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IMPROVING ACCURACY AND REDUCING COSTS OF ENVIRONMENTAL BENEFIT ASSESSMENTS

Reconciling Averting Behavior and Contingent Valuation Benefit Estimates of Reducing Symptoms of Ozone Exposure

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Notice

This document is a preliminary draft. It has not been formally released by the U.S. Environmental Protection Agency and should not at this stage be construed to represent Agency policy. It is being circulated for comments on its technical merit and policy implications.

1. INTRODUCTION

Previous applications of the contingent valuation method (CVM) have resulted in comparatively large estimates of willingness to pay (WTP) to avoid symptoms of ozone exposure. Berger et al. (1985), for example, found that raw averages of CVM bids to avoid one day of cough and headache were $105 and $173, respectively. Moreover, Dickie et al. (1986) reported that averages of CVM bids to avoid these and other ozone symptoms such as chest tightness, throat irritation, and pain on deep inhalation always were larger than corresponding estimates obtained using the averting behavior method (ABM). Frequently, average CVM bids exceeded their ABM counterparts by factors between five and ten. A number of conjectures were advanced to explain this discrepancy; but none could be firmly supported. As a consequence, policy makers interested in establishing dollar benefits of reduced ozone symptoms are forced to choose between two sets of highly divergent estimates of WTP.

This report uses a new data set to reconcile differences between CVM and ABM estimates of reduced ozone-related health symptoms. The reconciliation approach, which focuses on the CVM, involves three steps. First, each respondent is directly asked for his WTP to avoid one day of recently experienced ozone-related symptoms such as headache, cough, and chest tightness. Second, each bid is multiplied by the number of times

per month that a symptom occurs and monthly bids are totaled across symptoms. Third, respondents are advised of these totals and given an opportunity to revise their bids. Results obtained from new data collected during July-October, 1986 from 221 residents of Glendora and Burbank, California reveal that averages of revised bids are dramatically lower than averages of original bids. For example, original bids to avoid one day of cough averaged $355.10, whereas revised bids averaged $1.24; original bids to avoid one day of headache averaged $178.39, whereas revised bids averaged $1.19. These results suggest that in CVM studies of frequently occurring events such as health symptoms, care should be taken to ensure that respondents are aware of the implications of their bids for total expenditure. Moreover, revised bids to eliminate one day of all nine ozone symptoms considered actually are lower than corresponding ABM estimates. This relationship between the two sets of estimates should be expected, as explained more fully in Dickie et al., because ABM overestimates WTP. In addition to reducing symptoms, averting goods used in the ABM calculations may represent sources of direct utility.

The remainder of this report, which is submitted as part of a larger on-going study of morbidity-ozone relationships, is divided into four sections. Section 2 briefly reviews previous estimates of WTP to reduce minor symptomatic discomforts and stresses reasons why such estimates are important in a policy context. Section 3 highlights key features of data used to implement the three step approach to obtaining revised CVM bids. Section 4 presents the original and revised CVM estimates of WTP to avoid ozone related symptoms. Also presented in Section 4 are supplementary

tabulations and regression results that explain the behavior of individual CVM bids. A summary and conclusions are presented in Section 5.

2. POLICY CONTEXT AND LITERATURE REVIEW

Reducing symptoms or discomforts of ozone exposure is an important source of dollar benefits for three interrelated reasons. First, as discussed more fully in Gerking et al. (1984), minor symptomatic discomforts can occur even in healthy adults at ambient ozone levels below the present federal standard of 12 pphm. Second, even though these discomforts are less serious than diseases such as asthma, emphysema, and chronic bronchitis, they do cause individuals to limit activities. Third, these discomforts and activity limitations are experienced by a large share of the exposed population. As a consequence, willingness to pay to avoid them may be substantial and should be taken into account in the regulatory impact assessment process.

Three methods have been used to measure benefits of reduced health symptoms of ozone exposure: (1) cost of illness (COI), (2) averting behavior (ABM), and (3) contingent valuation (CVM). Unfortunately, these methods have produced widely divergent benefit estimates. This point is documented in the remainder of this section through a brief survey of pertinent literature. Readers interested in a more complete and evaluative review are referred to Chestnut and Violette (1984) and Dickie et al. (1986). Application of COI tends to result in small benefit estimates because it considers only direct and indirect expenditures required for symptom relief. Examples of costs considered by this method include medical expenses and income foregone due to work loss. A fundamental criticism of the cost of illness approach, however, is that willingness to

pay (WTP) to avoid symptoms is not correctly measured. Harrington and Portney (1987) and Berger et al. (1985) argue that on theoretical grounds, WTP generally exceeds COI estimates because the latter accounts neither for the disutility effects of symptoms (i.e., "pain and suffering") nor for defensive expenditures for goods other than medical care. Empirical studies confirm this finding. Rowe and Chestnut (1986) estimate the ratio of WTP/COI for reduced bad asthma days to be approximately 2.0. Benefit calculations for 10 percent reductions in ambient ozone levels by Dickie (1987) yield corresponding ratios of approximately 5 for normal individuals and 11 for individuals with respiratory impairments. Consequently, the CVM, in which individuals are asked directly for their WTP to avoid symptoms, and the ABM, in which WTP is inferred from individual behavior, have received increasing attention.

There also are substantial differences between estimates of WTP using the ABM and CVM approaches. Although there have been several theoretical studies relating to the ABM (i.e., Harrington and Portney, 1987; Berger et al., 1985; Courant and Porter, 1981; Harford, 1984; Bockstael and McConnell, 1983; and Bartik, 1986), Gerking and Stanley (1986) and Dickie et al. (1986) represent the only attempts to apply this approach in an empirical setting. Gerking and Stanley estimate benefits of ozone control in St. Louis and Dickie et al. estimate benefits of reduced ozone-related minor symptomatic discomforts. In the latter study, calculations of WTP were obtained by combining estimates of the marginal product of averting activities in reducing symptoms with direct data on the costs of those averting activities. These calculations, shown in Tables 1 and 2, pertain to persons with normal respiratory function and those with impaired

TABLE 1. AVERTING BEHAVIOR AND WTP: NORMAL SUBSAMPLE

Symptom	Averting Good	Change in Probability of Symptom	Expected Symptom-Days Avoided	WTP per Symptom-Day Avoided
Could Not Breathe Deep	---[a]	---[a]	---[a]	---[a]
Pain on Deep Inhalation	GASCOOK*	.0079	2.88	$29.12
Out of Breath Easily	---[a]	---[a]	---[a]	---[a]
Wheezing/ Whistling Breath	---[a]	---[a]	---[a]	---[a]
Chest Tight	ACCAR***	.0116	4.25	$35.76
Cough	ACCAR***	.0287	10.47	$14.18
	GASCOOK***	.0866	31.63	$2.66
Throat Irritation	ACCAR***	.0291	10.63	$14.30
Sinus Pain	ACCAR***	.0300	10.94	$13.89
Headache	ACCAR*	.0211	7.69	$19.77

[a]No coefficients of averting goods were correctly signed and statistically significant at 10 percent using a one-tail test in symptom production function.

*Denotes coefficient significant at .01 (one-tail) in symptom production function.

**Denotes coefficient significant at .05 (one-tail) in symptom production function.

***Denotes coefficient significant at .10 (one-tail) in symptom production function.

SOURCE: Dickie et al. (1986, p. 6)

TABLE 2. AVERTING BEHAVIOR AND WTP: IMPAIRED SUBSAMPLE

Symptom	Averting Good	Change in Probability of Symptom	Expected Symptom-Days Avoided	WTP per Symptom-Day Avoided
Could Not Breathe Deep	GASCOOK**	.0908	33.14	$2.53
Pain on Deep inhalation	ACCAR*	.0258	9.41	$16.15
Out of Breath Easily	GASCOOK***	.0954	34.82	$2.41
Wheezing/ Whistling Breath	GASCOOK**	.0781	28.51	$2.94
	ACHOME***	.0677	24.70	$16.80
Chest Tight	ACHOME*	.0476	17.38	$23.87
	ACCAR*	.0709	25.88	$5.87
	GASCOOK***	.2376	86.71	$0.97
Cough	ACCAR*	.0536	19.56	$7.77
Throat Irritation	ACCAR**	.0685	24.99	$6.08
Sinus Pain	ACHOME**	.0505	18.45	$22.49
Headache	ACHOME*	.0629	22.96	$18.07
	APHOME*	.0634	23.41	$5.21

* Denotes coefficient significant at .01 (one-tail) in symptom production function.

** Denotes coefficient significant at .05 (one-tail) in symptom production function.

*** Denotes coefficient significant at .10 (one-tail) in symptom production function.

SOURCE: Dickie et al. (1986, p. 7)

respiratory function. In these tables, the first column on the left hand side lists symptoms of ozone exposure and the second column lists the averting activity (or activities) used in the marginal product and price calculations. As shown, the four averting activities used are: (1) automobile air conditioning (ACCAR), (2) home air conditioning (ACHOME), (3) home air purifier (APHOME), and (4) switching from gas to electric cooking (GASCOOK). The third column from the left gives the change in daily probability of symptom occurrence as the averting good is employed; and in the fourth column, the daily probability change is multiplied by 365 to obtain the expected number of days per year the symptom would be avoided. Dividing the expected number of symptom days avoided into annualized full prices for the averting good yields the WTP per symptom-day avoided. Dickie et al. discuss these estimates more fully in Chapters 1 and 7 of their report; yet it is worth repeating that the four averting goods analyzed may provide direct utility. Thus, the calculations of WTP to avoid symptoms shown in Tables 1 and 2 are upper bound estimates. In any case, Table 1 shows that WTP estimates for the normal subsample range from $2.66 to avoid one day of cough to $35.76 to avoid one day of chest tightness and four WTP estimates cluster in the range from $13.89 to $19.77. WTP was not calculated for three symptoms, could not breathe deep, out of breath easily, and wheezing/whistling breath, because respondents in the normal subsample seldom experienced them. Table 2 shows that WTP calculations for the respiratory impaired subsample for each of nine symptoms considered range from $0.97 to $23.87.

Raw or unrevised CVM estimates of WTP to avoid one day of these symptoms tend to be larger than those obtained by the ABM. Averages of CVM

TABLE 3. CVM ESTIMATES OF WTP FOR AVOIDING SYMPTOMS FOR ONE DAY

	Normal	Impaired
Symptom	Mean Bid	Mean Bid
Could not Breathe Deep	$ 32	$271
Pain on Deep Inhalation	$ 42	$194
Out of Breath Easily	$256	$374
Wheezing/Whistling Breath	$ 12	$334
Chest Tight	$204	$198
Cough	$140	$205
Throat Irritation	$ 45	$213
Sinus Pain	$ 97	$239
Headache	$126	$154

SOURCE: Dickie et al. (1986, p. 15)

bids collected by Dickie et al. are reported in Table 3. These bids were obtained from the same respondents who provided data to support the ABM WTP estimates just discussed. CVM bids were obtained only from respondents who reported having experienced the symptom within the previous 48 hours. Consequently, bids are linked to specific, recent events that are fresh in respondent's minds. As shown by comparing the figures in Table 3 with those in Tables 1 and 2, the CVM bids for avoiding symptoms always are larger than those obtained with the ABM, and certain CVM bids exceed their ABM counterparts by a factor 10 or more. Also, in contrast to the ABM estimates, the CVM bids from impaired individuals exceed those elicited from normal individuals.

CVM bids obtained by Dickie et al. are roughly comparable to those found by Loehman et al. (1979) and Berger et al. (1985), although the latter studies did not distinguish between normal and respiratory impaired respondents. The Loehman et al. study considered three classes of symptoms: (1) shortness of breath/chest pain, (2) coughing/sneezing, and (3) head congestion/eye, ear, or throat irritation. The three symptoms were defined in terms of severity and duration as follows. A minor symptom would allow continuation of normal daily activities, while a severe symptom would require restriction of daily activities. Duration was defined as one, seven, or 90 days. Approximately 1800 questionnaires were mailed to residents of the Tampa Bay area of Florida; about 400 of these were returned. Following an explanation that sometimes there exists a tradeoff between discomfort and money, respondents were asked to value the symptoms listed above by marking a payment card which listed 10 values ranging from $0 to $1000. As shown in Table 4, mean CVM bids exceed the medians,

TABLE 4. MEAN AND MEDIAN WTP TO AVOID SYMPTOMS

(Loehman et al., 1979)

	Days of Health Effect					
	1		7		90	
Symptom	Mean	Median	Mean	Median	Mean	Median
Mild Shortness Breath	$48.61	$ 4.90	$ 73.87	$13.64	$145.93	$35.96
Severe Shortness Breath	79.15	10.92	136.12	35.93	251.84	97.80
Mild Cough/Sneeze	26.40	2.31	44.67	7.84	86.03	22.85
Severe Cough/Sneeze	45.77	6.95	72.29	19.90	147.48	50.56
Mild Head Congestion/ Eye, Ear, Throat Irritation	32.50	3.80	41.51	9.58	90.37	25.14
Severe Head Congestion/ Eye, Ear, Throat Irritation	53.42	8.17	80.32	20.34	179.94	61.68

SOURCE: Dickie et al. (1986, p. 43)

reflecting a distribution skewed to the right. The authors suggest that this skewness reflects extremely high bids from some respondents who may have objected to the WTP question. As Chestnut and Violette (1984) point out, however, the skewness may be partly attributable to the increasing size of the increments between dollar amounts listed on the payment card as the dollar amounts increased in size. Nevertheless, mean CVM bids shown in Table 4 for eliminating symptoms for one day are higher than corresponding ABM estimates for similarly defined symptoms. Also, after adjusting for inflation between the late 1970s and the mid 1980s, the bids reported in Table 4 are roughly comparable to those in Table 3.

The Berger et al. (1985) research considered seven symptoms: (1) coughing spells, (2) stuffed up sinuses, (3) throat congestion, (4) itching eyes, (5) drowsiness, (6) headache, and (7) nausea. Door-to-door and mall intercept methods were used to sample 131 individuals in Denver and Chicago; nine incomplete surveys reduced the number of observations to 122. Respondents were asked the number of symptom days experienced in the previous year and the costs associated with each symptom. Respondents then were asked to rank the symptoms according to their relative undesirability and to state their WTP for additional symptom-free days. Table 5 presents mean CVM bids obtained in the Berger study. As was the case in Dickie et al., only respondents who actually experienced the symptom were allowed to bid. Mean bids obtained again are larger than those shown for similar symptoms considered by Dickie et al. using the ABM method. Moreover, the estimates imply that a hypothetical respondent experienced each of these symptoms 10 days per year, he would be willing to pay nearly $8000 annually to obtain complete relief.

TABLE 5. DAILY WTP TO AVOID SYMPTOMS

(Berger et al., 1985)

Symptom	Number Experiencing Symptom[a]	Mean Daily WTP
Coughing Spells	27	$105.34
Stuffed Up Sinuses	43	38.84
Throat Congestion	24	43.93
Itching Eyes	16	172.23
Heavy Drowsiness	6	173.89
Headache	48	173.21
Nausea	18	91.24

[a]Only those experiencing the symptom are included in calculating the sample statistics.

SOURCE: Dickie et al. (1986, p. 46)

3. DATA

Data used to analyze CVM bids were collected by telephone interviews of 221 residents of Glendora and Burbank, California. These individuals, who previously participated in the UCLA study of Chronic Obstructive Respiratory Disease (CORD) (Detels et al., 1979, 1981) were contacted during the period July-October, 1986. Each of these individuals also completed in-person baseline questionnaires and follow-up telephone interviews that supported empirical work presented in Dickie et al. Chapter 4 of that study discusses in greater detail characteristics of the data and issues relating to sample selection.

An entirely new questionnaire was designed for the present study (see Appendix A). The introductory section of this instrument updated information on residence, employment, and earnings that previously was collected in the Dickie et al. study. The next group of questions ascertained which of 26 health symptoms the respondent experienced in the past twelve months and asked the respondent to focus on those (up to three) that were most bothersome. Then, more details were obtained about the most bothersome symptoms. In particular, respondents were asked about the frequency (both days in past month and days in past year), duration, and severity of symptoms, as well as averting actions undertaken to make themselves feel better. Information collected on averting activities included: (1) specific actions taken to relieve symptoms, (2) change in symptom severity brought about by these actions. Thus, the respondent was led to think about his most bothersome symptoms as well as effectiveness of averting actions prior to reporting WTP from a payment card in the following contingent valuation question. This question was answered by

each respondent for up to three symptoms. If the respondent reported no symptoms, WTP was not elicited. Finally, respondents were given an opportunity to revise bids for symptom avoidance. Interviewers multiplied the bids times frequency of occurrence during the previous month and then added these values across symptoms. Total implied monthly expenditures to avoid the most bothersome symptoms then were presented and respondents were asked, "On a monthly basis, is [this total] what you would be willing to pay to eliminate these symptoms?" If the response was negative, they were first asked whether they instead would be willing to pay more or less and then asked what dollar amount they instead would be willing to pay.

Of 221 respondents, 165 reported having at least one symptom, and thus answered one or more contingent valuation questions. Data obtained from raw or original bids implied the frequency distribution total monthly expenditures to eliminate symptoms shown in Table 6. Values range from a low of zero to a high of $899,910. The highest three implied monthly expenditure figures are larger than annual income of any sample member. Revised total monthly expenditure figures, shown in the second column of Table 6, are much lower. These figures span zero to the $201-$300 range. Confronting respondents with total monthly expenditure implications of their original bids, therefore, results in dramatic revisions of amounts that would be willingly spent to avoid symptoms.

4. RESULTS

This section presents preliminary results of a further analysis of CVM bids and related information that pertain to the nine ozone symptoms considered by Dickie et al. (1986).

TABLE 6. FREQUENCY DISTRIBUTION FOR CONTINGENT VALUATION BIDS TO ELIMINATE UP TO THREE MOST BOTHERSOME SYMPTOMS FOR A MONTH[a]

Dollar Amount	Total Monthly Expenditure Implied by Original Bids	Revised Total Monthly Expenditure
$ 0- 1	50	113
1- 10	19	12
11- 20	8	4
21- 30	10	4
31- 40	7	1
41- 50	3	8
51- 60	6	2
61- 70	0	2
71- 80	1	2
81- 90	1	0
91- 100	1	6
101- 150	8	3
151- 200	3	4
201- 300	5	1
301- 400	4	0
401- 500	3	0
501- 600	3	0
601- 700	3	0
701- 800	5	0
801- 900	3	0
901-1000	5	0
1001-1500	3	0
1501-2000	2	0
2001-3000	2	0
3001-4000	1	0
9,250	1	0
30,000	1	0
40,180	1	0
299,970	1	0
899,910	2	0
Missing Observations	3	3
TOTAL	165	165

[a]Frequency distribution shows number of respondents.

Tables 7 through 15 provide frequency distributions and summary statistics. Frequency distributions presented for each symptom show the pattern of: (1) original or raw bids, (2) revised bids, and (3) revised bids with exclusions based on consistency checks. For all except throat irritation, out of breath easily, and wheezing/whistling breath, distributions of original bids include at least one value of $9999 or more (coded as $9999) to eliminate one day's experience with the symptom. For the symptoms chest tight, pain on deep breath, and could not breathe deep, at least one bid of $5000 also was reported. The next largest bids were $500 to eliminate one day of wheezing/whistling breath and $100 or less in the case of all other symptoms. Thus, the bids exceeding $5000 would appear to be outliers and, in any case, their presence contributes to mean original bids which are larger than corresponding ABM WTP estimates reported in Tables 1 and 2.

Revised bids to avoid one day of ozone related symptoms were calculated using equation (1)

$$RB_i = B_i(RTME/ITME) \qquad (1)$$

where RB_i denotes the revised bid for symptom i, B_i denotes the original bid for symptom i, RTME denotes respondent's revised total monthly expenditures to eliminate (up to three) most bothersome symptoms, and ITME denotes total monthly expenditures implied by the respondent's original bids. Thus, the ratio used to compute RB_i is specific to respondents but not to symptoms. For a given respondent, each B_i is adjusted using the same ratio. A more precise procedure would have been to obtain adjustment ratios for each symptom, however, this approach was ruled out in order to keep the questionnaire as brief and simple as practicable. As shown in

TABLE 7. SUMMARY OF CVM BIDS TO AVOID SINUS PAIN OR DISCOMFORT FOR ONE DAY

Original Bid Distribution		Revised Bid Distribution		Revised Bid Distribution with Consistency Check Exclusions	
Value	Frequency	Value	Frequency	Value	Frequency
$ .00	9	$ .00	24	$ .00	8
1.00	10	.09	1	.33	1
2.00	3	.33	1	1.19	1
5.00	3	.36	1	1.64	1
10.00	6	.40	1	1.67	1
15.00	1	.42	1	2.62	1
20.00	2	.48	1	2.69	1
25.00	2	.63	3	2.86	1
30.00	2	1.19	1	3.33	2
33.00	1	1.64	1	4.71	1
50.00	3	1.67	1	6.02	1
100.00	1	2.62	1	7.14	1
9999.00	1	2.69	1	Missing	1
Missing	1	2.86	1		
		3.33	2		
		4.71	1		
		6.02	1		
		7.14	1		
		Missing	1		
Valid Cases	44	44		20	
Mean	$239.50	$ .94		$ 1.88	
Median	3.50	.00		1.42	
Standard Error	228.49	0.26		0.487	
t-ratio	1.05	3.62*		3.86*	

*Denotes significance at 5% level.

TABLE 8. SUMMARY OF CVM BIDS TO AVOID COUGH FOR ONE DAY

Original Bid Distribution		Revised Bid Distribution		Revised Bid Distribution with Consistency Check Exclusions	
Value	Frequency	Value	Frequency	Value	Frequency
$ .00	14	$ .00	20	$ .00	17
1.00	4	2.14	1	2.14	1
10.00	1	2.48	1	2.48	1
15.00	1	2.86	1	2.86	1
20.00	3	3.11	1	3.11	1
25.00	1	3.33	3	3.33	1
35.00	1	4.71	1	4.71	1
50.00	3	6.67	1	6.67	1
9999.00	1	9.52	1	9.52	1
Missing	0	Missing	1	Missing	1
Valid Cases	29		28		
Mean	$ 355.10		$ 1.24		$ 1.39
Median	1.00		.00		.00
Standard Error	344.45		.45		.50
t-ratio	1.03		2.76*		2.78*

*Denotes significance at 5% level.

TABLE 9. SUMMARY OF CVM BIDS TO AVOID THROAT IRRITATION FOR ONE DAY

Original Bid Distribution		Revised Bid Distribution		Revised Bid Distribution with Consistency Check Exclusions	
Value	Frequency	Value	Frequency	Value	Frequency
$ .00	8	$ .00	19	$ .00	11
1.00	5	.75	1	1.43	1
5.00	1	1.43	1	2.86	1
10.00	6	2.86	1	3.11	1
20.00	1	3.11	1	3.33	1
25.00	2	3.33	1	6.52	1
50.00	1	6.52	1	24.10	1
100.00	2	24.10	1	Missing	0
Missing	0	Missing	0		
Valid Cases	26		26		17
Mean	$ 15.00		$ 1.56		$ 2.43
Median	3.00		.00		.00
Standard Error	5.40		.93		1.43
t-ratio	2.78*		1.68		1.70

*Denotes significance at 5% level.

TABLE 10. SUMMARY OF CVM BIDS TO AVOID CHEST TIGHT FOR ONE DAY

Original Bid Distribution		Revised Bid Distribution		Revised Bid Distribution with Consistency Check Exclusions	
Value	Frequency	Value	Frequency	Value	Frequency
$ .00	9	$ .00	17	$ .00	5
3.00	3	.81	1	1.04	1
5.00	1	1.04	1	7.14	1
10.00	1	7.14	1	8.43	1
20.00	1	8.43	1	9.57	1
30.00	1	9.57	1	14.29	1
35.00	2	14.29	1	15.00	1
50.00	4	15.00	1	Missing	1
5000.00	2	Missing	1		
9999.99	1				
Missing	0				
Valid Cases	25		24		11
Mean	$ 813.72		$ 2.35		$5.04
Median	5.00		.00		1.05
Standard Error	471.59		.96		1.82
t-ratio	1.73		2.45*		2.77*

*Denotes significance at 5% level.

TABLE 11. SUMMARY OF CVM BIDS TO AVOID COULD NOT BREATHE DEEP FOR ONE DAY

Original Bid Distribution		Revised Bid Distribution		Revised Bid Distribution with Consistency Check Exclusions	
Value	Frequency	Value	Frequency	Value	Frequency
$ .00	16	$ .00	25	$ .00	11
1.00	1	.81	1	1.04	1
2.00	1	1.04	1	1.43	1
3.00	1	1.43	1	3.08	1
4.00	1	3.08	1	7.14	1
5.00	1	7.14	1	14.29	1
10.00	1	14.29	1	25.00	1
20.00	1	25.00	1	Missing	0
35.00	1	Missing	0		
50.00	3				
100.00	1				
5000.00	1				
9999.00	3				
Missing	0				
Valid Cases	32	32		17	
Mean	$1139.58	$1.65		$3.06	
Median	1.00	.00		.00	
Standard Error	544.56	.90		1.64	
t-ratio	2.09*	1.83		1.87	

*Denotes significance at 5% level.

TABLE 12. SUMMARY OF CVM BIDS TO AVOID PAIN ON DEEP BREATH FOR ONE DAY

Original Bid Distribution		Revised Bid Distribution		Revised Bid Distribution with Consistency Check Exclusions	
Value	Frequency	Value	Frequency	Value	Frequency
$ .00	7	$ .00	12	$ .00	4
3.00	1	4.17	1	4.17	1
4.00	1	7.14	1	7.14	1
20.00	1	11.43	1	11.43	1
40.00	1	25.00	1	25.00	1
50.00	2	Missing	2	Missing	0
100.00	1				
5000.00	1				
9999.00	1				
Missing	2				
Valid Cases	16		16		8
Mean	$ 954.13		$ 2.65		$ 5.97
Median	3.50		.00		2.08
Standard Error	678.33		1.60		3.11
t-ratio	1.41		1.66		1.92

TABLE 13. SUMMARY OF CVM BIDS TO AVOID OUT OF BREATH EASILY FOR ONE DAY

Original Bid Distribution		Revised Bid Distribution		Revised Bid Distribution with Consistency Check Exclusions	
Value	Frequency	Value	Frequency	Value	Frequency
$ .00	9	$ .00	14	$ .00	6
1.00	1	.61	1	4.17	1
2.00	1	4.17	1	Missing	1
3.00	1	Missing	1		
10.00	2				
50.00	2				
Missing	1				
Valid Cases	16		16		8
Mean	$ 7.88		$ .30		$ .60
Median	.00		.00		.00
Standard Error	4.20		.26		.56
t-ratio	1.88		1.15		1.07

TABLE 14. SUMMARY OF CVM BIDS TO AVOID WHEEZING/WHISTLING BREATH FOR ONE DAY

Original Bid Distribution		Revised Bid Distribution		Revised Bid Distribution with Consistency Check Exclusions	
Value	Frequency	Value	Frequency	Value	Frequency
$ .00	5	$ .00	7	$ .00	4
2.00	1	.54	1	2.14	1
5.00	1	2.14	1	14.29	1
35.00	1	14.29	1	Missing	1
50.00	2	Missing	1		
500.00	1				
Missing	0				
Valid Cases	11		10		6
Mean	$ 58.36		$ 1.70		$ 2.74
Median	2.00		.00		.00
Standard Error	44.59		1.41		2.34
t-ratio	1.31		1.21		1.17

TABLE 15. SUMMARY OF CVM BIDS TO AVOID HEADACHE FOR ONE DAY

Original Bid Distribution		Revised Bid Distribution		Revised Bid Distribution with Consistency Check Exclusions	
Value	Frequency	Value	Frequency	Value	Frequency
$ .00	14	$ .00	41	$ .00	4
1.00	18	.04	1	.63	1
2.00	4	.10	1	1.67	1
5.00	8	.18	1	2.14	1
7.00	1	.30	1	2.20	1
10.00	2	.38	1	2.50	1
15.00	1	.48	1	2.99	1
20.00	2	.63	2	3.75	1
35.00	1	.95	1	6.52	1
50.00	3	1.67	1	6.67	1
75.00	2	2.14	1	8.33	1
100.00	4	2.20	1	14.29	1
9999.00	1	2.50	1	17.86	1
Missing	1	2.99	1	Missing	1
		3.75	1		
		6.52	1		
		6.67	1		
		8.33	1		
		14.29	1		
		17.86	1		
		Missing	1		
Valid Cases	61	61		16	
Mean	$ 178.39	$ 1.19		$ 4.35	
Median	1.00	.00		2.35	
Standard Error	163.72	.42		1.32	
t-ratio	1.09	2.83*		3.30*	

*Denotes significance at 5% level.

Tables 7-15, averages of revised bids always are lower, and frequently dramatically lower, than averages of original bids. In the case of sinus pain, for example, B_i = $239.50 while RB_i = $.94 and for headache, B_i = $178.39 while RB_i = $1.19. A key reason for these striking results is that confronting respondents with the implications of their original bids for total monthly expenditure caused, in some cases, a complete reassessment of WTP. The large outlier values present in the original bid vanish in the frequency distributions of revised bids. In fact, the largest revised bid calculated for any of the nine symptoms was $25! Yet, despite the comparatively low values for revised bids, the null hypothesis that the true mean bid equals zero would be rejected at the 5 percent level for four of nine symptoms.

The revised bid values should be interpreted as lower bound estimates of WTP to avoid one day of ozone-related symptoms. Rowe and Chestnut (1986), in their analysis of southern California asthmatics who participated in the UCLA CORD study, found that consistency checks applied to contingent valuation data frequently provide a basis for discarding ill-considered bids. The procedure used here to obtain revised bids effectively eliminates WTP estimates that violate budget constraints; yet, it does not identify inconsistencies such as low or zero bids to avoid either severe symptoms or symptoms that prompted the respondent to take averting action. As a consequence, Tables 7-15 present a third frequency distribution for each symptom that shows the effects of discarding certain low or zero bids. The consistency checks applied are:

(1) If symptom severity rank is 4 or 5 and the bid is $1 or less, the bid is excluded.

(2) If averting action is undertaken to reduce the severity or duration of a symptom and the bid is $1 or less, the bid is excluded.

Admittedly, these criteria are somewhat arbitrary, but any consistency checks used would suffer this problem. When applied to the revised bids, they eliminate roughly half of the observations for each symptom and more than half of the zero bids. Nevertheless, even with these comparatively large number of exclusions, averages of revised bids by symptom remain low. The range of these averages is $.60 to avoid one day of out of breath easily to about $6.00 to avoid one day of pain on deep breath.

Averages of revised bids both before and after imposing consistency checks are lower than corresponding WTP estimates reported in Tables 1 and 2. As discussed more fully in Dickie et al., however, the ABM estimates represent an upper bound to WTP. Averting goods or actions used in making the ABM calculations in that study were: (1) automobile air conditioning, (2) home air conditioning, (3) home air purification, and (4) switching from a gas to an electric range for cooking. Each of these goods is likely to be a source of direct utility in addition to reducing frequency or severity of symptoms. These direct utility effects are included in the ABM WTP calculations. In any case, the two sets of revised CVM estimates presented here together with the ABM estimates indicate that averages of raw or original CVM bids are likely to inflate estimates of WTP to avoid ozone related symptoms for one day. Moreover, revising bids by confronting respondents with their implied monthly total expenditures for symptom avoidance, reconciles much of the absolute discrepancy between CVM and ABM WTP estimates.

A further perspective on the revised bids can be obtained by examining their relationships to other variables. Three approaches are used. First, revised bids are cross tabulated by whether averting action was taken and by symptom severity. Second, mean bids for each symptom were calculated according to whether the respondent had impaired respiratory function. Third, regressions were run to determine whether variation in revised bids for particular symptoms can be explained by variables such as health status (normal or respiratory impaired), income, averting actions, and symptom severity. Both of these approaches reveal patterns in the revised bids that are consistent with the theory elaborated in Dickie et al.

Table 16 shows cross tabulations of whether a respondent took averting action to reduce severity or duration of a symptom by the amount of the revised bid. The decimal fractions in the body of the table show the proportion of respondents who reported taking an averting action and the figures in parentheses show the number of observations in a cell. For example, of the 20 individuals whose revised bids to avoid one day of cough was $0-2, 15 percent took averting action such as using cough drops or cough medicine. Proportions of respondents taking averting action tends to rise with increases in the amount bid. There are only two exceptions to this pattern and these occur in cases where there are two observations or fewer in a cell. Apparently, if a symptom is bothersome enough to warrant averting action, it also tends to warrant a larger bid.

The connection between symptom severity and averting behavior is examined more carefully in Table 17. The entries in the body of this table are interpreted in the same way as in Table 16. Thus, of the 17 persons experiencing sinus pain, 82.4 percent took averting action such as using a

TABLE 16. CROSS TABULATION OF MITIGATION BY BID

	Bid			
Symptom	$0-2	$2-10	$10-25	Overall
Sinus Pain	.667 (36)	.875 (8)	---[a]	.705 (44)
Cough	.150 (20)	.750 (8)	---[a]	.344 (28)
Throat Irritation	.476 (21)	1.00 (4)	1.00 (1)	.577 (26)
Chest Tight	.579 (19)	1.00 (3)	1.00 (2)	.667 (24)
Could Not Breathe Deep	.536 (28)	.500 (2)	1.00 (2)	.563 (32)
Pain on Deep Breath	.417 (12)	1.00 (2)	1.00 (2)	.562 (16)
Out of Breath Easily	.533 (15)	1.00 (1)	---[a]	.562 (16)
Wheezing/Whistling Breath	.500 (8)	.000 (1)	1.00 (1)	.500 (10)
Headache	.882 (51)	1.00 (8)	1.00 (2)	.901 (61)

[a]Denotes no bids in this category.

TABLE 17. CROSS TABULATION OF MITIGATION BY SYMPTOM SEVERITY

Symptom	Severity Rank 1	2	3	4	5	Overall
Sinus Pain	.000 (2)	.444 (9)	.824 (17)	.786 (14)	1.000 (3)	.711 (45)
Cough	.200 (5)	.222 (9)	.462 (13)	.000 (1)	1.000 (1)	.344 (29)
Throat Irritation	.333 (3)	.500 (8)	.333 (6)	.875 (8)	1.000 (1)	.577 (26)
Chest Tight	1.000 (1)	.571 (7)	.500 (4)	.727 (11)	1.000 (1)	.667 (24)
Could Not Breathe Deep	---[a]	.500 (6)	.385 (13)	.727 (11)	1.000 (2)	.563 (32)
Pain on Deep Breath	---[a]	.667 (3)	.400 (5)	.700 (10)	---[a]	.500 (18)
Out of Breath Easily	---[a]	.000 (1)	.454 (11)	.800 (5)	---[a]	.529 (17)
Wheezing/Whistling Breath	.400 (5)	.000 (2)	1.000 (1)	1.000 (2)	1.000 (1)	.545 (11)
Headache	.750 (4)	.818 (11)	.895 (19)	.957 (23)	1.000 (5)	.903 (62)

[a]Denotes no bids in this category.

nasal decongestant or pain relievers including aspirin or acetaminophen. Again an expected pattern emerges: averting action is likely if symptoms are perceived as more severe. Exceptions can be noted particularly in situations where severity rank equals three. Nevertheless, when severity rank equals four or five, proportions of respondents taking averting action are almost always larger than when severity is ranked one or two.

Table 18 separately calculates mean revised bids for normal and respiratory impaired respondents. As discussed in Dickie et al. (1986), respiratory impaired respondents are those with physician diagnosed asthma, bronchitis, emphysema, or other lung disease. All other respondents are classified in the normal subsample. Interestingly, the mean revised bids for the impaired group are no larger than those in the normal subsample for all symptoms except wheezing/whistling breath and chest tight. This same relationship between WTP for symptom avoidance was observed using the ABM (compare Tables 1 and 2) and was explained based on differences in the symptom production functions of the two groups by Dickie et al. (see Chapter 1, pp. 10-14). Briefly, even though the marginal cost schedule for symptom avoidance for the impaired group lies above that for the normal group, WTP for the normal group still may be lower if impaired respondents experience symptoms more frequently.

Preliminary regression results to explain the variation in revised bids for each of the nine ozone related symptoms are presented in Table 19. Explanatory variables used are defined below:

RANK= Severity of last occurrence of symptom on a 1-5 scale; 1 denotes least severity, 5 denotes greatest severity.

TABLE 18. MEANS OF CONTINGENT VALUATION METHOD BIDS TO AVOID SYMPTOMS FOR NORMAL AND RESPIRATORY IMPAIRED RESPONDENTS

Symptom	Normal Budget Constraint Bid	Impaired Budget Constraint Bid
Sinus Pain	$1.11	$.59
Cough	1.70	.31
Throat Irritation	2.22	.73
Chest Tight	1.30	3.61
Could Not Breathe Deep	1.83	1.43
Pain on Deep Breath	3.11	.00
Out of Breath Easily	.00	.00
Wheezing/Whistling Breath	.43	2.97
Headache	1.26	.60

TABLE 19. REGRESSION RESULTS: REVISED CONTINGENT VALUATION BIDS USED AS DEPENDENT VARIABLES

(t-statistics in parentheses)

Symptom	RANK	ACT	EFFECT	FREQ	IMPAIR	INCFAM	Constant	R^2	Number of Observations
Sinus Pain	-.212 (-.659)	.528 (.639)	.774 (.800)	-.00817 (-.241)	-.622 (-.937)	-.00211 (-.135)	2.45 (1.77)	.14	40
Cough	.239 (.445)	2.83 (2.67)	-2.76 (-1.86)	-.00142 (-.343)	-.965 (-.964)	-.00304 (-1.26)	1.93 (1.02)	.45	26
Throat Irritation	1.501 (1.29)	4.185 (1.33)	-2.11 (-.513)	-.0396 (-.837)	-1.56 (-.683)	.00299 (.507)	-4.12 (-.877)	.51	24
Chest Tight	-.592 (-.621)	8.42 (2.88)	-6.98 (-1.93)	-.00828 (-.625)	2.47 (1.05)	-.000174 (-.032)	.930 (.157)	.49	22
Could Not Breathe Deep	-1.03 (-.700)	7.24 (1.97)	-6.60 (-1.53)	-.00201 (-.160)	-2.15 (-.878)	-.00370 (-.788)	5.89 (1.09)	.24	28
Pain on Deep Breath	2.033 (.677)	1.71 (.215)	1.06 (.108)	.0751 (.964)	-2.07 (-.397)	-.026 (-2.204)	8.15 (.652)	.54	15
Out of Breath Easily	.832 (1.14)	-.608 (-.551)	-2.57 (-2.35)	-.00159 (-.482)	---* (-.965)	-.00312 (.094)	.263	.69	10
Wheezing/Whistling Breath	1.42 (.653)	12.10 (.543)	-8.101 (-.458)	-.0457 (-.749)	---*	-.0036 (-.246)	1.31 (.112)	.54	10
Headache	.767 (1.53)	.782 .327	-2.71 (-.138)	-.00252 (-.2951	-.594 (-.596)	.000837 (.221)	-1.97 (-.705)	.08	55

*Variable could not be entered in equation because of correlation problems.

ACT = 1 if respondent took averting action to relieve symptom, 0 otherwise.

EFFECT = Difference between initial severity rank and severity rank after averting action was taken divided by initial severity rank. Was set equal to zero if no averting action was taken.

FREQ = Annual frequency of symptom occurrence.

IMPAIR = 1 if respondent is in impaired subsample, 0 otherwise.

INCFAM = Family income of respondent.

Coefficients of RANK, ACT, and INCFAM are expected to be positive. Respondents with more severe symptoms, who are bothered enough to take averting action, and who have greater financial resources are likely to have greater WTP to avoid symptoms. Coefficients of EFFECT and FREQ on the other and are expected to be negative. Greater reductions in severity; that is, larger values of EFFECT, due to averting actions are likely to lead to lower WTP. This relationship can be established by referring to the model underlying the ABM, which indicates that WTP equals marginal cost of symptom avoidance. Marginal cost, in turn, equals the unit cost of an averting good divided by its marginal productivity in reducing symptoms. If marginal productivity of averting actions is low (or zero, implying that such actions are not worth undertaking), WTP would be comparatively large. Additionally, assuming constant costs of averting actions and diminishing marginal productivity in reducing symptoms, WTP should decrease with FREQ. After adjusting for symptom frequency, the sign of the coefficient of IMPAIR should be positive. In other words, given the same frequency of symptom occurrence, respiratory impaired individuals have higher marginal costs of symptom avoidance and, therefore, larger WTP.

The preliminary regression results in Table 19 indicate that, overall, performance of the nine equations is not particularly strong. Two of the

equations have low R^2 values (sinus pain, R^2 = .14 and headache, R^2 = .08) and the null hypothesis of no linear relation between the dependent variable and all explanatory variables cannot be rejected at the 5 percent level. Three other regressions, those for pain on deep breath, out of breath easily, and wheezing/whistling breath are based on 15 or fewer observations. Nevertheless, in the out of breath easily equation, the coefficient of EFFECT is negative and significantly different from zero at the 5 percent level. Explanatory variables perform somewhat better in the remaining four equations. The coefficient of RANK has the expected sign (positive) and is significantly different from zero at the 10 percent level using a one-tail test in the throat irritation equation. The coefficients of ACT are positive and significant at the 10 percent level or lower using a one-tail test in equations for cough, chest tight, throat irritation and cannot breathe deep. Coefficients of EFFECT are negative and significant at 10 percent using a one-tail test in equations for cough, chest tight and cannot breathe deep. Coefficients of FREQ, IMPAIR, and INCFAM never attained even marginal significance levels with expected signs.

Further empirical work to refine these regression estimates is continuing. As a consequence, the results presented in Table 19 are preliminary and used advisedly. Three econometric issues presently are being explored. First, the equations were estimated using ordinary least squares even though a significant percentage of dependent variable values were zero. Limited dependent variable estimation methods, such as tobit, would be more appropriate. Second, the estimates do not account for the sample selection bias problem discussed earlier. Third, estimation efficiency might be improved using seeming unrelated regressions, although

a possible difficulty in applying this approach involves the different numbers of observations in each equation. In any case, more refined regression estimates can be made available to USEPA later in spring, 1987.

5. SUMMARY AND CONCLUSIONS

The main purpose of this report is to reconcile differences between contingent valuation method (CVM) and averting behavior method (ABM) estimates of willingness to pay (WTP) to avoid health symptoms of ozone exposure including chest tightness, throat irritation, headache, and pain on deep breath. Average CVM bids to avoid one day of these symptoms frequently exceed their ABM counterparts by factors between five and ten. As a result, policy makers are left with inadequate guidance concerning the health benefits of ozone control. The reconciliation approach used in this report focuses on obtaining revised bids in a contingent valuation framework. After obtaining WTP to avoid one day's experience with up to three bothersome symptoms, interviewers calculate implications of these bids for total monthly expenditures by multiplying the bid times frequency of occurrence. Respondents confronted with these monthly total expenditure figures often make substantial downward revisions in their original bids. For example, original bids to avoid one day of headache averaged $178.39, whereas revised bids averaged $1.19; original bids to avoid one day of cough averaged $355.10 whereas revised bids averaged $1.19. These results suggest that in CVM studies of frequently occurring events such as health symptoms, care should be taken to ensure that respondents are aware of total expenditure implications of their bids. Moreover, revised bids to eliminate all nine ozone symptoms considered are lower than ABM estimates reported in Dickie et al. (1986). This relationship is expected because

ABM overestimates WTP; in addition to reducing symptoms, averting goods used in the ABM calculations may represent sources of direct utility. Thus, to avoid one day of frequently occurring ozone-related health symptoms, WTP is effectively bounded.

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APPENDIX A

REVISED FOLLOW-UP QUESTIONNAIRE

UCLA/WYOMING OZONE STUDY

Revised Follow-Up Questionnaire

R.I.D.# _____ 1 - 7

Respondents Name _____ Form type 21 (8 9)

Record # 01 (10-11)

Interviewer I.D. _____ 12

Date _____ 13-16

Time beginning _____ 1 - 7

Length of Interview _____ 21-22

INTERVIEWER: PLEASE ASK THE RESPONDENT IF THEY HAVE THEIR COPY OF THE PURPLE SYMPTOM SEVERITY SCALE THAT WAS SENT TO THEM WITH THEIR LETTER. Yes _____ No _____

IF THEY DO NOT HAVE THE SCALE INSTRUCT THEM TO GET A PIECE OF PAPER AND PENCIL AND HELP THEM REPRODUCE THE SCALE TO USE DURING THE INTERVIEW.

IF THEY HAVE THE SCALE PROCEED WITH THE INTERVIEW.

1. Have you moved since we talked to you last?
   yes _____
   no _____

2. Have you changed jobs ?
   yes _____
   no _____

IF "YES" TO EITHER QUESTION-FILL OUT APPENDIX: IF "NO" TO BOTH QUESTIONS PROCEED WITH THE INTERVIEW.

FIRST I °D LIKE TO READ YOU A LIST OF SYMPTOMS OTHER PEOPLE SOMETIMES HAVE. AS I READ EACH ONE, PLEASE TELL ME IF IT HAS BOTHERED YOU ANYTIME IN THE PAST MONTH (THE MONTH ENDING TODAY).

	YES	Did you have this:				Thinking about the times you had this symptom in the past month, did It bother you:			NO	
	In the last month	yesterday		day before yesterday		a great deal	moderate	very mildly		
		yes	no	yes	no					
1. Did your eyes feel irritated?	1	1	2	1	2	3	2	1	2	23-27
2. Did you feel that you could not see as well as usual?	1	1	2	1	2	3	2	1	2	28-32
3. Were your eyes unusually sensitive to bright light?	1	1	2	1	2	3	2	1	2	33-37
4. Did you have a ringing in your ears?	1	1	2	1	2	3	2	1	2	38-42
5. Did you have pain in your ears?	1	1	2	1	2	3	2	1	2	43-47
6. Did you have sinus pain or discomfort?	1	1	2	1	2	3	2	1	2	48-52
7. Did you have a nosebleed?	1	1	2	1	2	3	2	1	2	53-57
8. Was your nose dry and painful?	1	1	2	1	2	3	2	1	2	58-62
9. Was your nose runny?	1	1	2	1	2	3	2	1	2	63-67

1

	YES	Did you have this: In the last month		yesterday		day before yesterday	Thinking about the times you had this symptom In the past month, did It bother you: a great deal	moderate	very mildly	NO	
			yes	no	yes	no					
10. Did you have a cough? *	1	1	2	1	2		3	2	1	2	68-72
11. Was your throat irritated? *	1	1	2	1	2		3	2	1	2	73-77
12. Was your voice husky or did you lose your voice?	1	1	2	1	2		3	2	1	2	10-11 / 12-16
13. Did you bring up phlegm, sputum or mucous from your chest?	1	1	2	1	2		3	2	1	2	17-21
14. Did your chest feel tight? *	1	1	2	1	2		3	2	1	2	22-26
15. Did you feel that you could not take a deep breath? *	1	1	2	1	2		3	2	1	2	27-31
16. Did you have pain when you took a deep breath? *	1	1	2	1	2		2	2	1	2	32-36
17. Did you get out of breath easily? *	1	1	2	1	2		3	2	1	2	37-41
18. Did your breathing sound wheezing or whistling *	1	1	2	1	2		3	2	1	2	42-46

Dup.(1-9)
Rec.# 02

	YES in the last month	Did you have this: yesterday yes	yesterday no	day before yesterday yes	day before yesterday no	Thinking about the times you had this symptom in the past month, did it bother you: a great deal	moderate	very mildly	NO	
19. Did you feel that your heart was beating very fast at times when you were resting?	1	1	2	1	2	3	2	1	2	47-51
20. Did you get tired easily?	1	1	2	1	2	3	2	1	2	52-56
21. Did you feel faint or dizzy?	1	1	2	1	2	3	2	1	2	57-61
22. Did you feel spaced out or disoriented?	1	1	2	1	2	3	2	1	2	62-66
23. Did you have a headache? *	1	1	2	1	2	3	2	1	2	67-71
24. Did you have chills or fever? (which?) --------	1	1	2	1	2	3	2	1	2	72-76
25. Did you feel nauseated (sick to your stomach)?	1	1	2	1	2	3	2	1	2	10-11 / 12-16
26. Did you have swollen glands?	1	1	2	1	2	3	2	1	2	17-21

Dup. (1-9)
Rec. # 03

IF THERE ARE NO SYMPTOMS:
GO TO THE END OF THE QUESTIONNAIRE - AND OBTAIN SOCIAL SECURITY NUMBER

AFTER THE LIST IS COMPLETE, CHECK FOR THE HIGHEST LEVELS OF RESPONSE FOR SYMPTOMS MARKED WITH AN ASTERISK LOCK AT THE PERCIEVED SEVERITY SCALE RESPONSES AND CHOOSE THOSE THREE WHICH HAVE THE HIGHEST VALUES. IF THERE ARE MORE THAN THREE SYMPTOMS WITH EQUALLY HIGH VALUES, ASK QUESTION 2 BELOW.

IF THERE IS AT LEAST ONE SYMPTOM BUT LESS THAN THREE SYMPTOMS:
GO TO Q3.

Q2. We want to concentrate only on those symptoms that have bothered you the most during the past month. Of the following symptoms (READ LIST OF CONTENDERS) which three were the most bothersome for you in the past month?

1. _____

2. _____

3. _____

Q3. Now, I would like to ask you some questions about these symptoms. We are interested in:

1. how often they happen
2. how much discomfort or bother they cause you and
3. what you do to make yourself feel better when you have these symptoms.

We'll start with the first symptom on the list which is [SYMPTOM 1].

THE SET OF QUESTIONS WHICH FOLLOW ARE TO BE ASKED FOR EACH OF THE THREE SYMPTOMS LISTED ABOVE IN QUESTION 2. ASK THE ENTIRE SET: OF QUESTIONS FOR SYMPTOM 1, THEN REPEAT THIS PROCEDURE FOR SYMPTOM 2, THEN SYMPTOM 3.

SYMPTOM 1 _____ 22-23

Q3a. How many days in the past month did you have -- SYMPTOM

DAYS _____ 24-25

Q3b. About how many days during the past year did you experience this symptom?

DAYS _____ 26-28

Q3c. Sometimes people experience symptoms more or less often during different seasons of the year. Please the ink about the past year, from July 1985 to the present. During the past month, did you experience [SYMPTOM] more often, about the same number of times or less often than in the months of:

Q3c.1 During June, July and August of 1985? (summer)

(1) MORE OFTEN
(2) SAME
(3) LESS OFTEN

29

Q3c.2 During September, October and November of 1985? (fall)

(1) MORE OFTEN
(2) SAME
(3) LESS OFTEN

30

Q3c.3 During December, January and February of 1985-1986? (winter)

(1) MORE OFTEN
(2) SAME
(3) LESS OFTEN

31

Q3c.4 During March, April and May of 1986? (spring)

(1) MORE OFTEN
(2) SAME
(3) LESS OFTEN

32

Q3d. Now, looking at the scale, labeled symptom severity, notice that the value 1 stands for very little discomfort or bother - where you just barely know the symptom is there and, at the other end, the number 5 stands for maximum discomfort or bother.

Q3d.1 Using this scale, how would you rank the amount of discomfort or bother you had the last time you experienced [SYMPTOM] ?

RANK ---------- 33

Q3d.2 Using this scale, how would you rank the amount of discomfort or bother you had when it was the worst episode of [SYMPTOM] in the last month?

RANK ---------- 34

Q3d.3 Using the symptom severity scale that we used before, how severe was this symptom last summer: the months of June, July and August of 1985?

RANK ---------- 35

Q3d.4 Using the symptom severity scale that we used before, how severe was this symptom last fall; the months of September, October and November of 1985?

RANK ---------- 36

Q3d.5 Using the symptom severity scale that we used before, how severe was this symptom last winter: the months of December, January and February of 1985-1096?

RANK ---------- 37

Q3d.6 Using the symptom severity scale that we used before, how severe was this symptom last spring; the months of March, April and May?

RANK ---------- 38

People who are bothered by symptoms sometimes take actions to relieve them. For example:
- someone may see a doctor or
- take medication prescribed by a doctor or
- take a nonprescription medication or
- stay home from work or
- limit their activities to only those that are the most important - or do something else

when they are bothered by a symptom.

Q3e.1. The last time you experienced [SYMPTOM] did you do anything or take any action at all to relieve you discomfort or bother from it?

(1) YES

(2) No 39

6

Q3e.2. please tell me what you did.

RECORD THE RESPONSE ON THE FOLLOWING PAGE.

[INTERVIEWER, THE NEXT QUESTION REFERS TO SPECIFIC PROBES ON PAGE 8 OF THIS QUESTIONNAIRE. DIFFERENT SYMPTOMS HAVE DIFFERENT PROBES. LOCK UP SYMPTOM ONE ON THE PROBE SHEET AND ASK THE ENTIRE QUESTION ACCORDING TO IT°S CONTENT.]

Q3e.3. For [SYMPTOM], people sometimes take actions such as [LIST FOR SYMPTOM]. Did you do any of these to relieve [SYMPTOM] this past month?

Q3e.4. When [SYMPTOM] was the worst it was during this past month, did you take any action to relieve your discomfort or bother?

(1) YES

(2) NO

40

Q3e.5. Please tell me what you did.

RECORD THE RESPONSE ON THE FOLLOWING PAGE. FOLLOW THE ENTRY WITH A (W).

[INTERVIEWER, THE NEXT QUESTION ALSO REFERS TO SPECIFIC PROBES ON PAGE 8 OF THIS QUESTIONNAIRE SO USE THE PROBE SHEET FOR THIS TOO.]

Q3e.6. For [SYMPTOM], people sometimes take actions such as [LIST FOR SYMPTOM]. Did you do any of these to relieve [SYMPTOM] when it was the worst that it was during the past month?

SYMPTOM 1 ----------

POSSIBLE ACTIONS TO RELIEVE SYMPTOMS

SYMPTOMS & POSSIBLE ACTIONS	LAST YES	LAST NO	WORST YES	WORST NO	RESPONDENT'S WORDS FOR ACTION	
EYES						
eye drops	1	2	1	2	----------	41-44
sunglasses	1	2	1	2		

EAR						
ear drops	1	2	1	2	----------	45-46
NOSE AND SINUS						
inhalent	1	2	1	2	----------	
ice packs	1	2	1	2		
humidifier	1	2	1	2	----------	47-54
dehumidifier	1	2	1	2		
THROAT						
cough medicine	1	2	1	2	----------	
drink hot liquids	1	2	1	2		
throat lozenges	1	2	1	2	----------	55-62
decongestants	1	2	1	2		
BREATHING						
broncho dialator	1	2	1	2	----------	
respirator	1	2	1	2		
air purifier/ conditioner	1	2	1	2	----------	63-68
HEART						
rest	1	2	1	2	----------	
limit activites	1	2	1	2	----------	69-72
						Dup. (1-9) Rec.# 04 10-11
OTHER						
over-the-counter medicine such as aspirin	1	2	1	2	----------	
consult physician	1	2	1	2		
use prescription or non-prescription medicine	1	2	1	2	----------	12-25
rest	1	2	1	2		
stay indoors	1	2	1	2	----------	
heat pads	1	2	1	2		
cold compresses	1	2	1	2		

Action Codes:

Last: _____ 26-35

Worst: _____ 36-45

Q3f. Think about the last time you did [ACTION] to relieve [SYMPTOM]. After you did this, how would you rank the amount of discomfort or bother you experienced from [SYMPTOM] on the 1 - 5 severity scale?

RANK _____ 46

ONLY ASK Q3g IF RESPONDENT SAID HE/SHE TOOK [ACTION] WHEN [SYMPTOM] WAS THE WORST. THIS MAY BE THE SAME TIME REFERRED TO IN Q3f ABOVE.

Q3g. Think about when [SYMPTOM] was the worst that it was last month. After you did [ACTION] how would you rank the amount of discomfort or bother you experienced from [SYMPTOM] on the 1 - 5 severity scale?

RANK _____ 47

Think about the last time in the past month when you had [SYMPTOM]. Suppose it had been possible to pay a sum of money to have eliminated [SYMPTOM] immediately that one time. What sum of money would you have been willing to pay?

We are not talking about getting rid of [SYMPTOM] forever; we are talking about the amount of money you would have been willing to pay to have eliminated the symptom that one time.

FURTHER EXPLANATION:

Think of this as the price of a special treatment that would prevent the symptom one time. How high a price would you have been willing to pay to eliminate the symptom this one time?

Q3h. What sum of money would you have been willing to pay?

AMOUNT _____ 48-51

SYMPTOM 2 _____ 52-53

Q3a. How many days in the past month did you have -- SYMPTOM

DAYS _____ 54-55

Q3b. About how many days during the past year did you experience this symptom?

DAYS _____ 56-58

Q3c. Sometimes people experience symptoms more or less often during different seasons of the year. Please think about the past year, from July 1985 to the present. During the past month, did you experience [SYMPTOM] more often, about the same number of times or less often than in the months of:

Q3c.1 During June, July and August of 1985? (summer)

(1) MORE OFTEN
(2) SAME
(3) LESS OFTEN
59

Q3c.2 During September, October and November of 1985? (fall)

(1) MORE OFTEN
(2) SAME
(3) LESS OFTEN
60

Q3c.3 During December, January and February of 1985-1986? (winter)

(1) MORE OFTEN
(2) SAME
(3) LESS OFTEN
61

Q3c.4 During March, April and May of 1986? (spring)

(1) MORE OFTEN
(2) SAME
(3) LESS OFTEN
62

Q3d. Now, looking at the scale, labeled symptom severity, not ice that the value 1 stands for very little discomfort or bother - where you just barely know the symptom is there and, at the other end, the number 5 stands for maximum discomfort or bother.

Q3d.1 Using this scale, how would you rank the amount of discomfort or bother you had the last time you experienced [SYMPTOM] ?

RANK _____ 63

Q3d.2 Using this scale, how would you rank the amount of discomfort or bother you had when it was the worst episode of [SYMPTOM] in the last month?

RANK _____ 64

Q3d.3 Using the symptom severity scale that we used before, how severe was this symptom last summer: the months of June, July and August of 1985?

RANK _____ 65

Q3d.4 Using the symptom severity scale that we used before, how severe was this symptom last fall; the months of September, October and November of 1985?

RANK _____ 66

Q3d.5 Using the symptom severity scale that we used before, how severe was this symptom last winter; the months of December, January and February of 1985-1096?

RANK _____ 67

Q3d.6 Using the symptom severity scale that we used before, how severe was this symptom last spring; the months of March, April and May?

RANK _____ 68

Q3.e People who are bothered by symptoms sometimes take actions to relieve them.

For example:
- someone may see a doctor or
- take medication prescribed by a doctor or
- take a nonprescription medication or
- stay home from work or
- limit their activities to only those that are the most important - or do something else

when they are bothered by a symptom.

Q3e.1. The last time you experienced [SYMPTOM] did you do anything or take any action at all to relieve you discomfort or bother from it?

(1) YES

(2) NO

69

Q3e.2. please tell me what you did.

RECORD THE RESPONSE ON THE FOLLOWING PAGE.

[INTERVIEWER, THE NEXT QUESTION REFERS TO SPECIFIC PROBES ON PAGE 13 OF THIS QUESTIONNAIRE. DIFFERENT SYMPTOMS HAVE DIFFERENT PROBES. LOOK UP THIS RESPONDENT°S SECOND SYMPTOM ON THE PROBE SHEET AND ASK THE ENTIRE QUESTION ACCORDING TO IT°S CONTENT.]

Q3e.3. For [SYMPTOM], people sometimes take actions such as [LIST FOR SYMPTOM]. Did you do any of these to relieve [SYMPTOM] this past month?

Q3e.4. When [SYMPTOM] was the worst it was during this past month, did you take any action to relieve your discomfort or bother?

(1) YES

(2) No

70

Q3e.5. Please tell me what you did.

RECORD THE RESPONSE ON THE FOLLOWING PAGE. FOLLOW THE ENTRY WITH (W).

[INTERVIEWER THE NEXT QUESTION ALSO REFERS TO SPECIFIC PROBES ON PAGE 13 OF THIS QUESTIONNAIRE SO USE THE PROBE SHEET FOR THIS TOO.]

Q3e.6. For [SYMPTOM], people sometimes take actions such as [LIST FOR SYMPTOM]. Did you do any of these to relieve [SYMPTOM] when it was the worst that it was during the past month?

SYMPTOM 2 _____

POSSIBLE ACTIONS TO RELIEVE SYMPTOMS

SYMPTOMS & POSSIBLE ACTIONS	LAST YES	LAST NO	WORST YES	WORST NO	RESPONDENT'S WORDS FOR ACTION	
EYES						
eye drops	1	2	1	2		71-74
sunglasses	1	2	1	2		
EAR						
ear drops	1	2	1	2		75-76
NOSE AND SINUS						Dup.(1-9) Rec.# 05
inhalent	1	2	1	2		10-11
ice packs	1	2	1	2		
humidifier	1	2	1	2		12-19
dehumidifier	1	2	1	2		
THROAT						
cough medicine	1	2	1	2		
drink hot liquids	1	2	1	2		
throat lozenges	1	2	1	2		20-27
decongestants	1	2	1	2		
BREATHING						
broncho dialator	1	2	1	2		
respirator	1	2	1	2		
air purifier/ conditioner	1	2	1	2		28-33
HEART						
rest	1	2	1	2		
limit activites	1	2	1	2		34-37
OTHER						
over-the-counter medicine such as aspirin	1	2	1	2		
consult physician	1	2	1	2		
use prescription or non-prescription medicine	1	2	1	2		38-51
rest	1	2	1	2		
stay indoors	1	2	1	2		
heat pads	1	2	1	2		
cold compresses	1	2	1	2		

Action Codes:

Last: _____ 52-61

WORST: _____ 62-71

13

Q3f. Think about the last time you did [ACTION] to relieve [SYMPTOM]. After you did this, how would you rank the amount of discomfort or bother you experienced from [SYMPTOM] on the 1 - 5 severity scale?

RANK _____ 72.

ONLY ASK Q3g IF RESPONDENT SAID HE/SHE TOOK [ACTION] WHEN [SYMPTOM] WAS THE WORST. THIS MAY BE THE SAME TIME REFERRED TO IN Q3f ABOVE.

Q3g. Think about when [SYMPTOM] was the worst that It was last month. After you did [ACTION] how would you rank the amount of discomfort or bother you experienced from [SYMPTOM] on the 1 - 5 severity scale?

RANK _____ 73

Think about the last time in the past month when you had [SYMPTOM]. Suppose It had been possible to pay a sum of money to have eliminated [SYMPTOM] immediately that **one** time. What sum of money would you have been willing to pay?

We are **not** talking about getting rid of [SYMPTOM] forever: we are talking about the amount of money you would have been willing to pay to have eliminated the symptom that one time

FURTHER EXPLANATION:

Think of this as the price of a special treatment that would prevent the, symptom one time. How high a price would you have been willing to pay to eliminate the symptom this one time?

Q3h. What sum of money would you have been willing to pay?

AMOUNT _____ 74-77

Dup. (1-9)
Rec.# 06
10-11

SYMPTOM 3 _____

Q23a. How many days in the past month did you have -- SYMPTOM

DAYS _____ 14-15

Q3b. About how many days during the past year did you experience this symptom?

DAYS _____ 16-18

Q3c. Sometimes people experience symptoms more or less often during different seasons of the year. Please think about the past year, from July 1985 to the present. During the past month, did you experience [SYMPTOM] more often, about the same number of times or less often than in the months of:

Q3c.1 During June, July and August of 1985? (summer)

(1) MORE OFTEN
(2) SAME
(3) LESS OFTEN 19

Q3c.2 During September, October and November of 1985? (fall)

(1) MORE OFTEN
(2) SAME
(3) LESS OFTEN 20

Q3c.3 During December, January and February of 1985-1986? (winter)

(1) MORE OFTEN
(2) SAME
(3) LESS OFTEN 21

Q3c.4 During March, April and May of 1986? (spring)

(1) MORE OFTEN
(2) SAME
(3) LESS OFTEN 22

15

Q3d. Now, looking at the scale labeled symptom severity notice that the value 1 stands for very little discomfort or bother - where you just barely know the symptom is there and, at the other end, the number 5 stands for maximum discomfort or bother.

Q3d.1 Using this scale, how would you rank the amount of discomfort or bother you had the last time you experienced [SYMPTOM] ?

RANK ---------- 23

Q3d.2 Using this scale, how would you rank the amount of discomfort or bother you had when it was the worst episode of [SYMPTOM] In the last month?

RANK ---------- 24

Q3d.3 Using the symptom severity scale that we used before, how severe was this symptom last summer: the months of June, July and August of 1985?

RANK ---------- 25

Q3d.4 Using the symptom severity scale that we used before, how severe was this symptom last fall; the months of September, October and November of 1985?

RANK ---------- 26

Q3d.5 Using the symptom severity scale that we used before, how severe was this symptom last winter; the months of December, January and February of 1985-1096?

RANK ---------- 27

Q3d.6 Using the symptom severity scale that we used before, how severe was this symptom last spring; the months of March, April and May?

RANK ---------- 28

Q3.e People who are bothered by symptoms sometimes take actions to relieve them. For example:

- someone may see a doctor or
- take medication prescribed by a doctor or
- take a nonprescription medication or
- stay home from work or
- limit their activities to only those that are the most important -or do something else

when they are bothered by a symptom.

Q3e.1. The last time you experienced [SYMPTOM] did you do anything or take any action at all to relieve you discomfort or bother from it?

(1) YES

(2) NO

29

[ASK FOR ALL SYMPTOMS REGARDLESS OF THE VALUE ASSIGNED ON THE SEVERITY SCALE]

Q3e.2. please tell me what you did.

RECORD THE RESPONSE ON THE FOLLOWING PAGE.

[INTERVIEWER, THE NEXT QUESTION REFERS TO SPECIFIC PROBES ON PAGE 18 OF THIS QUESTIONNAIRE. DIFFERENT SYMPTOMS HAVE DIFFERENT PROBES. LOOK UP THIS RESPONDENT°S THIRD SYMPTOM ON THE PROBE SHEET AND ASK THE ENTIRE QUESTION ACCORDING TO IT°S CONTENT.]

Q3e.3. For [SYMPTOM], people sometimes take actions such as [LIST FOR SYMPTOM]. Did you do any of these to relieve [SYMPTOM] this past month?

Q3e.4. When [SYMPTOM] was the worst it was during this past month, did you take any action to relieve your discomfort or bother?

(1) YES

(2) No

30

Q3e.5. Please tell me what you did.

RECORD THE RESPONSE ON THE FOLLOWING PAGE. FOLLOW THE ENTRY WITH (W)>

[INTERVIEWER, THE NEXT QUESTION ALSO REFERS TO SPECIFIC PROBES ON PAGE 18 OF THIS QUESTIONNAIRE SO USE THE PROBE SHEET FOR THIS TOO.]

Q3e.6. For [SYMPTOM], people sometimes take actions such as [LIST FOR SYMPTOM]. Did you do any of these to relieve [SYMPTOM] when it was the worst that it was during the past month?

SYMPTOM 3 _____

POSSIBLE ACTIONS TO RELIEVE SYMPTOMS

SYMPTOMS & POSSIBLE ACTIONS	LAST YES	LAST NO	WORST YES	WORST NO	RESPONDENT'S WORDS FOR ACTION
EYES					
eye drops	1	2	1	2	
sunglasses	1	2	1	2	31-34
EAR					
ear drops	1	2	1	2	35-36
NOSE AND SINUS					
inhalent	1	2	1	2	
ice packs	1	2	1	2	
humidifier	1	2	1	2	
dehumidifier	1	2	1	2	37-44
THROAT					
cough medicine	1	2	1	2	
drink hot liquids	1	2	1	2	
throat lozenges	1	2	1	2	
decongestants	1	2	1	2	45-52
BREATHING					
broncho dialator	1	2	1	2	
respirator	1	2	1	2	
air purifier/ conditioner	1	2	1	2	53-58
HEART					
rest	1	2	1	2	
limit activites	1	2	1	2	59-62
OTHER					
over-the-counter medicine such as aspirin	1	2	1	2	
consult physician	1	2	1	2	
use prescription or non-prescription medicine	1	2	1	2	63-76
rest	1	2	1	2	
stay indoors	1	2	1	2	
heat pads	1	2	1	2	
cold compresses	1	2	1	2	

Dup.(1-9) Rec.# 07 10-11

Action Codes:

Last: _____ 12-21

Worst: _____ 22-31

Q3f. Think about the last time you did [ACTION] to relieve [SYMPTOM]. After you did this, how would you rank the amount of discomfort or bother you experienced from [SYMPTOM] on the 1 - 5 severity scale?

RANK _____ 32

ONLY ASK Q3g IF RESPONDENT SAID HE/SHE TOOK [ACTION] WHEN [SYMPTOM] WAS THE WORST. THIS MAY BE THE SAME TIME REFERRED TO IN Q3f ABOVE.

Q3g. Think about when [SYMPTOM] was the worst that It was last month. After you did [ACTION] how would you rank the amount of discomfort or bother you experienced from [SYMPTOM] on the 1 - 5 severity scale?

RANK _____ 33

Think about the last time in the past month when you had [SYMPTOM]. Suppose It had been possible to pay a sum of money to have eliminated [SYMPTOM] immediately that one time. What sum of money would you have been willing to pay?

We are not talking about getting rid of [SYMPTOM] forever: we are talk ing about the amount of money you would have been willing to pay to have eliminated the symptom that one time.

FURTHER EXPLANATION:

Think of this as the price of a special treatment that would prevent the symptom one time. How high a price would you have been willing to pay to eliminate the symptom this one time?

Q3h. What sum of money would you have been willing to pay?

AMOUNT _____ 34-37

Q4. OVERALL SYMPTOM VALUES

Now that I have a lot of information about the three individual symptoms, I would like to ask a question that considers all three at once.

Let's add up the separate amounts you would pay to eliminate the severity of all three Individual symptoms we talked about.

For [SYMPTOM 1] you said you would pay [WTP 1] and you said it happened

[_____] times per month. [WTP 1] x [-- TIMES PER MONTH] = _____,

which is the amount you would pay to eliminate [SYMPTOM 1] on a monthly basis.

For [SYMPTOM 2] you said you would pay [WTP 2] and you said It happened

[_____] times per month. [WTP 2] x [-- TIMES PER MONTH] = _____,

which Is the amount you would pay to eliminate [SYMPTOM 2] on a monthly basis.

For [SYMPTOM 3] you said you would pay [WTP 3] and you said it happened

[_____] times per month. [WTP 3] X [-- TIMES PER MONTH] = _____,

which is the amount you would pay to eliminate [SYMPTOM 3] on a monthly basis.

This gives a grand total of [AMOUNT 1] + [AMOUNT 2] + [AMOUNT 3] =

_____ [SUM]

which is what you would be willing to pay to eliminate these three symptoms. On a monthly basis Is [SUM] what you would be willing to pay to eliminate these three symptoms?

(1) YES

38

(2) NO

IF NO:

Q4a. Would you be willing to pay more or less than [SUM].

(1) MORE

(2) LESS

39

Q4b. What dollar amount would you be willing to pay? _____

40-43

That is the last question.

As we said in the letter, we will be sending you a check for your help with our study. Your check will be sent in the mail and will take about 4 - 5 weeks to arrive. In order to print a check however, the University requires us to submit your Social Security number along with your name and address. What Is your Social Security number?

Social Security number _____

THANK YOU AGAIN FOR YOUR HELP.