J. ENVIRONMENTAL SYSTEMS, Vol. 21(2) 157-166, 1991-92

THE REACTIONS OF HOUSEHOLD RESIDENTS TO LOW-FLOW SHOWER HEADS*

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ABSTRACT

This project investigated the acceptance of water and energy conserving low-flow shower heads by household residents. Subjects were given an opportunity to install one of thirteen different shower heads in their homes. The shower heads differed on three factors: water flow, flow delivery (regular or aerating), and control mechanism (present or absent). In response to questions posed during two telephone interviews, the subjects indicated they were extremely satisfied with the performance of the shower head they had tested and generally preferred it to their old one. This was true soon after they had installed it, as well as several weeks later. There were no significant differences between the thirteen different shower heads, the three shower head factors or any of the demographic variables investigated in this study. The results of the study also raised several questions concerning the actual water and energy savings attributable to low-flow shower heads, as well as cost-effective methods for disseminating this device among a large population of individuals.

This investigation explored factors that influence public acceptance of the leading low-flow shower heads currently on the market. The main goal was to find out whether or not individuals would prefer them to conventional shower heads, and, if so, what features of the new shower heads might be responsible for this effect. Or would individuals instead respond to the new heads as they did to earlier

* This project was supported by Bonneville Power Administration's Office of Energy Resources.

doi: 10.2190/5UM2-TNKJ-8XTM-RDFF
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shower flow restrictors, which were so unpopular that many people simply removed them, or never bothered to install them in the first place?

To find out how people would respond to the improved, energy-efficient shower heads currently on the market, I recently investigated the reactions of a large sample of individuals throughout the Northwest, who were given an opportunity to install one of twelve different low-flow shower heads in their residences [1].

After space conditioning, heating water is the second largest source of energy consumption in most United States households [2]. In turn, its single largest component is the energy required to heat the water used in taking a shower [3]. The water used in showering constitutes some 25 percent of normal household water consumption [4]. Low-flow shower heads can reduce water consumption by significant amounts, thus helping to conserve water and energy resources.

For example, assuming a shower duration of ten minutes and a standard six gallons-per-minute (gpm) shower head, it has been estimated that converting to a new 2 gpm low-flow shower head can produce an annual savings of 14,600 gallons of water in a single residence [5]. In turn, this can save a homeowner over $13 per year in water costs (at 70 cents/100 cu. ft.) and more than $74 per year in energy costs (at 5 cents/KWh). It is clear that the introduction of low-flow shower heads can produce significant dollar savings in the cost of both energy and water.

Most of the prior research in this area has consisted of informal consumer opinion studies of a small number of selected individuals [6, 7], or has been part of broader studies of residential energy conservation, water heater retrofits or water conservation [4, 8, 9]. These investigations told little about the general level of public satisfaction with low-flow shower heads, barriers which might prevent their widespread adoption, and, more specifically, the differential effects of the various features which distinguish the currently available models.

METHOD

A sample of 894 participants was randomly selected from households within the Bonneville Power Administration's (BPA) operational territory. The sample was segmented by geographical area in proportion to its representation in the BPA region. During the telephone recruitment screener, respondents were asked to test one of thirteen different shower head models (twelve low-flow models and one standard 4.5 gallons-per-minute model) at home. As shown in Table 1, most subjects lived in the urban areas of Washington and Oregon and were largely middle age residents of single family dwellings.

Shower heads were selected for the study on the basis of water flow, construction quality, price (under $15), performance, and other factors. They differed primarily in three ways that previous studies had indicated were important in determining user acceptance: water flow (high: 3.0 to 2.4 gpm; medium: 2.3-2.0 gpm; low: 1.9 to 1.3 gpm), flow delivery (regular or aerating), and control

Table 1. Characteristics of Sample/Participants

	Participants (Percent) (N = 894)	Installers (Percent) (N = 616)
Geography		
Seattle, WA	29	28
Other WA	23	24
Portland, OR	17	16
Other OR	18	19
Boise, ID	2	2
Other ID	8	8
Montana	3	3
Age		
Under 35	35	34
35 - 49	38	37
50 - 64	20	21
65 and over	7	7
People in Household		
One	11	9
Two	31	33
Three	21	20
Four	23	22
Five and more	14	16
Household Type		
Single-Family	82	85
Multiple-Family	17	14
Income		
Under $20,000	18	16
$20,000 - $34,999	31	31
$35,000 - $49,999	24	25
$50,000 and more	17	18
Sex		
Men	47	50
Women	53	50

mechanism (present or absent). These factors were systematically varied in a three factor design (including a control group).

Procedure

Each participant was asked in telephone interviews to compare the new shower head with the old, in terms of overall performance and seven features: ease of installation, spray quality, noise level, water force, water volume, spray adjustment, and hair rinsing. The subjects were first interviewed two to three weeks after they had received the shower head and again, several weeks later, during a relatively brief follow-up interview.

RESULTS

Initial Survey

Table 2 compares the shower heads according to the subject's ratings of overall satisfaction and the seven performance features. Most subjects were quite pleased with the low-flow shower head they had tested, with the mean satisfaction rating across all the heads equal to 7.6, on a scale from one to ten. Variations among shower heads were small (from 6.90 to 8.44). Nor were any of the shower heads significantly less preferred than the standard (4.5 gpm) shower head tested by the control group ($F = 0.159$, $df = 12/17$, *NS*). In addition, none of the demographic variables (age, sex, and income) were associated with the overall measure of shower head satisfaction. The shower heads were viewed favorably by subjects throughout the region, by both males and females and by individuals from all the age groups and income levels we sampled.

Sixty-three percent of the subjects rated the new head as better than their old one, 19 percent judged it about the same, 18 percent found it worse, and 1 percent were uncertain. Regardless of the model tested, the mean satisfaction rating for the new shower head (6.2) was significantly greater than mean satisfaction rating (7.6) of the older models ($t = 14.6$, $df = 12$, $p < .001$).

As indicated in Table 2, subjects were fairly satisfied with each of the shower head's features, including water force (mean = 7.86) and water volume (mean = 7.94). Neither of these features should be a major barrier to the acceptance of the new models, as difference among shower heads on these features were slight.

When asked to identify the feature of the shower head they liked the least most subjects mentioned none (see Table 3). On the other hand, when the subjects were asked to identify the shower head feature they liked best, the highest percentage (37%) mentioned its water and energy saving potential and 21 percent cited the force of water delivered (see Table 4).

The presence or absence of a control switch, and the type of system (aerating or non-aerating) did not significantly affect ratings. Shower heads at the lower end of

Table 2. Summary of Selected Mean Shower Head Ratings

	Overall Satisfaction	Spray Dispersion	Water Force	Water Volume	Adjustment	Hair Rinse
Aerating Models						
ETL 2001 (2.4-3.0 gpm)	6.93	7.4	7.9	7.6	7.8	7.9
ETL 321 (1.3-1.9 gpm)	7.19	7.5	8.0	8.1	6.7	7.6
Incredible Head ES165 (1.3-1.9 gpm)	7.47	7.9	7.5	7.8	7.6	8.0
Whedon DS2B (2.0-2.3 gpm)	7.88	8.2	8.1	8.4	8.2	8.0
Whedon DS1B (2.0-2.3 gpm)	7.57	7.8	7.7	7.7	7.0	7.1
Chicago 6001B (2.4-3.0 gpm)	7.74	8.3	7.9	8.0	6.8	8.0
Non-Aerating Models						
Ondine 29446 (2.4-3.0 gpm)	8.44	9.0	8.2	8.5	7.5	8.2
Chatham 202 (2.0-2.3 gpm)	8.28	8.7	8.0	7.7	8.5	8.2
Niagara N2133 (1.3-1.9 gpm)	6.90	6.7	7.6	7.4	7.1	7.2
Nova B6401 (1.3-1.9 gpm)	7.38	8.0	7.5	7.6	6.5	7.4
Teledyne SS1P (2.0-2.3 gpm)	8.06	8.3	8.4	8.1	7.5	8.2
Moen 3900A (2.4-3.0 gpm)	7.36	8.2	6.8	7.3	7.1	7.1
Delta Delex 6122 (Control-4.5 gpm)	8.21	8.9	8.5	9.0	7.5	8.9

the water flow range were not as highly rated as those at the middle and upper end, but these differences were relatively small.

Follow-Up Survey

In order to measure the extent to which the participants continued to hold the views they had initially expressed, a brief unannounced follow-up call was made two and one-half to four weeks after the first survey. As shown in Table 5, 85 percent of the successfully contacted subjects continued to use the low-flow shower head they had been sent, and 15 percent removed it. The overall level of satisfaction continued high (8.24, slightly more than the comparable mean on the first survey). There were no differences among the thirteen heads on long term measures of acceptance.

Table 5 also reveals that the principal reason given by the subjects for removing the shower head dealt with various features of the head's water spray system (54%), as well as the degree to which the spray mechanism could be adjusted

Table 3. Most Disliked Feature of Low-Flow Shower Heads

Category of Responses	Number/Percentage
Spray quality	90 (15%)
Low water pressure	74 (12%)
No spray adjustment	68 (11%)
Spray pattern	55 (9%)
Low water volume	38 (6%)
Design	38 (6%)
Noise	36 (6%)
Leaks	13 (2%)
Uses more hot water	11 (2%)
No pulsating feature	9 (1%)
Other	20 (3%)
No single feature	221 (36%)

Table 4. Most Liked Feature of Low-Flow Shower Heads

Category of Responses	Number/Percentage
Saves water/energy efficient	227 (37%)
Good water pressure	128 (21%)
Even spray dispersal	104 (17%)
Adjustable spray	97 (16%)
Soft/gentle spray	96 (16%)
Pulsating spray	29 (5%)
Design	25 (4%)
Other	37 (5%)
No single feature	62 (10%)

(22%). Far fewer had any concerns about lower water volume. This finding is consistent with the relatively infrequent occurrence of this complaint during the initial survey.

DISCUSSION

Taken together, the evidence obtained in this study indicates that the participants were very satisfied with the performance of the low-flow shower heads they tested. However, it may be necessary to quality this conclusion. The final population of subjects was a highly selective one, composed of volunteers drawn from the much larger pool of subjects who were originally asked to participate and

Table 5. Summary of Follow-Up Results

Total Respondents	520
Retained shower head	444 (85%)
Removed shower head	76 (15%)
Overall Satisfaction Rating	Mean = 8.4
Reason(s) for Removing	
Prefer spray adjustment	17 (22%)
Other spray features	51 (54%)
Lower water volume	26 (34%)
Other	18 (25%)

eventually installed the shower head. Nearly one-third of the successfully recruited subjects never installed the shower head they had been sent. Thus, the high degree of acceptance among installers may not be representative of a similar degree of acceptance in the larger population of individuals who had been initially asked to participate in the study.

Moreover, in spite of the fact that individuals were offered a new low-flow shower head free of charge, and were informed it would help them to save both water and energy, Table 6 indicates that nearly three-fourths of those originally contacted declined to participate in the study. Furthermore, not all of the individuals who agreed to participate installed the shower head after they received it. Only 18 percent of the original sample of 3,404 initially contacted individuals actually installed the shower head and completed the first survey. As noted, almost one-third (31%) of the 894 successfully recruited subjects did not install the head: this was the case ever after they had been called back a second (and last) time.

Much higher installation rates have been achieved by several recently reported neighborhood canvassing programs. For example, the device installation rate of water conserving devices in a recent neighborhood retrofit program in San Jose, California has been reported to be over 90 percent [10]. A water conservation kit was delivered door-to-door. A series of check-up canvasses followed. According to the program's director, the program was largely effective because it relied on resident installation of the water saving devices. In addition, perhaps the circulation of canvassers throughout the neighborhood aroused the curiosity of the residents which, in turn, led them to talk about the program and encouraged participation.

Table 6. Sample Populations

Population Category	Size	
Original Sample Population		
Initially Contacted	3,404	
Participants–Agreed to participate and sent shower head	894	(26%)
Non-participants–Declined to participate	2,510	(74%)
Final Sample Population–Successfully recruited	894	
Respondents–Installed and completed survey	616	(69%)
Non-respondents–Did not install shower head	278	(31%)
Considering installation	160	(57%)
Declined to install	53	(19%)
Did not receive shower head	13	(5%)
Phone disconnected	13	(5%)
Incorrect phone number	6	(5%)
Never reached	33	(2%)
Sub-total non-respondents	278	(12%)

Table 7. Self-Reported Behavioral Effects of Low-Flow Shower Heads

Estimated Change	Water Volume (Percent)	Shower Duration (Percent)	Hot Water Consumption (Percent)
Greater	8	15	7
Less	33	13	44
No Change	54	70	38
Uncertain	5	2	11

Water and Energy Savings

Further research is required to obtain precise measures of the amount of water and energy saved by low-flow shower heads. A number of anecdotal reports suggest that individuals may take longer showers and/or increase the hot water temperature setting with low-flow shower heads. While Table 7 indicates that 95 percent of the subjects said they did not do either of these things, there is no independent confirmation of these reports.

Past attempts to assess these concerns have been based on evidence derived from multi-component water conservation projects or energy retrofit programs, which have, for example, introduced water-conserving devices (e.g., low-flush toilets or toilet dams, or water heater retrofits using water-heater wraps and pipe insulation). As a result, the estimated water and energy savings were derived from the combined effects of several different devices, making it impossible to isolate the savings derived from the low-flow shower heads from those produced by additional components of the retrofit program.

Detailed real-time information about the amount of water and energy consumed while individuals are showering would provide direct evidence on the water and energy savings derived from using low-flow shower heads. It would also provide evidence on the possibility of a compensatory take back effect with low-flow shower heads. For example, Geller reported that the water saved by installing three water conservation devices (toilet dams, shower flow restrictors, and shower control switches allowing the user to regulate the flow of water from fully on to fully off) in over 100 residences was not large and far less than predicted [11]. He suggested that a "take back effect" may have operated to diminish the water conserving potential of these devices, and speculated that informing the subjects about their water saving potential may have led them to flush their toilets more often and take longer or more frequent showers.

Continuous real-time measures of the amount of water and energy consumed while individuals are showering could be obtained from electronic transducers wired to a remote data logger and mounted in plumbing fittings. Transducers could monitor pressure, flow rate, temperature, and total-per-shower water consumption of low-flow shower heads.

CONCLUSION

On the whole, the weight of the evidence obtained in this investigation suggests, contrary to an often expressed view, that the diminished water flow of these new shower heads is not a major barrier to their acceptance. As long as the shower head is one of the "leading" low-flow models, a high degree of satisfaction can be expected. Participants also clearly preferred the new shower head to their old one, continued to use it throughout the follow-up period, and fully intended to keep it installed after the project ended. However, it is not known whether or not net water or energy savings actually were realized.

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