

## Impact of a Daily Season Parking Scheme on Car Park Usage at the Workplace

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**Introduction – What is the issue today?**

**Part 1: Impact of Daily Season Parking on Car Park Usage @ Land Transport Authority, Singapore**


**Part 2: Results from “Car-Lite” RCT at Singapore’s Ministry of Environment and Water Resources (ENV Building)**

**Summary and Discussion**




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### What is the issue today?



One policy lever to reduce car use is to **charge for workplace parking**. In Singapore, workplace parking is usually paid on a monthly basis at a fixed amount determined by the employer.

However, monthly season parking as described above might engender a **sunk cost effect** (Arkes and Blumer, 1985). Moreover, the cost of monthly season parking is **not salient**, implying that people may not be considering all relevant costs when making the decision to drive to work.



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### Daily Season Parking (DSP) @ LTA

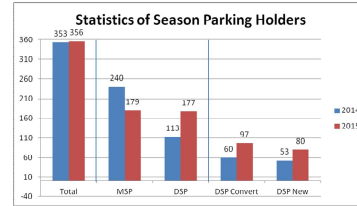
- Implemented in August 2013 as a possible nudge to mitigate the sunk cost effect and to make the marginal cost of driving more salient
- Existing Monthly Season Parking (MSP) holders are given the option to convert to DSP
  - Decision to convert is irrevocable, but parking privileges remain the same
  - New staff (and new applicants) are emplaced on DSP (no choice)

Season parking charges (as of Dec 2015):

	Monthly Season Parking (MSP) Holders	Daily Season Parking (DSP) Holders
Open Air Car Park	\$565	\$53.60
Multi-Storey Car Park	\$590	\$55

\$55 = US\$0.75

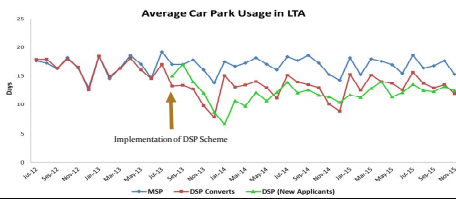
### As at Dec 2015, 177 staff were under DSP scheme, among them 97 were converted from MSP; 179 staff remained under MSP scheme



Note: DSP Convert – staff who are now DSP Holders, previously converted from MSP scheme  
 DSP New – all new Season Parking Holders are automatically opted in the DSP scheme after the implementation of DSP in Aug 2013

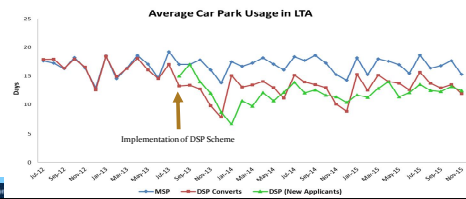
### DSP holders used the car park less than the MSP holders after conversion

Avg. No. of Days Per Month	MSP holders	DSP Holders	Difference between MSP and DSP Holders
Jan 14 to Dec 14	16.9 days	12.4 days	4.5 days
Jan 15 to Dec 15	17.1 days	11.4 days	5.7 days
Difference	+ 0.2 days	- 1 days	



### New DSP holders use the car park less than DSP-converts

Avg. No. of Days Per Month	DSP-Converts	New DSP Holders
Jul 12 – Jul 13	16.2 days	-
Aug 13 – Dec 14	12.6 days	11.6 days
Jan 15 – Dec 15	12.0 days	10.6 days



To account for individual differences between DSP-converts & MSP holders, a Difference-in-Difference (DID) analysis was used to estimate the impact of DSP on car park usage

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**Regression Results**

- Regression adjusted estimates showed that DSP scheme reduced car park usage by approximately **3.5** days per month per DSP-convert as compared to those who remained on the MSP scheme
- Robustness tests also show that this result is statistically significant

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**Regression Results**

	Change in average monthly car park usage		
Effect of DSP on car park usage	<b>-4.00***</b> (0.437)	<b>-4.03***</b> (0.435)	<b>-3.46***</b> (0.490)
Clustered regression	Yes	Yes	Yes
Included time (month) fixed effects	No	Yes	Yes
Included individual fixed effects	No	No	Yes
R square	0.11	0.18	0.52
Observations	12827	12827	12827

Note: Standard errors reported in parentheses  
\*\*\*p<0.01, \*\*p<0.05, \*p<0.1

DSP scheme reduced car park usage by approximately **3.5** days per month per DSP-convert as compared to those who remained on the MSP scheme

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**Main reasons why MSP holders remain in their current scheme**

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**1. Unaware of the cost savings brought about by DSP scheme**

- We found that about 3/4 of non-converts would financially benefit from switching to DSP.

Average car park usage for MSP holders

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**Main reasons why MSP holders remain in their current scheme**

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**2. Consistent side trips for daily travel**

- Sending their children to school and work-related trips
- More convenient to drive daily to the office, hence the savings may not be significant on months with more working days

**3. Troublesome due to the need to top up CashCard\* frequently**

\*This is a stored value card that is used to pay for parking at many public car parks in Singapore. The card has to be topped up whenever the value is low.

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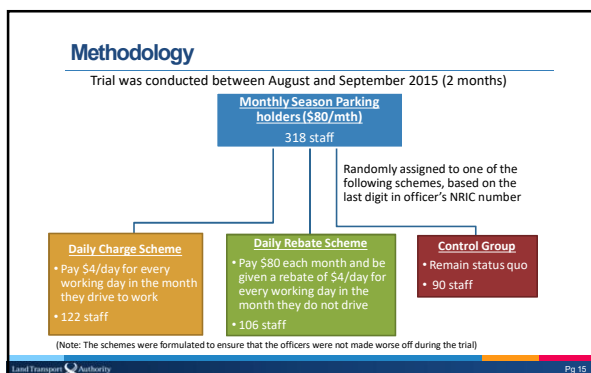
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## Introduction

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1. To investigate whether a usage-based pricing policy could reduce the rate at which officers with monthly season parking drive to work
2. Findings could inform ways to discourage driving to work and encourage alternative modes of transport instead
  - a. Decrease road congestion
  - b. Reduce pollutant and carbon emissions

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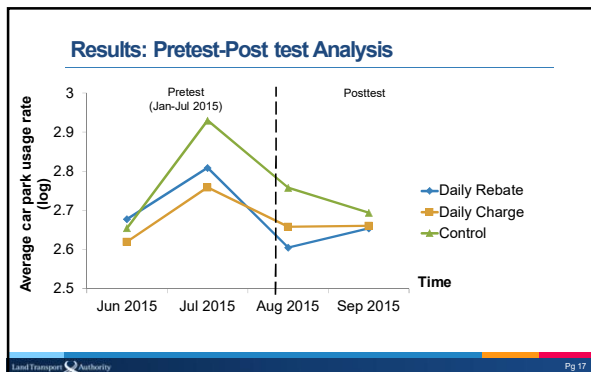


## Methodology

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1. Used difference-in-differences specification to estimate the impact of Daily Charge and Daily Rebate schemes on frequency of car park use
2. Communications approach
  - a. Email flyers sent in end July 2015 to inform officers of the trial and the group they were in
  - b. Email flyers sent in end August 2015 and end September 2015 to remind officers about the end date of the trial and prompt them to check the charges/rebates on their upcoming payslip

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### Results: Difference-in-Difference Analysis

Explanatory Variables	Change in Car Park Usage Rate	
	August 2015	September 2015
Daily Rebate	<b>-0.145***</b> (0.054)	<b>0.055</b> (0.057)
Daily Charge	<b>-0.029</b> (0.053)	<b>0.070</b> (0.065)
Clustered by Individuals	Yes	
Observations	2520	

Note: Tests to ascertain that the treatment and control groups saw parallel trends were cleared at 10% level of significance.  
 \*\*\* p<0.01, \*\* p<0.05, \* p<0.1.

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- ### What could explain the results?
- Compared to the Control Group, officers in Daily Rebate scheme reduced their car park usage rate in the 1<sup>st</sup> month of the trial by 14.5%, but failed to maintain it
    - Framed to calculate the number of days they do not drive each month (which was likely to be a small number), thus less effortful to calculate and make judgment
    - The eventual saving might not have been enough to motivate them after the 1<sup>st</sup> month of trial – possibly because of the hassle of disrupting their own habits
  - No significant reduction in car park usage rate for officers in Daily Charge scheme as compared to officers in Control Group
    - Mentally anchored to pay \$80 each month for parking?
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### Summary

- 1. Implementation of DSP scheme in LTA has been successful in reducing car-park usage among staff**
  - a. Average car park usage of DSP holders (11.4 days) was 5.7 days less than MSP holders (17.1 days)
  - b. DSP scheme reduced car park usage by approximately 3.5 days per month per DSP-convert
  - c. Success of the scheme prompted introduction of **Only DSP** at our new site office
- 2. Majority of MSP holders will benefit financially from converting to DSP**
  - a. Why they don't convert is still a bit of a puzzle, at least to neo-classical economists
- 3. However, effects of DSP on car-park usage can be context & organization-specific**
  - a. As seen in the different results from the "Car-Lite" Parking Trial at ENV Building

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### Reasons for Different Findings (Speculative)

- 1. Psychological (temporal) distance**
  - a. Parking charges or rebates were reflected in officers' payslip
  - b. Officers might not check their payslip or could only check at end of the month
  - c. However, the reward of time flexibility which came with driving was immediate
  - d. Perceived higher value in the convenience from driving and discounted the money savings
- 2. Self-selection (in LTA's scheme)**
  - a. Under a voluntary scheme, those able to gain most from a change to the status quo will choose to convert, hence converts will display a larger than average effect size
  - b. All monthly season parking holders at ENV were enrolled into the parking trial, thus smaller effect observed

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### Reasons for Different Findings (Speculative)

- 3. Organizational culture**
  - a. Car-lite initiative was intentionally less prominent for ENV Building staff to simulate what other building management might do.
  - b. LTA's employee benefits includes \$120 per month per employee for public transport, thus the cost differential between driving and taking public transport would be higher.
- 4. Worthiness of lifestyle changes**
  - a. Initiative was only a trial for 2 months
  - b. Might not find it worthwhile to change their routines for a short-term scheme

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### What's Next?

- 1. Trying to get more government agencies to introduce Daily Season Parking at the workplace.**
- 2. A stated adaptation survey to estimate behavioral change when car park charges are doubled or even tripled from current levels.**

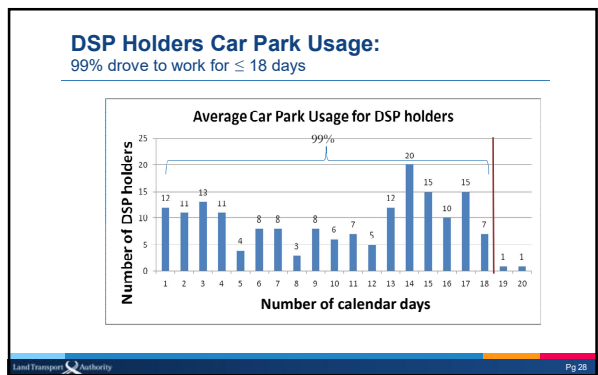
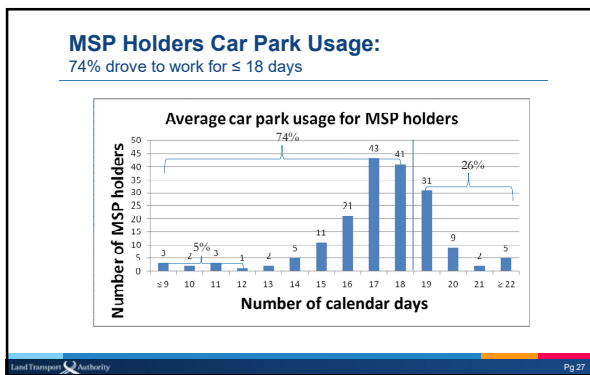
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Thank you  
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Backup Material

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To account for individual differences between DSP-converts & MSP holders, a Difference-in-Difference (DID) analysis was used to determine the impact of DSP on car park usage

No. of days of car park usage	Before Aug 2013 (Pre-DSP)	After Aug 2013 (Post-DSP)
Treatment Group (i.e. DSP converts)	A	B
Control Group (i.e. MSP holders/non-converts)	C	D

DID = Impact of DSP on car park usage = [(B - A) - (D - C)] days

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### Regression Model

$$\text{Model: } Y_{im} = \alpha + \beta_1 dsp + \beta_2 post + \beta_3 dsp * post + \epsilon$$

- $Y_{im}$  = Average number of days for car park usage by individual  $i$  at time  $m$
- $\alpha$  = average number of days for car park usage by MSP holders before DSP was implemented.
- $\beta_1$  = treatment group (DSP holders) specific effect (to account for average permanent differences between treatment and control)
- $\beta_2$  = general effect of DSP implementation
- $\beta_3$  = DID Estimator (policy effect of DSP on car park usage)

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### Technical Results

```

//DID model, with clustered regression
. reg usage dsp post DID, cl(iunumber)

Linear regression                               Number of obs = 12827
                                                F( 3, 463) = 42.07
                                                Prob > F = 0.0000
                                                R-squared = 0.1069
                                                Root MSE = 4.9949

(Std. Err. adjusted for 464 clusters in iunumber)

```

usage	Coef.	Robust Std. Err.	t	P> t	[95% Conf. Interval]
dsp	-.2086074	.358334	-0.58	0.561	-.9127699 .4955552
post	-.1136022	.1485683	0.76	0.445	-.1783495 .4055539
DID	-4.003026	.4366234	-9.17	0.000	-4.861035 -3.145017
_cons	16.73224	.1368248	85.01	0.000	16.34546 17.11902

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### Technical Results (2)

```

//DID model, with IU number & time (month) FE [added on 23 Feb 2016]
. xi: reg usage dsp post DID i.mth i.iunumber, cl(iunumber)

Linear regression                               Number of obs = 12827
                                                F( 40, 463) = .
                                                Prob > F = .
                                                R-squared = 0.5253
                                                Root MSE = 3.715

(Std. Err. adjusted for 464 clusters in iunumber)

```

usage	Coef.	Robust Std. Err.	t	P> t	[95% Conf. Interval]
dsp	1.571692	.5406919	2.91	0.004	.5091774 2.634206
post	-.7811775	.3050465	-2.56	0.011	-1.380625 -.1817304
DID	-3.463984	.4699699	-7.07	0.000	-4.426825 -2.501144

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### DID, with management fixed effects

```
. reg usage dsp post DID mgmt, cl(iunumber)
```

Linear regression

Number of obs = 12827  
 F( 4, 463) = 33.32  
 Prob > F = 0.0000  
 R-squared = 0.1094  
 Root MSE = 4.988

(Std. Err. adjusted for 464 clusters in iunumber)

usage	Coef.	Robust Std. Err.	t	P> t	[95% Conf. Interval]
dsp	-.32363	.3648674	-0.89	0.376	-1.040631 .3932713
post	.112907	.1482188	0.76	0.451	-.1792579 .4031719
DID	<b>-4.023642</b>	.43832	-9.18	0.000	-4.884985 -3.162299
mgmt	.6552302	.3567613	1.84	0.067	-.0458417 1.356302
_cons	16.62555	.2067525	80.41	0.000	16.21926 17.03184

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### Poisson Regression

```
. poisson usage dsp post DID, cl(iunumber) irr
```

Iteration 0: log pseudolikelihood = -42164.522  
 Iteration 1: log pseudolikelihood = -42164.522

Poisson regression

Number of obs = 12827  
 Wald chi2(3) = 98.63  
 Log pseudolikelihood = -42164.522  
 Prob > chi2 = 0.0000


(Std. Err. adjusted for 464 clusters in iunumber)

usage	IRR	Robust Std. Err.	z	P> z	[95% Conf. Interval]
dsp	.9875326	.0213331	-0.58	0.561	.9465933 1.030242
post	1.006789	.0089264	0.76	0.445	.989445 1.024438
DID	<b>.7594582</b>	.0237111	-8.81	0.000	.7143786 .8073824
_cons	16.73224	.1968018	239.53	0.000	16.35092 17.12244


Rate of car-park usage by the DSP holders was approximately 76% of that by the MSP holders

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#### Car Park Gantry at LTA



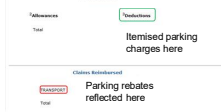
#### Cash Card and IU



#### Car Park Gantry at ENV Building



#### Payslip Template



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### Pretest-Posttest Analysis

Car Park Usage Rate	Pretest		Posttest (Aug 15)			Posttest (Sep 15)			n
	M	SD	M	SD	t	M	SD	t	
Daily Rebate	2.572	0.476	2.609	0.467	0.648	2.656	0.396	1.814	97
Daily Charge	2.528	0.565	2.657	0.493	2.621	2.656	0.447	2.680	108
Control	2.554	0.610	2.755	0.241	2.971	2.691	0.366	1.806	79

\*\*\* p<0.01, \*\* p<0.05, \* p<0.1.

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### Parallel Trends Test

The test indicated that the control group followed similar trend to the treatment groups during pre-treatment

<i>Explanatory Variables</i>	<i>Change in Car Park Usage Rate</i>
<i>Daily Rebate × Pre-treatment</i>	<b>0.0449</b> (0.038)
<i>Daily Charge × Pre-treatment</i>	<b>0.0328</b> (0.0399)
Fixed effects	Yes
Observations	1923

\*\*\* p<0.01, \*\* p<0.05, \* p<0.1, based on robust standard errors.

### Regression (with Fixed Effects)

<i>Explanatory Variables</i>	<i>Change in Car Park Usage Rate</i>	
	August 2015	September 2015
<i>Daily Rebate</i>	<b>-0.126**</b> (0.0519)	<b>0.0134</b> (0.0497)
<i>Daily Charge</i>	<b>-0.0466</b> (0.0467)	<b>0.0205</b> (0.055)
Observations	2520	2520

Note: Tests to ascertain that the treatment and control groups saw parallel trends were cleared at 10% level of significance. \*\*\* p<0.01, \*\* p<0.05, \* p<0.1, based on robust standard errors.

### Post-Trial Survey

### Methodology

1. Survey asked about officers' driving patterns, perception towards driving and comments on the trial
2. Released on MEWR intranet in early November 2015
3. Email flyers were sent to encourage officers in Daily Charge and Daily Rebate schemes to participate in the survey
4. Out of 228 officers, 46 responded to the survey

### Survey Results

Survey Responses (n = 46)	Inference
<ul style="list-style-type: none"> <li>57% found the monthly season parking fee at ENV Building <b>inexpensive</b></li> </ul>	<p>Cost of monthly season parking does not deter the majority from applying for monthly permits to drive to work</p> <p>Low monthly cost also translated to low daily charge / rebate</p>
<ul style="list-style-type: none"> <li>74% agreed or strongly agreed that driving had become their <b>habits</b></li> </ul>	<p>Driving to work has become a daily routine which does not go through much conscious consideration</p>

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### Survey Results

Survey Responses (n = 46)	Inference
<ul style="list-style-type: none"> <li>57% drove between work and home with <b>regular side-trips</b></li> <li>13% often had <b>work-related trips</b></li> </ul>	<p>Most officers drive to work for personal and family needs more than for work-related needs</p>
<ul style="list-style-type: none"> <li>85% agreed or strongly agreed that they enjoyed the <b>time flexibility</b> that came with driving to work</li> </ul>	<p>Perceived control which comes with driving is important for the majority</p>
<ul style="list-style-type: none"> <li>63% indicated that <b>public transport was inconvenient or very inconvenient</b></li> </ul>	<p>Public transport is perceived as inconvenient not so much due to the commute time/distance but due to lowered control over activities</p>

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### Survey Results

What do you think of the monthly season parking fee at ENV Building?	Freq.	%
Very Cheap	0	0
Inexpensive	26	56.52
Expensive	19	41.3
Very Expensive	1	2.17

Which of the following patterns form the largest proportion of your daily weekday travel?	Freq.	%
Direct commute between workplace and home with little or no side-trips	14	30.43
Commuting between workplace and home with regular side-trips (e.g. For children's travel)	26	56.52
Work-related trips (e.g. To go for meetings off-site)	6	13.04
Family or personal reasons (e.g. Appointments)	0	0

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### Survey Results

What are the considerations that you make before deciding to drive to work? (May choose more than one)	Freq.	%
I need to send family members to work or school	26	56.52
I need to drive to other private appointments scheduled for the day	10	21.74
I need to drive off-site to work appointments scheduled for the day	19	41.3
I need to run errands for my household	12	26.09
Weather of the day	8	17.39

Others:

- Time of the year. If school holidays, lighter crowd at train and bus stations.
- Public transport is not convenient.
- Rather get stuck in traffic jam in the comfort of my car than get stuck on MRT.
- Long distance from home to work.
- Packed and inconvenient public transport.
- Convenient and shorter travelling time.
- Home is too far away.
- To save time on travelling.
- Convenience.

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### Survey Results

Driving to work has become a habit of mine	Freq.	%
Strongly disagree	1	2.17
Disagree	4	8.7
Neutral	7	15.22
Agree	27	58.7
Strongly agree	7	15.22

I enjoy the time flexibility that comes with driving a car to work.	Freq.	%
Strongly disagree	1	2.17
Disagree	1	2.17
Neutral	5	10.87
Agree	26	56.52
Strongly agree	13	28.26

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### Survey Results

How would you rate coming to work by public transport	Freq.	%
Very inconvenient	13	28.26
Inconvenient	16	34.78
Convenient	16	34.78
Very convenient	1	2.17

Did you check the parking fees charged / parking rebates received on your pay slip?	Freq.	%
Yes	32	69.56
No	14	30.43

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### Survey Results

During the parking trial, did the potential money savings motivate you to try to reduce your frequency of driving to work?	Freq.	%
I was not motivated at all	20	43.48
I was slightly motivated	15	32.61
I was quite motivated	7	15.22
I was highly motivated	4	8.7

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