



Cognitive Discordance

An Observation from a Study on PM_{2.5} Exposure in
the Beijing Subway

ASIC, 2018

Oakland, CA



What is Cognitive Discordance?

- A lack of agreement or consistency between a person or population's knowledge and behavior

Our Project:

- Investigate PM2.5 levels in the Beijing subway cars
- Assessing passenger awareness of air pollution and related adaption behavior

Interviewing Passengers

Basic Information	Males (N=325)	Females (N=293)	Average
Years of riding subway	5.74	5.59	5.67
Subway rides per week	10.80	10.24	10.53
Average length of one-way commute, h	1.00	0.89	0.95

Basic Information	Males (N=325)	Females (N=293)	Total
Age, n (%)			
18-25	65 (20.0)	96 (32.8)	161 (26.1)
26-35	212 (65.2)	145 (49.5)	357 (57.8)
36-45	40 (12.3)	41 (14.0)	81 (13.1)
46-60	7 (2.2)	10 (3.4)	17 (2.8)
60+	1 (0.3)	1(0.3)	2(0.3)
Monthly Income, n(%)			
<3000 RMB	6 (1.8)	16 (5.5)	22 (3.6)
3000-5000 RMB	36 (11.1)	55 (18.8)	91 (14.7)
5001-10000 RMB	162 (49.8)	173 (59.0)	335 (54.2)
10001-20000 RMB	107 (32.9)	43 (14.7)	150 (24.3)
>20000 RMB	14 (4.3)	6 (2.0)	20 (3.2)
Education Status, n (%)			
Middle School or lower	6 (1.8)	2 (0.7)	8 (1.3)
High School	19 (5.8)	16 (5.5)	35 (5.7)
Undergraduate	222 (68.3)	213 (72.7)	435 (70.4)
Graduate School	78 (24.0)	62 (21.2)	140 (22.7)
Occupation, n (%)			
Teacher	11 (3.4)	21 (7.2)	32 (5.2)
Healthcare field	17 (5.2)	21 (7.2)	38 (6.1)
Government Worker	41 (12.6)	31 (10.6)	72 (11.7)
Business	223 (68.6)	195 (66.6)	418 (67.7)
Non-profit	2 (0.6)	6 (2.0)	8 (1.3)
Other	31 (9.5)	19 (6.5)	50 (8.1)
Has Children, n(%)			
Yes	102 (31.4)	92 (31.4)	194 (31.4)
No	223 (68.6)	201 (68.6)	424 (68.6)
Smoker, n (%)			
Yes	68 (20.9)	10 (3.4)	78 (12.6)
No	211 (64.9)	274 (93.5)	485 (78.5)
Occasional	46 (14.2)	9 (3.1)	55 (8.9)

Assessing Pollution: Using the AirBeam to measure PM_{2.5}



Interviewing Subway Passengers



Air Pollution Levels: Time Series Data



Subway Line 6: Changes in Pollution



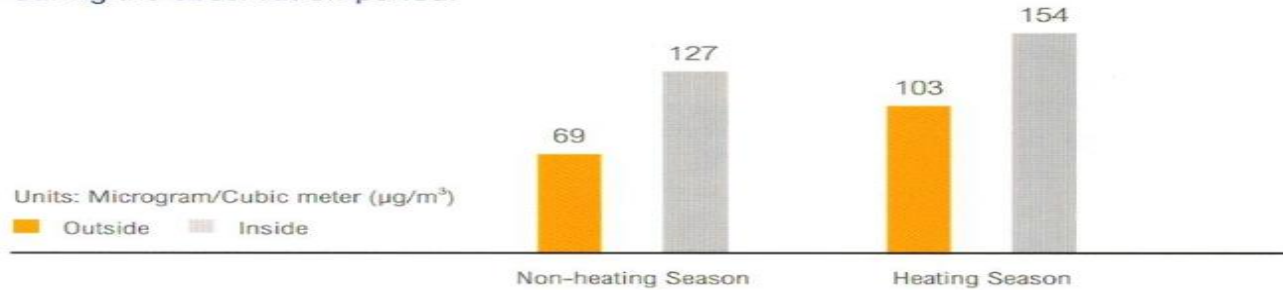
Subway Line 8: Changes in Pollution

What do we know now?

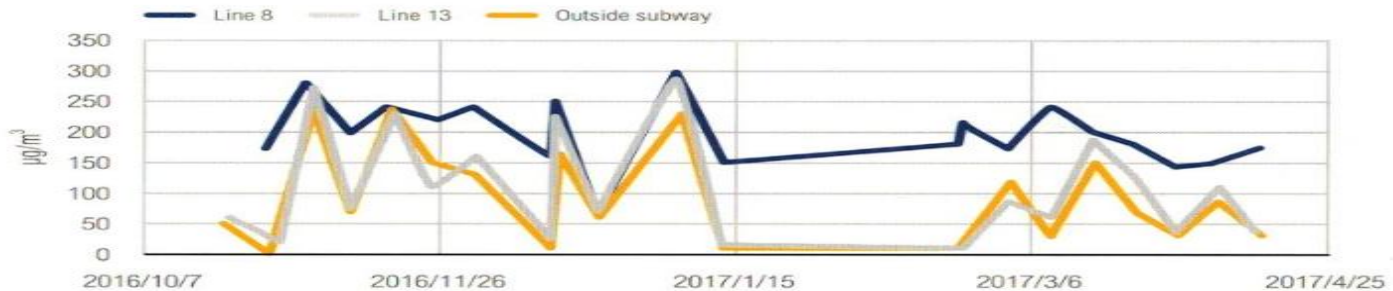
- Subway PM2.5 levels
- Passenger knowledge on air pollution
- (dis)agreements between passenger knowledge and behavior
- Passenger willingness to pay

PM_{2.5} Monitoring Results

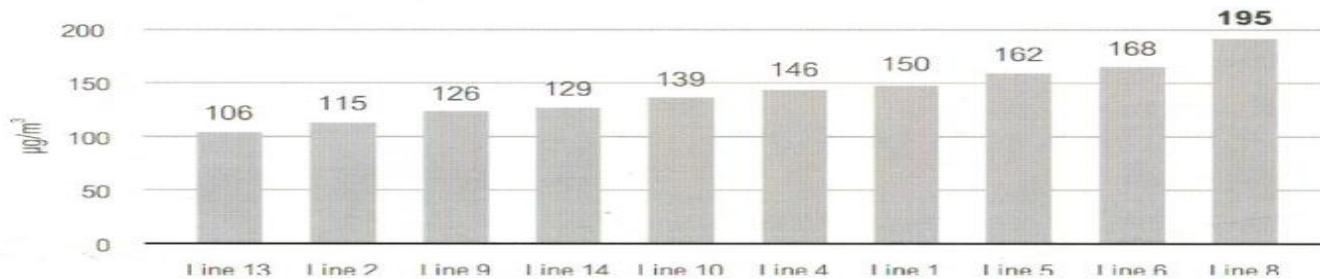
No matter heating season or non-heating season, the concentration of PM_{2.5} in the subway is higher than the outdoor air during the observation period.¹



The concentration of PM_{2.5} in the subway is positively correlated with the concentration of PM_{2.5} outside the subway.



During the observation period, the PM_{2.5} concentration on Line 8 reached the highest level, with Line 13 being observed the lowest concentration of PM_{2.5} at $106\mu\text{g}/\text{m}^3$, but still far above the level of national second-level standard of ambient air quality (annual average of $35\mu\text{g}/\text{m}^3$).



- How is the subway's air quality?
- Should subway passengers wear masks?

1. 76% of respondents believed that air pollution concentrations outside the subway were worse



76%

2. Respondents who never wore masks totaled 36%, who always wore masks totaled only 7%.



36%

Does not wear mask on the subway

7%

Wore mask on subway

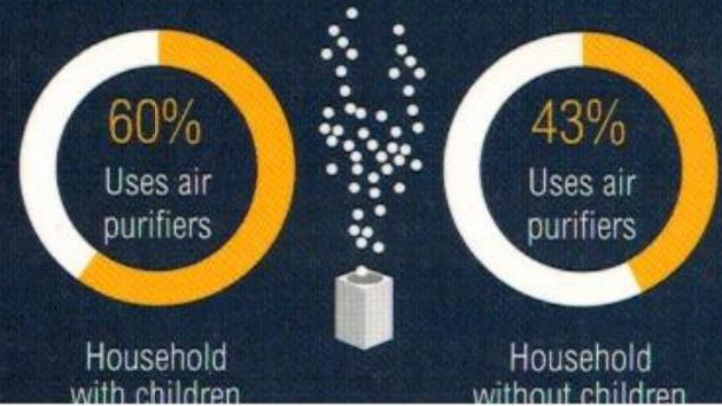
Demographics and Behavior

- Passenger indoor air filter use and age
- Indoor air filter use and presence of children

3. Individuals from the ages 26-35 and 36-45 were both likely to use air purifiers, but the largest proportion of air purifier uses were in the age range from 36-45.

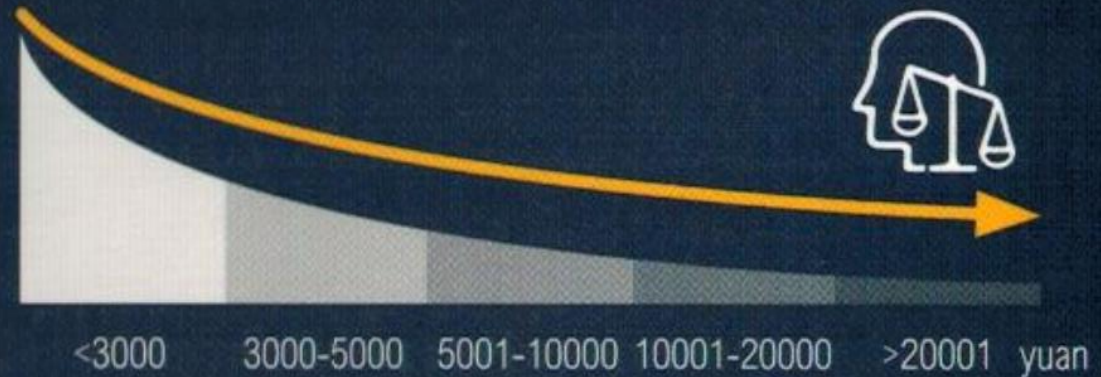


4. Around 60% respondents with children are more likely to use air purifiers, in contrast to 43% for respondents without children.



- Income levels and consumer responsibility
- Protective measures and gender

5. The higher income of the respondents, the lower percentage considered consumers should take responsibility for air pollution

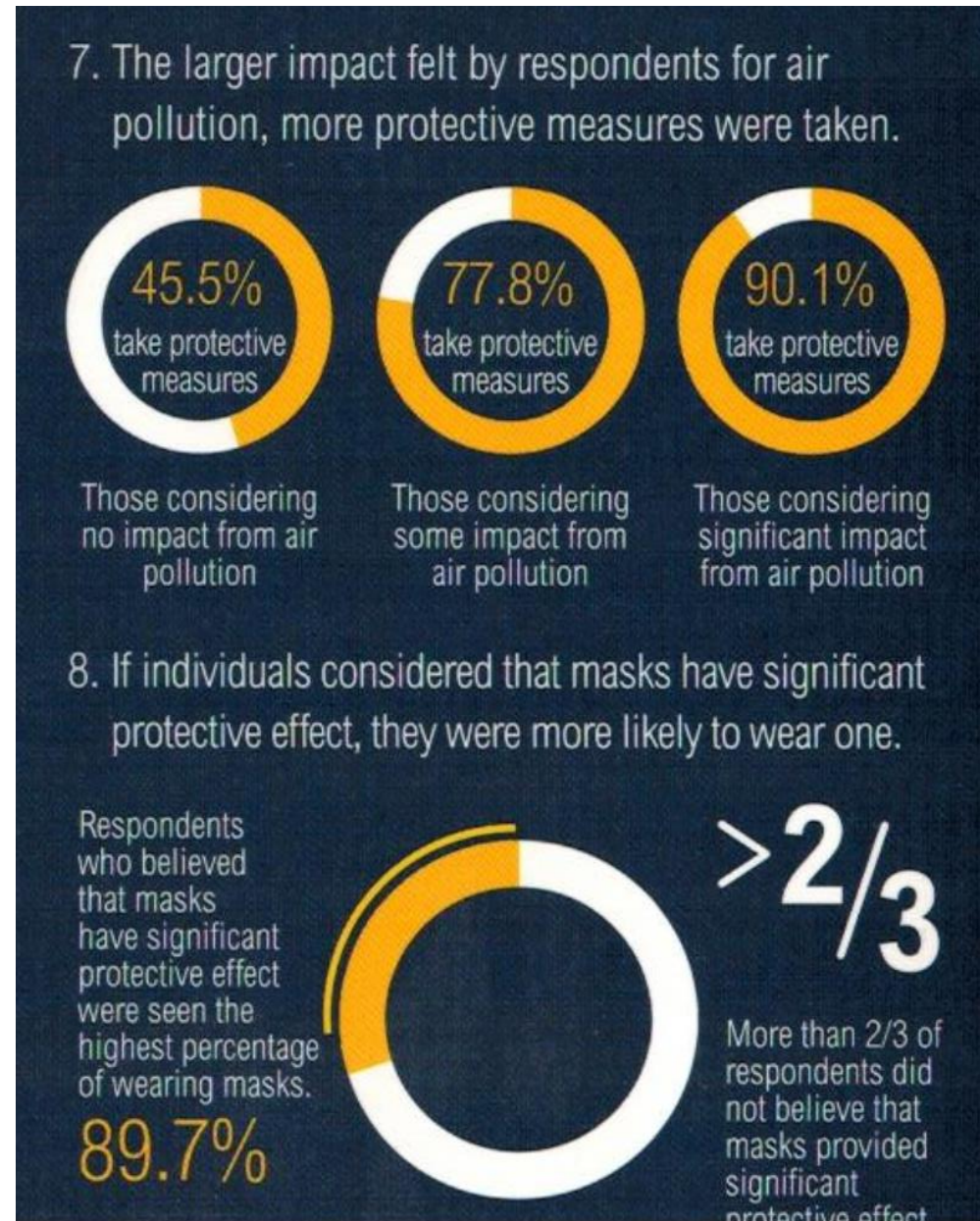


6. If thinking personally affected by air pollution, more women would take protective measures.



- Relationship between knowledge and behavior

- Air pollution levels and protective behavior
- Perceived mask efficacy and consumer use



Another Angle: Consumer Willingness to Pay

1. Willingness to pay for renewable energy



Among those who believe that renewable energy would help mitigate Beijing's air pollution, 478 people were willing to pay more, while 67 people were not willing to pay more.



The highest amount that individuals who believe renewable energy's mitigation role in Beijing's air pollution were willing to pay each month was 50 RMB per month.



Women were more willing to pay more than men.



Compared to young people, 46-60 year olds were less likely to pay more.

2. Comments on masks and willingness to pay for masks

A total of 199 people think that masks have a significant protective effect, among whom those respondents would pay below 50 RMB for an anti-smog mask were seen the largest percentage, accounting for 90.1%.



- Effects of gender on willingness to pay

3. Relationship between commuters' gender and willingness to pay

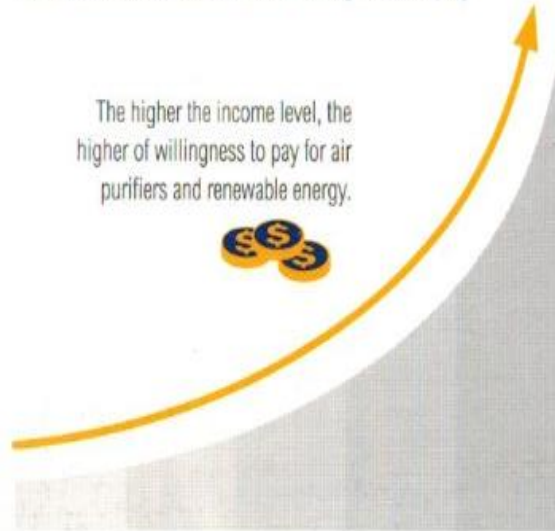
Compared to men, women paid more for air purifiers and masks.



- Effects of income and education attainment on willingness to pay

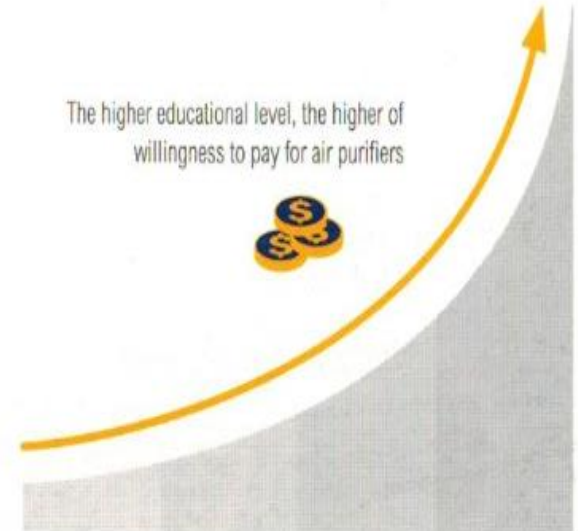
4. Impact of education on willingness to pay

The higher the income level, the higher of willingness to pay for air purifiers and renewable energy.



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The higher educational level, the higher of willingness to pay for air purifiers



Middle school and below High school University Master degree and above

The Challenge: Is our knowledge incomplete?

- The heart of behavior change: People's priorities of wants and needs, a contradiction between short- and long-term wishes
- From investigating the subway: The influence of health – population versus individual

4. Riding the subway to work for 16 years can lead to the death risks from all-cause mortality, poor cardiopulmonary function and lung cancer increased by 1.23%, 1.83%, 2.42%, respectively.



5. If the survey respondents were to take the subway by wearing masks all journey, the death risks from all-cause mortality, poor cardiopulmonary function and lung cancer will be reduced by 0.61% -1.11%, 0.91% -1.65%, and 1.20% -2.18%, respectively.



Note: ¹ Outdoor air quality monitoring data were from Beijing Municipal Environmental Monitoring Center.

² CA Pope III, RT Burnett, MJ Thun etc, Lung Cancer, Cardiopulmonary mortality, and long-term exposure to fine particulate air pollution, The Journal of the American Medical Association, 2002.

1. According to a 16-year cohort study of 500,000 people in the United States, the death risks from all-cause mortality, poor cardiopulmonary function and lung cancer increased by 4%, 6% and 8% respectively for each $10 \mu\text{g}/\text{m}^3$ increase in $\text{PM}_{2.5}$ concentrations.²



3. The survey respondents take the subway to work every day and are exposed to $3.12 \mu\text{g}/\text{m}^3$ of $\text{PM}_{2.5}$ concentration per day.

$3.12 \mu\text{g}/\text{m}^3$
PER DAY

According to the survey results, the respondent's weekly ride frequency was 10 times per week; a one-way subway ride averaged 1 hour, then round-trip exposure of 2 hours a day and 5 days a week; Chinese official holidays are 11 days. The increased exposure is calculated according to the above assumptions.

Cognitive Discordance faced by Air Pollution

- Individuals:
- Populations: Peer Influence
- Society: Culture (morals, theories) and Laws

Thank you for your attention!

