA. This shows that there appears to be a reasonable fit on weekdays, which is the majority of the sample, to negate the need for re-weighting of results.



At the same time it should be noted that sampling at weekends does not reflect the demand profiles, as can be observed in the graphs for Saturdays and Sundays below. This might require further consideration when conducting future surveys.

That said, in this instance, given the low volumes in the sample and relatively small variations in delay, the results remain representative without re-weighting.



## 2.3 Respondents by Route

The following table is a breakdown of the number of NPS respondents used in the analysis by route. The highest number of responses are for Non-London North (Northern flows), these cover those respondents who travelled from Doncaster and North to places other than London Kings Cross. Routes included in 'Other flows' are for locations further south of Doncaster and East Yorkshire to places other than London Kings Cross.

Overall, these provide a good distribution of results from across the EC network.

Flow	NPS Respondents	% NPS by route
London <> Commuter Core	1311	14%
London <> North East	1432	15%
London <> North Yorks	1141	12%
London <> Scotland	756	8%
London <> South & East Yorks	507	5%
London <> West Yorks	1273	14%
Non - London North (Northern flows)	1817	19%
Non - London South (Other flows)	1169	12%
<b>Grand Total</b>	<b>9406</b>	<b>100%</b>

### 3 Relationship between Satisfaction and Performance

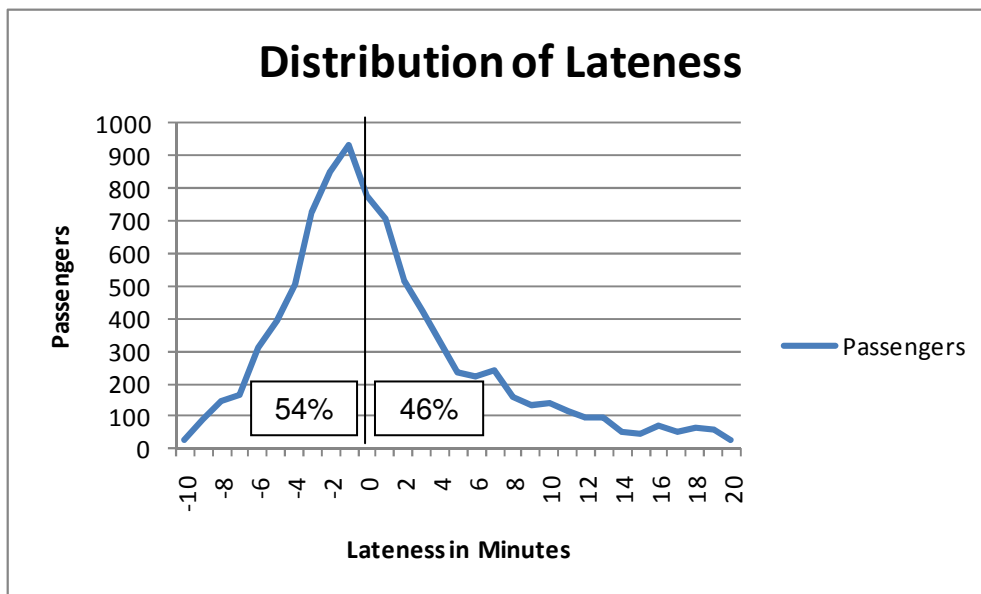
By matching each NPS respondent to the actual train used, we can identify the lateness experienced on each occasion for their specific station-to-station journey and can examine how the precise level of punctuality affects their recorded levels of satisfaction.

#### 3.1 Satisfaction with Punctuality Over Time

For the study period as a whole, 81% of passengers were satisfied with the punctuality of their service and were on average 5.4 minutes late. Satisfied passengers on average experienced 3.4 minutes of average lateness compared with dissatisfied passengers who suffered 21.1 minutes.

	Satisfied	Neither	Dissatisfied	Total
Total	81%	10%	9%	9406
Average Lateness	3.4	6.8	21.1	5.4

The following graph shows the distribution of lateness. 54% of passengers arrive right time or early (RTE), whilst 13% of passengers are later than the PPM threshold at time to 10, and 6% of all passengers are more than 20 minutes late.



The following table shows the change in satisfaction, average lateness and PPM for the NPS respondents by wave. Autumn '07 (Wave 17) had the worst levels of punctuality and satisfaction and it is noted that this was around the time of franchise changeover from GNER to National Express East Coast (November 2007).

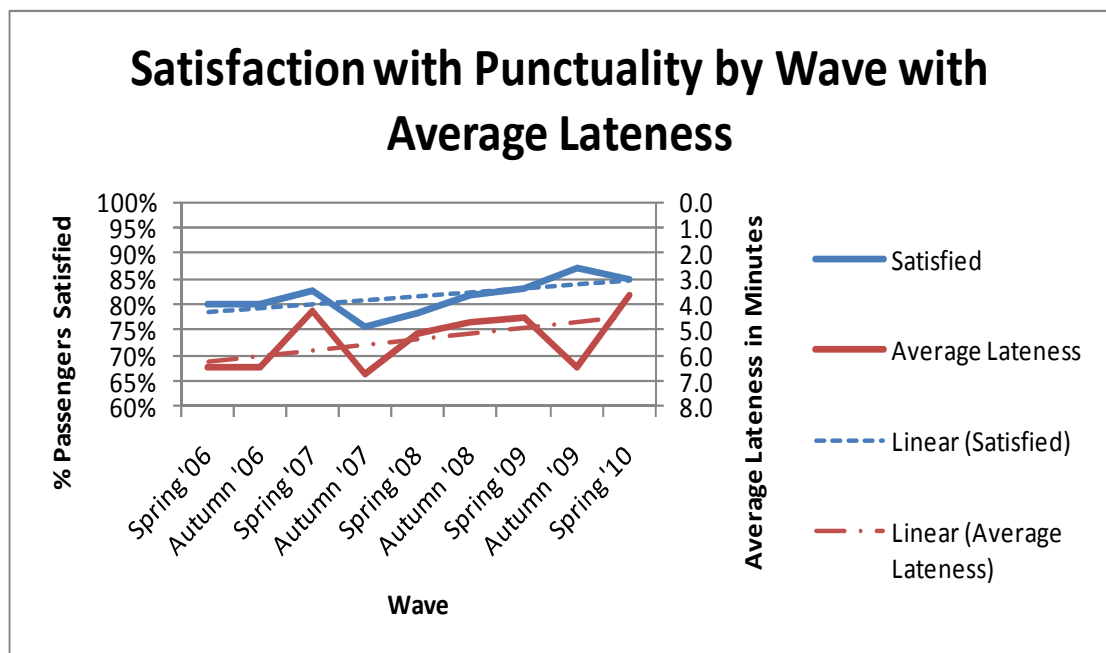
Punctuality & Satisfaction by NPS Wave	% satisfied	% Not Satisfied	Average Lateness	PPM of NPS Sample	% NPS sample outside PPM
Spring '06	80%	20%	6.5	83%	17%
Autumn '06	80%	20%	6.5	81%	19%
Spring '07	83%	17%	4.2	87%	13%
Autumn '07	76%	24%	6.7	82%	18%

Spring '08	78%	22%	5.2	83%	17%
Autumn '08	82%	18%	4.7	86%	14%
Spring '09	83%	17%	4.6	89%	11%
Autumn '09	87%	13%	6.4	89%	11%
Spring '10	85%	15%	3.6	88%	12%
Grand Total	<b>81%</b>	<b>19%</b>	<b>5.4</b>	<b>85%</b>	<b>15%</b>

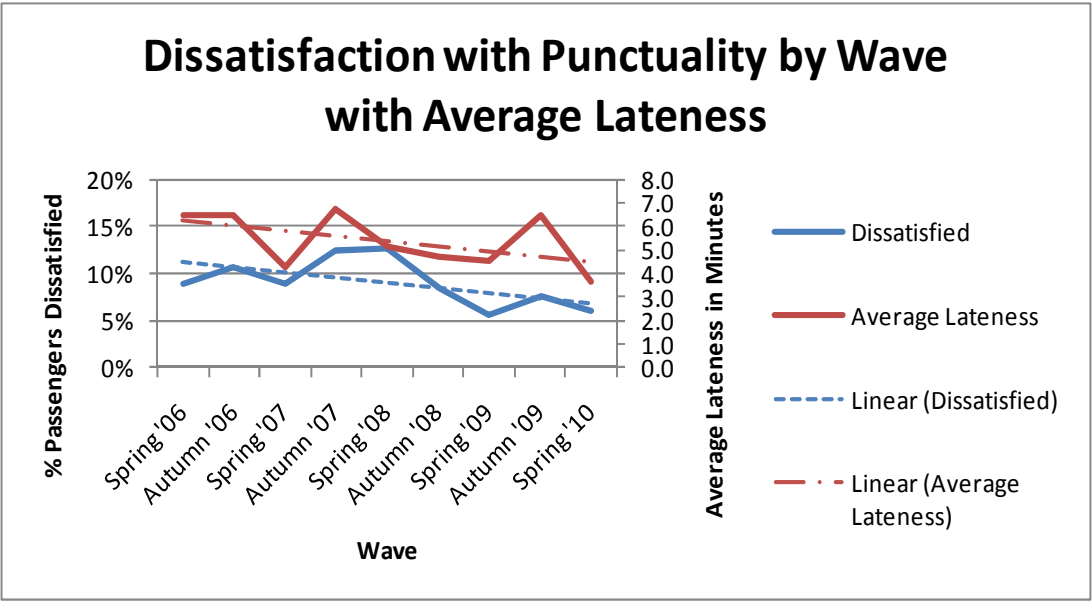
There has been an increase in satisfaction levels generally over time and there has been a corresponding, but slightly smaller, reduction in the levels of dissatisfaction over time. This can be seen by comparing the two graphs below.

On average there is only a small (1%) difference between Autumn and Spring waves, with lower levels of satisfaction being experienced in the Autumn when services are generally less reliable.

Over time, average lateness has improved slightly more than average satisfaction, as observed by the difference in the gradients of the straight lines in the graph below. This means that the rate of improvement in satisfaction will be slightly lower than the rate of improvement in average lateness.

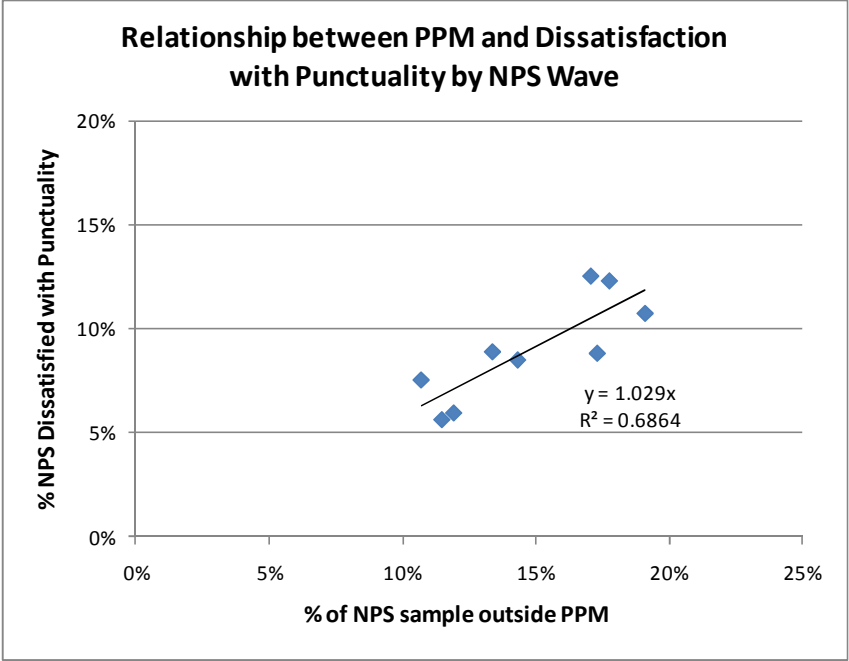


Dissatisfaction has fallen by approximately 5% over the time being studied and average passenger lateness has generally improved over time.



### 3.2 Relationship between Satisfaction and Journeys ‘outside PPM’ or Lateness

We expect satisfaction to decrease (and dissatisfaction to increase) as punctuality falls. For each NPS Wave, if we plot the proportion of passengers not satisfied (i.e. neither very or fairly satisfied) against the number of journeys in the NPS sample that fall outside the PPM score (more than 10mins late) we can see a relationship between the two (although the relationship is not so good at higher levels of delay).



Conversely, examination of the data shows dissatisfaction with punctuality increases 3% for every 1% increase in trains falling outside PPM.

### 3.3 Satisfaction with Punctuality by Distance

The highest levels of satisfaction have been observed on longer-distance flows (i.e. London to Scotland and London to the North East), even though, on average, passengers experience higher average lateness on their journey than that of the commuter core, which has the lowest average lateness.

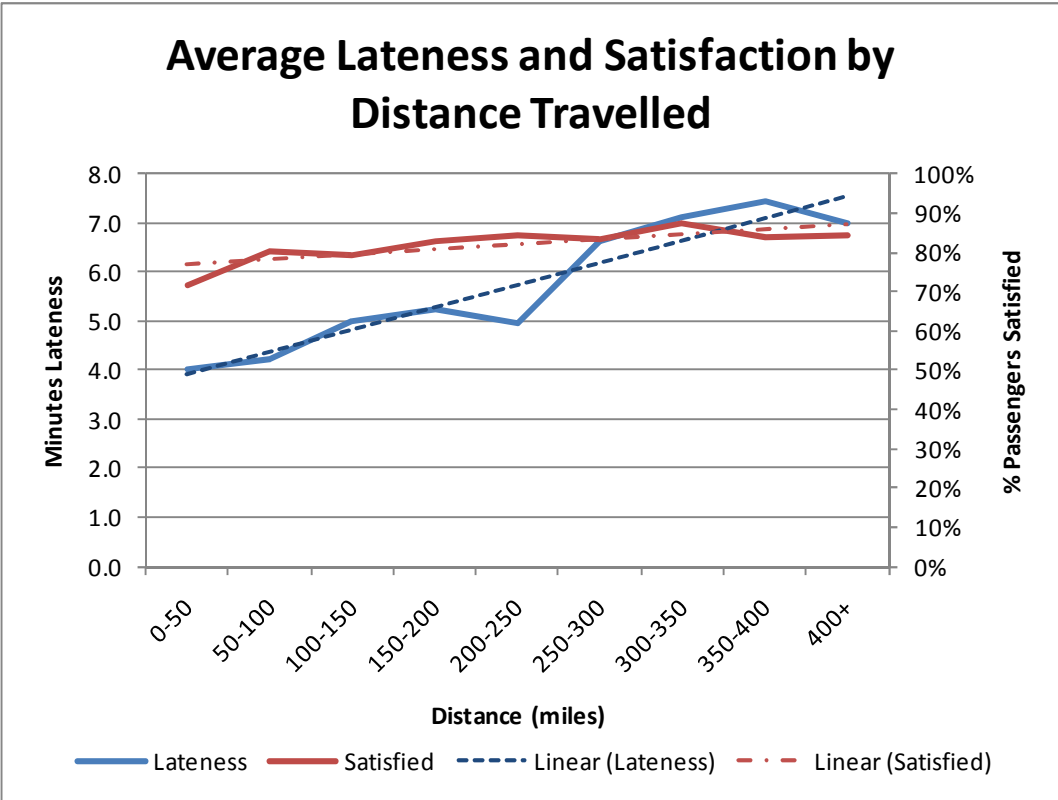
Flow	Satisfied	Neither	Dissatisfied	Total	Lateness
London <> Scotland	85%	8%	7%	756	7.2
London <> North East	84%	8%	8%	1432	5.8
London <> South & East Yorks	83%	10%	7%	507	6.1
London <> West Yorks	83%	10%	7%	1273	4.3
London <> North Yorks	82%	9%	9%	1141	6.0
Other flows	80%	11%	9%	1169	5.0
London <> Commuter Core	80%	10%	11%	1311	3.6
Northern flows	78%	11%	11%	1817	6.0
<b>Grand Total</b>	<b>81%</b>	<b>10%</b>	<b>9%</b>	<b>9406</b>	<b>5.4</b>

Examining the directionality of travel shows that there appears to be a ‘funnel effect’, Southbound (where there is more congestion as routes converge into London), meaning passengers experience higher average lateness and are less satisfied travelling into London than away. The flows in the table below are sorted by highest to lowest satisfaction in the Southbound direction.

Flow	Satisfied		Lateness	
	Northbound	Southbound	Northbound	Southbound
London <> Scotland	85%	84%	6.9	7.8
London <> West Yorks	83%	83%	4.0	5.0
Non - London North (Northern flows)	74%	82%	7.2	4.6
London <> South & East Yorks	87%	79%	8.0	4.0
London <> North Yorks	86%	78%	4.6	7.3
London <> North East	87%	78%	5.2	6.8
Non - London South (Other flows)	83%	78%	4.1	5.8
London <> Commuter Core	84%	75%	2.4	4.9
<b>Overall</b>	<b>83%</b>	<b>79%</b>	<b>5.1</b>	<b>5.7</b>

The average lateness of Southbound passengers is over half a minute more than Northbound passengers who, on average, suffer 5.1 minutes of delay.

We can also see there is a strong linear correlation between average lateness and distance travelled, meaning the further trains travel, the later they become. At the same time the distance travelled appears to have very little influence on the level of satisfaction with punctuality.



### 3.4 Satisfaction with Punctuality Geographically

There is no statistically significant relationship between the level of satisfaction with punctuality and the amount of average lateness suffered by station. The table below shows, for example, that Alnmouth (59% satisfaction, 6.2 average minutes late (AML)) and Perth (72% satisfied, 4.9 AML) have the lowest levels of passenger satisfaction despite having very different levels of lateness. Darlington and Durham have similar levels of lateness to Perth, but passengers are far more satisfied (86% satisfied, 4.8 & 4.9 AML respectively).

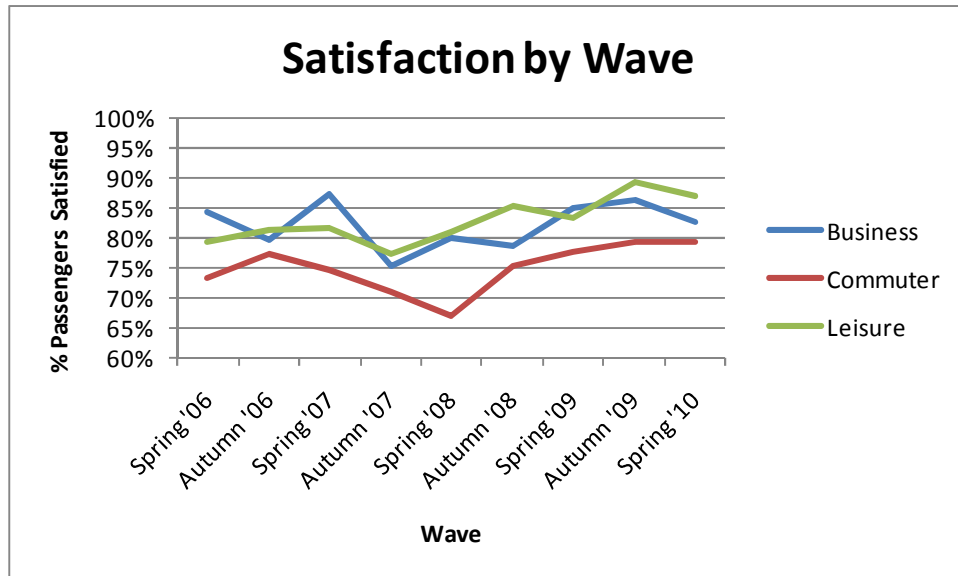


Destination Station	Satisfied	Ranked by Satisfaction (highest 1)	Lateness	Ranked by Lateness (least 1)	Difference in Rank
DARLINGTON	86%	1	4.8	8	-7
DURHAM	86%	2	4.9	11	-9
YORK	84%	3	5.0	12	-9
NEWCASTLE	84%	4	5.4	13	-9
GRANTHAM	84%	5	2.5	3	2
WAKEFIELD WESTGATE	84%	6	5.8	15	-9
DONCASTER	83%	7	6.2	17	-10
LEEDS	83%	8	3.1	5	3
NORTHALLERTON	83%	9	1.4	1	8
PETERBOROUGH	82%	10	4.4	6	4
EDINBURGH	81%	11	6.6	20	-9
RETFORD	80%	12	2.4	2	10
NEWARK NORTH GATE	80%	13	3.1	4	9
INVERNESS	80%	15	4.9	10	5
BERWICK-UPON-TWEED	80%	14	12.4	23	-9
HAYMARKET	79%	16	5.7	14	2
DUNDEE	79%	17	9.2	22	-5
LONDON KINGS CROSS	79%	18	6.0	16	2
GLASGOW CENTRAL	78%	19	6.3	19	0
ABERDEEN	78%	20	12.5	24	-4
STEVENAGE	77%	21	7.6	21	0
MOTHERWELL	74%	22	4.7	7	15
PERTH	72%	23	4.9	9	14
ALNMOUTH	59%	24	6.2	18	6

The findings from the above table correspond with the higher levels of satisfaction found on the London <> North East route. The map below shows, geographically how, satisfaction varies throughout the EC network<sup>4</sup>, and confirms that there isn't an obvious link between satisfaction, AML and location.

<sup>4</sup> Note that the size of the circle at each location is a representation of the amount of demand





### 3.6 Satisfaction with Punctuality by Frequency of Travel

The table below shows that there appears to be an inverse relationship between satisfaction and lateness; the groups that suffer more lateness appear to be more satisfied. Clearly, this is counter-intuitive.

However, if we consider frequency of travel we can see that those passengers who travel least are more satisfied than those who travel more regularly i.e. once a week or more.

Frequency of travel	Travellers	Satisfied	Lateness
3 or more times a week	6%	69%	4.5
Once or twice a week	8%	78%	5.2
1 or 2 times a month	18%	81%	5.6
Once every 2-3 months	21%	83%	5.1
Once every 6 months	12%	84%	6.0
Less often	18%	84%	5.3
Never/First time today	16%	82%	5.4
Don't know/no answer	1%	69%	5.7
<b>Grand Total</b>	<b>9406</b>	<b>81%</b>	<b>5.4</b>

This helps to explain the previous findings concerning journey purpose or distance.

As we would expect, commuters travel much more frequently than business and leisure travellers, who have similar travel frequencies, and yet, the average delay experienced between commuters and other passengers is similar.

Frequency of travel by journey purpose (excludes First Time Travellers)	Business	Commuter	Leisure	Total
Frequent (once per week or more)	12%	60%	3%	16%
Infrequent (less than once per week)	88%	40%	97%	84%
<b>Total</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>
Average Lateness	4.9	5.4	5.6	5.4

#### 4 Perception of Delay

The NPS survey includes a question asking whether passengers have suffered a delay on their journey. Using actual train performance data we can see that 92% of passengers who travelled on trains arriving on time said they suffered no delay (but that 8% did state they had suffered a delay).

However, this also shows that 81% still said they suffered no delay when the train was between 1 and 5 minutes late. This falls to 51% for 6-10 minutes and 28% for 11-20 minutes.

Only 12% (sum of RTE to 11-20 delay) regarded a delay of less than 20 minutes as “serious”. But for delays of at 20 minutes or more, 86% regarded their delay as either minor or serious.

Actual Lateness vs. Perception or attitude to delay	No delay	Yes: Minor delays	Yes: Serious delays	Grand Total
Right Time or Early	92%	7%	1%	100%
1-5	81%	18%	1%	100%
6-10	51%	47%	2%	100%
11-20	28%	66%	6%	100%
20+	14%	41%	45%	100%

For those arriving Right Time or Early (RTE) we can see that those stating they suffered a minor delay is higher for those who travel more frequently. This might suggest that when ranking satisfaction with punctuality “on the day of travel” that perception or attitudes are influenced to some degree by other factors amongst more frequent travellers.

Perception or attitude to delay for RTE passengers by frequency of travel	No delay	Yes: Minor delays	Yes: Serious delays	Grand Total
3 or more times a week	88%	11%	1%	100%
Once or twice a week	90%	8%	2%	100%
1 or 2 times a month	91%	8%	1%	100%
Once every 2-3 months	92%	7%	1%	100%
Once every 6 months	93%	6%	1%	100%
Less often	93%	6%	1%	100%
Never/First time today	93%	7%	1%	100%

One-third of regular travellers register a delay at 1-5 min lateness, compared to around one-sixth of less frequent travellers. This might be because more frequent travellers take into account their experience of delays on previous journeys, or possibly because regular travellers are more sensitive to delay (more likely to affect their lifestyle routine) or perhaps they are simply more aware of the scheduled journey time.

Perception or attitude to delay for passengers 1-5 min late by frequency of travel	No delay	Yes: Minor delays	Yes: Serious delays	Grand Total
3 or more times a week	68%	31%	1%	100%
Once or twice a week	73%	27%	1%	100%
1 or 2 times a month	81%	18%	2%	100%
Once every 2-3 months	82%	18%	0%	100%
Once every 6 months	86%	14%	0%	100%
Less often	83%	16%	1%	100%
Never/First time today	85%	14%	1%	100%

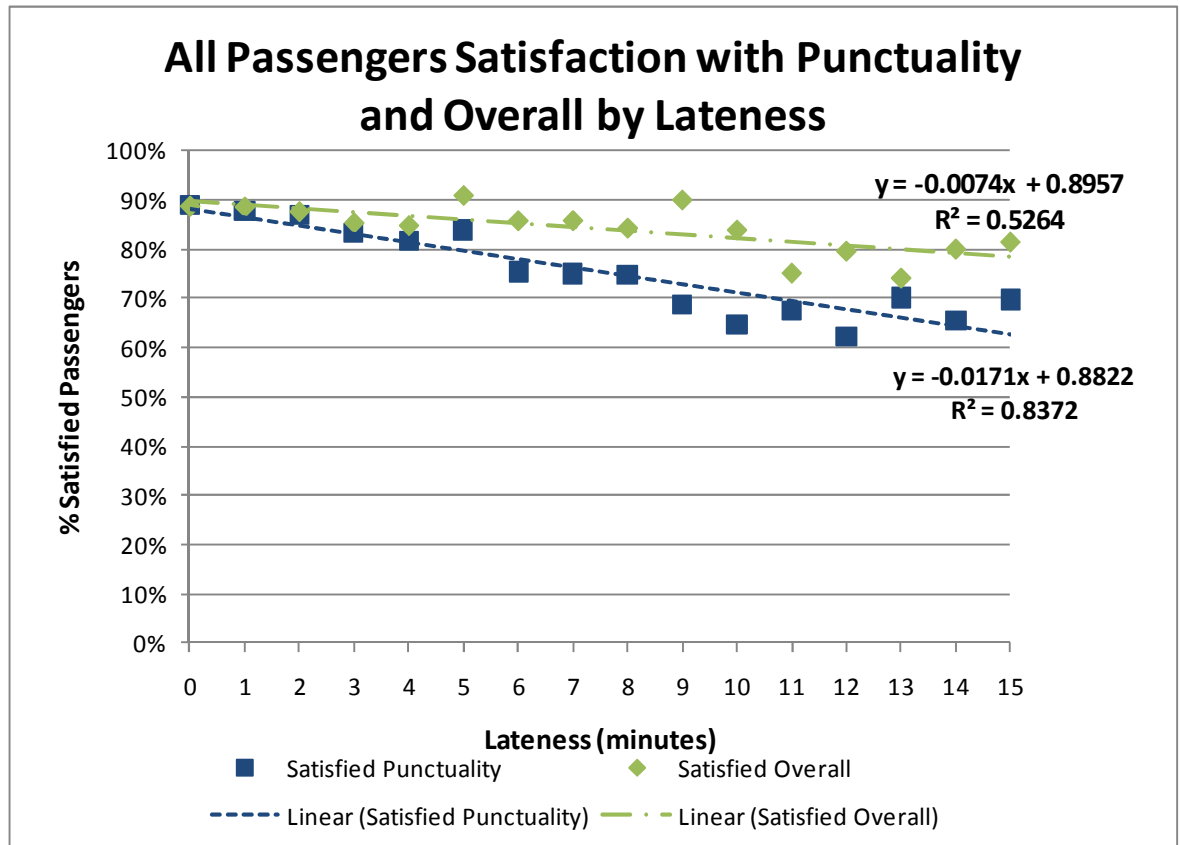
Comparing reactions to the same level of delay by frequent and infrequent travellers, we can see how frequent travellers are more sensitive to lower levels of lateness than infrequent travellers.

% of passengers regarding delay as Minor or Serious, by actual lateness	Frequent Traveller (once per week or more)	infrequent Traveller (less than once per week)
RTE	11%	8%
1-5	30%	17%
6-10	60%	47%
11-20	80%	70%
20+	90%	85%

## 5 Satisfaction “Gradient”

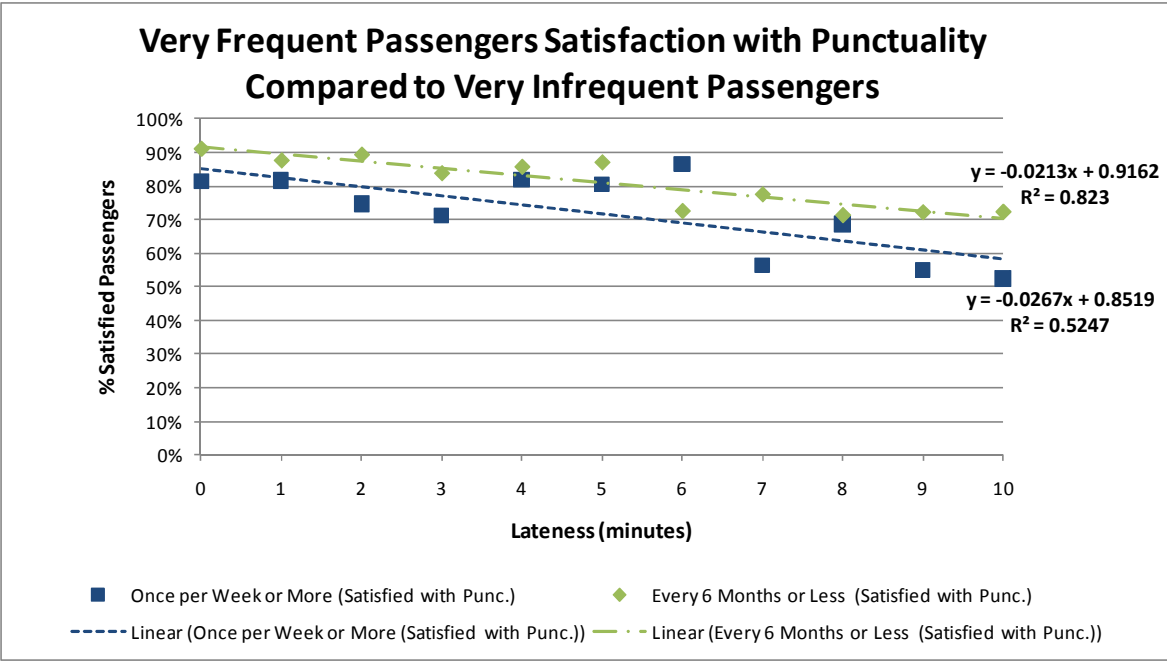
The rate at which satisfaction falls with increasing lateness can be plotted. This rate of change is referred to as the gradient and is shown on the graph below.

When examining the NPS question that relates to ‘Overall Satisfaction with Trip’ we can see there appears to be some relationship between lateness suffered although this isn’t very strong ( $R^2 = 0.53$ ). But as we might expect, there is a much stronger relationship between lateness and satisfaction with punctuality, which is the most suitable measure to use ( $R^2 = 0.84$ ).

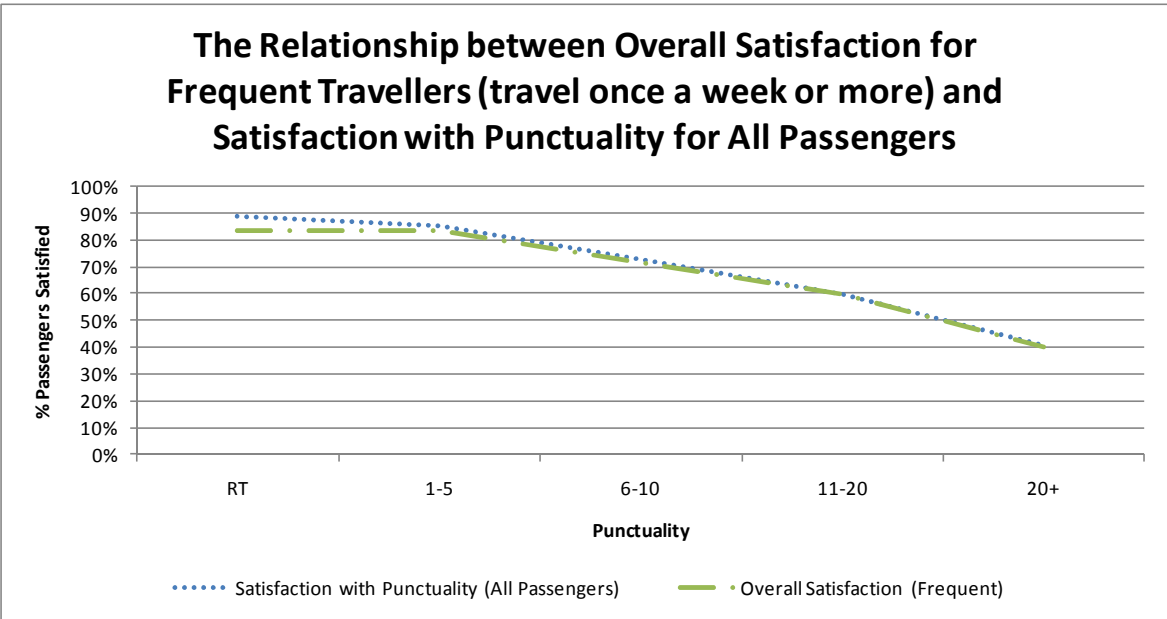


The proportion of passengers satisfied with punctuality falls as the lateness of the service increases (the gradient). For every additional minute of lateness, satisfaction falls by 2 %.

Earlier analysis has shown how satisfaction and perception of delay varies by frequency of travel. If we examine travel between very frequent travellers (once per week or more), and very infrequent travellers (less than once every six months), we can see a clear difference, with a ‘gradient’ of reduction of 2.1% satisfied per minute of lateness for very infrequent travellers compared with 2.7% for very frequent travellers.



Then when we examine the overall satisfaction of frequent travel and compare this to the satisfaction with punctuality for all passengers we can see that the overall satisfaction of frequent travellers is driven by satisfaction with punctuality.

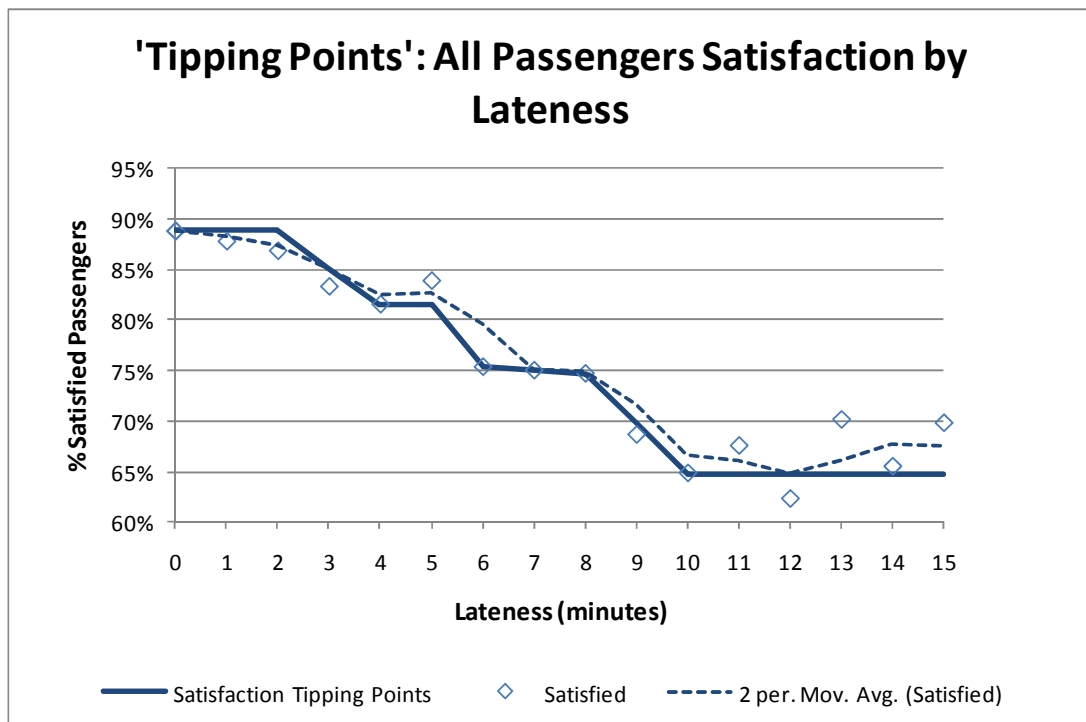


## 6 Satisfaction Tipping point

While the previous section indicates that satisfaction decreases gradually with increased lateness, the rate of change is not constant, and the graphs below show that the 'gradient' is shallow for lower levels of lateness. This might suggest a 'Tipping Point' (or series of tipping points), below which passenger awareness is lower, or concern over the delay is lower, and then change rapidly at given levels of delay.

Examination of the data shows that potential Tipping Points appear around:

- 2-4 minutes
- 5-6 minutes
- 8-10 minutes

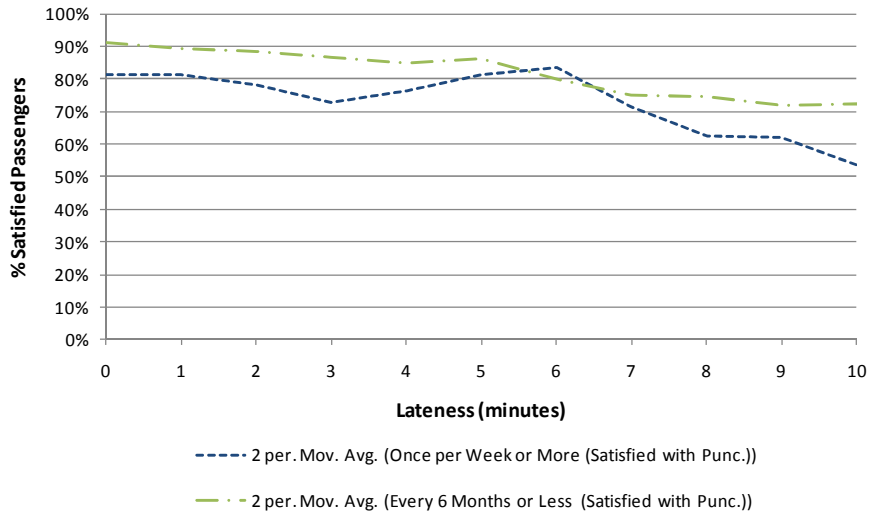


If we consider very frequent and very infrequent travellers (and apply an average over two minutes of delay to smooth results, a 2 point moving average), we can see this effect is particularly pronounced for very frequent travellers, although it can still be seen for very infrequent travellers (albeit less conclusive).

The Tipping Point is shown at 5-6 minutes when examining satisfaction with punctuality for frequent travellers.



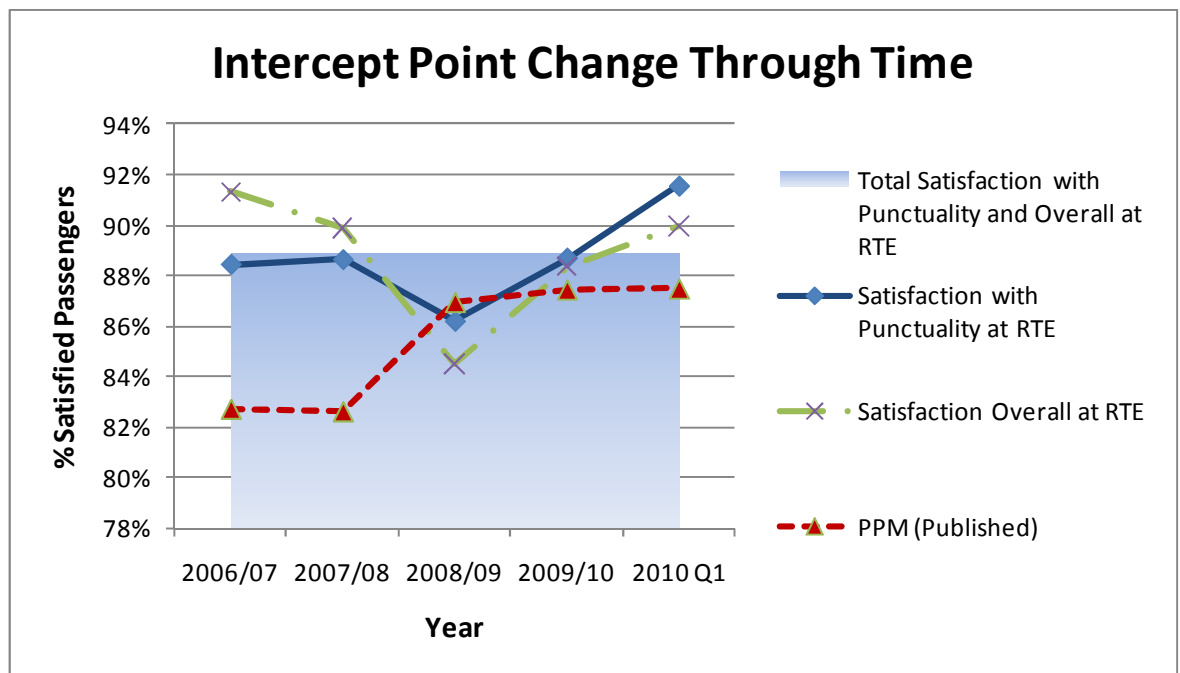
### Very Frequent Passengers Satisfaction with Punctuality Compared to Very Infrequent Passengers



## 7 Satisfaction “Intercept”

This section, and the previous analysis examining perception to delay, has shown that even for services arriving Right Time or Early not all passengers are satisfied with punctuality. The reasons for this are unclear, but may provide further insight into the perception of punctuality and delay over time of by different passenger types.

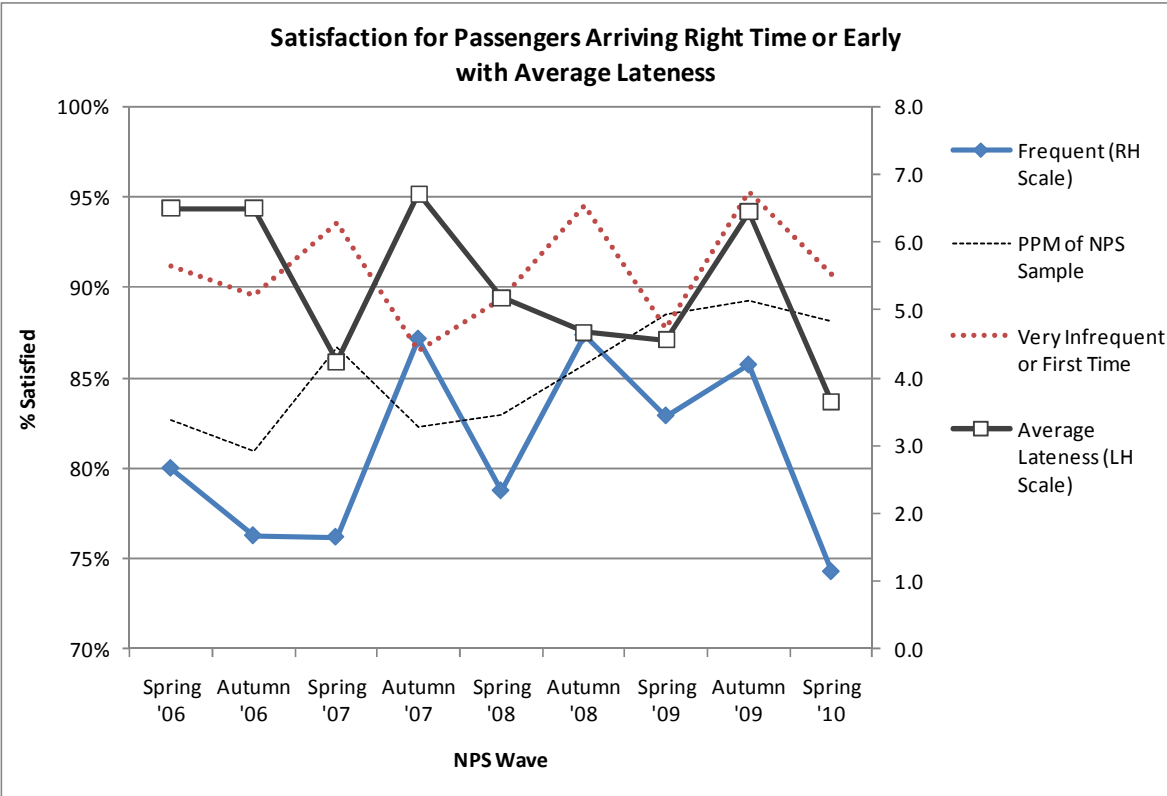
The graph below shows that total satisfaction with punctuality over the whole study period (waves 14-22) averaged at 88% for passengers that were RTE (the blue block background in the graph below). When looking at PPM and satisfaction (both with punctuality and overall) over time at RTE we can see there is little or no obvious relationship.



Those passengers travelling more frequently give a lower rating for punctual services on the day of travel than for infrequent travellers. This is consistent with findings from other TOCs with high proportions of commuters, and where this difference has previously been seen between commuters and business or leisure travellers.

For passengers arriving Right Time or Early (RTE), if we plot the proportion of passengers satisfied over time and compare this with performance, we can see that those travelling very infrequently or for the first time have a consistently higher satisfaction than those who travel more frequently.

Furthermore, the graph shown below might suggest that proportion of frequent travellers who are satisfied may be related to the average lateness seen during the period, and that therefore the intercept value might be influenced by previous (but recent) experience of delay (Note the sample size is relatively small).

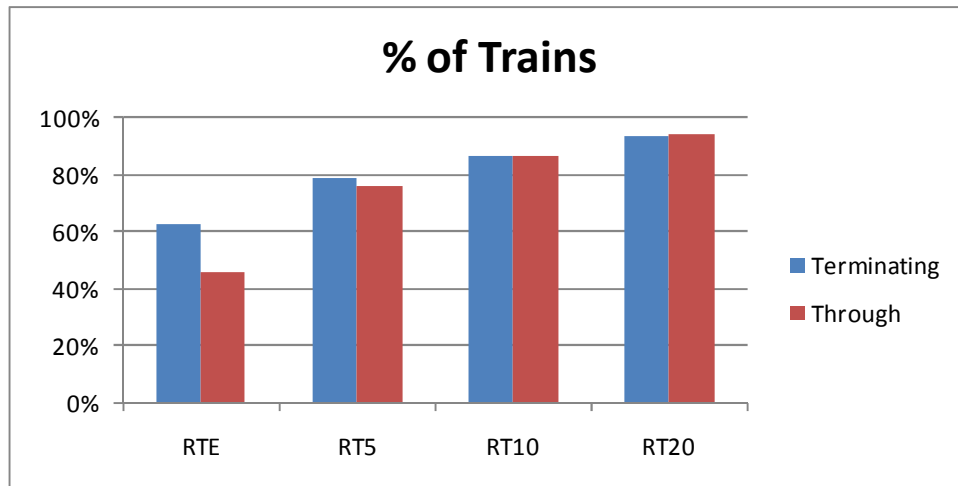


## 8 Through vs. Terminating

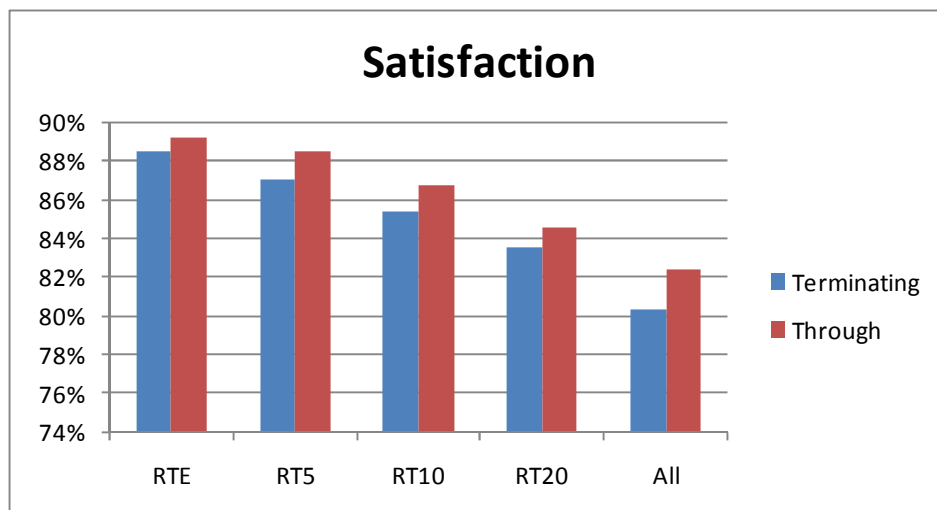
PPM is measured at a train's final destination, rather than punctuality at each station en route. This section looks at the difference between passengers getting off at intermediate (through) stations and passengers leaving the train at the station it terminates at.

The chart below shows the difference in the amount of trains that fall inside each 'right time' classification and split between through and terminating trains. For through trains only 46% are right time or early, but when terminating it is 17% higher at 63%. This difference is much smaller for RT10, where both categories show a value of 87%.

This passengers alighting at intermediate (through) stations suffer a larger number of small delays than those alighting at the terminating station. This is likely to be related to the pathing allowance in most services on the approach to their terminus.



That said, this difference is not reflected in levels of satisfaction. The chart below shows that, throughout all the lateness categories, passengers are noticeably less satisfied when alighting the train at its terminating station than at through stations, and that this difference increases to over 2% difference for trains over 20 minutes late.



This difference occurs without a significant difference in average train lateness with both through and terminating trains very close to the overall average lateness of 5.4 minutes per train. As a large number of the through trains experience only small delay (1 to 5 minutes late), this tends to support the previous finding in tipping points, that passenger satisfaction is not so greatly influenced by short delays.

From this we might speculate that where services are 'held' outside stations awaiting platforms etc. that there may be some perception of delay. However, this is conjecture and no direct evidence is available to support this.

## 9 Halo Effect

Previous studies undertaken by Passenger Focus have shown the importance of punctuality in influencing passenger satisfaction. We have also seen in Section 5, that overall satisfaction tends to fall as lateness increases. This might suggest that satisfaction with other service attributes might change with lateness, and where other attributes fall as lateness increases, this may be described as ‘halo effect’.

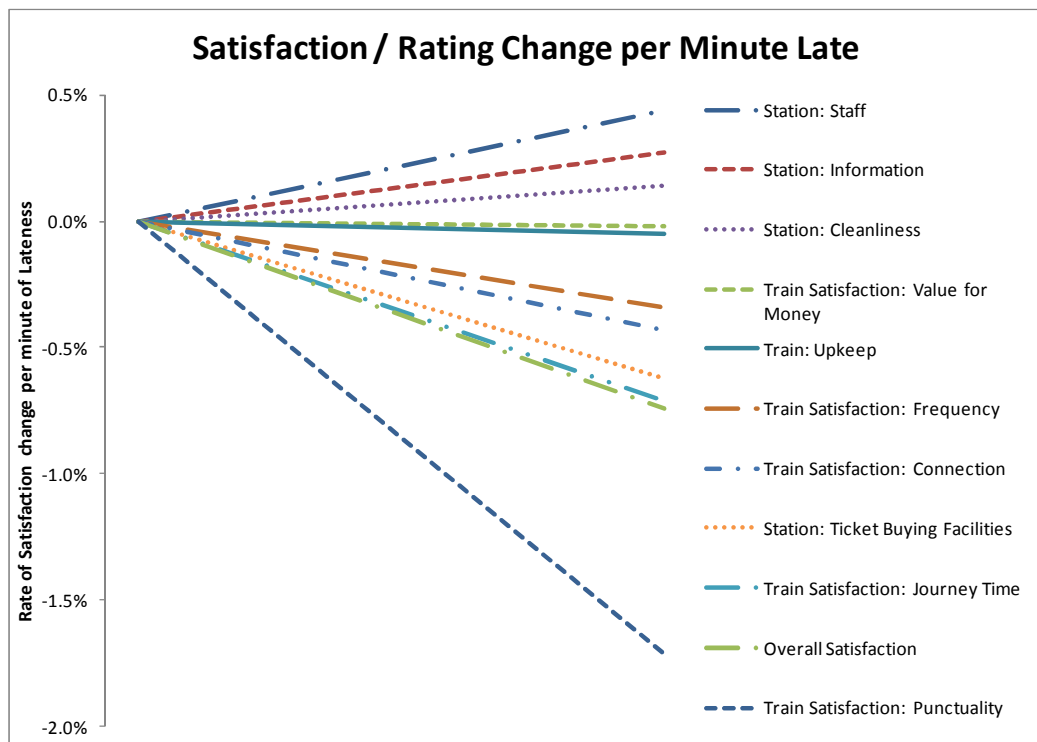
We have firstly examined this by plotting how satisfaction with a range of attributes changes as lateness increases, and showing an average rate of change. The following graph shows that punctuality has the fastest rate of change in satisfaction per additional minute of lateness, and confirms the gradient shown in previous sections. The other measures of satisfaction in the NPS survey change at a much lower rate per minute of lateness, with some not changing at all (i.e. they are not influenced by delay) and some showing an inverse relationship.

Examining the chart we can see that Overall Satisfaction falls by between 0.5% and 1.0% for every minute of lateness. This is also the same for satisfaction with journey time and similar to satisfaction with Station Ticket Buying Facilities. There also appears to be a similar relationship (but a shallower gradient) with satisfaction with connections, and frequency.

There does not appear to be any relationship with train upkeep or value for money.

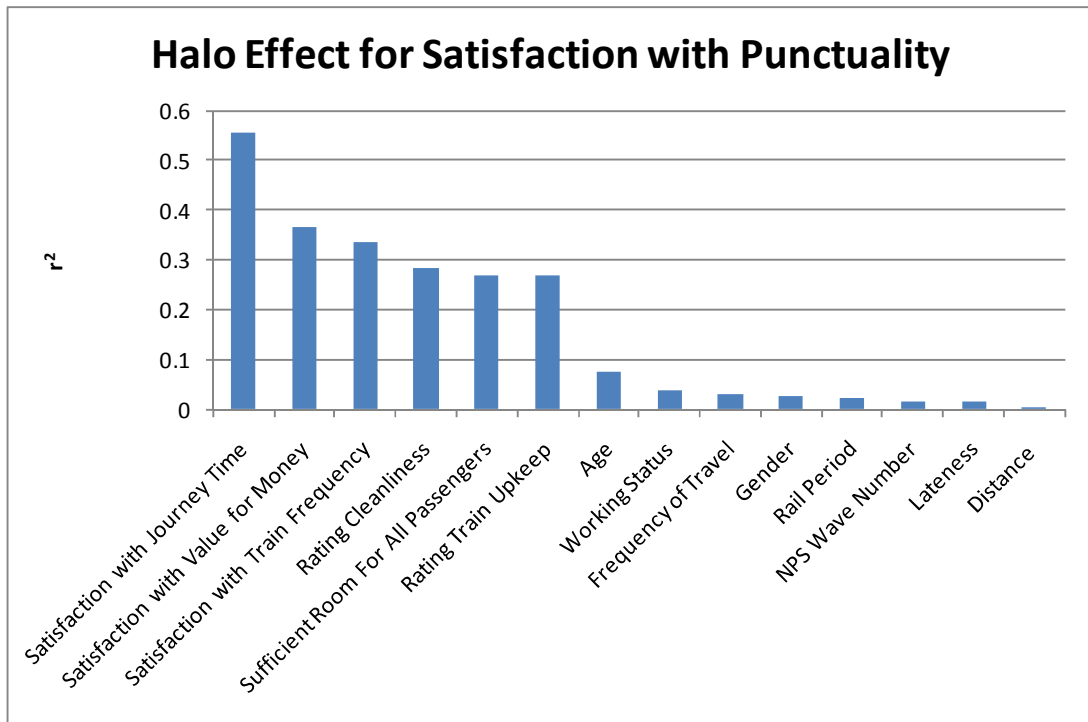
Satisfaction with station staff and station information appears to increase as lateness increases. Whilst at first glance this may be counter-intuitive, it might reflect the increasing need for these service attributes when trains are delayed, and appreciation when staff or information is given once trains are delayed.

This demonstrates that satisfaction with punctuality is the largest influencing factor on overall satisfaction and therefore improving satisfaction with punctuality will improve overall satisfaction.

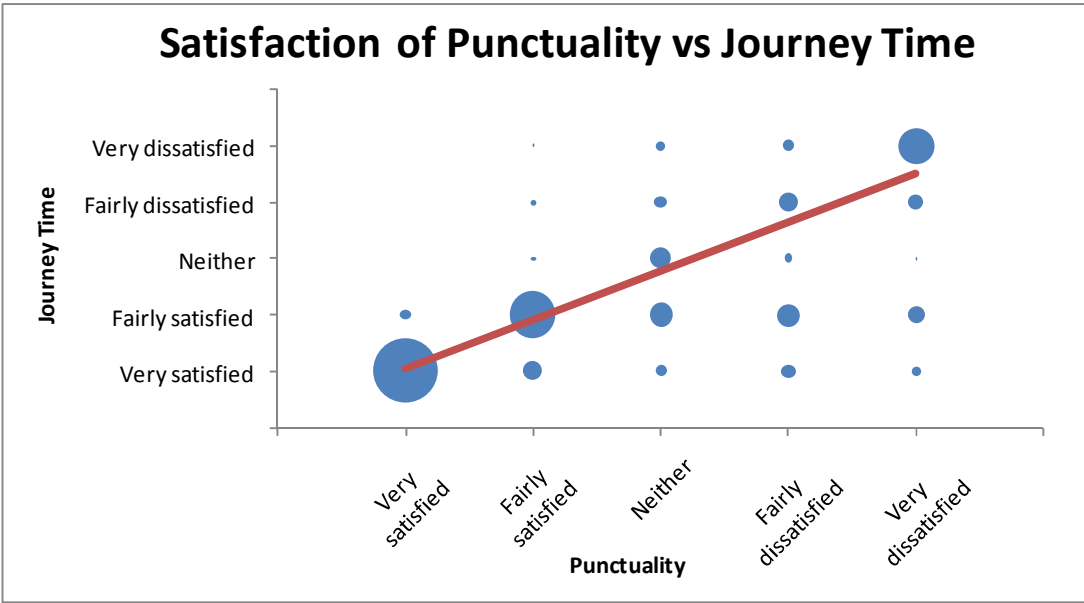


However, the strength of the relationship is not certain from these plots. For a straight forward way to look at this problem a matrix was created to check for correlation between different variables (NPS questionnaire answers). Values closer to 1 or -1 tell us that there is a linear relationship between the variables. Whereas values close to 0 indicate that no linear relationship exists.

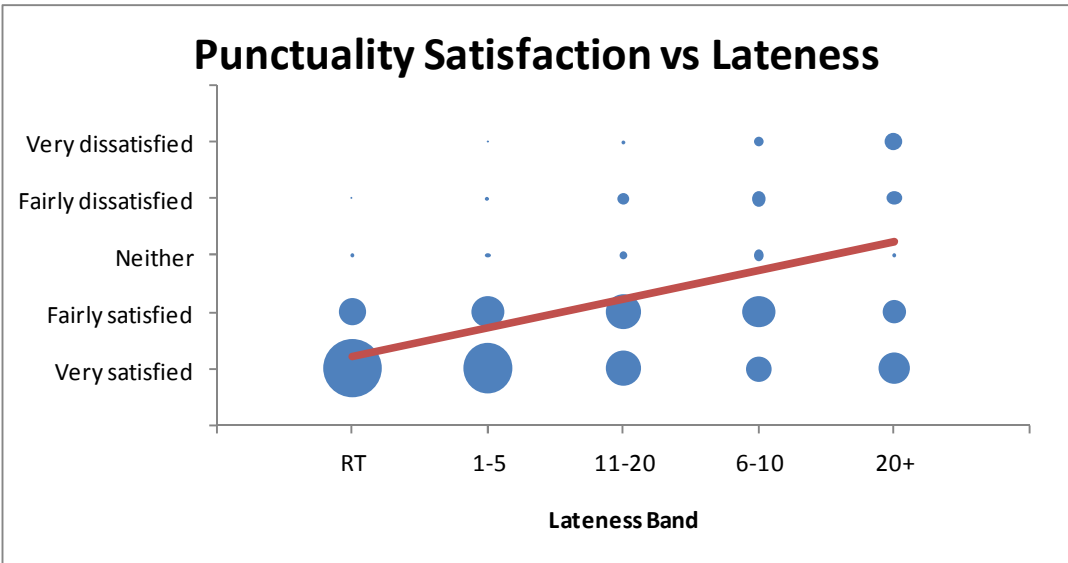
The chart below shows the coefficient of determination ( $r^2$ ) for the satisfaction with punctuality compared with a selection of other variables used in the analysis. Here it can be seen that there is a connection between satisfaction with punctuality and other subjective measures from the NPS data, suggesting that when punctuality is rated highly the other values are rated higher and when it is rated badly other categories are rated badly. For comparison, we can see that for other (non NPS satisfaction) variables there is no direct linear connection.



Examining this further, the next graph shows two variables where  $r^2 = 0.56$  and here we can see that there is an obvious straight line that we can draw through the data that follows the general distribution of the data. The bubbles are larger the more people answered both questions as indicated in the chart and are normalized for each column, so a trend can easily be seen.



The last chart shows the relationship we have focussed most of our research on. Although there is a line drawn through the data, it is far less obvious to decide where to draw the line and the test for linear correlation suggests that there is no line that will properly represent the data. Independent of that there is an obvious distribution to the data, essentially suggesting the later the train arrives the less people are satisfied with punctuality and it is this that most the research has centred on.





## 10 Conclusions

Our key findings are:

- Satisfaction with punctuality is the largest influencing factor on overall satisfaction, therefore improving satisfaction with punctuality will improve overall satisfaction
- On average, passenger satisfaction with punctuality falls by 2% for every additional minute of lateness (the gradient) and Overall Satisfaction falls by between 0.5% and 1%
- The rate of change at which passenger satisfaction with punctuality varies with lateness is not constant. There appears to be a series of 'tipping points' at 2-4, 5-6 and 8-10 minutes of lateness suffered
- Perception of delay varies by frequency of travel and more frequent travellers are generally less satisfied and more sensitive to delay than those who don't travel as often. This largely explains why commuters and shorter distance travellers appear less satisfied than longer-distance passengers for the same level of delay.
- Not all passengers say they are satisfied with punctuality even when their service arrives on time or early (RTE) (the 'intercept'). Only 89% of passengers are satisfied (both overall and with punctuality) at RTE, and for frequent travellers this might be influenced by their previous (but recent) experience of delay.
- The overall satisfaction of frequent travellers is driven by satisfaction with punctuality
- Passengers travelling to intermediate (through) stations experience higher levels of small delays than those travelling to stations at which the train terminates. However, this variation is not reflected in passenger satisfaction, where passengers travelling to terminating stations are less satisfied than those travelling to through stations.
- Overall satisfaction, satisfaction with journey time, frequency, connections and ticket buying facilities falls as punctuality falls (lateness increases) and therefore there is a Halo effect associated punctuality for some (but not all) service attributes.

## APPENDIX A Detailed NPS to Bugle Matching Methodology

The aim of the process is to establish how late a train was running, when a passenger that filled in an NPS questionnaire, alighted their train. To this end for each NPS entry the corresponding entry in Bugle has to be found to give the punctuality of the train along its route.

Steps:

- 1) NPS to bugle + direction
  - 2) Establish Ids
  - 3) Direct match ID
  - 4) Time allowance for second ID
  - 5) Establish which match and keep correct Head Code
  - 6) Use unique ID to find lateness
  - 7) Check error catches to make sure everything has run correctly
- 
- 1) The first step is to make the NPS data compatible with the Bugle data. To this end NPS station names, dates and time are all formatted in the same style as the Bugle data. Additionally to this directionality is added to both NPS and Bugle data so that it is easy to establish if a train is travelling north- or southbound.
  - 2) To easily compare NPS and Bugle data several IDs are created. These consist of combined data from every entry. The exact use is explained further along in the process.
  - 3) The first match is comparing an ID containing date, time, direction, origin station and destination. This will match up any data where the passenger boarded the train at the train's origin station. When a match occurs we record the head code of the train they boarded, this also applies to the further matching attempts.
  - 4) To match up any data where the passenger got on at an intermediate stop we use an ID consisting of date, time, direction and origin station. As the times recorded in Bugle do not necessarily perfectly reflect the timetabled times a leeway of 13 minutes before and 10 minutes after the departure time recorded in the NPS data is allowed to find a match with the Bugle data and find the train that was boarded.
  - 5) As this process makes it possible for multiple matches to be found it is essential consider which are the most appropriate to use going forward in the analysis. So if the first match comes back positive we use that result as we know it is correct. With the secondary match we prioritise earlier than the departure time over later times and the least time difference has the highest priority.
  - 6) Now that we know what train people are travelling on an ID consisting of date, head code and destination is used to retrieve the lateness of the train the NPS passenger was travelling on.
  - 7) Throughout this process error checking ensures that incorrect matches are excluded and no NPS data is matched up to the incorrect entry in bugle.

## APPENDIX B Additional Analysis

### Satisfaction breakdowns

	Satisfied	Neither	Dissatisfied	Total
Total	81%	10%	9%	9406
Lateness	3.4	6.8	21.1	5.4

Route	Satisfied	Neither	Dissatisfied	Total	Lateness
London <> Commuter Core	80%	10%	11%	1311	3.6
London <> North East	84%	8%	8%	1432	5.8
London <> North Yorks	82%	9%	9%	1141	6.0
London <> Scotland	85%	8%	7%	756	7.2
London <> South & East Yorks	83%	10%	7%	507	6.1
London <> West Yorks	83%	10%	7%	1273	4.3
Northern flows	78%	11%	11%	1817	6.0
Other flows	80%	11%	9%	1169	5.0
<b>Grand Total</b>	<b>81%</b>	<b>10%</b>	<b>9%</b>	<b>9406</b>	<b>5.4</b>

Purpose	Satisfied	Neither	Dissatisfied	Total	Lateness
Commute	75%	12%	13%	1465	5.4
Business	82%	9%	9%	2952	4.8
Leisure	83%	9%	8%	4989	5.7
<b>Grand Total</b>	<b>81%</b>	<b>10%</b>	<b>9%</b>	<b>9406</b>	<b>5.4</b>

Route	Satisfied		Lateness	
	Northbound	Southbound	Northbound	Southbound
London <> Commuter Core	84%	75%	2.4	4.9
London <> North East	87%	78%	5.2	6.8
London <> North Yorks	86%	78%	4.6	7.3
London <> Scotland	85%	84%	6.9	7.8
London <> South & East Yorks	87%	79%	8.0	4.0
London <> West Yorks	83%	83%	4.0	5.0
Northern flows	74%	82%	7.2	4.6
Other flows	83%	78%	4.1	5.8
<b>Grand Total</b>	<b>83%</b>	<b>79%</b>	<b>5.1</b>	<b>5.7</b>

Purpose	Satisfied		Lateness	
	Northbound	Southbound	Northbound	Southbound
Business	84%	80%	4.3	5.5
Commute	77%	73%	5.5	5.3
Leisure	84%	81%	5.5	5.9
<b>Grand Total</b>	<b>83%</b>	<b>79%</b>	<b>5.1</b>	<b>5.7</b>

Reason for leisure trip	Travellers	Satisfaction	Lateness
A day out	6%	81%	5.3
On personal business	9%	83%	5.2
Other leisure trip	13%	86%	5.5
Shopping trip	3%	82%	5.2
Sport	2%	84%	4.9
Travel to/from holiday	18%	84%	6.7
Visiting friends or relatives	48%	82%	5.6
<b>Grand Total</b>	<b>4989</b>	<b>83%</b>	<b>5.7</b>

Frequency of travel	Travellers	Satisfied	Lateness
3 or more times a week	6%	69%	4.5
Once or twice a week	8%	78%	5.2
1 or 2 times a month	18%	81%	5.6
Once every 2-3 months	21%	83%	5.1
Once every 6 months	12%	84%	6.0
Less often	18%	84%	5.3
Never/First time today	16%	82%	5.4
Don't know/no answer	1%	69%	5.7
<b>Grand Total</b>	<b>9406</b>	<b>81%</b>	<b>5.4</b>

## Demographics

Age Group	Travellers	Satisfied	Lateness
16-25	9%	80%	4.9
26-34	12%	80%	4.7
35-44	19%	81%	5.7
45-54	25%	82%	5.2
55-59	12%	82%	6.1
60-64	11%	83%	5.4
65+	11%	84%	5.1
Not stated	1%	70%	8.2
<b>Grand Total</b>	<b>9406</b>	<b>81%</b>	<b>5.4</b>

Gender	Travellers	Satisfied	Lateness
Female	53%	83%	5.1
Male	45%	80%	5.6
Not stated	2%	71%	7.0
<b>Grand Total</b>	<b>9406</b>	<b>81%</b>	<b>5.4</b>

## Satisfaction with Punctuality by Demographics

Older people are most satisfied with punctuality and satisfaction falls with age although there is only a 4% difference over the whole range of those who stated their age. The younger age groups suffer the least amount of lateness and are least satisfied.

Age Group	Travellers	Satisfied	Lateness
65+	11%	84%	5.1
60-64	11%	83%	5.4
55-59	12%	82%	6.1
45-54	25%	82%	5.2
35-44	19%	81%	5.7
26-34	12%	80%	4.7
16-25	9%	80%	4.9
Not stated	1%	70%	8.2
<b>Grand Total</b>	<b>9406</b>	<b>81%</b>	<b>5.4</b>

However, this difference might be explained by the fact that younger people travel more frequently than older passengers (and not that they experience higher levels of delay).

Proportion of Frequent & Infrequent travellers by age group (note: excludes first time travellers)	Under 45	45 or Over	Total
Frequent (once per week or more)	52%	48%	100%
Infrequent (less than once per week)	38%	62%	100%
Average Lateness (for comparison)	5.2	5.4	5.4

## Weekdays

Purpose	Weekday				Saturday	Sunday	Total
	AM Peak	Day Off Peak	PM Peak	Evening Off Peak	Off Peak	Off Peak	
Commuter	28%	9%	23%	19%	3%	6%	<b>16%</b>
Business	45%	27%	45%	27%	6%	9%	<b>31%</b>
Leisure	27%	64%	32%	54%	91%	85%	<b>53%</b>
<b>Total</b>	<b>2062</b>	<b>3358</b>	<b>1918</b>	<b>509</b>	<b>830</b>	<b>729</b>	<b>9406</b>

Satisfaction	Weekday				Saturday	Sunday	Total
	AM Peak	Day Off Peak	PM Peak	Evening Off Peak	Off Peak	Off Peak	
Satisfied	80%	83%	80%	78%	84%	80%	<b>81%</b>
Neither	10%	9%	10%	10%	10%	9%	<b>10%</b>
Dissatisfied	10%	8%	10%	12%	7%	11%	<b>9%</b>
Average of Lateness	5.4	5.5	5.4	6.7	3.3	6.1	<b>5.4</b>

Satisfaction	Weekday	Saturday	Sunday	Total
Satisfied	81%	84%	80%	81%
Neither	10%	10%	9%	10%
Dissatisfied	9%	7%	11%	9%
Average of Lateness	5.5	3.3	6.1	5.4
<b>Total</b>	<b>7847</b>	<b>830</b>	<b>729</b>	<b>9406</b>

## Ranking

The Stations below are ranked in descending order with the highest satisfaction percentage at the top.

Destination Station	Satisfied	Neither	Dissatisfied	Total	Lateness
DARLINGTON	86%	6%	8%	343	4.8
DURHAM	86%	9%	6%	245	4.9
YORK	84%	8%	8%	961	5.0
NEWCASTLE	84%	9%	7%	815	5.4
GRANTHAM	84%	9%	7%	237	2.5
WAKEFIELD WESTGATE	84%	12%	5%	225	5.8
DONCASTER	83%	10%	7%	510	6.2
LEEDS	83%	9%	9%	902	3.1
NORTHALLERTON	83%	15%	3%	40	1.4
PETERBOROUGH	82%	9%	9%	584	4.4
EDINBURGH	81%	10%	8%	740	6.6
RETFORD	80%	12%	7%	82	2.4
NEWARK NORTH GATE	80%	10%	10%	315	3.1
BERWICK-UPON-TWEED	80%	11%	9%	105	12.4
INVERNESS	80%	14%	6%	50	4.9
HAYMARKET	79%	17%	3%	29	5.7
DUNDEE	79%	2%	19%	43	9.2
LONDON KINGS CROSS	79%	10%	12%	2591	6.0
GLASGOW CENTRAL	78%	11%	10%	134	6.3
ABERDEEN	78%	8%	14%	76	12.5
STEVENAGE	77%	12%	11%	108	7.6
MOTHERWELL	74%	11%	15%	47	4.7
PERTH	72%	20%	8%	25	4.9
ALNMOUTH	59%	30%	11%	27	6.2

The Stations below are ranked by how often they are either the journeys origin or destination.

Station	Usage	% of Journeys
LONDON KINGS CROSS	6665	68%
YORK	1944	20%
NEWCASTLE	1732	18%
EDINBURGH	1541	16%
LEEDS	1338	14%
DONCASTER	1064	11%
PETERBOROUGH	1043	11%
NEWARK NORTH GATE	679	7%
GRANTHAM	648	7%
DARLINGTON	608	6%

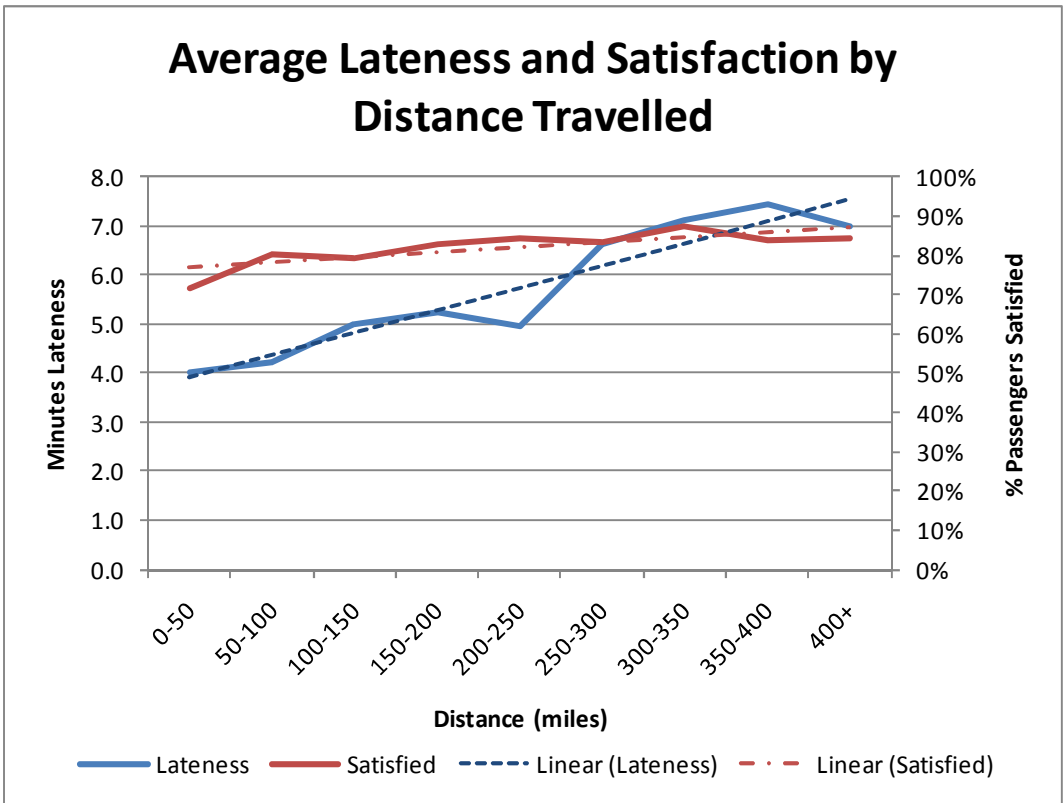
Below it can be seen how the flows are ranked, split by journey purpose

Business	Commute	Leisure	All
London <> West Yorks	Northern flows	Northern flows	Northern flows
London <> North East	London <> Commuter Core	London <> North East	London <> North East
London <> North Yorks	Other flows	Other flows	London <> Commuter Core
London <> Commuter Core	London <> North East	London <> West Yorks	London <> West Yorks
Northern flows	London <> North Yorks	London <> Scotland	Other flows
Other flows	London <> West Yorks	London <> North Yorks	London <> North Yorks
London <> South & East Yorks	London <> South & East Yorks	London <> Commuter Core	London <> Scotland
London <> Scotland	London <> Scotland	London <> South & East Yorks	London <> South & East Yorks

## Distance

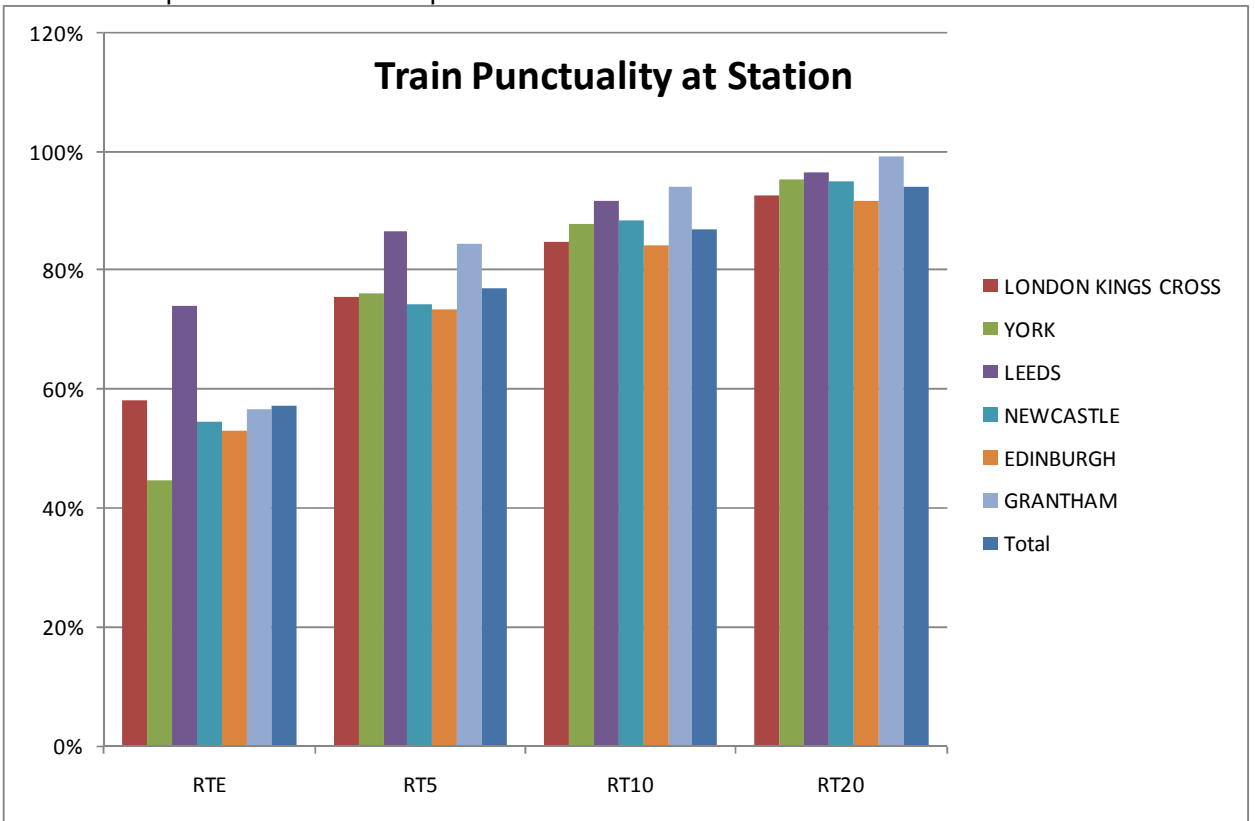
	Lateness	Distance
London <> Commuter Core	3.6	101.9
London <> North East	5.8	256.9
London <> North Yorks	6.0	189.8
London <> Scotland	7.2	409.2
London <> South & East Yorks	6.1	159.6
London <> West Yorks	4.3	183.8
Northern flows	6.0	116.8
Other flows	5.0	138.6
<b>Total</b>	<b>5.4</b>	<b>182.5</b>

Distance	Lateness	Satisfied	Neither	Dissatisfied	Travellers
0-50	4.0	72%	14%	14%	745
50-100	4.2	80%	10%	10%	978
100-150	5.0	79%	10%	11%	1593
150-200	5.3	83%	9%	8%	3235
200-250	4.9	84%	9%	7%	735
250-300	6.6	83%	8%	8%	1182
300-350	7.1	87%	9%	4%	166
350-400	7.4	84%	8%	8%	565
400+	7.0	85%	8%	8%	207
<b>Total</b>	<b>5.4</b>	<b>81%</b>	<b>10%</b>	<b>9%</b>	<b>9406</b>



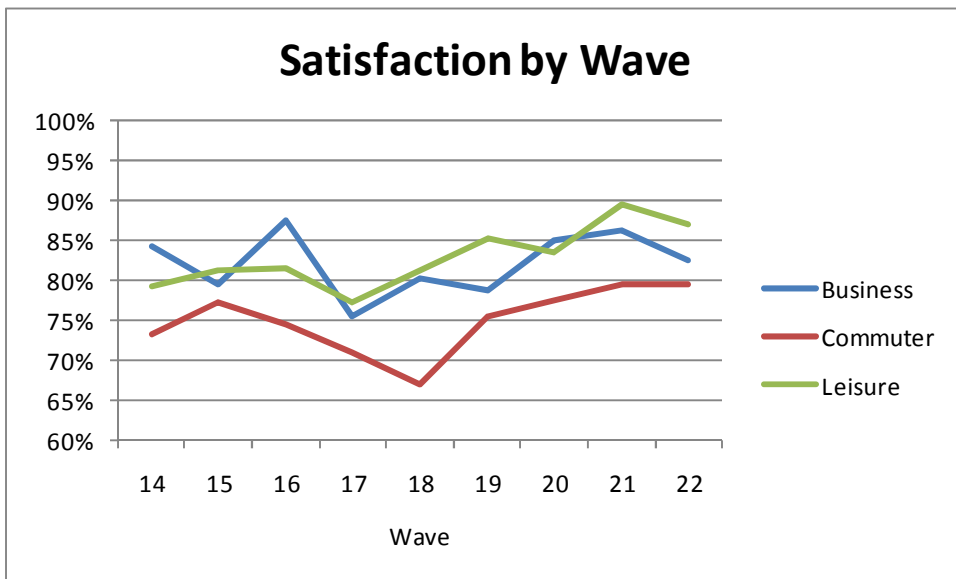
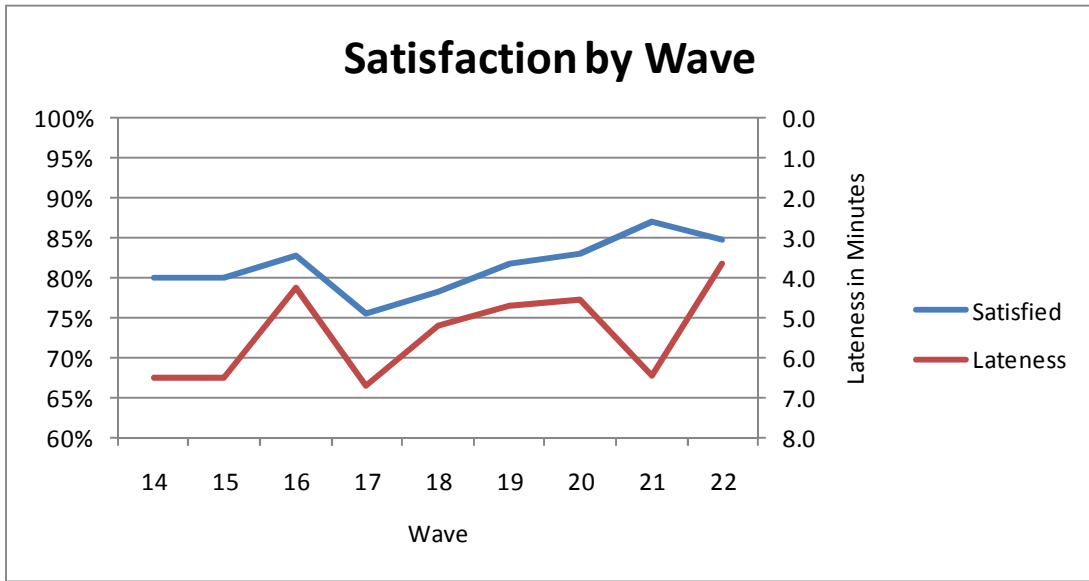
### Punctuality

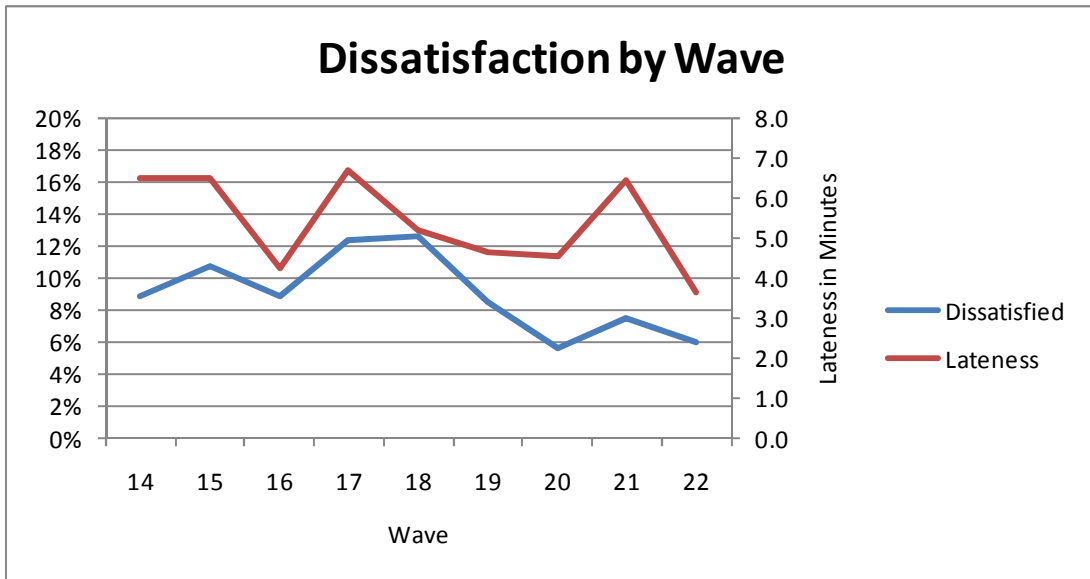
Below is a representation of how punctual the trains are for a selection of busier stations.





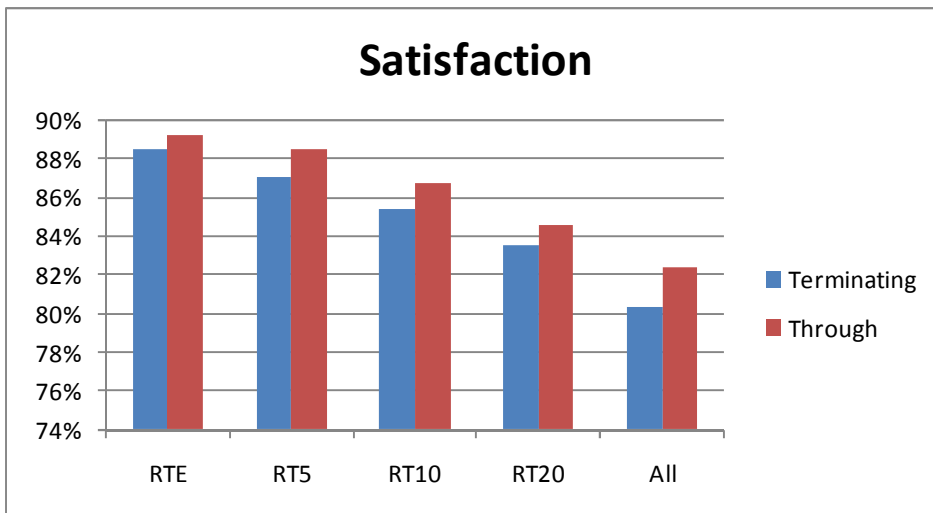
### Satisfaction by Wave

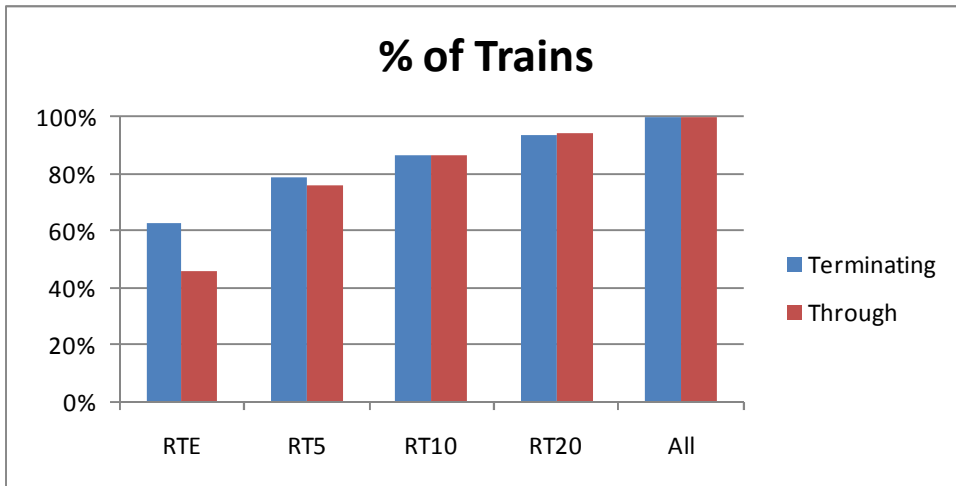




### Terminating vs. Through

Lateness	% Satisfied	Average Lateness		
		Satisfied	Not Satisfied	Total
Train Terminates	80%	0.03	12.70	2.53
Through Train	82%	2.92	12.65	4.63
<b>Total</b>	<b>81%</b>	<b>1.58</b>	<b>12.67</b>	<b>3.64</b>





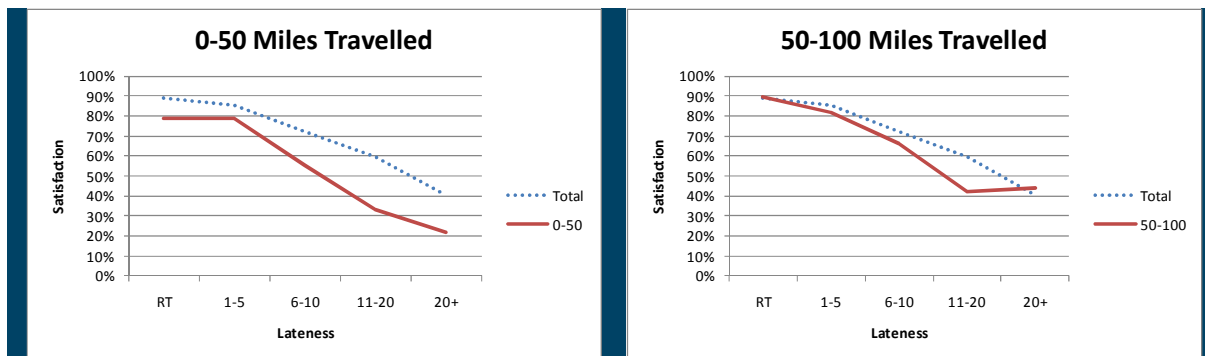
The table below shows the differences for passengers alighting at Doncaster from trains heading Northwest, North or South.

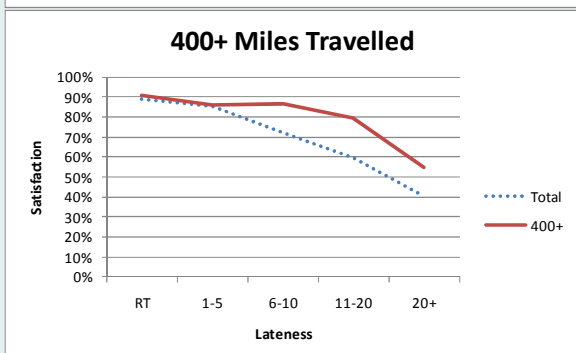
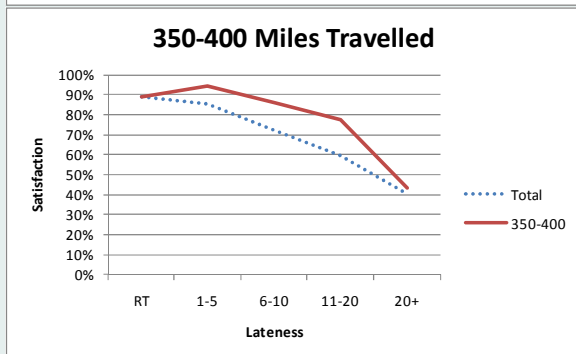
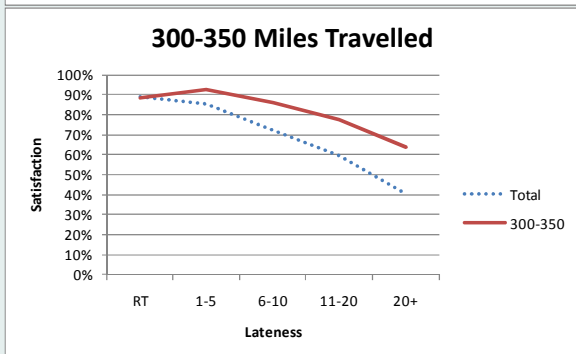
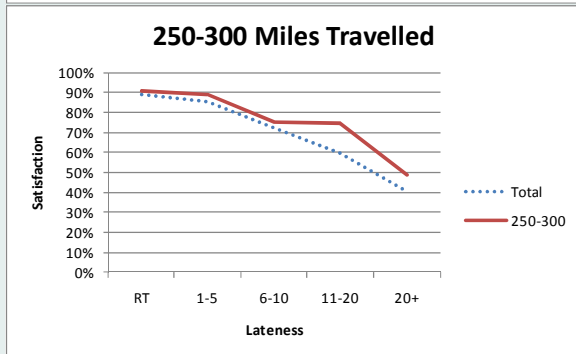
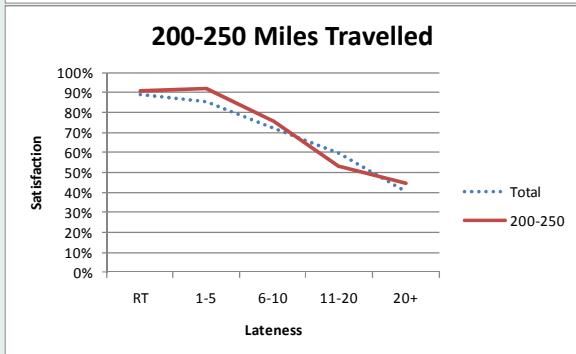
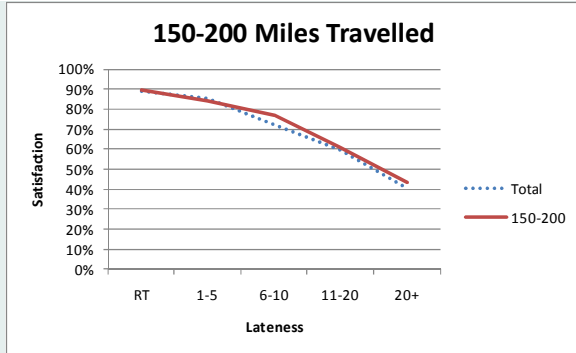
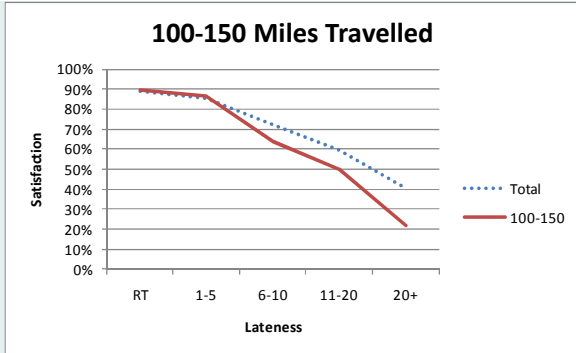
Train routes for passengers alighting at Doncaster		
Route	Average Lateness	% Satisfied
North	4.34	88%
Northwest	8.25	83%
South	3.92	79%

### Satisfaction vs. Lateness Charts

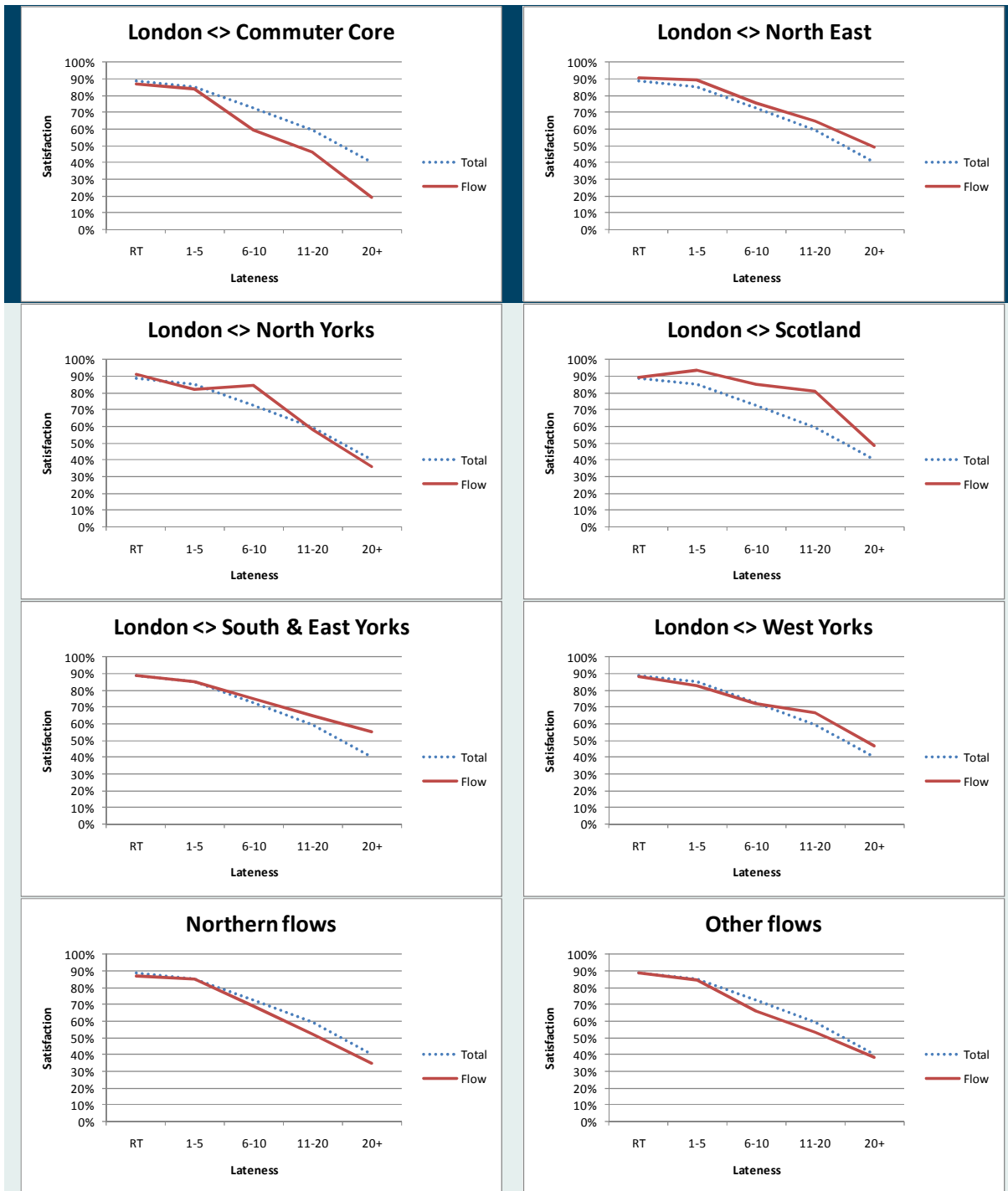
In this section the charts show how passenger satisfaction behaves with increasing lateness for a selection of different splits.

#### Distance

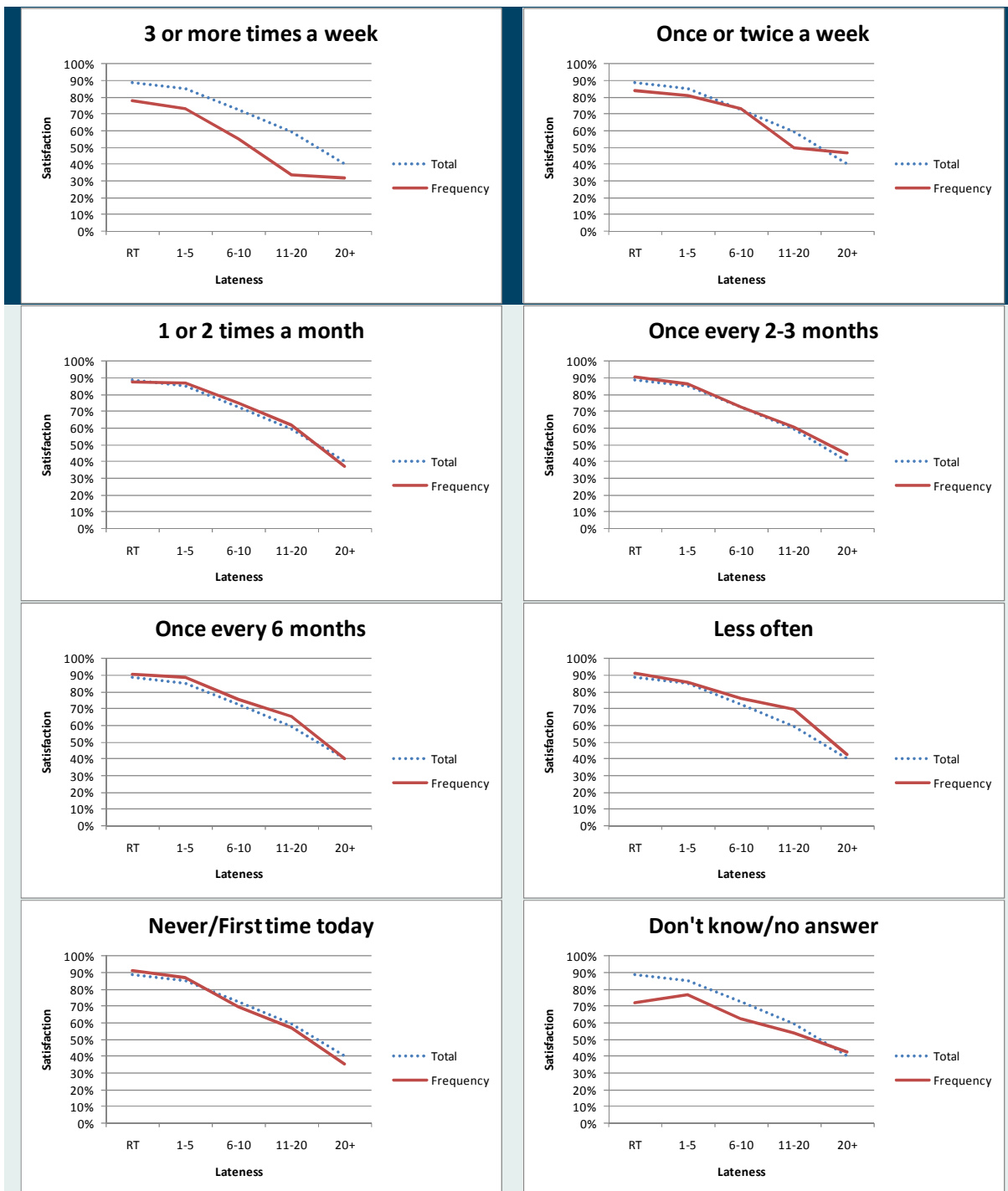




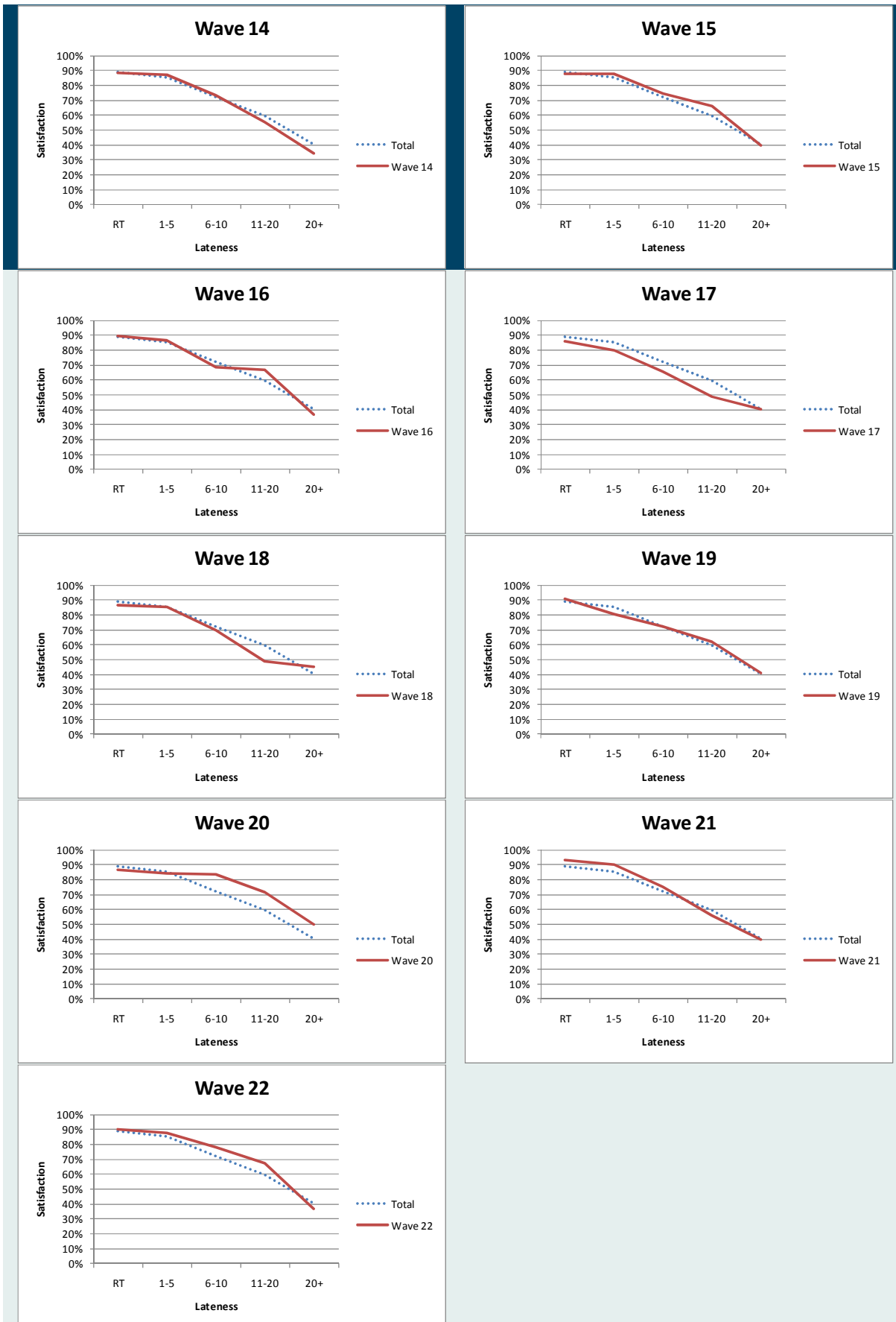
# Flow



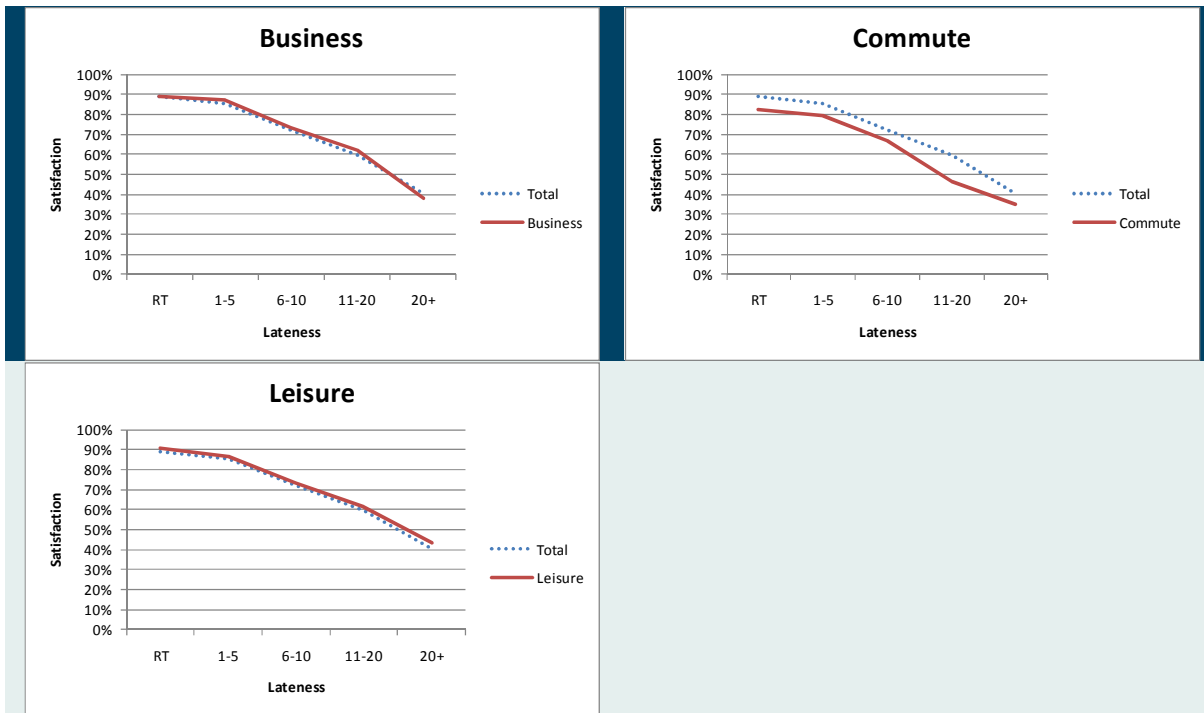
# Frequency



# NPS Wave



## Journey Purpose



## Various Satisfactions and Ratings

The charts below show the percentage of people that answered “satisfied” or “good” out of the total amount of people rating the corresponding category. This excludes people not answering the question, having no opinion or that did not use the services/facilities.

