

Post-accident adaptation behavior and dynamic travel information: A comparison between the elderly and non-elderly

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Introduction

- Serious negative impacts of traffic accidents are represented not only by the large amount of property losses and human injury and fatality tragedies, but also the huge amount of travel time losses, follow-up accident recurring and so on.
- It is expected that effective countermeasures of ITS-based real-time accident information provision play various important roles in solving the above negative impacts.
- Information provision studies about how to provide valuable information and whether or not display reliability information to drivers become more and more important in the current traffic accident information studies.

Purpose

- ▶ Focusing on the expressway in Japan, this study examines how individualized dynamic traffic information influences drivers' adaptation behavior under different decision scenes and contexts.

In addition to conventional traffic information, several new types of traffic information related to the occurrence of traffic accidents are also reflected.

Expressways under study

4

Total length
More than 1,200 km

Chugoku Region West NEXCO



A large-scale web survey

2,500
persons

Pilot
Survey
(2011.12)

- Travel information needs

Residents residing in the five prefectures in the Chugoku Region, who used the expressway at least once within the past one year.

1,923
persons
(78%)



Fresh 577
persons

SP Survey
(2012.04)

- Adaptation behavior

577 Drop out
persons

new respondents: 577

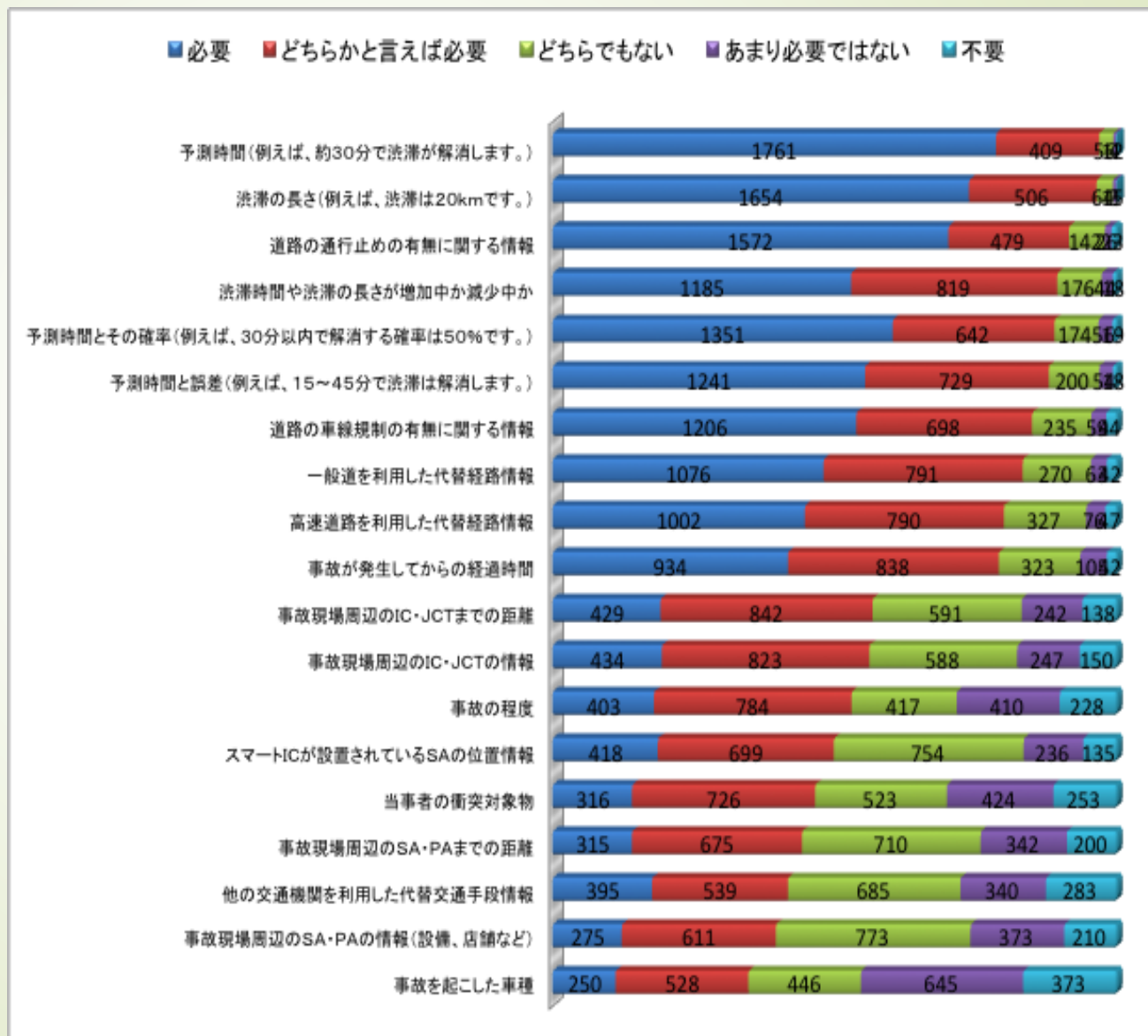
Representative sample:

30,000 SP responses
(No. 1 in the world !?)

- 2,500 respondents (12 cards/person)
- 3 scenes: Before departure, On the way to expressway, On expressway
(10,000(=2,500 * 4 SP)/scene)

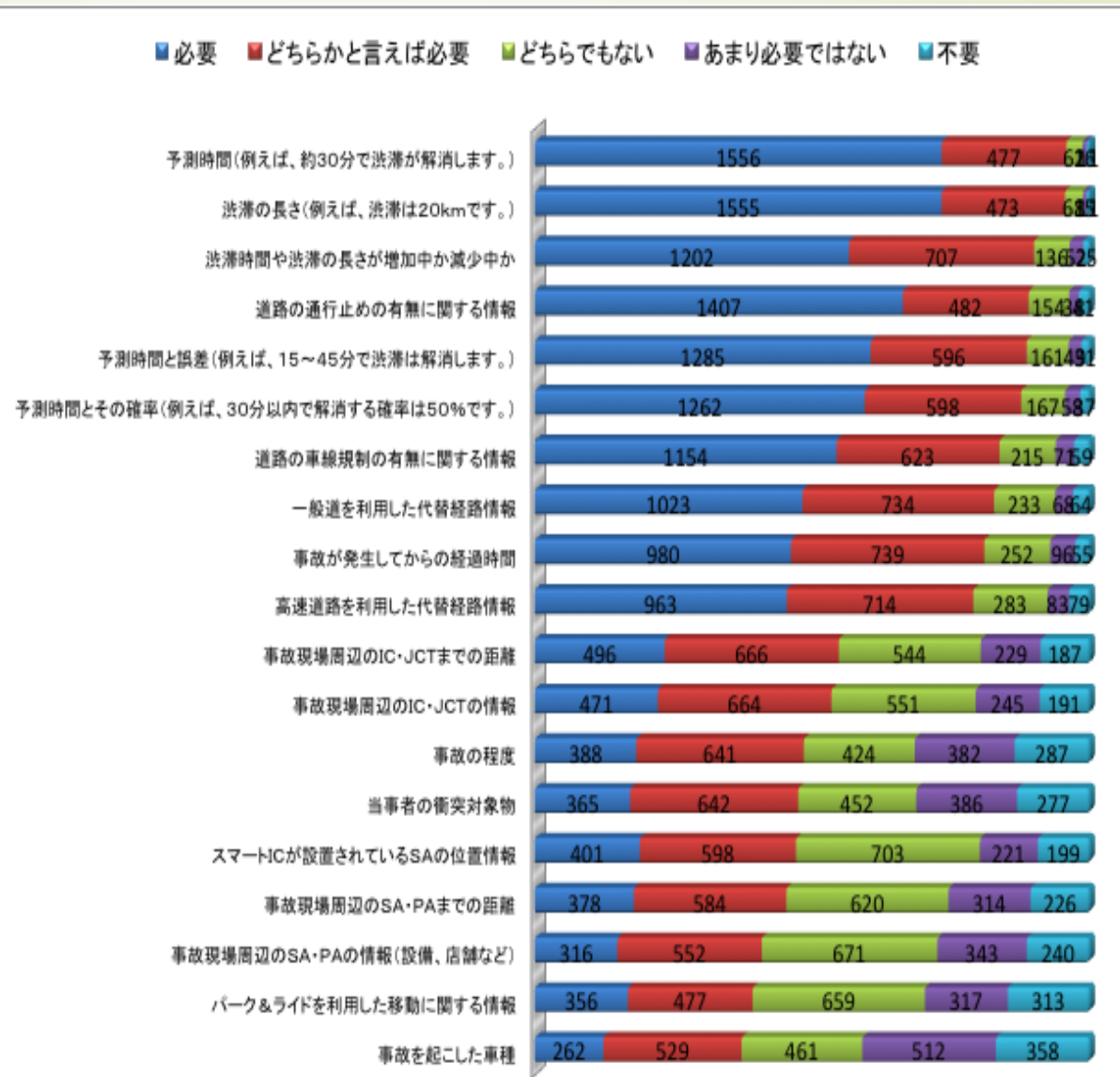
Travel information needs

Before
departure



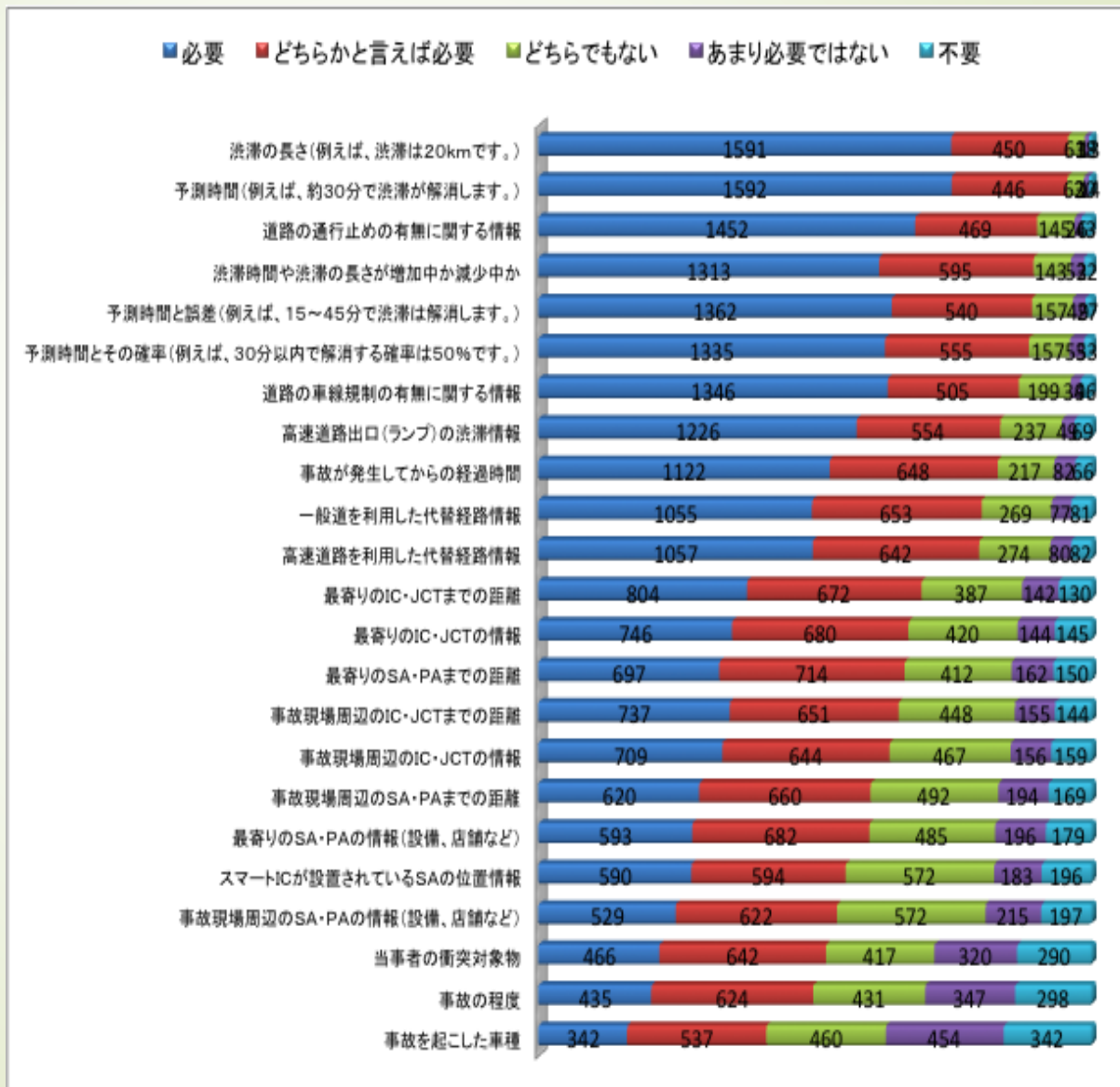
Travel information needs

On the way
to
expressway



Travel information needs

On expressway



SP survey: Attributes

Based on the pilot survey conducted in 2011, this study selected 12 attributes, each of which has two or three levels, including

- ◆ **accident condition information** (two attributes): (1) location from entrance ramp to the accident site (hereafter, distance to site) (close or far) and (2) accident severity (fatal, no fatal, or no information));
- ◆ **accident impact information** (two attributes): (3) queue length (long, short, or no information) and (4) queue changing trend (increase, decrease, or no information);
- ◆ **alternative route or travel mode information** (three attributes): (5) ordinary road, (6) other expressway route, and (7) other travel modes; all the three attributes have the same three levels, i.e., yes, no, or no information; and
- ◆ **traffic measure information** (five attributes): (8) traffic regulation (with/without regulation, or no information), (9) clearance time (long, short, or no information), (10) clearance time estimation accuracy (high or low), (11) probability of clearing away the traffic congestion at a certain clearance time (high (80%), low (60%)), and (12) time provision method (point information or interval information).

Orthogonal fractional factorial design: 24 SP profiles were obtained

SP survey: Alternatives

Before departure & On the way to expressway		On expressway	
1	No change	1	No change
2	Change departure time (Early departure)	2	Wait& see at SA/PA
3	Alternative ordinary road	3	Alternative expressway
4	Other travel mode	4	Ordinary road detour
5	Cancel the trip	5	Ordinary road
		6	Other travel mode
		7	Cancel the trip

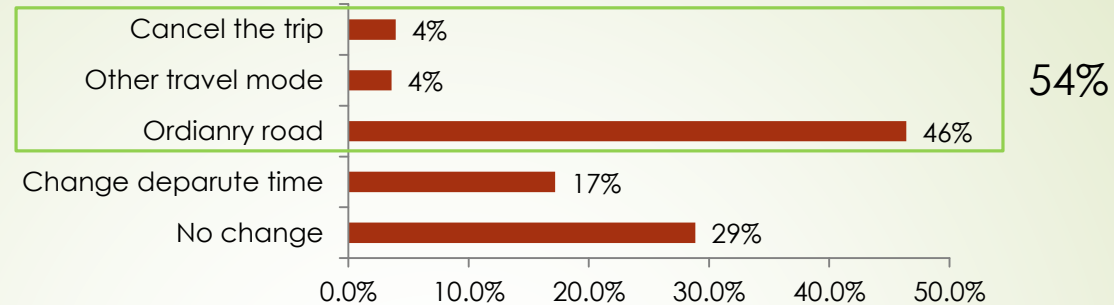
SP profiles

Card no.	Q-length	Q-trend	Clearance time	Accuracy of clearance Time interval	Time interval provision	Accident Severity	Alternative ordinary road	Alternative expressway	Other travel mode	Lane regulation	Distance to accident site	Clearance time accuracy
card_1	Long	No info	Short	No info	No info	No info	No info	No info	No info	No info	Long	60%
card_2	No info	Increasing	Short	No info	No info	No info	Don't have	Don't have	Have	Don't have	Long	60%
card_3	Short	Decreasing	Long	No info	No info	No info	Have	Have	Don't have	Have	Short	60%
card_4	Short	Increasing	Long	High accuracy	Provision	No info	No info	No info	Have	No info	Short	80%
card_5	Long	Decreasing	Long	High accuracy	No info	Have fatal accident	Have	No info	Have	Don't have	Long	60%
card_6	Long	Increasing	Short	Low accuracy	No info	No fatal accident	Don't have	No info	Don't have	Have	Short	80%
card_7	No info	Decreasing	Short	Low accuracy	Provision	Have fatal accident	Don't have	Have	Have	No info	Short	60%
card_8	Long	Decreasing	Short	High accuracy	Provision	No info	Don't have	Don't have	Don't have	Don't have	Long	80%
card_9	Long	No info	Long	No info	No info	Have fatal accident	Don't have	Have	Don't have	No info	Long	80%
card_10	No info	Decreasing	Long	Low accuracy	No info	No fatal accident	Have	Don't have	No info	No info	Long	80%
card_11	No info	Decreasing	Short	Low accuracy	No info	No info	No info	No info	Don't have	No info	Long	60%
card_12	Short	Increasing	Short	High accuracy	No info	Have fatal accident	Don't have	Have	No info	No info	Long	60%
card_13	No info	No info	Short	High accuracy	No info	Have fatal accident	No info	Don't have	Don't have	Have	Short	60%
card_14	Short	No info	Long	Low accuracy	No info	No info	Don't have	Don't have	No info	Don't have	Short	60%
card_15	Long	Increasing	Short	Low accuracy	No info	No info	Have	Have	Have	Have	Long	60%
card_16	Long	Increasing	Long	Low accuracy	Provision	Have fatal accident	No info	Don't have	No info	Have	Long	60%
card_17	No info	No info	Long	High accuracy	No info	No fatal accident	Don't have	No info	Have	Have	Long	60%
card_18	Long	Decreasing	Short	High accuracy	No info	No fatal accident	No info	Have	No info	Don't have	Short	60%
card_19	Short	Increasing	Short	High accuracy	No info	No fatal accident	Have	Don't have	Don't have	No info	Long	60%
card_20	No info	Increasing	Short	No info	No info	Have fatal accident	Have	No info	No info	Don't have	Short	80%
card_21	Short	No info	Short	Low accuracy	Provision	Have fatal accident	Have	No info	Don't have	Don't have	Long	60%
card_22	Short	No info	Short	Low accuracy	No info	No fatal accident	No info	Have	Have	Don't have	Long	80%
card_23	Short	Decreasing	Short	No info	No info	Have fatal accident	No info	Don't have	Have	Have	Long	80%
card_24	No info	No info	Short	High accuracy	Provision	No info	Have	Have	No info	Have	Long	80%

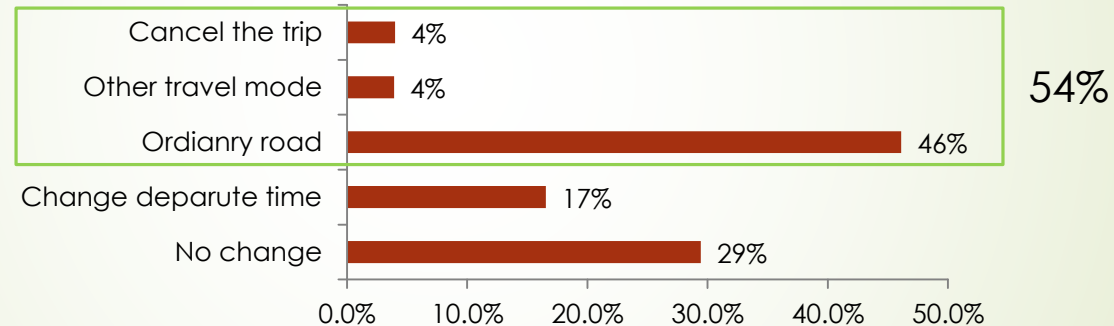
Stated adaptation behavior

12

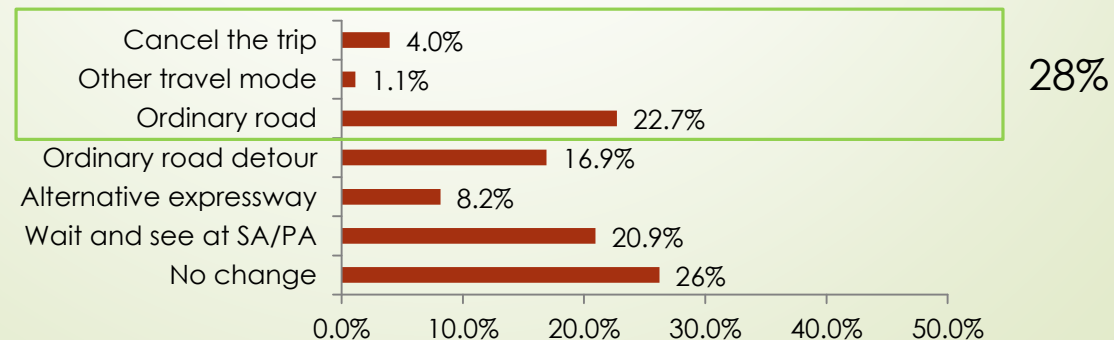
Before Departure



On the Way to Expressway

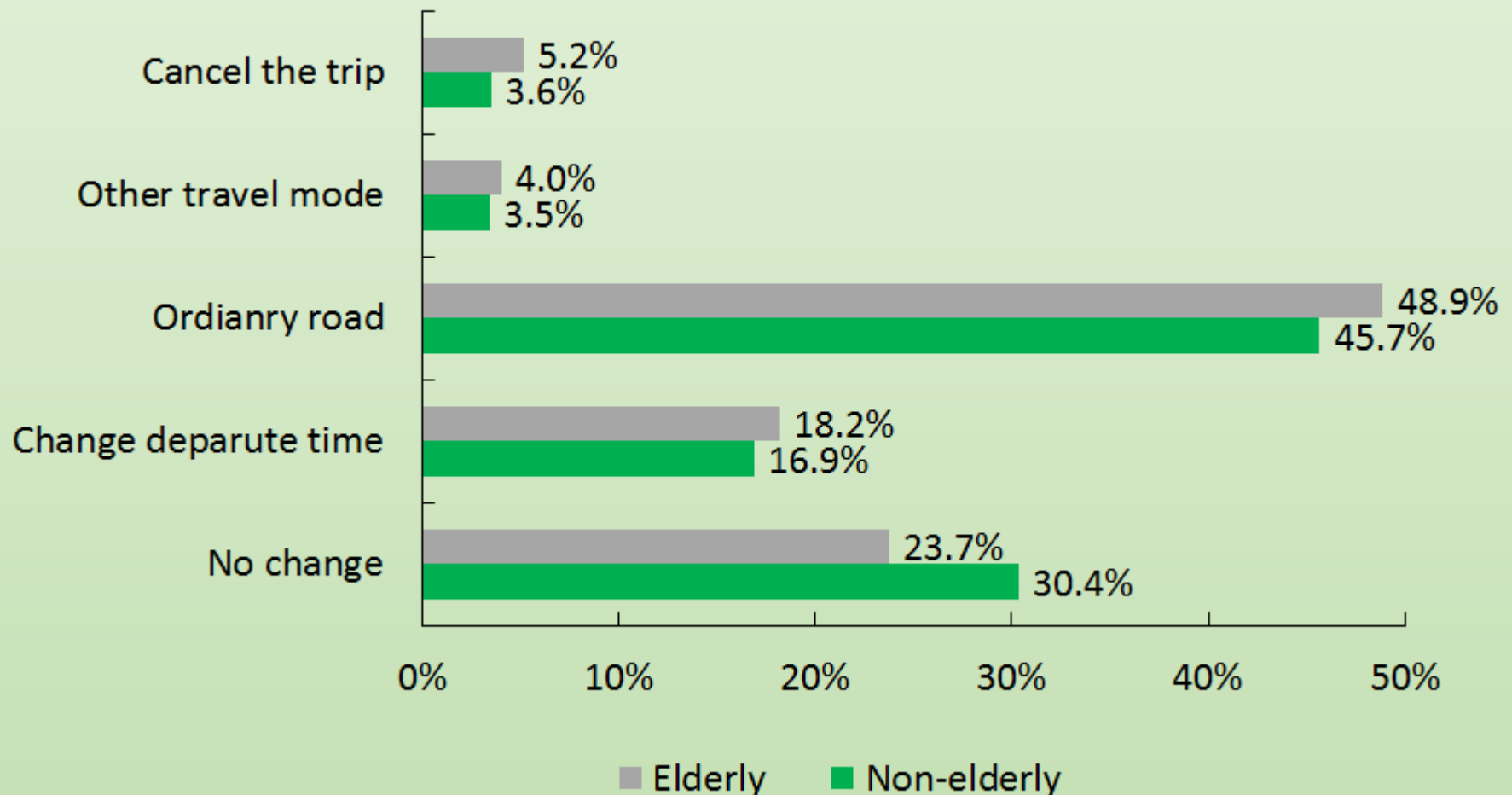


On Expressway



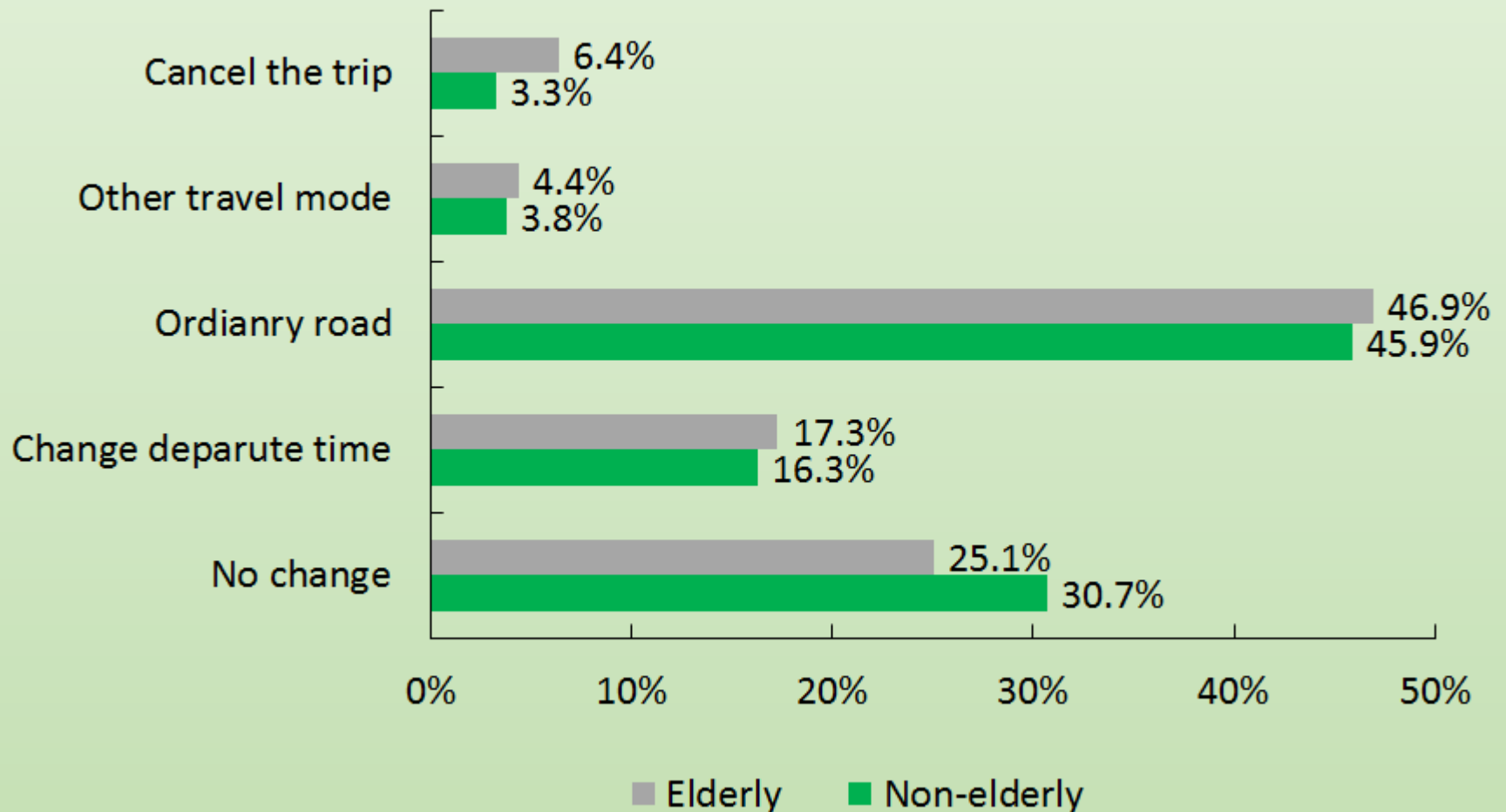
Stated adaptation behavior

Adapation behaviour: Before Departure



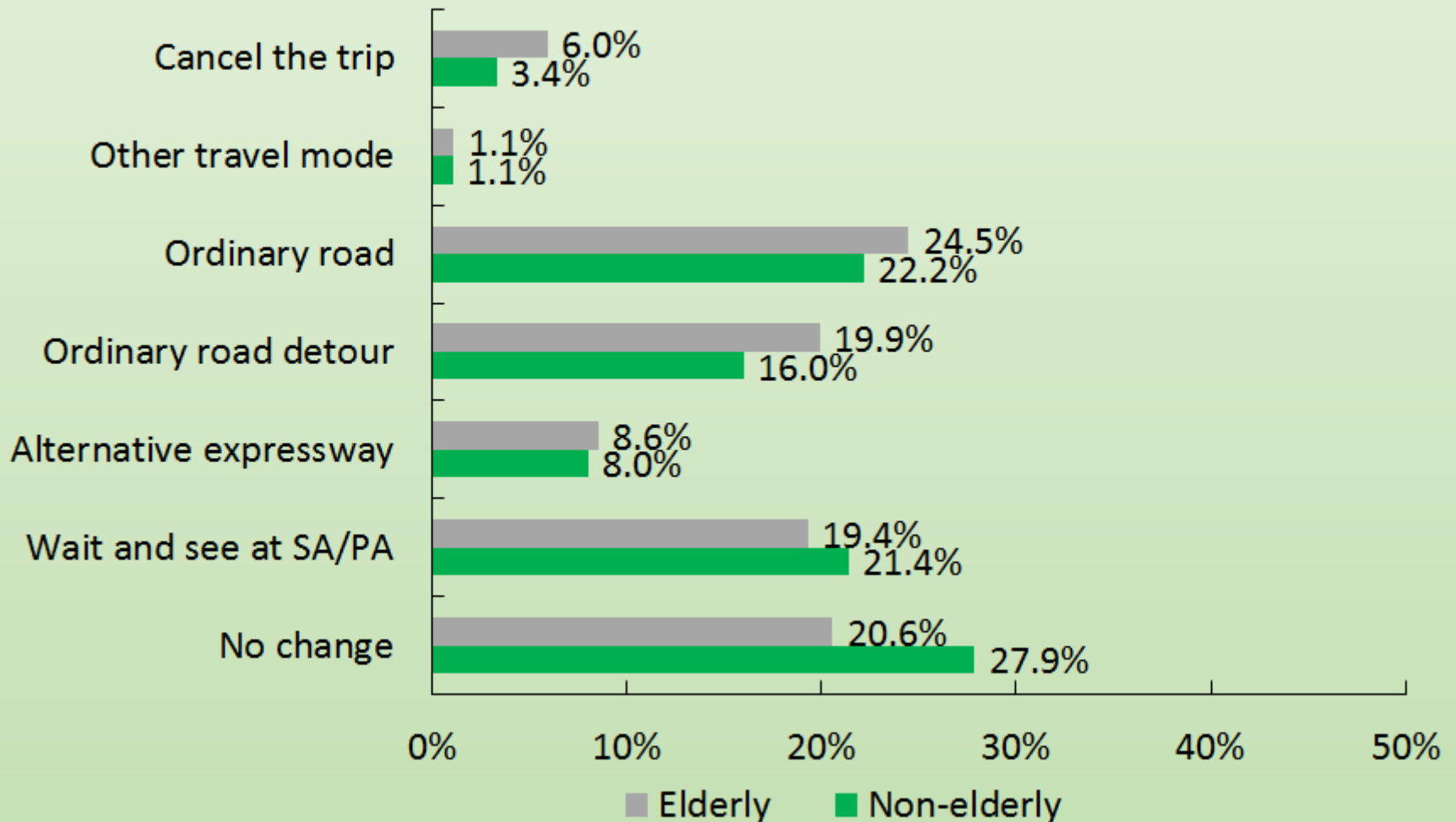
Stated adaptation behavior

Adapataction behavoiur: On the way to expressway



Stated adaptation behavior

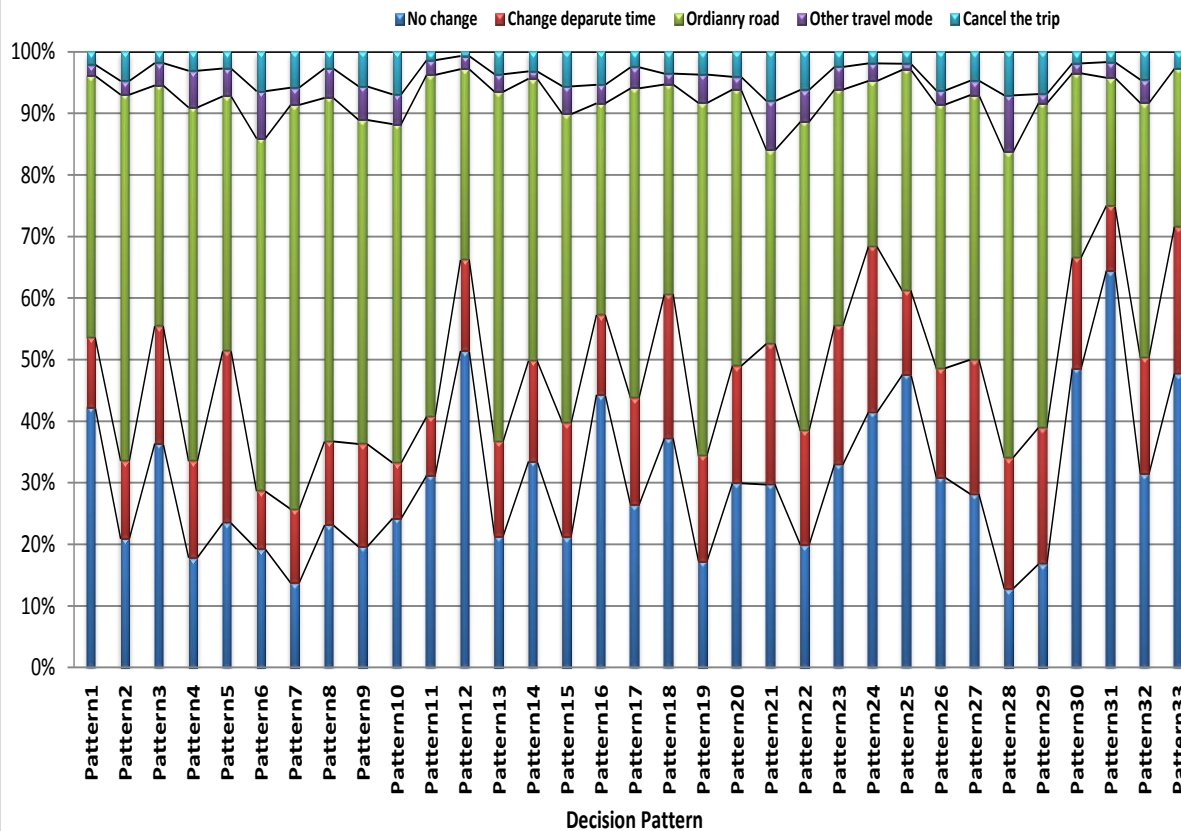
Adapatation behavoir: On expressway



Heterogeneous adaptation

Before Departure

Decision Pattern & Route Choice Behavior (Before Departure)



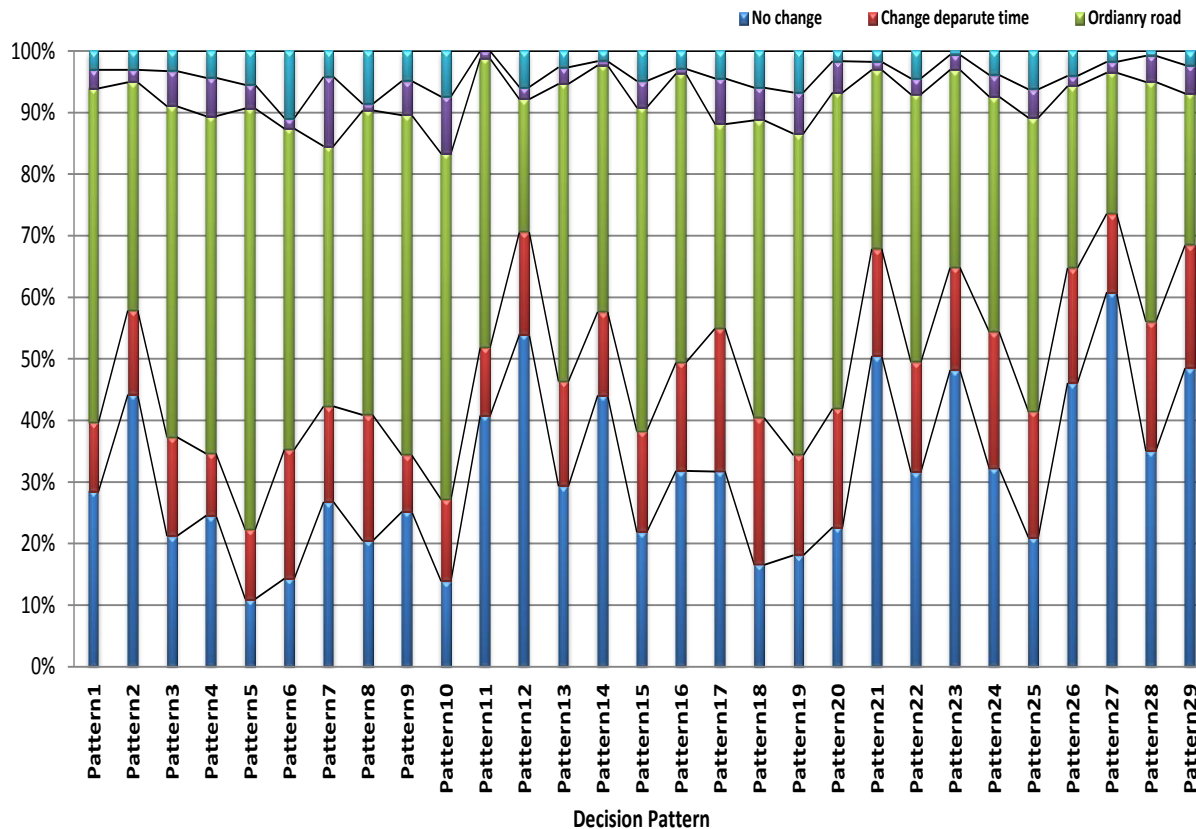
Pattern#	Distance to Site	Clearance Time	No fatal accident	Queue decrease	Fatal accident	clearing away %
1	<=17.4	<=20				
2	<=17.4	(20,28]	0			
3	<=17.4	(20,28]	1			
4	<=17.4	(28,48]	0			
5	<=17.4	(28,48]	1			
6	<=17.4	(48,68]				
7	<=17.4	(68,72]	0			
8	<=17.4	(68,72]	1			
9	<=17.4	>72		0		
10	<=17.4	>72		1		
11	(17.4,34.8]	<=28		0		
12	(17.4,34.8]	<=28		1		
13	(17.4,34.8]	(28,84]	0			
14	(17.4,34.8]	(28,84]	1			
15	(17.4,34.8]	>84				
16	(17.4,34.8]	<=20				
17	(17.4,34.8]	(20,68]		0		
18	(17.4,34.8]	(20,68]		1		
19	(17.4,34.8]	(68,84]		0		
20	(17.4,34.8]	(68,84]		1		
21	(17.4,34.8]	(84,106]				
22	(17.4,34.8]	>106				
23	(69.3,140]			0	0	
24	(69.3,140]			1	0	
25	(69.3,140]	<=28			1	
26	(69.3,140]	(28,72]			1	
27	(69.3,140]	(72,106]			1	
28	(69.3,140]	(106,142]			1	
29	(69.3,140]	>142			1	
30	>140				0	0.6
31	>140				0	0.8
32	>140			0	1	
33	>140			1	1	

Note: "clearing away %" represents "the probability of clearing away the traffic congestion at a certain clearance time;

Heterogeneous adaptation

On the way to expressway

Decision Pattern & Route Choice Behavior (Way to Expressway)



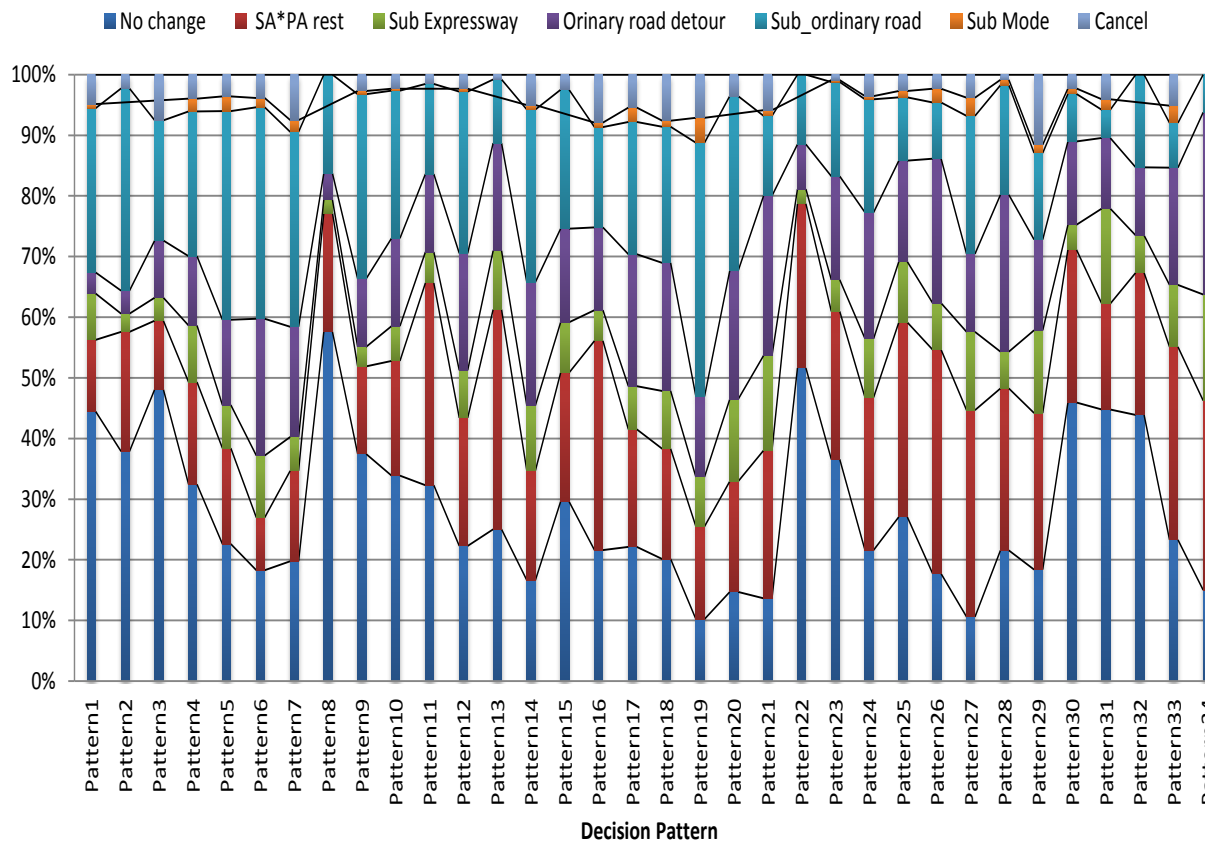
Pattern#	Distance to Site	Clearance Time	No fatal accident	Queue decrease	Fatal accident	clearing away %
1	<=17.4	<=28	0			
2	<=17.4	<=28	1			
3	<=17.4	(28,48]				
4	<=17.4	(48,84]			0	
5	<=17.4	(48,84]			1	
6	<=6	(84,106]				
7	(6,10.5]	(84,106]				
8	(10.5,17.4]	(84,106]				
9	<=6	>106				
10	(6,17.4]	>106				
11	(17.4,34.8]	<=20				
12	(34.8,69.3]	<=20				
13	(17.4,69.3]	(20,42]				0.6
14	(17.4,69.3]	(20,42]				0.8
15	(17.4,69.3]	(42,84]	0			
16	(17.4,69.3]	(42,84]	1			
17	(17.4,69.3]	(84,106]			0	
18	(17.4,69.3]	(84,106]			1	
19	(17.4,69.3]	>106		0		
20	(17.4,69.3]	>106		1		
21	(69.3,140]	<=42				
22	(69.3,140]	(42,68]				0.6
23	(69.3,140]	(42,68]				0.8
24	(69.3,140]	>68			0	
25	(69.3,140]	>68			1	
26	>140				0	0.6
27	>140				0	0.8
28	>140				1	0.6
29	>140				1	0.8

Note: "clearing away %" represents "the probability of clearing away the traffic congestion at a certain clearance time;

Heterogeneous adaptation

On expressway

Decision Pattern & Route Choice Behavior(On expressway)



Pattern#	Distance to Site	Clearance Time	No fatal accident	Queue decrease	Fatal accident	Time accuracy	clearing away %
1	<=6	<=20					
2	(6,10.5]	<=20					
3	(10.5,17.4]	<=20					
4	<=17.4	(20,68]		1			
5	<=17.4	(20,68]		0			
6	<=17.4	>68		1			
7	<=17.4	>68		0			
8	(17.4,69.3]	<=20		1			
9	(17.4,69.3]	<=20		0			
10	(17.4,69.3]	(20,42]	0				
11	(17.4,69.3]	(20,42]	1				
12	(17.4,69.3]	(42,48]	0				
13	(17.4,69.3]	(42,48]	1				
14	(17.4,69.3]	(48,72]	0				
15	(17.4,69.3]	(48,72]	1				
16	(17.4,69.3]	(72,106]		1			
17	(17.4,69.3]	(72,106]		0			
18	(17.4,69.3]	>106					<=4.8
19	(17.4,69.3]	>106					(4.8,7.7]
20	(17.4,69.3]	>106					(7.7,12]
21	(17.4,69.3]	>106					>12
22	(69.3,140]	<=42		1			
23	(69.3,140]	<=42		0			
24	(69.3,140]	(42,106]				0.6	
25	(69.3,140]	(42,106]				0.8	
26	(69.3,140]	(106,136]			0		
27	(69.3,140]	(106,136]			1		
28	(69.3,94.5]	>136					
29	(94.5,140]	>136					
30	>140	<=106			0		
31	>140	>106			0		
32	>140	<=68			1		
33	>140	(68,136]			1		
34	>140	>136			1		

Note: "clearing away %" represents "the probability of clearing away the traffic congestion at a certain clearance time;

MNL analysis

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Before departure				On the way to expressway			On expressway					
Alternatives	Early departure	Ordinary Road	Others	Early departure	Ordinary Road	Others	Rest at nearby SA/PA	Other expressway	Detour from ordinary	Ordinary road usage	Others	
Factors (inc. SP attributes)												
Constant	-1.16 0.30	2.11 1.32	6.35 -0.01	-0.75 0.03	2.45 1.05	1.65 0.09	2.23 0.70	-4.09 -0.49	4.48 0.46	3.45 0.33	5.45 -0.56	
Distance_site	-1.95 -1.84	-5.53 -5.15	-3.68 -5.21	-1.61 -1.83	-5.41 -4.47	-3.44 -4.15	0.00 0.00	0.49 -1.13	-5.12 -4.68	-2.59 -2.10	0.00 0.00	
Fatal_accident	-0.13 0.26	0.07 0.49	0.16 0.60	0.14 0.23	0.05 0.33	0.12 0.36	-0.05 0.03	0.23 0.16	-0.03 0.10	0.14 0.07	-0.05 0.30	
Clearance time	0.00 -0.11	-0.05 0.38	0.02 0.36	-0.06 0.04	0.00 0.11	0.03 0.13	-0.04 -0.12	-0.13 -0.04	-0.03 0.03	0.00 0.09	0.03 0.09	
Queue length	-3.16 7.05	0.27 -3.04	-1.38 -3.77	1.23 0.52	1.12 0.42	1.02 -0.31	1.74 0.60	1.97 1.62	0.21 0.47	0.31 0.56	0.39 0.65	
Trip purpose	0.05 -0.04	0.25 0.04	0.30 0.19	-0.14 0.06	0.17 0.10	0.21 0.15	-0.05 0.02	-0.14 -0.09	0.12 0.08	-0.05 -0.02	-0.41 0.06	
No_fatal_accident	0.03 -0.10	-0.13 -0.27	0.20 -0.28	-0.11 -0.23	-0.44 -0.36	-0.52 -0.72	0.05 -0.10	0.36 -0.46	-0.14 -0.44	-0.27 -0.56	-0.22 -0.51	
Traffic_regulation	0.21 0.06	0.00 0.08	0.08 0.06	0.02 -0.03	-0.18 -0.05	0.06 -0.08	0.15 0.05	-0.22 0.09	-0.10 -0.03	-0.19 -0.03	0.03 -0.10	
No_traffic_regulation	-0.02 -0.05	-0.23 -0.14	-0.50 -0.20	-0.08 -0.11	-0.27 -0.15	-0.34 -0.17	-0.06 -0.10	-0.66 -0.22	-0.19 -0.28	-0.49 -0.11	-0.64 0.00	
Clearance_time_accuracy	-0.80 -0.60	-1.47 -1.09	-1.93 -0.98	-1.45 -0.17	-1.30 -0.55	-1.83 -0.62	-1.31 -0.04	-2.07 0.30	-1.70 -0.60	-1.72 -0.40	-1.55 -0.56	
Time_interval_value	3.94 2.65	5.10 2.51	7.45 1.91	8.10 9.08	3.11 7.60	6.06 13.48	9.28 13.09	17.19 23.06	13.71 15.52	9.18 7.54	14.60 11.60	
Time_interval_info	0.08 0.02	-0.04 -0.19	0.40 -0.19	-0.39 -0.49	-0.25 -0.50	-0.16 -0.89	-0.02 -0.62	-0.52 -1.45	-0.48 -0.85	-0.34 -0.50	-0.05 -0.69	
Queue_increasing_trend	-0.14 0.08	-0.11 0.05	-0.14 -0.02	-0.07 -0.09	-0.07 0.00	-0.36 -0.10	0.08 0.03	0.16 -0.42	-0.09 -0.10	-0.05 0.02	-0.25 -0.02	
Queue_dcreasing_trend	0.05 -0.17	-0.17 -0.43	-0.29 -0.43	0.24 -0.21	-0.30 -0.38	-0.50 -0.56	0.13 -0.02	-0.02 -0.46	-0.11 -0.37	-0.14 -0.32	-0.62 -0.29	
Alternative_expressway	-0.15 0.00	0.10 0.19	0.08 0.15	-0.39 -0.05	-0.08 -0.01	-0.89 0.06	-0.32 -0.22	1.06 0.62	0.06 -0.18	-0.21 -0.26	-0.23 -0.04	
Alternative_no_expressway	-0.21 0.04	-0.12 0.03	0.00 0.18	-0.14 0.04	-0.19 -0.03	-0.23 -0.01	-0.45 -0.09	-0.63 -0.21	-0.35 -0.26	-0.19 0.05	-0.30 0.01	
Alternative_ordinary_road	-0.04 -0.13	0.30 0.10	0.08 -0.34	-0.03 -0.01	0.29 0.24	0.11 -0.21	-0.19 0.01	0.18 0.46	0.17 0.14	0.56 0.21	-0.26 -0.16	
Alternative_no_ordinary_road	0.39 0.05	0.06 -0.11	0.37 -0.13	0.28 0.05	-0.02 -0.10	0.73 -0.12	0.37 0.12	0.09 0.24	-0.13 0.01	0.04 -0.10	0.54 -0.06	
Alternative_mode	-0.20 -0.08	-0.04 -0.02	-0.15 -0.10	-0.12 -0.07	-0.02 -0.04	0.15 0.06	-0.11 -0.01	-0.09 0.05	-0.28 -0.20	0.02 0.11	-0.55 0.03	
Alternative_no_mode	-0.06 -0.06	-0.28 -0.06	-0.20 -0.13	-0.40 -0.13	-0.31 -0.17	-0.24 -0.05	-0.17 -0.10	-0.23 -0.23	-0.47 -0.26	-0.33 -0.13	-0.06 -0.01	
Age	0.26 0.02	0.04 0.10	-0.84 0.01	0.27 0.00	-0.01 0.07	-0.04 -0.06	-0.21 -0.06	0.64 -0.05	-0.40 0.10	-0.23 0.11	-0.66 -0.02	
Gender	-0.26 -0.25	-0.38 -0.13	-0.84 -0.41	-0.21 -0.20	-0.31 -0.19	-0.78 -0.37	-0.16 -0.32	0.22 -0.36	-0.37 -0.39	-0.27 -0.29	-0.94 -0.53	
Income	0.00 -0.37	0.00 -0.25	-0.41 -0.18	0.07 -0.24	0.14 -0.16	-0.22 -0.16	-0.19 -0.25	0.70 -0.30	0.02 -0.12	0.20 -0.14	0.10 -0.19	
Housewife	0.36 -0.30	0.01 -0.16	-0.35 -0.39	0.18 -0.27	-0.06 -0.30	-0.38 -0.43	0.12 -0.34	0.76 -0.45	-0.09 -0.42	0.30 -0.42	-0.09 -0.60	

Reference:
no change

Upper:

Elderly

Lower:

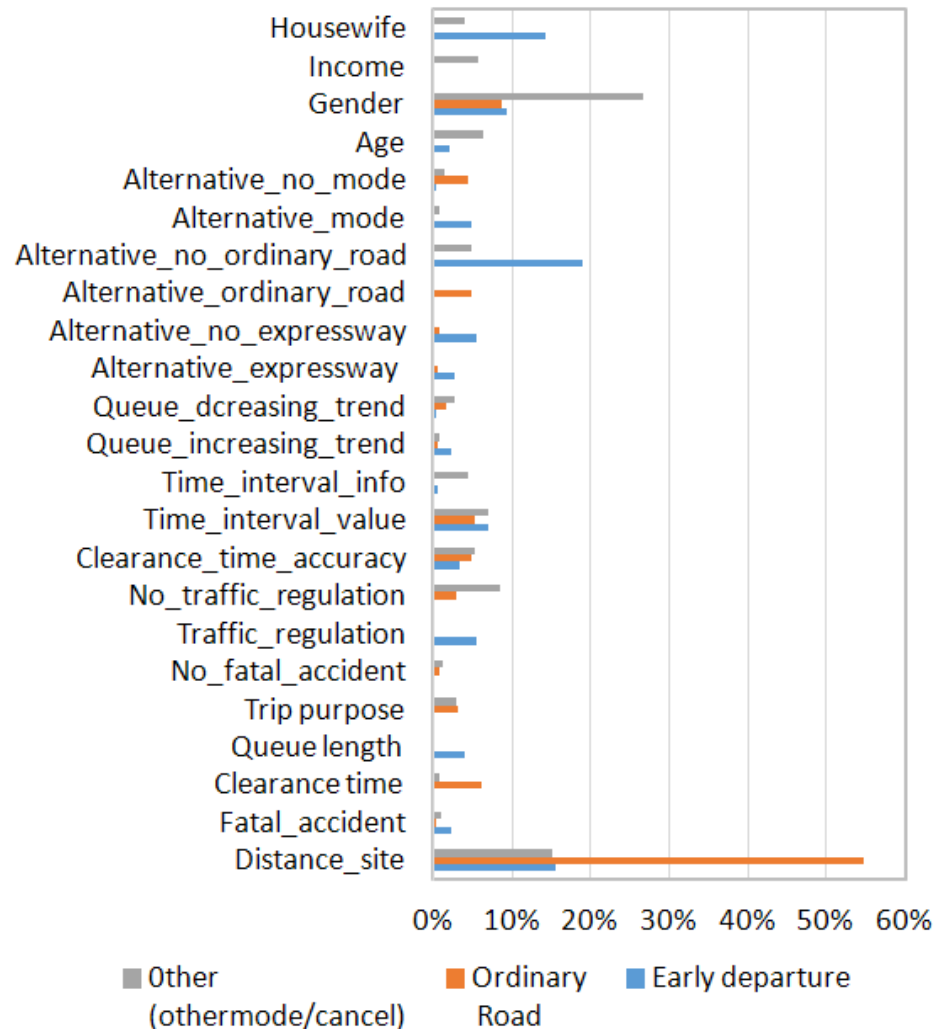
Non-elderly

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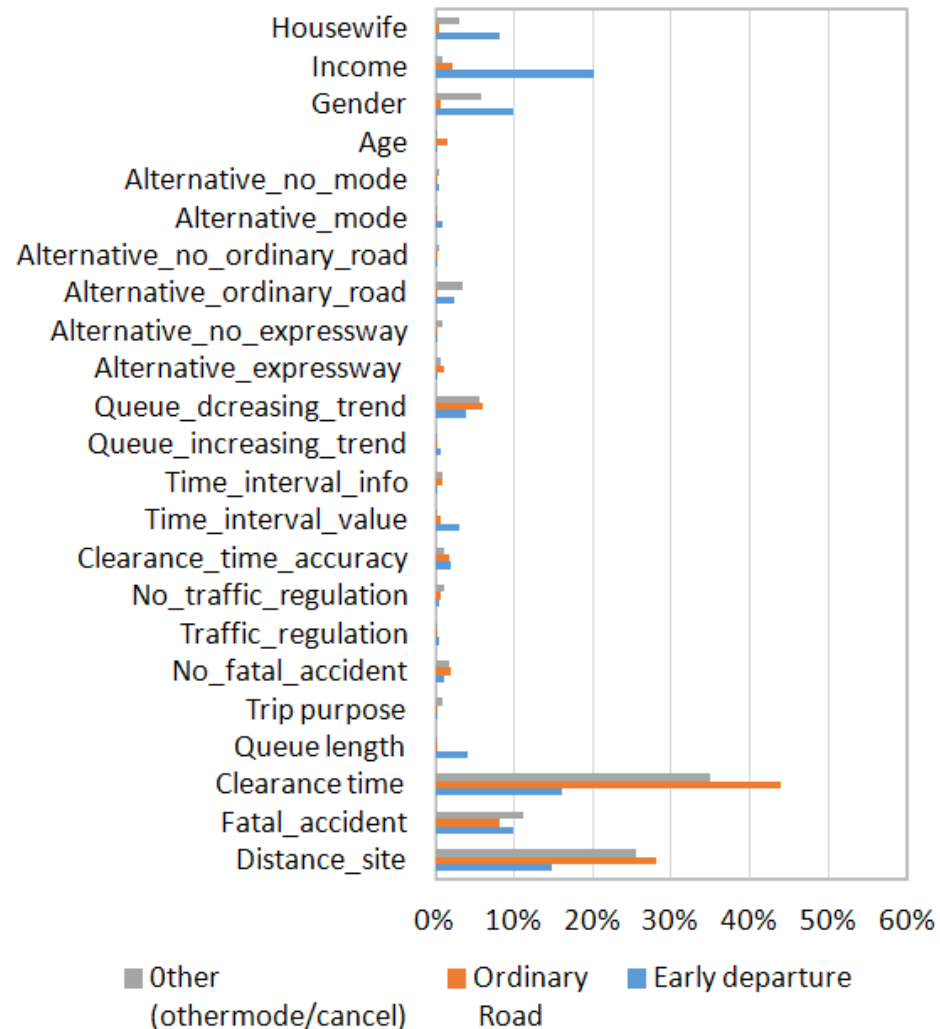
Influential factors

(Variance proportion (larger) -> Influence (Larger))

Before departure (Elderly)



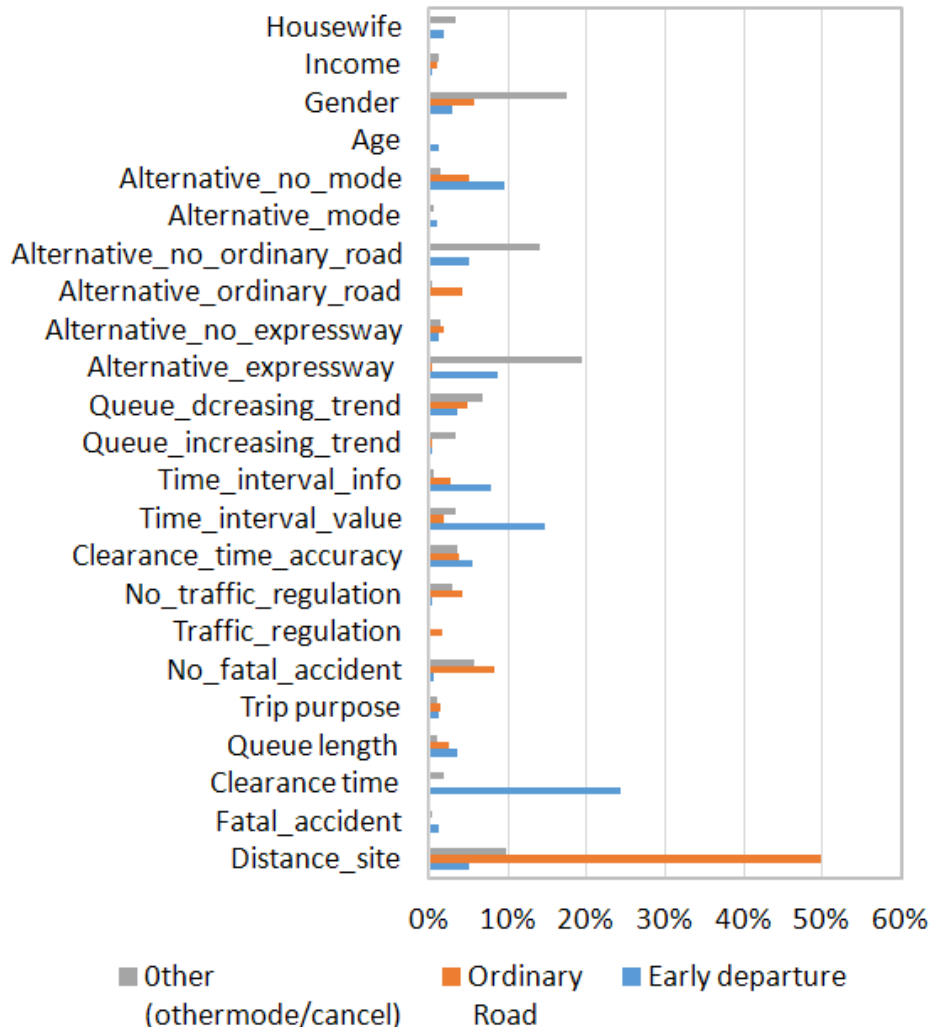
Before departure (Non-elderly)



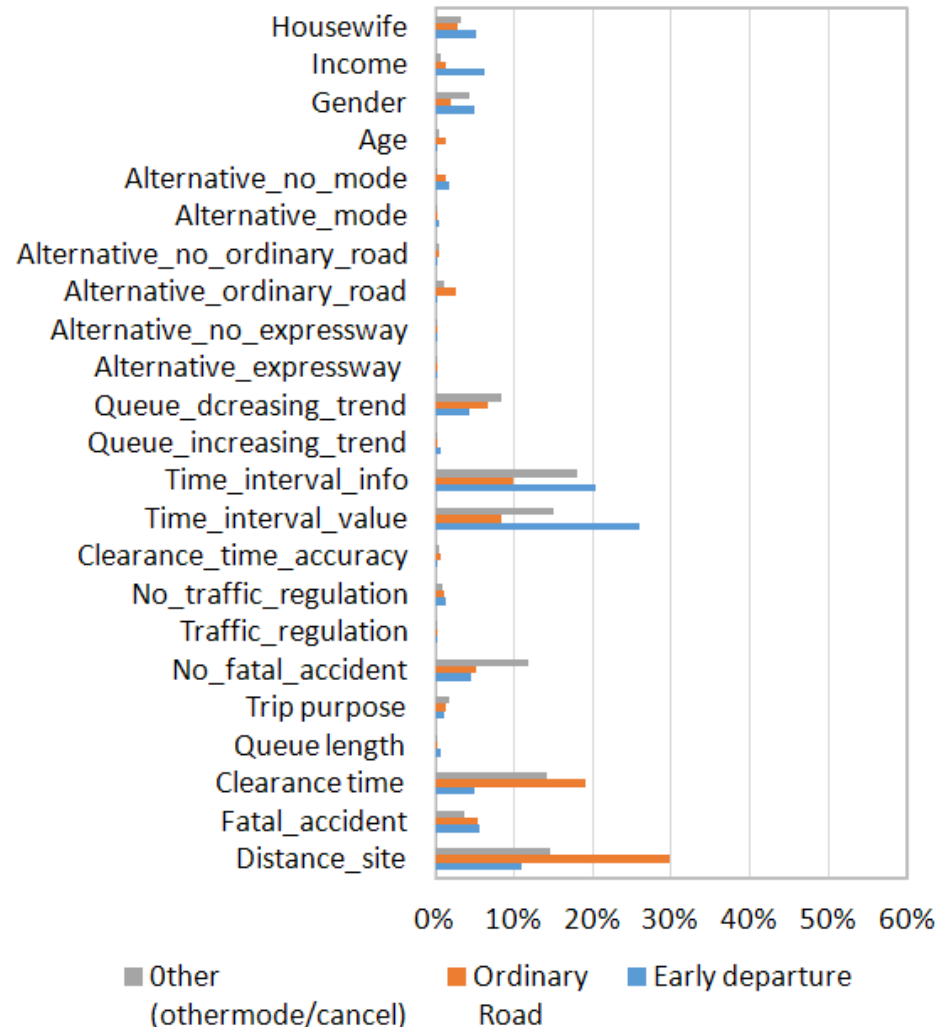
Influential factors

(Variance proportion (larger) -> Influence (Larger))

On the way to expressway (Elderly)



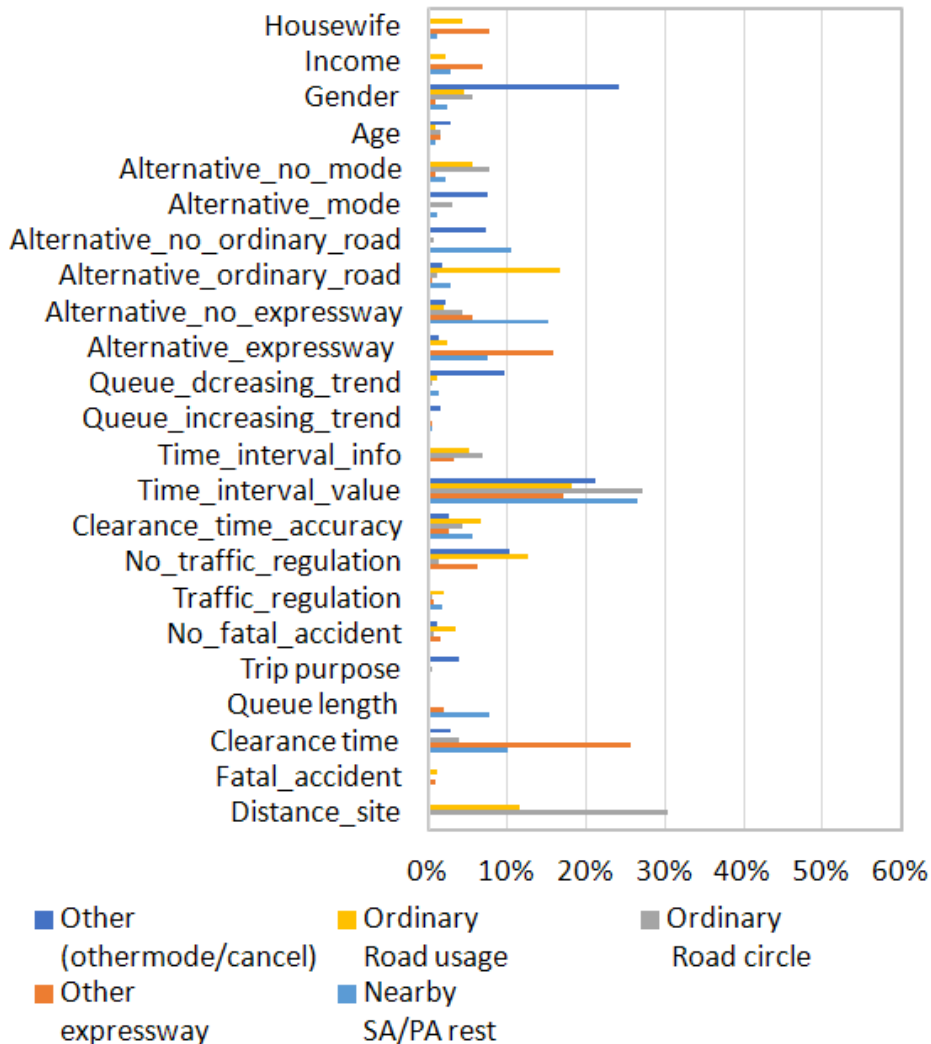
On the way to expressway (Non-elderly)



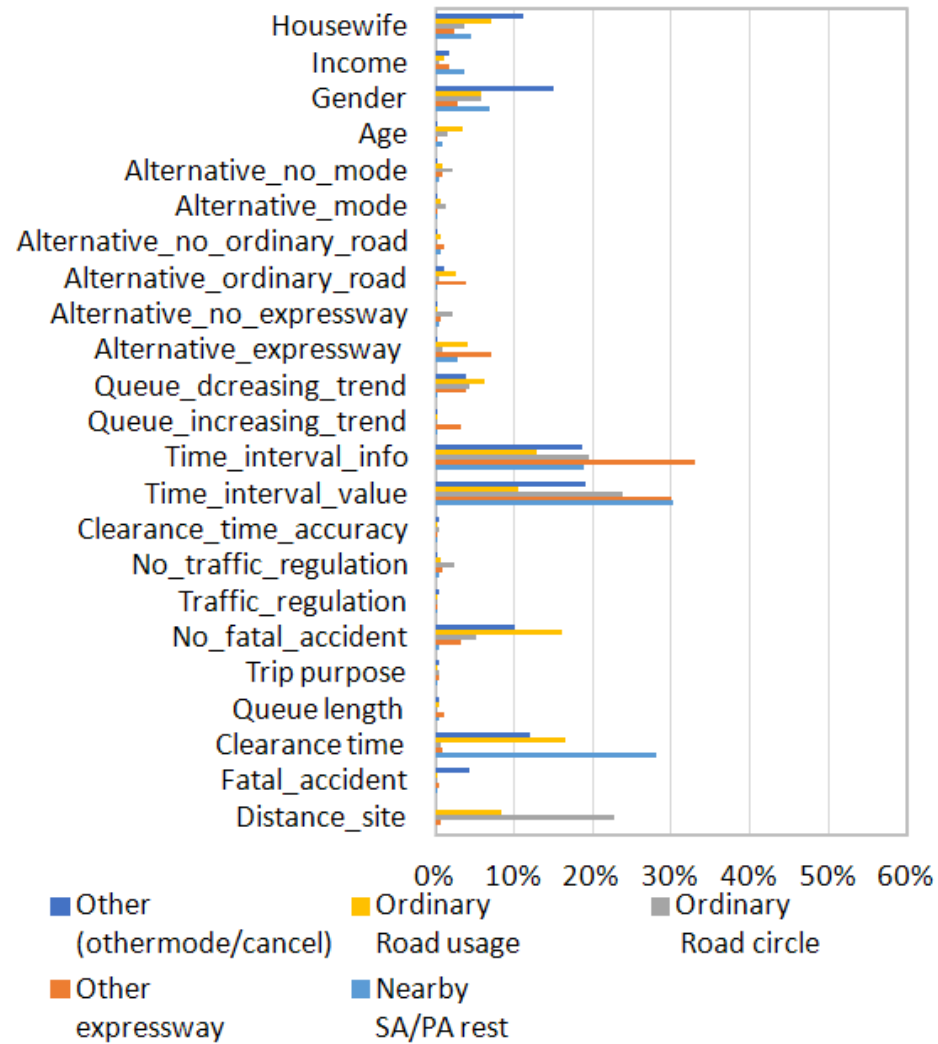
Influential factors

(Variance proportion (larger) -> Influence (Larger))

On expressway (Elderly)



On expressway (Non-elderly)



Conclusions

- Influential information contents are considerably different across the adaptation patterns, confirming the importance of individualized dynamic traffic information.
- Nearly 70% of drivers' behaviors will be influenced by the information provision of traffic accident related information on expressways.

Conclusions

Influential information	Elderly	Non-elderly
Before departure	1.Distance to accident site 2.No alternative ordinary road 3.Time interval value 4.Clearance time accuracy 5.No traffic regulation	1.Clearance time 2.Distance to accident site 3.Fatal accident (info) 4.Queue decreasing trend
On the way to expressway	1.Distance to accident site 2.Clearance time 3.Alternative expressway 4.Time interval value	1.Distance to accident site 2.Time interval info 3.Time interval value 4.Clearance time
On expressway	1.Time interval value 2. Clearance time 3. Distance to accident site 4.Alternative routes/modes	1.Time interval info 2.Time interval value 3.Clearance time 4.No fatal accident 5. Distance to accident site

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