EVIDENCE BASED PUBLIC HEALTH POLICY AND PRACTICE

How willing are parents to improve pedestrian safety in their community?

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Study objective: To determine how likely parents would be to contribute to strategies to reduce pedestrian injury risks and how much they valued such interventions.
Design: A single referendum willingness to pay survey. Each parent was randomised to respond to one of five requested contributions towards each of the following activities: constructing speed bumps, volunteering as a crossing guard, attending a neighbourhood meeting, or attending a safety workshop.
Setting: Community survey.
Participants: A sample of 723 Baltimore parents from four neighbourhoods stratified by income and child pedestrian injury risk. Eligible parents had a child enrolled in one of four elementary schools in Baltimore City in May 2001.
Main results: The more parents were asked to contribute, the less likely they were to do so. Parents were more likely to contribute in neighbourhoods with higher ratings of solidarity. The median willingness to pay money for speed bumps was conservatively estimated at $6.43. The median willingness to contribute time was 2.5 hours for attending workshops, 2.8 hours in community discussion groups, and 30 hours as a volunteer crossing guard.
Conclusions: Parents place a high value on physical and social interventions to improve child pedestrian safety.

One of every five deaths in children age 1–14 is attributable to motor vehicles—one quarter of these are from pedestrian injuries.[1] Numerous risk factors for child pedestrian injuries have been identified, including characteristics of the child and the family, as well as the road environment. Interventions that address both child behaviour and the environment have been designed and evaluated, with more emphasis being placed on the benefits of engineering solutions in recent years.[2–4]

Intervening in target areas will require public support as well as resources and little is known about the barriers and facilitators of success. We know virtually nothing about how much money and volunteer time parents would offer to support behavioural and engineering solutions to the child pedestrian injury problem. Roberts[5] sent the results from a case-control child pedestrian injury study to 715 parents in New Zealand and requested that they sign and return a petition supporting the study's prevention recommendations. Only 31% of parents returned the petition and they were more likely than non-respondents to be from higher socioeconomic status (SES) groups and to not have had a child injured as a pedestrian.

In an era of limited resources, an ability to state clearly the value that parents place on effective child injury prevention interventions could facilitate decision making by those responsible for public safety. The objective of this paper is to use a method known as contingent valuation to quantify what parents are willing to do to make their neighbourhoods safer. Contingent valuation is a survey method in which the subjects are asked to supply a quantified amount of resources to achieve a desirable outcome.[6] This method has been used in the past to evaluate the willingness of members of the public to pay contributions to support poison control centres.[7] The questions that respondents confront are of the form: ''Would you do/or pay ''BID'' in order to achieve the desirable outcome?'' In each printed questionnaire ''BID'' takes on only one of a set of predetermined values such that each respondent only responds to a single randomly assigned bid, but all bid values of interest are covered in the population sampled. Giving each subject only one possible bid while giving other subjects different bids covers the whole range while keeping each subject's response to the bids fresh and untainted by exposure to a succession of offers.

METHODS

Theoretical framework

The willingness to give up or trade any scarce resource is assumed to be a function of the amount of the resource one possesses (the endowment), and a price dictating how much of a perceived benefit one receives in exchange for giving up some of the resource.

In this setting, our respondents were being asked to give up their time or their money with the implication that this contribution might lead to a perceived benefit—a neighbourhood that was safer for their children. Through the study design we could control the amount of resources requested of each subject (the bid price). However, we could not control the amount of resources respondents had (the endowment), nor could we control each subject's perception of how beneficial their contribution would be in realising child pedestrian safety. We used self reported income and the amount of time volunteered to charitable causes as proxies for each subject's endowment. To control for perceived benefit, we include subjects' perception of the efficacy of each strategy, the perceived probability of pedestrian injury and traffic volume in their neighbourhood. Because the risk of pedestrian injuries is correlated with the age and sex of the child, we included these objective measures as well.

Two other control variables are each respondent's schooling and their response to the question, ''Do you think that people in your neighbourhood would work together to get changes made?'' We interpret a response of ''Yes'' to this question as indicating that the respondent perceives a sense of neighbourhood solidarity. The response to this

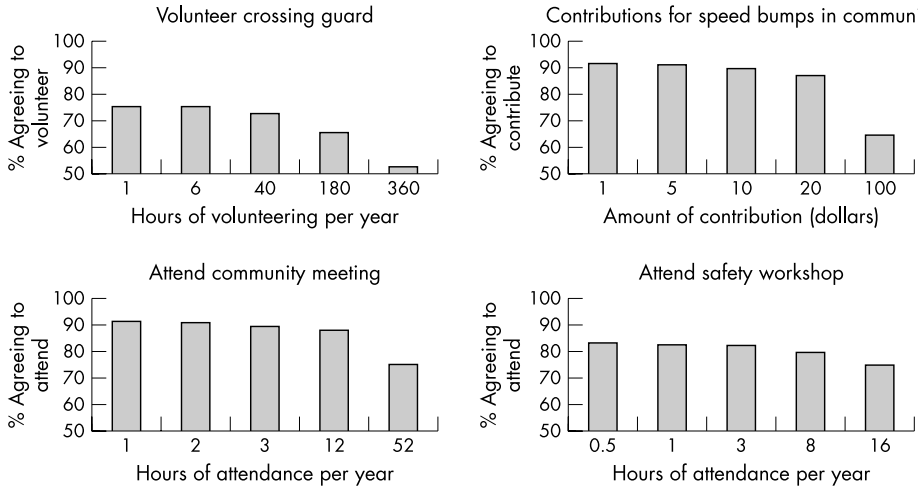

Figure 1 Percentage of respondents agreeing to contribute by size of contribution requested. Percentage agreeing to contribute has been adjusted using parameters from probit models.

neighbourhood solidarity question could indicate how fruitful respondents believe their contributions will be.

Study population

Four Baltimore City Elementary Schools participated in our research effort. One of each school type is represented: the low income high risk, low income low risk, high income high risk, and high income low risk. These four schools were identified by examining census data on median income by census tract and police data on the incidence of pedestrian injuries for children age 0–15 by census tract. High income communities were defined as having a median household income for the corresponding census tracts greater than $50 000 while low income communities had median household income by census tract of less than $30 000. High risk communities had child pedestrian injury rates of greater than 300 injuries per 100 000 person years, based on police reports for 1995–1999. Low risk communities had child pedestrian injury rates of less than 250 injuries per 100 000 person years based on the same database.

Distribution of surveys and sampling

Surveys were distributed by classroom teachers of elementary school students in spring of 2001. In three of these schools, surveys were administered to the entire student population—that is, all classes in the school. Our low income high risk school had a prohibitively high number of students for this approach, thus we administered surveys to a random sample of classes designed to enrol half of the kindergarten through six student body. Using a random number list within each grade level, a total of 32 of 64 possible classrooms were sampled.

Teachers distributed survey material to students who were asked to give them to their parents. Parents received a $10 cheque by post for returning a completed survey. Children were given a small incentive (pencil or sticker) upon

Table 1 Descriptive data from parent survey

Variable	Number non-missing out of 723 maximum	Mean or percentage	Standard deviation	Minimum	Maximum
Responses to survey on willingness to volunteer and risk perceptions					
Would volunteer to be a crossing guard? (1 = Yes)	721	68.0%		0	1
Percentage who say crossing guards would not work or not needed	718	17.4%		0	1
Would pay money to fund for speed bumps (1 = Yes)	716	85.1%		0	1
Percentage who say speed bumps would not work or not needed	719	13.6%		0	1
Would attend neighbourhood meeting to discuss safety? (1 = Yes)	719	87.6%		0	1
Percentage who say meetings would not work or not needed	721	5.5%		0	1
Would attend a workshop on community safety? (1 = Yes)	719	80.3%		0	1
Percentage who say workshops would not work or not needed	718	9.1%		0	1
Percentage responding on behalf of a boy	723	50.0%		0	1
Perceives pedestrian injury very likely	723	15.4%		0	1
Perceived neighbourhood solidarity—imputed	723	58.5%		0	1
Perceived neighbourhood solidarity	687	58.5%		0	1
Perceives neighbourhood has a lot of traffic	687	41.4%		0	1
Neighbourhood characteristics					
Low income, high injury neighbourhood	723	25.2%		0	1
Low income, low injury neighbourhood	723	29.3%		0	1
High income, high injury neighbourhood	723	29.1%		0	1
High income, low injury neighbourhood	723	16.4%		0	1
Respondents' characteristics					
Annual household income (dollars)	651	$29551	$25924	$2500	$100000
Annual household income—imputed (dollars)	723	$29706	$25031	$2500	$100000
Highest grade completed (years)	615	12.7	2.3	7	24
Highest grade completed—imputed (years)	723	12.7	2.1	7	24
Child's age (years)	723	7.7	1.9	3	12
Number of hours spent volunteering last month	723	5.6	16.5	0	100

Table 2 Coefficients from probit model for willingness to pay or volunteer for community safety

Variables	Would volunteer to be a crossing guard	Would attend neighbourhood meeting to discuss safety	Would pay money to fund for speed bumps	Would attend a workshop on community safety
Number	703	703	699	701
Pseudo-r^2	0.061	0.135	0.171	0.074
Bid†	−0.002 (−4.740)**	−0.016 (−4.990)**	−0.011 (−7.180)**	−0.015 (−1.510)
Distrust of the strategy	−0.039 (−0.280)	−0.617 (−2.580)**	−0.935 (−5.920)**	−0.529 (−2.850)**
Annual income ($1000 dollars)	−0.005 (−1.630)	−0.004 (−1.290)	0.002 (0.460)	0.000 (−0.060)
Age of the child	−0.051 (−1.850)	−0.078 (−2.200)*	−0.055 (−1.590)	−0.026 (−0.860)
Whether child was a boy	−0.009 (−0.090)	0.031 (0.240)	0.094 (0.730)	0.162 (1.430)
Number of hours volunteering last month	0.003 (0.980)	0.006 (1.080)	−0.003 (−0.910)	0.006 (1.380)
Perceives high likelihood of pedestrian injury	0.071 (0.480)	0.371 (1.640)	0.113 (0.620)	0.151 (0.870)
Perceives neighbourhood solidarity	0.110 (0.990)	0.299 (2.010)*	0.368 (2.660)**	0.381 (3.050)**
Perceives heavy neighbourhood traffic	−0.261 (−2.370)*	−0.075 (−0.520)	0.226 (1.630)	0.025 (0.200)
Highest grade completed by parent	−0.044 (−1.410)	−0.083 (−2.230)*	−0.002 (−0.040)	−0.053 (−1.600)
Constant	1.855 (4.100)**	3.288 (5.850)**	1.521 (2.620)**	1.727 (3.520)**

†Bids (expressed in hours for columns A, B, and D and dollars for column C) were randomly assigned to subjects. See text for details. Dummy variables for school neighbourhood included in all models. *Z statistics given in parentheses: * $p<0.05$, ** $p<0.01$.

returning the completed survey to their teacher. About two weeks after the survey was distributed, a reminder postcard was distributed to all students by the teacher. The study was approved by the Committee on Human Research at the Johns Hopkins Bloomberg School of Public Health.

Subjects were randomly assigned to receive one of five different versions of the survey which differed in the amount of resources asked of the subject. The response to each request for participation could be either ''Yes'' or ''No''. Later in the survey subjects were asked to rate the perceived efficacy of the same safety countermeasures. We asked ''How well do you think these things would work to make your neighbourhood a safer place to walk?'' with response items for each activity as ''Would not work'', ''Might work'', ''Would work well'', and ''Not needed in my neighbourhood''.

Response

The target population was 1959 students enrolled in the selected classrooms. An unknown fraction of the 1959 students would have been ineligible if a sibling received a survey packet. We received 723 usable surveys. Using 1959 as a conservative base, this is a response rate of 37%. Because the survey was anonymous, no data were available to compare responders to non-responders. The mean age of the index children that the parents answered for was 7.7 (SD = 1.9) and exactly half were male.

Missing data

Data on parents' schooling were missing for 16% of respondents, and data on perceived neighbourhood solidarity were missing for 6% of subjects. Data were more likely to be missing for respondents who were unwilling to contribute to

Table 3 Elasticities from probit models in table 2. (Percentage change in probability of contributing/percentage change in X)

Variables	Would volunteer to be a crossing guard	Would attend neighbourhood meeting to discuss safety	Would pay money to fund for speed bumps	Would attend a workshop on community safety
Bid†	−0.105 (−4.670)*	−0.039 (−4.900)*	−0.064 (−6.900)*	−0.027 (−1.510)
Income ($dollars)	−0.070 (−1.630)	−0.025 (−1.290)	0.011 (0.460)	−0.002 (−0.060)
Age of the child	−0.199 (−1.850)	−0.113 (−2.200)	−0.092 (−1.590)	−0.065 (−0.850)
Number of hours volunteering last month	0.009 (0.980)	0.006 (1.090)	−0.004 (−0.910)	0.011 (1.390)
Highest grade completed by parent	−0.285 (−1.410)	−0.198 (−2.200)	−0.004 (−0.040)	−0.217 (−1.600)

†Bids (expressed in hours for columns A, B, and D and dollars for column C) were randomly assigned to subjects. See text for details. Dummy variables for school neighbourhood included in all models. *Z statistics given in parentheses: * $p<0.05$, ** $p<0.01$.

safety. To limit the degree of sample selection bias we imputed the missing variables using a regression based on area of residence. Models with imputed data were compared with models with missing data to assess how much difference imputation made.

Data analysis

We estimate a probit function as follows:

$$\text{Probability (Subject ''i'' says ''yes'' to Bid)} = C+\beta_1 \text{Bid Size}_I+\beta_2 X_I \quad (1)$$

In this regression, the bid size (one of five possible bids put into the survey instrument) encountered by the subject has been randomly assigned to the subject. The X variables include the endowment and perceived risk variables discussed above. In this manner we can statistically control for the effects of income and other variables that might influence willingness to contribute. We use the probit distribution rather than logit because of probit's theoretical advantage in handling distributions with outliers. The coefficients from the probit model allow us to compute the imputed probability that each subject will make the requested contribution based on each subject's characteristics. These imputed probabilities are shown in figure 1. We compute the population estimate of willingness to contribute as the weighted average of the amount each subject was requested to contribute times the imputed probability that they would agree to contribute. More explicitly:

For each subject:

$$\text{Expected Contribution of the i-th respondent (Named ''i'')} = \text{(Predicted Probability ''i'' will pay)} \times \text{(Size of Bid Requested of ''i'')} \quad (2)$$

After implementing equation 2, one can then compute the population median of the expected contribution of subjects, {1, 2, 3,…i, …N}. The median willingness to contribute indicates how receptive an entire population would be to a request for contributions.

Because the interpretation of the probit coefficients is difficult, they have been converted into elasticities for all of the continuous independent variables. This conversion was carried out using the delta method.[8] In this instance an elasticity is the percentage change in the probability of contributing from a percentage change in the relevant independent variable—holding all other variables at their means.

RESULTS

As can be seen in table 1, most (68% to 87.1%) of the respondents affirmed their willingness, when asked to contribute time or money to make the community safer. As can be seen from figure 1, even at the highest bids, over 50% of subjects agreed to contribute. Respondents had a higher probability overall of being willing to attend community meetings (0.88: 95% CI: 0.85 to 0.90) than either to give time volunteering as crossing guards (0.68: 95% CI: 0.65 to 0.71) or to listen to a speaker's presentation on safety (0.80: 95%CI: 0.77 to 0.83).

In simple bivariate logistic analysis of the determinants of various contributions the willingness to attend meetings was positively related to self rated perception of high pedestrian injury risk: (OR = 2.78, 95% CI: 1.179 to 7.993). Willingness to attend a safety workshop was also positively related to self rated perception of high pedestrian injury risk (OR = 1.70, 95% CI: 0.942 to 3.273).

Key points

- Respondents value improved pedestrian safety
- Higher income respondents less willing to volunteer time
- Likelihood of contributing inverse to size of requested contribution
- Neighbourhood solidarity increases likelihood of contributing
- Median parent in the neighbourhood willing to pay $6.43 for speed bumps

Some respondents (9.1%–17.4%) believed that the strategies that were suggested ''would not work'' or were not needed. Respondents in this category were significantly more likely to live in the high income, low injury neighbourhood.

The willingness to contribute declined slightly as the size of the contribution increased for all four types of activities (see fig 1). This declining willingness is small but significant as can be seen from the probit coefficients on the ''Bid'' variable in table 2. Because probit coefficients are difficult to interpret, table 3 offers elasticities, which are defined as the percentage change in willingness to participate associated with a percentage change in covariates. For instance, the −0.105 elasticity for crossing guards suggests that a 10% increase in the number of hours required of volunteers would reduce the probability of volunteering in the population by 1.05% (= (−0.105)×(10%)). Overall the amount of time they would have to give up to participate was a rather weak determinant of whether they expressed a willingness to participate.

Higher income was associated with less willingness to volunteer to be a crossing guard or to attend a neighbourhood meeting, but the effects were not statistically significant. From table 3, a 10% increase in income would lead to a 0.70% (= (−0.070)×(10%)) reduction in the probability of volunteering to be a crossing guard. Analogous to higher income, higher schooling levels reduced the probability of volunteering, but the effects had little significance. Schooling effects showed that a 10% increase in an individual parent's schooling (for example, going from 12 years of schooling to 13.2 years) would decrease that individual's probability of volunteering time to attend a workshop by a percentage that ranged from 1.98% to 2.85%.

Even though parents with older children cited a higher likelihood of pedestrian injury, those answering about older children were less likely to volunteer. This finding was unchanged even when risk perception was not controlled in alternative models. Whether or not parents perceived a high risk of pedestrian injury risk was not associated with their willingness to contribute. The perception of heavy traffic was not associated with contributing except for having a negative association with the willingness to be a volunteer crossing guard. Judging from table 2, one of the strongest predictors of contribution may be the perception of neighbourhood solidarity, which was positively associated with three of the four outcomes.

We computed the median willingness to contribute using the algorithm described in equation 2. The median expected contributions for this population are 30 hours per person per year in crossing guard patrol, $9.11 per person to be contributed towards speed bumps, 2.8 hours per person per year in community meetings to discuss safety, and 2.5 hours per person per year attending workshops on pedestrian safety.

Policy implications

- Investments in physical and social structures to reduce pedestrian injuries are intensely valued by communities.
- There is an untapped willingness to volunteer to improve pedestrian safety that could be mobilised by interventions.
- Policymakers might expect willingness to volunteer to decline with greater affluence.

DISCUSSION

One potential explanation for the enthusiasm of our respondents to contribute to pedestrian safety could be self selection into the sample. The willingness to take the trouble to fill out a survey on pedestrian safety (even for a $10 subject fee) is potentially correlated with both an interest in this issue and a willingness to contribute time to research on the topic.

To assess how much self selection bias could be changing the estimates let us make the following conservative assumptions

- Non-respondents would have all expressed zero willingness to contribute
- Respondents would have all expressed zero willingness to contribute at bids higher than the bids they confronted
- The response rate was 35%

Under these conservative assumptions the median expected contributions for this population are 22.7 hours per person per year in crossing guard patrol, $6.43 per person to be contributed towards speed bumps, 3.5 hours per person per year in community meetings to discuss safety, and 1.4 hours per person per year attending workshops on pedestrian safety. Thus even under these conservative assumptions about response bias, there is a high degree of community willingness to participate in activities designed to improve child pedestrian safety.

A second limitation of willingness to pay studies in general is scepticism that respondents would actually make the contributions they say they would. Although the single bid design was used in the study to limit the problem of framing bias, subjects may still have wanted to present themselves in a positive light and provide ''feel good'' responses of willingness to contribute to the community. There have been studies that validate statements of willingness to pay by follow up with real life opportunities to actually make good the statements of willingness.[9] This research suggests that there is some upward bias in estimates of stated willingness to contribute compared with actual contributions.[10]

Several findings emerged that were in contradiction to the theoretical framework. Higher incomes had no significant effect on the likelihood of contributing money or time. Clearly high income is confounded with high wages and a high cost of time. As discussed above perceiving a high likelihood of pedestrian injury depends on traffic density and child's age. The lack of significance of the self ratings of risk may be attributable to this measure's collinearity with density and child's age, both of which were significant in at least one of the models.

In conclusion, our study showed that high proportions of respondents value improvements in neighbourhood safety. Parents seem to be ready and willing to educate themselves about child pedestrian safety through participating in workshops and community meetings. Moreover, they say they are willing to expend comparatively large amounts of their own time and money to obtain improved safety features in their neighbourhood. For instance, respondents' valuation of speed bumps can be conservatively estimated at $6.43. Thus the 2000 parents in our study neighbourhoods would place a $19 000 value on the construction of speed bumps. This is enough to fund the construction of about 10 speed bumps in the four neighbourhoods we studied. The approximate cost per speed bump is $1500 to $2000.

The key challenge for public policymakers is to devote public resources to projects whose public value is at least as large as the investment. This study emphasises that investments in physical and social structures to reduce pedestrian injuries are indeed valued by communities. Furthermore, members of the neighbourhoods we studied expressed eagerness to contribute their own resources to these activities.

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