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Public frames in the road pricing debate: A Q-methodology study

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ABSTRACT

A deep understanding of people's support for road pricing may help policymakers to design more practical pricing schemes that are effective in abating congestion but lead to less public opposition. This study adds to the rich body of road pricing acceptability literature by taking a different approach that focuses on the underlying pattern of the arguments, beliefs and attitudes, which largely determine the viewpoint of individuals with respect to road pricing. We apply Q-methodology to find these viewpoints by asking respondents to rank order subjective arguments that are subtracted from the public debate on road pricing and to identify shared viewpoints that are called frames. Analysis revealed four frames: *The polluter should pay*, *Focus on fair alternatives*, *What's in it for me?* and *Don't interfere*. Only the *Polluter should pay* frame is positive about road pricing. The other three frames are negative about road pricing, which suggests that there is not just one single block of citizens opposed to road pricing, but that quite different arguments are used in the various frames. We discuss how these frames can be used by policy-makers that intend to implement road pricing, to fine-tune the design, communication and implementation process of road pricing schemes.

1. Introduction

For over 100 years, many road pricing schemes have been promoted by transport experts. It is regarded as 'the best' way (in increase of welfare terms) to manage congestion problems when infrastructure expansion is impossible or difficult (too expensive, spatial limitations). Despite the strong theoretical argument, only a few schemes worldwide have been implemented and most attempts to implement such schemes failed. The lack of the necessary public and political backing are regarded as the main reasons for most failures (Vonk Noordegraaf et al., 2014). Because of the longstanding issues around the implementation of road pricing and the increase of car related problems such as congestion, considerable research efforts have been conducted on the acceptability of road pricing instruments (see an overview in Schade and Schlag, 2003a).

Previous studies revealed a wide range of factors related to the acceptability of charging-based road pricing instruments. Socio-demographic variables, scheme-related variables, such as the perceived distribution of costs and benefits and self-interest, and other attitudinal variables, such as problem perception and trust in governments, among other things, correlate with the level of acceptability (Schade and Schlag, 2003b). These often purely quantitative studies are well-suited to investigate the statistical associations of multiple variables and the models typically explain between 30 and 60% of the variation to accept a certain road pricing instrument (e.g. Chen et al., 2007; Kim et al., 2013; Sun et al., 2016). A limitation of this quantitative, variables-centred approach is that it does not give a complete view of the individuals' viewpoints concerning the topic at hand, and it can even give a distorted view (Kroesen and Bröer, 2009). However, it is relevant to study people's complete sets of beliefs, attitudes and opinions, since the general public is very heterogeneous in its worldviews when it comes to public policies such as road pricing. A few studies in current literature on road pricing took a different approach and studied, for example, the relation between acceptability and certain homogeneous clusters based on socioeconomic backgrounds (Gehlert et al., 2011). However, as Anable (2005) argues, more meaningful insights may be obtained when an approach is adopted whereby groups are defined from empirical data and people are clustered according to their worldviews, attitudes, and motivations. Pronello and Rappazzo (2014) defined clusters of citizens in the road pricing debate ranging from 'fierce opponents' to 'supporters' and interpreted these clusters using the subjective statements given by the respondents in focus groups. However, what they do not make explicit is whether and how the participants' statements, opinions and feelings were used in the process of identifying these clusters. This is also not possible with focus groups since not all respondents present their positions towards all the

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statements/arguments made. Consequently, it may be that two people end up in the 'fierce opponents' cluster, yet they may have different underlying reasons.

In this paper, we assume that individuals create their own set of beliefs and attitudes about road pricing under the influence of the public debate, and from this personal viewpoint evaluate (novel) road pricing instruments. When multiple people share a similar viewpoint regarding road pricing, this is regarded as a 'frame' in this study. We expect that different frames concerning road pricing exist because it is a well-developed debate in many countries that has received a lot of media attention, with varying arguments since it would affect many individuals and it touches upon values such as equity and environmental beliefs. Individuals can perceive the road pricing debate differently and, as shown by Ardıç et al. (2018), information from the debate can influence an individual's support for road pricing.

The main aim of this study is to identify road pricing frames. These frames can give a better understanding of the great heterogeneity of public beliefs and attitudes concerning road pricing. It provides insights in which factors play a role in accepting/rejecting road pricing schemes among different groups of people. These fresh insights can be used in the design and implementation of (novel) instruments that are effective and can count on wider public support. We identify the frames with a methodology that is used to systematically study individuals' viewpoints, which is called Q-methodology, in section 3. As further explained in section 2, in Q-methodology respondents rank order statements about road pricing in relation to each other. These rank orderings represent their individual viewpoint and when multiple of these viewpoints strongly correlate, they are interpreted as a frame. To the best of the authors' knowledge, this is the first systematic investigation into the rich variety of frames in the public debate and their relation to road pricing.

The study focuses on the public debate in the Netherlands where road pricing has been on the political agenda since 1960. Hence, the public debate about charging for road use is mature and contains many varying arguments to accept or reject road pricing. This makes it suitable for Q-methodology as we can use the statements from the public debate. Furthermore, this country is taking the lead in experiments concerning innovative road pricing instruments such as peak hour avoidance and tradable peak permit experiments (e.g. Ben-Elia and Ettema, 2011). This enables future research into the relations between frames and the acceptability of novel instruments.

The following section elaborates on the methodology. Then, the results are presented in section 3. Section 4 discusses these results. Section 5 completes the paper with conclusions and recommendations.

2. Q-methodology

Q-methodology is a mixed qualitative-quantitative method that is used to reveal the main views on a certain topic. It combines the richness of qualitative studies with the rigour of quantitative studies. Respondents rank order statements about the topic at hand in relation to each other and are asked to explain their choices. By comparing the rank orderings, similar viewpoints can be defined. Q-methodology is well-established in social, political and health research and has been applied a few times before in transportation studies. The method has been employed to study the relative importance of different motives to use a car (Steg et al., 2001), to define people's viewpoints on the role of transport in their lives (Rajé, 2007) and to segment travellers regarding their medium-distance travel decisions (Cools et al., 2009; Van Exel et al., 2003, 2011). Rajé explains that Q-methodology offers fresh insights, in comparison to approaches focused on (socio-demographic) variables, because it reveals that 'people across different social groups can share common perspectives and that within a particular social group there can be a number of perspectives' (Rajé, 2007, p. 476).

Q-methodology has several advantages. The most important one is that it allows respondents to express their own views (Corr, 2001), because the statements are derived from everyday communication and the respondent can use his or her own subjective criteria to evaluate the statements (Watts and Stenner, 2005). Furthermore, the statements are not structured to test any prior theories or hypothesis. Hence, the sample of statements in a Q-study (called Q-set) can be considered naturalistic and unstructured, and is therefore more realistic than a list of statements developed by researchers. An advantage of a Q-study over Likert scales, for example, is that respondents have to judge a statement in relation to all other statements. Respondents cannot equally agree with all statements, but they are forced to rank order the statements on a scorecard in the shape of a quasi-normal distribution. This study contains 42 statements (below we will explain why we choose 42) which, at least theoretically, forces the respondents to make 861 judgments [(1/2) (42) (42-1) = 861]. This provides the researcher with more information about the viewpoint (Corr, 2001) and also encourages respondents to construct their opinion about the topic.

The remainder of this chapter describes how we applied Q-methodology. Firstly, the concourse is defined. The concourse consists of the countless number of statements of opinion that can be found among members of a social group, all related to a single topic (Brown, 1980). Secondly, a balanced set of statements (Q-set) is selected that represents the concourse. Thirdly, the participants (P-set) that are expected to represent different viewpoints are selected. Fourthly, the data are collected by asking the P-set to place the Q-set on the scorecard. This procedure is called Q-sorting. This Q-sort represents the personal viewpoint, which is based on the assumption that the interpretation of a statement is relational: the meaning of each statement is inferred from the rank order in which it is placed and its position in relation to the other statements, as decided by the respondent (Wigger and Mrtek, 1994). Lastly, the completed scorecards, the Q-sorts, are factor analysed. When three or more Q-sorts correlate,[1] the respondents are said to share a similar frame. Thus instead of clustering variables as regular factor analyses do, the correlation matrix is transposed and the respondents' profiles are clustered (Stephenson, 1935). For detailed information about Q-methodology, we refer to Brown (1980) and >van Exel and De Graaf (2005).

2.1. Defining the concourse

In our study the concourse incorporates all statements made by people living in the Netherlands related to the topic of road pricing. Statements were sampled from two sources: the first was an internet based survey about road pricing held in 2006 among a sample of 1224 car owners who are members of the Dutch roadside assistance company (Hermans and Koomen, 2006), and the second was Twitter. We chose this survey because it was done in a period when there was a lot of public and political debate about road pricing in the Netherlands. The survey included an open-ended question in which the respondents were asked to explain where they stood/what they thought about the proposed road pricing scheme.[2] The 1293 answers to that question were included in the concourse. The debate about road pricing started up again in the months leading up to the Dutch national parliament elections in March 2017. In order to capture the statements from that period, we found Twitter to be the most accessible and complete source. We searched using hashtags with the Dutch synonyms for road pricing[3] and manually collected all Tweets from the period September 2016 to September 2017. In total we obtained a set of 731 reactions after removing the Tweets from organisations such as newspapers.

[1] The choice for a minimum of three correlated Q-sorts is explained in section 2.5.

[2] The survey proposed a national road pricing scheme in which car users would pay per kilometre driven and extra in the peak hours. Taxes on the possession and purchase of a vehicle would decrease.

[3] Road pricing (in Dutch: Rekeningrijden) (n = 533), kilometre charge (n = 192), congestion charge (n = 6).

2.2. Identification of the Q-set

A Q-set usually consists of 40–80 statements (Watts and Stenner, 2005). We choose to include 42 statements to minimise the cognitive effort required from respondents. In order to come to a representative Q-set from the concourse, Q-methodological researchers use a structured approach. This structure can either take form naturally through the data, or it may be imposed, based on existing theory (Brown, 1980). We found the latter approach more suitable for this study because of the large set of raw statements and the extensive theoretical knowledge on road pricing acceptability. We used Feitelson and Salomon's (2004) political-economic framework because it was developed to analyse and predict the adoption of complex technology innovations in which public and private parties play an important role. Since this framework covers a wide range of factors (in)directly related to acceptability, we expect to minimise the risk of overlooking important (sub)categories in the concourse. We selected the following categories from the framework: (1) problem perception, (2) suggested innovation, (3) technical requirements, (4) perceived effectiveness, (5) distribution of costs and benefits. We labelled all raw statements with one of these categories. Raw statements that contained multiple arguments were separated into statements with a single argument, while we tried to stay as close as possible to the original wording. Since not all statements referred to one particular category, we created a sixth category: (6) 'interplay between actors', for statements such as 'the government is not capable of implementing a road pricing instrument'. Next, within each category we clustered like statements into subcategories. Then, to ascertain a representative sample of statements, an equal number of statements from each category was selected to represent that category. If multiple statements covered a similar argument, we chose the clearest and most comprehensive one. We changed some of the negatively framed statements into positively formulated statements to finish up with a balanced set. The final Q-set of 42 statements can be found in the left-hand column of Table 2.

2.3. Selection of the P-set

The P-set does not require a large number of participants (Rajé, 2007) but is strategically chosen since the aim is to identify the different viewpoints that exist within a certain population, and not to test the distribution of the viewpoints within the larger population. In our case, respondents had to be 18 years or older, the minimum age required for obtaining a driver license in the Netherlands. We used car possession, employment rate and living area to balance the P-set. Hence, a matrix was designed, consisting of 12 (3 × 2 x 2) combinations: three car categories (no car, lease car, private car), two living area categories (rural, urban) and two employment rate categories (working and not working). We considered the combination of having a lease car and not working to be unrealistic and removed it from the matrix. A company called CG Research was hired to collect the data until each of the 10 cells in the matrix was represented by at least 5 respondents. This requirement was met when 130 respondents completed the survey. This number is quite large given that most Q-methodological studies have around 40 to 60 respondents, with outliers between 18 respondents (Rajé, 2007) up to 102 respondents (Davies and Hodge, 2007). The respondents were selected from the company's online panel and received a small fee for participating.

2.4. Administering the Q-sort

First, a small pilot study was organized among colleagues for a final check of the statements and questions, which led to a few minor modifications. In October 2017, we distributed the final survey to the respondents via an online tool.[4] The survey started with a short introduction about road pricing and explained the difference between a flat tax and a congestion tax. Thereafter, the 42 statements were presented in a random order and the respondents were asked to first place every statement on one of three piles (agree, neutral, disagree). In the next step, a scorecard with the shape of a quasi-normal distribution ranging from −5 (most disagree) to +5 (most agree) was presented. Thus, on this specifically shaped scorecard only four statements can be given the most extreme scores (−5 and +5), while gradually more statements can be given less extreme scores (six statements can be scored with the neutral score of 0), see Fig. 1. The way the respondents had to sort the statements was to proceed from the outside and work inwards: the respondents were asked to first select the two statements from the 'disagree' pile which they most strongly disagreed with and place them under −5. Then they were asked to place the two statements they most strongly agreed with under +5. This procedure continued until the statements from the neutral pile were also placed on the scorecard. In the following step, the respondents were asked to explain their choice for the four statements under −5 and +5 in an open-ended answer box. The survey ended with questions about personal characteristics.

2.5. Data analysis

A disadvantage of paying a fee for participating in this study is that this may partly attract respondents who only participate for the fee, and who will provide responses that are too hasty or trivial. To avoid this we calculated that a respondent would need at least 400 s to read 42 statements and sort them in relation to each other. 19 of the respondents spent less time than this so did not meet our criteria. Therefore these 19 were removed from the database. Of the remaining 111 respondents, 40 own a car, 35 have no car and 35 have a lease car (1 unknown). 70 respondents live in urban areas (1500 addresses or more per km^2) and 41 in rural areas. About half (53) have a paid job, 24 are retired, 5 are students and 28 do not have a paid job and are younger than 65 (the standard age of retirement) (1 missing value). Of the 28 respondents without a paid job, 4 are searching for a job. The combination of 'rural area – no car – unemployed' did not meet our criterion of a minimum of 5 respondents, because this type of respondent proved difficult to find.

To find viewpoints with a similar pattern, a correlation matrix of the 111 Q-sorts was constructed and factor-analysed using the centroid method. The PQMethod software was used for this purpose (Schmolck, 2014). We used the varimax rotation method to approximate a simple structure. We followed Brown (1980) recommendations and started with seven initial factors. The standard requirement in Q-methodological studies is that factors should have at least two Q-sorts that load significantly upon the factor. Because of our relatively large sample, we decided to only consider factors with three or more significant Q-sorts. We computed that loadings greater than ± 0.40 are significant at the 0.01 level[5] (see Watts and Stenner (2005) for the procedure). Three factors did not meet this second criterion and were removed from the

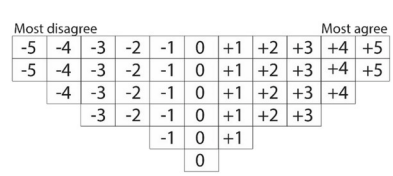

Fig. 1. Quasi-normal distribution.

[4] https://github.com/aproxima/htmlq https://github.com/aproxima/htmlq (last accessed March 2018), based on the work of Hackert and Braehler (2007).

[5] We used formula 2.58 *(1/$\sqrt{N}$) (with N = the number of statements).

Table 2
Factor arrays of the 4 rotated factors.

	A	B	C	D
1 Car use is a big problem for the environment.	+5	+2	+1	−1
2 Current congestion is very damaging to the economy.	+3	0	+1	+2
3 It is not necessary to do something about congestion.	−4	−5	−5	−3
4 There are not too many cars, there are too few roads.	−5	−3	−4	+1
5 People take their car too easily now.	+5	+1	+2	−2
6 Cars do not cause many problems outside the urban areas.	−3	−2	−1	0
7 Public transport or bicycles are good alternatives to the car in most cases.	+1	+3	0	−5
8 First it has to become clearer what the positive and negative effects of road pricing are before the decision to implement it can be made.	+2	+3	+4	+5
9 Measures to reduce congestion need to be paid from general tax money and the government should not let only car users pay for it.	−4	−1	+2	+3
10 The government should invest in improving public transport/bicycle infrastructure instead of introducing road pricing.	0	+4	−4	+1
11 Innovations, such as automated vehicles, will solve most of the problems in time.	0	−1	+1	+2
12 The current taxes for cars (fuel excise duty, vehicle circulation and purchase taxes) are better than road pricing because now you know what the costs of a car are.	−4	0	−1	+3
13 It is a good idea to make car users pay per kilometre (flat tax).	+4	−3	−3	−2
14 It is a good idea to make car users pay for busy roads during peak hours (congestion tax).	+3	−4	−1	−1
15 Road pricing is a relatively cheap measure to improve mobility.	+1	−3	−1	−3
16 The revenues raised by road pricing should be invested solely in improving the car system and not public transport.	−5	−4	+2	0
17 The design of a road pricing instrument that would really work and would not be too complex is impossible.	−3	0	−2	0
18 I'm afraid that many car drivers will take advantage of road pricing if it is implemented and commit fraud.	−1	0	−3	+1
19 Making car users pay for congestion tax is feasible with today's technology.	+4	0	0	−2
20 I am afraid that the government would get too much privacy-sensitive information on who drives where if congestion tax is introduced.	−2	+3	0	+4
21 If the government knows where all cars drive because of congestion tax, this information can be useful to redirect traffic in a better way.	+2	−2	+3	0
22 Car users will not reduce their road use if they have to pay to use the road.	−1	+1	−2	+4
23 Employers will be more inclined to introduce flexible working hours if a congestion tax is implemented.	+2	−1	+4	+1
24 It is a bad idea to make car possession cheaper, since people can then buy a (second) car more easily.	0	0	−4	−5
25 A flat tax will lead to a positive effect on the environment.	+2	−3	0	0
26 A flat tax will do the economy more good than harm.	0	−2	−3	−3
27 A congestion tax will do the economy more good than harm.	0	−1	0	−2
28 Congestion will not reduce through introducing congestion tax.	−3	+1	−2	+1
29 Everyone benefits from road pricing: you have to pay less or you can travel faster.	+1	−4	−1	−4
30 A flat tax is unfair for the people who do not have many alternatives; because they live in rural areas, for example.	−1	+2	+2	+3
31 Congestion tax is a punishment for people who drive to work.	−2	+3	+4	+3
32 It is unfair that people who live or work in a crowded area, like in many big cities, need to pay more for the congestion charge.	−2	+1	+3	+2
33Road pricing is unfair since wealthier people can afford it more easily than people with a lower income	−1	+5	+5	−1
34 Road pricing will not infringe people's freedom.	+3	−2	0	−1
35 Lease drivers, especially, will benefit from road pricing: their car expenses are paid for by their boss.	0	+5	+1	−4
36 My opinion about road pricing heavily depends on personal financial consequences.	−2	+2	+5	−1
37 Road pricing is mainly another way for the government to raise more taxes.	−3	+4	+1	+5
38 The government is capable of implementing a fair road pricing scheme.	+1	−5	−3	−4
39 The government appeases the strong lobby of car owners too often, while people without a car sometimes get overlooked.	+3	+2	−5	−3
40 If research shows that a certain road pricing scheme functions well, it should be implemented.	+4	−1	+3	0
41 Politicians change their opinion about road pricing too often.	+1	+4	+3	+4
42 If ever a road pricing scheme is implemented, it will probably be a scheme that is ineffective because of all the exemptions that will be thought of.	−1	+1	−2	+2

Table 1
Main socio-demographics and travel habits.

	Frame A	Frame B	Frame C	Frame D
Number of respondents	44	29	12	7
Highly educated	50%	45%	17%	57%
Gross household income per year in euros				
Not known	7%	34%	17%	29%
Less than 15,000	11%	14%	17%	14%
15,000–30,000	39%	28%	25%	14%
30,000–60,000	34%	24%	25%	14%
60,000 or more	9%	0%	17%	29%
Occupation				
(self)employed	52%	48%	36%	43%
unemployed	27%	24%	64%	29%
retired	20%	28%	0%	29%
Main mode of transport				
car	30%	41%	67%	71%
public transport	18%	20%	8%	0%
bicycle	52%	24%	17%	29%
walking	0%	14%	8%	0%
other	0%	3%	0%	0%
Car possession	57%	69%	91%	86%

analysis. In total, 92 of the participants load solely on one factor. Hence, 70% of the raw data (N = 130) or 83% of the cleaned data (N = 111) were used in the interpretation of the factors. The latter number is in line with previous studies that collected Q-sorts through face-to-face interviews (Cools et al., 2009; Kroesen and Bröer, 2009).

Finally, the Q-sorts were merged into factor arrays. A factor array represents a single 'idealized' Q-sort. In other words, the factor arrays represent hypothetical people loading 100% on the factors. Only respondents that solely and significantly load on a factor were used in the computation of the factor arrays. In line with our theoretical arguments made in the introduction, the factors are called frames from here on. The following section interprets the four frames.

3. Results

We labelled the four frames as follows: A: *The polluter should pay*, B: *Focus on fair alternatives*, C: *What's in it for me?* and D: *Don't interfere*. The interpretation of these frames will be described in this section. The similarities and differences between the frames can be derived from the factor arrays in Table 2. The values indicate how the 'idealized' Q-sort of each frame ranked the statements. Table 1 shows the main personal characteristics of the respondents per frame.

3.1. Frame A: polluter should pay

People in the first frame are quite positive about road pricing (13:+4[6]; 14:+3). This frame is characterized by the high perception of a problem. The respondents find the current level of car use a big problem for the environment *and* the economy, both in urban as rural areas (1:+5, 2:+3 and 6:−3). They strongly agree that congestion levels should be reduced, but do not consider building more roads to be a good solution (3:−4 and 4:−5). They believe road pricing is technically feasible (19:+4 and 17:−3) and also expect it to be effective in reducing congestion and emissions (28:−3 and 22:−1). The people in this frame do not attach high (or low) values to statements related to equity (e.g. 29:+1; 30:−1; 31:−2), in contrast to the other frames. On the other hand, this is the only frame that attaches a lot of value to the outcomes of road pricing research (40:+4). These findings are in line with the explanations given by the respondents, for example: 'the polluter should pay', 'the air quality/environment is bad', 'paying per kilometre is very simple'.[7]

In total, 44 respondents fit this frame and the frame can account for 17% of the total variance of the analysis. Looking at their personal characteristics, 57% own a car and 30% use the car as their main mode of transport. Most respondents use the bicycle or public transport as their main mode of transport, or they go by foot. 50% of the respondents are highly educated,[8] 11% have an income (gross national household income) of lower than 15,000 Euros (three respondents did not divulge their income). 27% are unemployed without having reached retirement age (67 years).

Altogether, frame A, '*The Polluter has to pay*' has a clear structure: the people find current car use a big problem and consider road pricing to be an effective and feasible solution to it.

3.2. Frame B: focus on fair alternatives

People in the second frame are negative about road pricing (13:−3 and 14:−4). This frame is characterized by attitudes towards (income) equality. Although people in this frame consider current car use to be an environmental threat (1:+2), they would rather see improvements in public transport or other alternatives, instead of introducing road pricing (10:+4). Actually, they are already quite positive about the current public transport and bicycle infrastructure as alternatives to the car (7:+3). They consider road pricing unfair for people with a lower income (33:+5) and think that it will be mainly lease car drivers who will benefit from system (35:+5). They are also afraid that road pricing would invade people's privacy (20:+3). In their comments, the respondents reveal that they find safety and health important and therefore they prefer public transport or the bicycle.

In total, 29 respondents fit this frame and it accounts for 11% of the total variance. Looking at their personal characteristics, 69% own a car, of which 41% use the car as their main mode of transport. 45% of the respondents are highly educated. Information about household income is scarce, since 10 respondents did not want to share information on their income. 24% are unemployed without having reached retirement age.

Overall, people in the '*Focus on fair alternatives*' frame find congestion a problem but consider road pricing to be an unfair solution that will only benefit a few groups. Instead, they prefer alternatives, such as public transport and the bicycle, that are open to all (income) groups and are environmentally friendly.

3.3. Frame C: What's it for me?

The people in the third frame are also negative about road pricing (13:−3 and 14:−1). This is the only frame in which the respondents clearly state that their opinion about road pricing heavily depends on their personal financial consequences (36:+5). Also, they most strongly disagree with the statement 'the government appeases the strong lobby of car owners too often..' (39:−5). In a similar way to all other frames, the people in this frame strongly agree that 'something has to be done' about congestion (3:−5).

Unlike the other frames, people in frame C do not want more investment in public transport/the bicycle system (10:−4). The construction of more roads is also not their preferred option (4:−4). People in frame C seem rather sceptical and state, in a similar way to people in frames B and D, that the effects of road pricing should be clearer before decisions can be made on implementation (8:+4). Unlike frame B, they slightly agree that road pricing should be implemented if research shows the scheme functions well (40:+3). However, currently, they consider road pricing to be unfair for those with a lower income (33:+5), for those who have to work (31:+4) and for those who live in crowded areas (32:+3). The comments given by the respondents indicate a lot of distrust of the government and the effectiveness of road pricing. They are also critical of public transport: 'the government is already investing in (and earning from) public transport'.

In total, 12 respondents fit this frame and it can account for 7% of the total variance. Looking at their personal characteristics, 91% own a car and 67% use the car as their main mode of transport. 17% (2/12) are highly educated. 17% have a gross household income of lower than 15,000 Euros/year. 64% are unemployed without having reached retirement age.

In conclusion, the respondents in the frame '*What's in it for me?*' seem afraid that road pricing will negatively affect their personal situation and need more information about how road pricing will affect them before they can form a final opinion. This is consistent with the socio-economic characteristics of the respondents. Indeed, except for one respondent, all respondents in this frame own a car and have a lower income and/or are regular car users. Thus, a road pricing scheme will probably affect them.

3.4. Frame D: Don't interfere

People in the fourth frame are also rather negative about road pricing (13:−2 and 14:−1). This frame is characterized by the sceptical attitude towards road pricing, road pricing institutions and politicians (38:−4 and 39:−3 and 41:+4). They consider road pricing mainly as another means for the government to raise more taxes (37:+5) and they do not believe road pricing will lead to a decrease in car use (22:+4). They are afraid road pricing will harm car users' privacy (20:+4) and prefer the current system because the costs are transparent (12:+3).

This is the only frame in which the respondents are very negative about public transport and the bicycle as alternatives to car trips (7:−5). They are not outspoken on whether the government should invest more in public transport (10:+1) and in contradiction to the other frames, frame D is not negative about the construction of more roads (4:+1). Like the other frames, they do think, 'something needs to be done about congestion' (3:−3), but their problem perception is not as dominant as in the other frames (e.g. 6:0). The respondents provided explanations, such as 'everything the government does, revolves around paying more taxes', 'it has to stay as it is now', 'the government is corrupt', 'public transport is bad', 'people who work are punished by road pricing'.

In total, 7 respondents fit this frame and it can account for 5% of the total variance. Looking at the personal characteristics, 86% own a car and 71% use the car as their main mode of transport. 57% (4/7) are highly educated. 29% are unemployed without having reached retirement age.

Altogether, frame D '*Don't interfere*' has a relatively clear structure:

[6] Read: the factor array attaches a value of +4 to statement 13.

[7] On request, the first author will provide the full list of comments given by the respondents.

[8] Highly educated: BSc degree or higher.

they are regular car users who find congestion a huge problem, but find road pricing neither a fair nor an effective solution. They trust neither the government nor the effectiveness and technique of road pricing.

4. Discussion, conclusions and recommendations

4.1. Discussion and conclusion

This study aimed to identify the frames around road pricing in the public debate in order to better understand attitudes towards road pricing instruments. Q-methodology enabled us to study subjective arguments in relation to each other and by this, reveal the underlying sets of 'beliefs and attitudes that give meaning to reality'. The analysis revealed four frames among the broader public in the Netherlands, which we have labelled: A: *The polluter should pay*, B: *Focus on fair alternatives,* C: *What's in it for me?* and D: *Don't interfere*.

We found that factors such as equity, institutional trust, environmental beliefs, self-interest and belief in effectiveness are important aspects that constitute the frames. This is not surprising and is in line with earlier studies (e.g. Schade and Schlag, 2003b). Because of the holistic, person-centred, qualitative yet statistically rigorous approach, this study offers a fresh perspective on road pricing acceptability.

An illustration of a fresh insight is that previous studies found strong links between environmental concerns and positive attitudes towards road pricing (Eliasson and Jonsson, 2011; Hamilton et al., 2014; Kim et al., 2013; Schuitema et al., 2011), but we could distinguish *two* types of people with environmental beliefs: people within frames A and B. People in frame A confirm the strong relation between environmental beliefs and acceptance of road pricing. However, people in frame B reject road pricing, mainly because they find it unfair for those with lower incomes. Börjesson et al. (2015) also report on a correlation between environmental and equity concerns. Their factor analysis revealed four factors in total: environment/intervention, equity, pricing and taxation. The person-centred approach of Q-methodology, however, gives us the insight into the fact that people who are positive about pricing, can also score highly on environmental beliefs. And people who are negative about taxation, can be in three different frames (B, C and D).

Another illustration is that earlier studies reported a relation between self-interest and acceptability (Börjesson et al., 2016; Schade and Schlag, 2003a). We also found this relation, since most people in frames C and D oppose road pricing and are frequent car users. The attitudes of people in frame C can largely be explained by self-interest. However, people within frame D show a more complex set of beliefs and values. It illustrates the paradox of liberals/libertarians, who usually like market-based solutions, but are negative towards road pricing. Their personal financial benefits are a neutral factor in the Q-set, but they oppose the instrument due to low trust in government and technology. Self-interest may still be applicable in this frame though. Bolderdijk et al. (2013) found that privacy concerns regarding registration devices (e.g. GPS devices needed for road pricing) increase with the expected personal financial costs. In other words, people in frame D might have adopted these 'privacy' and 'low trust in government' arguments in order to justify their rejection of road pricing.

A final remark is that we found a clear relationship between frames and personal characteristics. In short, relatively many frequent car users are in one of the negative frames, while cyclists and train users are overrepresented in the positive frame A. We do not claim that the relationships between frames and personal characteristics are unidirectional; travel habits may influence the frame someone fits into, and the other way around. Indeed, according to the cognitive dissonance theory (Festinger, 1957), people try to keep their behaviour and attitudes in harmony. And Kroesen et al. (2017) have empirically shown that attitude and travel behaviour mutually influence each other, whereby dissonant travellers are more inclined to change their attitudes than their behaviour. Thus, in line with these studies, someone in the 'Polluter should pay' frame who needs to travel a lot by car, might be more inclined to change his/her frame than his/her behaviour.

These insights emphasize that the public debate is much richer than just an accept/reject situation: the frames found showed that there are many ways to say 'no' or 'yes' to road pricing. Indeed, people within frames B, C and D all oppose road pricing but have varying reasons for being negative. Thus, there does not seem to be one bloc that is opposed to road pricing and which shares the same beliefs and attitudes towards road pricing. Two people can have the same level of acceptability while having totally different underlying arguments. This has been made more transparent because Q-methodology takes a person-centred approach and consequently the heterogeneity of the public becomes clearer.

4.2. Recommendations for policy and research

The search for a widely supported road pricing instrument is probably an illusion considering the great heterogeneity of beliefs, values, preferences and worldviews regarding road pricing amongst the public. Nevertheless, the four frames provide some input on how to design, and especially how to implement, a road pricing instrument that will be more accepted among the wider public.

People within frame A are already in favour of road pricing. They attach a lot of value to the environmental aspect, hence it is probably important for them that a road pricing instrument leads to environmental benefits in order to be and stay acceptable. Although this group is already in favour of road pricing, they will only become strong proponents when they have a strong incentive to win according to the theory of client politics (see King et al., 2007). When people in this frame feel more in charge of the revenue spending, they may become better mobilized and can influence the political feasibility of road pricing. Furthermore, people in frames B and C find road pricing very unfair since wealthier people can more easily afford the charges. Many existing road pricing schemes are indeed at least slightly regressive, which means that lower income groups pay a larger share of their income on the charges (Eliasson, 2016). However, as Eliasson discusses, the economic motivation of a congestion charge is to correct the price of car driving by including the external costs. In that perspective, one can argue that in the current situation (without road pricing) driving is actually subsidized. Emphasizing that road pricing is an instrument to pay in a different way for transportation, rather than to pay more for road use may lead to higher acceptability among people in frame B. Especially if the scheme is designed to make lower income groups benefit overall from the system which can be achieved by using the revenues to fund (public) transport improvements that target lower income people. People in frame B show a positive attitude towards public transport after all. Although this requires a rather large paradigm shift since many people consider road infrastructure a public good that is and should remain for free. The expected growth in paying for mobility services (such as shared bicycle or car) instead for mode possession may help this paradigm shift in time. People in frame C on the other hand seem to care mainly about their own financial consequences of the scheme. If the road pricing revenues are used to lower the fixed road and car taxes, a share of the people in this (car driver) frame will probably financially benefit from it and support the scheme. Thus these two frames illustrate one of many political dilemma's on how to design a road pricing scheme. Furthermore, people in frames C and D, seem more suspicious about road pricing and economic instruments (e.g. taxes) and the government in general. It is uncertain whether the attitudes and acceptability levels of these people towards road pricing can be influenced, but it would be interesting to study whether a scheme design that lacks any revenues for the government - such as tradable permits handled by a private party, for example - could increase their acceptance. Furthermore, more information and research about the effects of road pricing schemes might increase acceptability, especially for people within frames B and C. In particular, more certainty and a better understanding of the revenue recycling might decrease the lack of trust

(Dresner et al., 2006), which seems to be a fundamental problem for frames B, C and D, and increase acceptability (De Borger and Proost, 2012). Although people may already develop more positive attitudes towards road pricing when they get the impression that introduction of a pricing policy is almost inescapable (Schade and Baum, 2007).

Q-methodology does not provide information on how the frames are distributed over the population but we expect that the distribution will vary across regions. Therefore, we recommend studying the regional differences using frames in order to gain insight into which scheme design will be most feasible per region. If, for example, a region has a lot of frame A types, that region might be a good starting point for implementing a road pricing instrument with environmental effects. When this instrument proves to be effective, acceptability in other regions might increase and the scheme can be extended.

Regarding the methodology, we found Twitter a useful and easily accessible source for collecting the statements. A disadvantage is that Twitter is probably dominated by people who are familiar with technology and Tweets are usually posted and shared by people with an (strong) opinion. Hence, individuals on Twitter do not necessarily represent all viewpoints in a population. For future Q-studies we would recommend complementing Twitter statements with statements from more 'silent' individuals. This can be done by using reactions to a survey question as we did, or by interviewing various individuals. Moreover, the arguments in the debate we found using Twitter data show more heterogeneity than what most conventional road pricing studies looked at. Statements such as '11: innovations such as automated vehicles will solve congestion problems', '18: I'm afraid people will misuse the system and commit fraud' and '20: I am afraid that the government would get too much privacy-sensitive information on who drives where if congestion tax is introduced' were repeatedly found in our search for statements. Especially the latter statement helped to explain the difference between the frames since the factor array differs between −2 (frame A) to +4 (frame D). Thus, Twitter may be a relevant source to supplement Q-sets.

This study is a first step and follow-up studies need to be done before we can draw conclusions about the relation between frames and the acceptability of various road pricing instruments. Nevertheless, we can conclude that studying the frames offers a fresh perspective on road pricing acceptability, since a person-centred approach provides more insights into the coherence of the underlying beliefs, motives and (subjective) arguments.

CRediT authorship contribution statement

Lizet Krabbenborg: Conceptualization, Methodology, Formal analysis, Investigation, Writing - original draft. **Eric Molin:** Supervision, Writing - review & editing, Funding acquisition. **Jan Anne Annema:** Supervision, Writing - review & editing. **Bert van Wee:** Supervision, Writing - review & editing.

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