

Perceptions of PCE use by dry cleaners and dry cleaning customers

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Abstract

Recent studies by consumer and environmental groups have raised questions about Perchloroethylene (PCE) used by over 85% of the commercial dry cleaners in the United States, but classified as a possible or probable carcinogen. Many environmentalists favour replacing PCE dry cleaning with alternative, chlorine-free processes currently under development. However, even if these alternatives eventually provide adequate replacements, some time will be needed to convert technologies in an industry that is dominated by small, family-run businesses. This study examines the possibility of reducing PCE exposure with existing technology, through provision of information aimed at changing dry cleaner and customer behaviour. Dry cleaning customers and dry cleaning store owners and operators were interviewed to identify their mental models of how PCE risks are created and controlled. The interviews with dry cleaning customers revealed little awareness of concerns about PCE. Because few understood the actual dry cleaning process, customers had difficulty understanding the nature of the concern and methods of protecting themselves (other than dry cleaning their clothes less frequently). They did seem to understand, though, that dry cleaning is a chemical process and that some concerns probably exist. The interviews with dry cleaners revealed a much greater level of awareness of concerns and a wide range of related opinions. Most deny that such concerns should be given credence. However, their justifications often rely on anecdotal evidence and incomplete or incorrect assumptions. Most did acknowledge that more advanced technology, economic incentives, and current regulations provide appropriate opportunity and motivation for responsible business practices that minimize or reduce exposure. A communication strategy is derived from these results, relying on dry cleaner and dry cleaning customer education.

KEY WORDS: drycleaning; perchloroethylene; exposure; perceptions; mental models

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1. Introduction

1.1. BACKGROUND

Perchloroethylene (PCE), more formally known as tetrachloroethylene and more commonly known as 'perc,' is a chlorinated solvent used by an estimated 85 to 90% of the thousands of dry cleaners in the United States (Thompson and Evans, 1997). PCE is classified as a hazardous substance and as a possible-to-probable human carcinogen by the US Environmental Protection Agency (EPA). Concern about PCE exposure is also evident in Europe and elsewhere (Blair *et al.*, 1990; Altmann *et al.*, 1995; Bergerow *et al.*, 1996; Chao *et al.*, 1999); PCE is now considered a probable human carcinogen by the International Agency for Research on Cancer (IARC, 1995). These classifications pit many environmentalists against the proprietors of what are often family-run businesses.

Recent studies by consumer and environmental organizations have fueled the debate by taking their case to the popular media, increasing scrutiny of PCE as a potential health hazard. Consumers Union, which publishes *Consumer Reports*, has reported finding high PCE concentrations (in some cases higher than the OSHA workplace standard), in the air of apartments located above dry cleaning establishments in New York City (Wallace *et al.*, 1995). Both Consumers Union and Greenpeace have reported detectable levels of PCE residuals in dry cleaned clothes (Rice and Weinberg, 1994; Wallace and Groth, 1996), suggesting a possible threat to public health.

Disagreement about the conclusiveness of these epidemiological studies and the advisability of responses has led to often-heated debate. Steinberg (1997) describes the emotional reaction of some parents to the closing of their children's elementary school in Harlem. Newly located in a building that once housed a dry cleaning plant, the school was found to have elevated levels of PCE. Even though such low levels of PCE are thought to be a concern only for long-term exposures (and the school had been open for only four weeks), parents were described as 'bewildered, frightened and angry.'

Such incidents may reflect, in part, poor communication about the nature of the risk and its management. Partisans often depict risks in black-or-white terms. Either there is a risk, which should be completely eliminated, or there is not, and nothing need be done. Such arguments ignore the ranges of risk levels and of possible responses, including new technologies, improved process management, and changed consumer behaviour.

These options will be clearer after a brief description of the types of dry cleaning processes, typically referred to as 'generations.' First generation, or transfer, machines have separate units for washing and drying. The transfer of clothing from the washing unit to the drying unit releases a relatively high amount of PCE vapour and requires a person to handle PCE-soaked garments. As a result, there is both contact and inhalation exposure. PCE vapours from the drying cycle are typically vented outside the store, through the roof.

Subsequent generations add incremental improvements over the basic process. Second generation machines involve a 'dry-to-dry' process, where a single unit handles both the washing and the drying, eliminating the need for clothing transfer. Third generation machines add a refrigerated vapour condenser to reduce emissions from the drying cycle. Fourth generation machines use a 'closed loop' design that eliminates the intentional venting of PCE vapours during the drying cycle by recycling air through a more effective vapour condenser.

Fifth generation machines use the machine until the level reaches a preset limit. This prevents the machine from becoming completely dry, either intentionally (due to varied drying cycles) or unintentionally.

Currently, all five generations of machines are in use. The older generations are being phased out. Emissions are now required to be reduced (USEPA, 1992). In addition, new technologies have increased, including the use of non-chlorinated solvents.

Groups concerned with the health effects of chlorine-free alternatives to PCE, such as non-chlorinated petroleum-based solvents for cleaning, using liquid CO₂ for a 'wet cleaning' process (USEPA, 1993; Black, 1994), and the large capital investment required for such technologies (with the risk of clothing damage (with the use of a solvent).

1.2. RELATIONSHIPS AND PERCEPTIONS

Despite extensive research, many uncertainties remain regarding the health effects from PCE used in dry cleaning. The availability of alternatives mean that there is a need for more information. As a result, both consumers and businesses are concerned about these risks. However, information about the risks and exposures (Goldenhar *et al.*, 1997) is needed to make decisions as choosing an alternative technology (based on their technology) and their behaviours (e.g., in handling clothes).

Following the format of the previous section, relationships among people, places, and things in dry cleaning. As shown in Figure 2, the relationships between their PCE exposure through the use of dry cleaned clothes, air quality in these areas. The decision-making process and perception of these factors are discussed below.

1.3. EXPERT MODELING

Figure 2 presents an 'expert model' based on the technical literature on PCE emissions and pollution modelling. It shows how PCE emissions, the mode of

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Fifth generation machines add a PCE sensor, which prevents operators from opening the machine until the level of PCE vapour in the air above the drying clothes reaches a preset limit. This prevents 'shorting' a drying cycle, removing clothes that are not completely dry, either intentionally (to increase the clothing throughput) or unintentionally (due to varied drying times for different clothing materials).

Currently, all five generations of dry cleaning technology are still in use, although the older generations are no longer manufactured and modifications to reduce emissions are now required for older machines still in use (USEPA, 1978; USEPA, 1980; USEPA, 1992). In addition, as the price of PCE has gone up, the adoption of new technologies has increased, in order to reduce solvent loss.

Groups concerned with PCE risks have lobbied for its elimination, in favour of chlorine-free alternatives. Currently under development, these include using a less-toxic, non-chlorinated petroleum solvent in machines similar to those used in standard dry cleaning, using liquid CO₂ in a process performed under vacuum, and using water in a 'wet cleaning' process that is tightly controlled to reduce fabric damage and shrinkage (USEPA, 1993; Black, 1995). The barriers to implementing these alternatives include the large capital investment for new equipment, increased labour costs, potential clothing damage (with wet cleaning), and flammability concerns (with the petroleum solvent).

1.2. RELATIONSHIPS AFFECTING PCE EXPOSURE

Despite extensive research (Drye, 1991; Earnest, 1996; Thompson, 1997), significant uncertainties remain regarding the magnitude and control of possible health effects from PCE used in dry cleaning. That uncertainty and the incomplete development of alternatives mean that PCE-based dry cleaning is likely to continue for some time. As a result, both consumers and dry cleaners need information to decide how to deal with these risks. However, in many cases, they are unaware of these effects or their own exposures (Goldenhar *et al.*, 1999). For dry cleaners, such information could serve such decisions as choosing among technologies, emissions-reduction procedures, and exposure-avoidance behaviours. For customers, the decisions include choosing dry cleaners (based on their technology and management) and adopting exposure avoidance behaviours (e.g., in handling and storing dry-cleaned clothes).

Following the format of Kovacs *et al.*, (1997), Fig. 1 shows, schematically, the relationships among people, processes, and the environment that affect PCE exposure from dry cleaning. As shown, both dry cleaners and their customers have some control over their PCE exposure through their influence on such factors as the dry cleaning process, dry cleaned clothes, air flow in environments with PCE emissions, and the time spent in these areas. The decision to exercise such control can be affected by awareness and perception of these factors and any associated health risks.

1.3. EXPERT MODEL FOR PCE EXPOSURE

Figure 2 presents an 'expert model' of the PCE exposure process for dry cleaning based on the technical literature (cited above) as well as the input of experts in indoor air pollution modelling. It details the physical processes, the release and transmission of emissions, the mode of exposure and the potential health effects. For dry cleaners, PCE

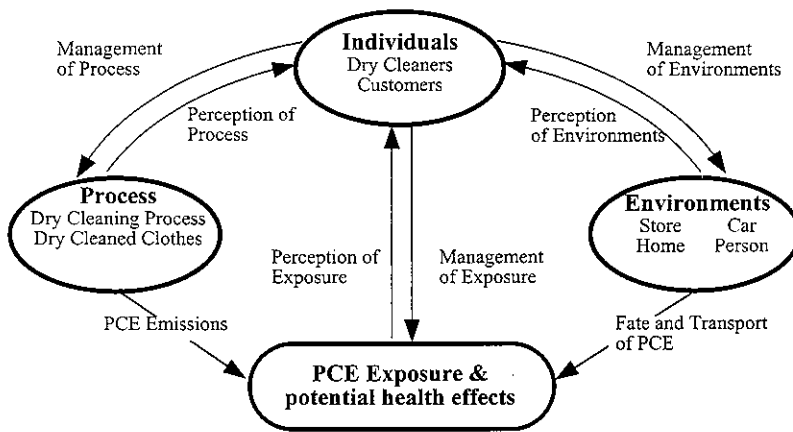


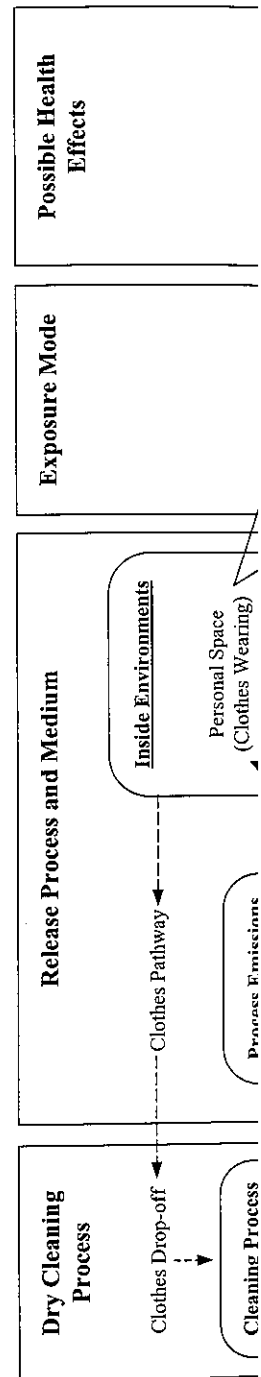
Fig. 1. Relationships of PCE exposure from dry-cleaning.

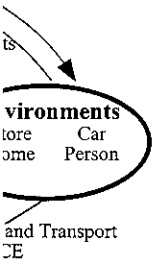
exposure routes are primarily within the store (exposure from handling and wearing their own dry cleaned clothes would be the same as for a customer, as discussed below). PCE emissions come from process operations and from the handling and storage of dry cleaned clothes. The level of PCE exposure depends on the type of equipment used, its maintenance and operation, storage and handling of clothes, store airflow characteristics, and the amount of time spent in the store.

For customers, PCE exposure routes arise from their visits to the cleaners and from clothing emissions in places where they take the clothes. The magnitude of exposure in the store depends on the factors affecting the cleaners, as well as how long they spend in the stores. Exposure from clothing emissions is affected by the amount of dry cleaning that they do, their handling and storage of clothes at home, airflow characteristics of their home, and how long they wear dry cleaned clothes (Chao *et al.*, 1999).

1.4. INDIVIDUAL CONTROL

Both dry cleaners and customers can exert some control over many of the factors that affect their PCE exposure. Dry cleaners can choose the store layout, type of equipment, operational procedures, and clothes handling methods. Their degree of control typically depends on their position in the store. Those who operate and maintain dry cleaning equipment can affect process-related emissions, while those who own the stores can control such structural factors as the technology, store layout, and ventilation system. Customers have indirect control over store-related factors by their choice of dry cleaner. They have more direct control over exposure related to clothing emissions. Again, whether people choose to exercise such control is a function of their perceptions of exposure processes and concerns over related health effects. These perceptions are the focus of this study.





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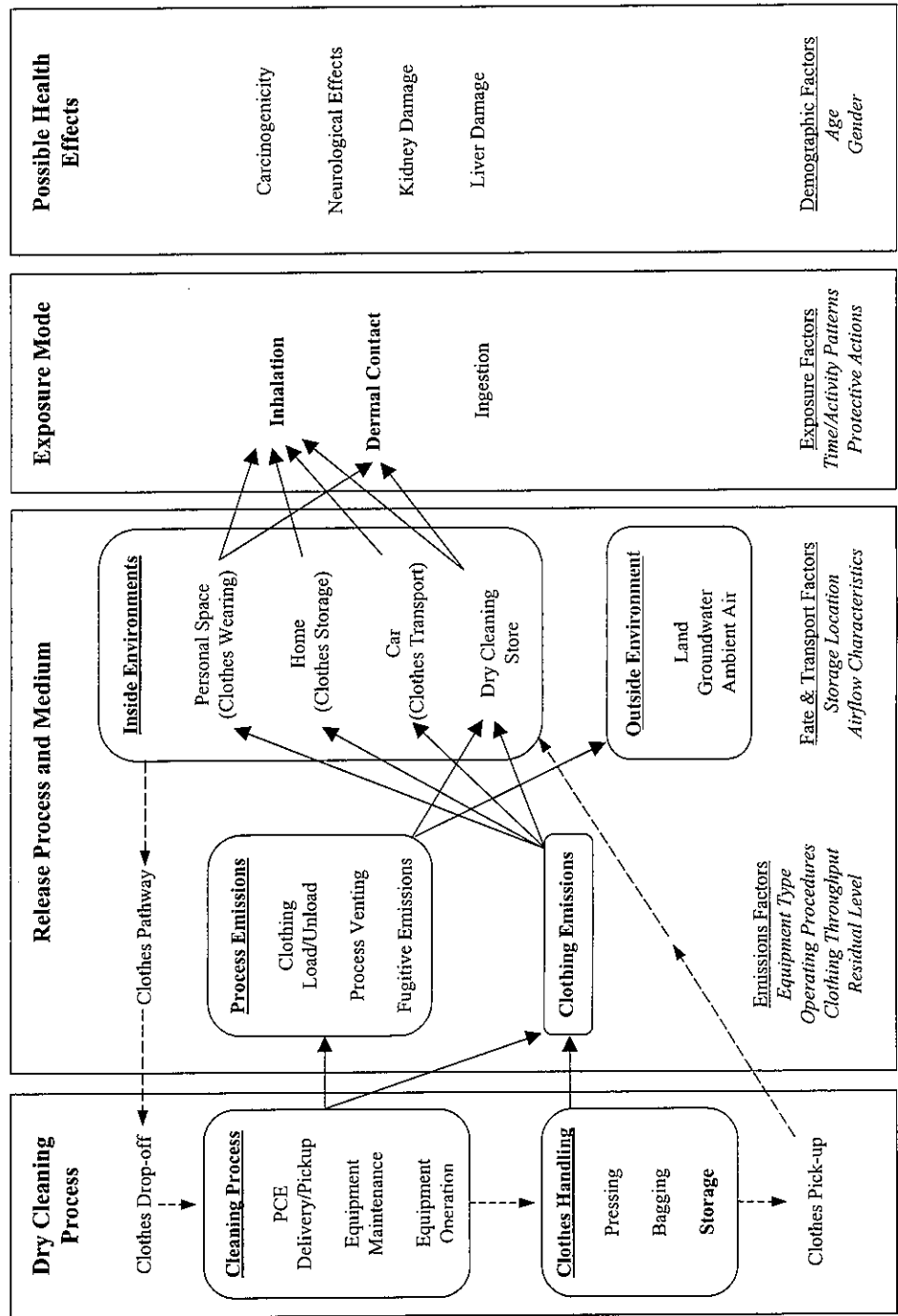


Fig. 2. Perchloroethylene exposure process expert model.

2. Methods

2.1 MENTAL MODEL INTERVIEWS

Interviews were performed with 20 dry cleaners and 30 customers. The structure of the interviews followed the 'mental models' approach (Bostrom *et al.*, 1992; Morgan *et al.*, 1992, 2001; Fischhoff *et al.*, 1997, 1998b; Fischhoff, 1999). Individuals' beliefs were elicited using a semi-structured interview protocol with open-ended questions designed to allow respondents to express whatever is on their minds, in their own terms.

The protocol was structured around the major areas of the expert model, so that participants had the opportunity to express themselves on its topics in a way that facilitated evaluating the completeness and accuracy of their understanding. Participants were prompted to discuss and expand upon each belief that they expressed, in order to clarify their intent. This procedure helps to reveal beliefs about a topic, even when participants do not use technical language. Responses were analysed by comparing participants' beliefs to the expert model. These findings can be used to design both risk communication and structured surveys (suitable for larger samples).

2.2 PARTICIPANTS

2.2.1. Dry cleaners. In order to obtain a varied sample, participants were recruited from two distinct sources, 14 from attendees of the Southern Dry Cleaners Show (Atlanta, Georgia, April, 1996), and 6 from stores in the Pittsburgh, Pennsylvania, metropolitan area. Their industry experience varied from 6 years to more than 40 (mean = 24.6). A majority operated only a single location, while six operated 2 to 4 locations and one had a chain of 12 stores. All expressed familiarity with the operation of dry cleaning equipment, with a majority still involved in day-to-day operations. Among those whose current duties were primarily administrative, all but one mentioned having been more involved in operations.

2.2.2. Customers. Thirty dry cleaning customers (8 men, 22 women) were recruited via an on-line bulletin board notice at Carnegie Mellon, offering \$10 in free services at the campus dry cleaning service. Some participants were students; most were campus staff members. They represented a wide range of customer types, from infrequent to frequent wearers of dry cleaned clothes. Their ages ranged from early twenties to over 60. Although all were recruited from the Carnegie Mellon campus, most did not regularly use the campus dry cleaning service or any other single store. In fact, many said that, even if they had a favourite dry cleaner, they frequently went to others when discounts were offered.

2.3 INTERVIEW PROTOCOLS

2.3.1. Dry cleaners. These interviews roughly followed the interview protocol attached as Appendix 1. The actual sequence of topics in a given interview varied as individual respondents raised specific topics. Participants were asked to describe their position and experience. They were then asked to focus on several specific issues related to PCE exposure: whether PCE odour is noticeable in their store(s), whether customers ever mention odour (either in the store or in clothes), what factors affect PCE emissions, and what technologies or procedures can reduce emissions.

Dry cleaners were next. They did not mention them specifically. Greenpeace. They were asked about their concerns and how they felt about them. They were asked what industry they worked for.

2.3.2. Customers. The interview questions were more structured. They become the initial response to the questions often encountered in previous research. Specific knowledge on a particular topic might produce should the respondent read the paper article, or word of mouth.

The interviews began with questions about why they take clothes to a dry cleaner, and why they take clothes to a dry cleaner. The questions serve the dual purpose of providing an unprompted response to the concerns. Customers were asked about dry cleaning, what they knew about dry cleaning, what their concerns were, who should be responsible, and followed by the dry cleaner's response.

Because odour is a real concern, we specifically asked whether they noticed it in the store.

2.4 ANALYSIS

Interviews with dry cleaners were transcribed. The transcripts were analysed for concepts in the expert model. Possible health effects, PCE exposure, and

3. Results

3.1 DRY CLEANERS

3.1.1. Perceptions of health effects. Dry cleaners expressed some knowledge about dry cleaning. Their perceptions of PCE exposure. The area of greatest concern was PCE exposure. As an administrative position, they were physically located near the business. For example:

Historically we have been asked to go do our dirty work for ourselves. As exposed to

Dry cleaners were next asked for their concerns regarding PCE exposure and, if they did not mention them spontaneously, about reports by EPA, Consumers Union, and Greenpeace. They were also asked to describe any past customer questions about concerns and how they had responded, or would respond in the future. Finally, they were asked what industry changes they expected or would like to see.

2.3.2. Customers. The interview protocol for customers is attached as Appendix 2. The questions were more structured than a typical mental models interview, in order to overcome the initial response of (something like), 'I have no idea how dry cleaning works,' often encountered in pretests. Participants were encouraged to guess when they had no specific knowledge on a topic. Such guesses should suggest the beliefs that customers might produce should their concern be aroused (e.g., in response to a TV item, newspaper article, or word of mouth).

The interviews began by asking customers to discuss dry cleaning in general, when and why they take clothes to the dry cleaner, what associations they have with newly dry cleaned clothes, and what they know of the dry cleaning process. These general questions serve the dual purpose of giving participants a structure for the interview and providing an unprompted opportunity to bring up topics such as environmental concerns. Customers were then asked to discuss: any concerns they had or had heard about dry cleaning, what actions they or dry cleaners could take in response to such concerns, who should be most worried about these risks, and what practices were followed by the dry cleaner that they most frequently patronized.

Because odour is a readily observable indicator of PCE exposure, customers were specifically asked whether they associate a specific odour with dry cleaning, and whether they notice it in the store or in their newly dry cleaned clothes.

2.4. ANALYSIS

Interviews with dry cleaners and customers were audiotaped to allow subsequent transcription. The transcripts were then coded to highlight statements corresponding to the concepts in the expert model. The analysis paid particular attention to concerns regarding possible health effects, PCE exposure pathways, and exposure management strategies.

3. Results

3.1. DRY CLEANERS

3.1.1. Perceptions of health concerns. All of the dry cleaners interviewed in this study expressed some knowledge of concerns about possible health effects associated with dry cleaning. Their perceptions of the validity of those concerns, however, varied widely. The area of greatest agreement was that dry cleaners themselves are at greatest risk for PCE exposure. As mentioned, even those dry cleaners currently holding mostly administrative positions had once been involved in actual operations. Most were still physically located near the operation and had close family members working in the business. For example:

Historically we have been right in [there]. We're an industry where we don't send people to go do our dirty work. We're an industry [where] we're in there doing our dirty work ourselves. As exposed as anybody is. - No. 5

The fact that these individuals are still in the dry cleaning business means that they had come to see the risks as nonexistent or small enough to be acceptable relative to the benefits. These excerpts illustrate some of their reasons for dismissing concerns.

As far as them being concerned about causing cancer, no I don't have that. I think it's foolish. Anytime, a lot of these tests are done on rat animals; they inject them with the perc. Actually if you inject anybody with any chemical it's going to do something to them. . . . As far as [I'm] concerned, unless I stick my head in that wheel, while the machine's running, that would be my only concern. – No. 18

We're a litigated society, and the employee listens to all that stuff, and gets sick and something like that, suddenly it's caused by the perc, and some percentage of our society is going to get this illness and that illness, and it becomes a convenient way to sue. – No. 5

I don't believe that people really believe that perc has the carcinogenic effect that's written about. . . . I do feel that some of the regs, are very, very, too stringent. The good that is achieved from the results does not justify the cost or expenses that one will run into, or the industry, or businesses in general will have to go to conform. . . . Those efforts and those funds can go to do better things that will serve the public. That's what really burns me up, as an individual. – No. 12

When information came out as the years progressed, I myself personally [saw] to it that each one of the stores has upgraded to the point where we're taking all precautions, that whatever studies that come out with, whether we agree or disagree, especially federal regulations as far as hazardous waste disposal, we met all these guidelines. – No. 14

Dry cleaners' first line of defense was typically that they had observed no ill effects in other dry cleaners or their customers.

Well, you've been here how many years? You never had a problem. You never had an odour. . . . If you had a problem you should tell me, if you haven't had a problem . . . – No. 16

My partner who's 70 and my dad who's 70, worked in perc plants almost all their lives, and they have not had any cancer problems, or health problems as far as lungs etc. – No. 1

I was in a meeting where there were five hundred people in the room, all dry cleaners. I stood up and I asked, 'Does anybody in this room know of any perchloroethylene related illnesses that they had, or anybody in their family ever had?' And nobody in that whole room raised a hand. And not only that, millions of people have worn clothes that have been dry-cleaned, and it hasn't caused any cancer in any of these people. Not since people that work with it, unload and loading dry clean machines every day [have ever had] a real case of cancer. – No. 9

A perfect example is approximately three years ago my father passed away from cancer. The first question asked for me and my family was, what was it caused from? His reply was, it wasn't the business. It was the cigarettes he had been smoking. And he quit smoking 15 years ago. Well, that was still part of the problem. It wasn't nothing to do with the chemicals. . . . I'm not a doctor, so I really can't say, but my professional opinion you're not going to (get sick). I've been in this business all my life, and I'm still here. I'm forty years old, and it hasn't bothered me yet. – No. 18

3.1.2. Release processes. Although they vigorously defended PCE use in dry cleaning as safe, dry cleaners acknowledged that process emissions should be controlled. This was particularly common in dry cleaners' opinions regarding PCE contamination in

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apartments above dry cleaners. No dry cleaner openly defended that situation and several clearly stated that it was unacceptable.

I certainly don't think that's something that's right, and should be corrected. - No. 1

In the instance of the situation in the fumes in the apartments, I felt that that was an issue that had to be addressed. Because anytime there's fumes present there, something is obviously not acceptable. - No. 15

New York has different problems. They have dry cleaners on the first floor. They have people living above. There are still transfer units being used, and that's wrong. - No. 16

The dry cleaners strongly denied any possibility that residual levels of PCE in dry cleaned clothes could be a harmful source of exposure to the wearer.

Never [have customers complained about residual left in the clothes]. There is no residual perc in the clothes, period. - No. 9

You read anywhere from that it's probable cancer causing . . . that clothes hanging in a car transporting them home from the dry cleaner, if you have any fresh foods, frozen foods in the car at the same time, they're going to absorb the Perchloroethylene. . . . absurdities from that extreme all the way to it is definitely, we believe, it is definitely hazardous to inhale perc fumes. - No. 2

I have had a customer recently that had heard something about the small amounts of chemicals that are possibly left in garments after dry cleaning and she was concerned about that. . . . I did agree with her on the fact that it is possible the small residual amount would be left in the garment. . . . Whether the fact that the amounts that were in there would harm her or not, that's where probably the disagreement was. Based on the article that she read, that was her assumption, and I didn't agree with that assumption. - No. 3

Thus, even if dry cleaners accepted the possibility of residual PCE, they denied any cause for concern. Most, however, argued simply that there is no residual, typically stating that new technologies had significantly reduced the amount of PCE used in the process and that any residual PCE would evaporate quickly.

Go back to the 37 drums we used to use down to one drum for two machines in one year. If there's perc left in the clothes coming from my plant now . . . It's very minor. - No. 4

Well, most of the new dry-to-dry machines are going to get just about all of it out. Because if it didn't we wouldn't be getting such good mileage out of our machines. I think that by the time the garment has been dry cleaned, it's hung on the line to be pressed, it's pressed, it's hung. If there is any additional perc perhaps in the shoulder pads or something, it's gone by the time you finally put a plastic bag on it [three or four hours later]. - No. 6

I would explain to her that we have the latest technology in the industry. And there is, there is not perc really left in the clothing by the time the customer gets it. Even if you have faulty equipment, because what happens it evaporates rapidly. - No. 20

3.1.3. *Exceptions.* While defending their use of PCE, 14 of the 20 dry cleaners did state that some members of the dry cleaning community do not always act responsibly.

I think there are people out in the industry who got in the industry without the knowledge of the dangers of Perc and what it can do, and are not as prudent with it as maybe they should be. - No. 1

We had an employee recently, that was hired away from us and now wants to come back to work for us, who said her [new] employer said 'I got these four or five barrels over there of that. Get rid of them. Don't tell me what you do with them, just get them out of here.' – No. 5

A lot of cleaners themselves are not well informed. A lot of them don't belong to associations. They don't participate. – No. 10

I'm not very smart, but I'm smart enough to know that you can't spill it on the floor and not clean it up. So, there's a lot of people out there who just don't get it. – No. 11

A person could definitely get clothes dry cleaned wrong. Anything you do wrong can cause trouble, right? And you can drown in a teaspoon of water, does that mean water is bad? No. If you use it right, you're not going to have some major problems. – No. 19

Consistent with these perceptions, some dry cleaners wanted better enforcement of existing laws in order to protect those dry cleaners who act in an environmentally responsible way from unfair competition with those who do not. To some extent, this call for better enforcement also reflected a desire for a moratorium on additional regulations. Nonetheless, some dry cleaners did propose additional regulations, such as education and certification requirements.

I'm basically a conservative Republican, small business, get out of my way sort of thing. But I think when you're dealing with hazardous chemicals, and dealing with things that can be harmful to society, then I think there's got to be some rules and laws with some teeth in it. I think [enforcement] is woefully inadequate. – No. 5

... maybe having some sort of certification of dry cleaners so that we know that at least every dry cleaner is at least knowledgeable of the problems of Perc. – No. 1

So let's start with regulation. Let's get a business relationship with the government, and all of the departments of environmental quality that are out there, and let's get some guys out there that come in and check out our plants. And make sure we're doing everything the way we're supposed to, and if not, let's get a list and start tightening up a little bit more. – No. 8

Another proposal was imposing a per-gallon tax on PCE purchases, in order to encourage dry cleaners to install more efficient equipment. These responses seem to stem from a particularly sensitive issue, mentioned by several dry cleaners, retroactive liability under the Superfund law.

The big problem is that thing [Superfund] is retroactive. And it's a stupid law. Why should we be responsible for something that wasn't a law back years and years ago? It wasn't a law. Now all of a sudden, we're responsible. It's destroyed a lot of families and businesses. – No. 20

For example, they passed Superfund in the 80s. But just say you had a little contamination that goes back all the way back to 1955, and you just inherited it in 1996. You are retroactively liable for something that wasn't against the law when it happened. – No. 9

In South Carolina and Florida, proceeds from such taxes support a fund to clean sites contaminated by once-legal past activities.

3.1.4. Industry future. Most of the dry cleaners saw technology as central to the future of dry cleaning. As presented above, many believed that the latest generations of tech-

nologies address any concerns with eliminating, the need for... can be successfully wet cleaned out subsequent to washing

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I think we're going to... With the techniques the... they just come cleaner

It's not the answer, it's a... probably wet clean 100... cleaning cloth, the same... Finishing is very time c

Many believed that n... reduce the number of d... to go out of business, a... nology. A similar proces... about the flammability c... out of business, in favou

For sure it's going to el... – No. 2

I think shopping center... Because they know, you... cutting out the dry clea

Cleaners who run a rea... to comply, or they'll ha... equipment up to standa

I think there's gonna be... are in are going to be... and do their part to kee

I see the industry chang... I see more places for p

3.1.5. Perceptions of th
concerns with their custo
tion consistent with resu

Relatively over the year... asked or inquired abou

When the problem with... world picked up on it... thing broke [recent pres... call me. – No. 4

nologies address any concerns. Some saw wet-cleaning technologies as reducing, but not eliminating, the need for PCE. Most believed that only a fraction of all clothes (25–50%) can be successfully wet cleaned, given the problems of shrinkage and finishing (stretching out subsequent to washing).

The more you can automate [the dry cleaning process], the more you can eliminate discretionary things in [drying cycle time, and residual level], the better your service. So we work very hard to eliminate those choices. Where we put the machine, and press the start button they can't stop it if they want to. – No. 5

I think we're going to do a lot more wet washing. We already do a lot of wet washing. With the techniques they got now I probably would do more, because in some garments they just come cleaner with wet wash. – No. 4

It's not the answer, it's a partial solution. We wet clean about 30% of leathers now. I could probably wet clean 100%. But I have nothing but problems after that 30% level. Wet cleaning cloth, the same way. After 25, 30, 40%, you develop problems [like] shrinkage. Finishing is very time consuming. – No. 16

Many believed that new technology and stronger enforcement of regulation would reduce the number of dry cleaning establishments. They expected smaller operations to go out of business, as a result of being less willing or able to invest in new technology. A similar process of industry concentration occurred in the past, when concerns about the flammability of petroleum solvents forced smaller neighbourhood operations out of business, in favour of larger dry cleaners in industrial areas.

For sure it's going to eliminate the small dry cleaning plants opening up on every corner. – No. 2

I think shopping centers are going to scare, and they're going to not lease to dry cleaners. Because they know, you know, where the scare is and that. So their leasing things will be cutting out the dry cleaner. – No. 17

Cleaners who run a real inefficient operations, as far as solvent usage, they'll either have to comply, or they'll have to go out of business. Buy the new equipment, or bring the old equipment up to standards. – No. 6

I think there's gonna be a lot less dry cleaners down the road, and I think the ones that are in are going to be environmentally aware of what's going on, and hopefully friendly and do their part to keep the risk down for everybody. – No. 3

I see the industry changing where they put dry cleaners in industrial areas like I have, and I see more places for people to pick up their clothes, like supermarkets. – No. 19

3.1.5. Perceptions of their customers. Few dry cleaners saw any need to discuss PCE concerns with their customers because so few of them had ever raised the issue (a perception consistent with results of the customer interviews presented below).

Relatively over the years, I could count on one hand for the amount of people that have asked or inquired about [health concerns]. – No. 3

When the problem with perc being in the groundwater came out, every news media in the world picked up on it. They were pounding on our doors wanting interviews. When this thing broke [recent press regarding residual in clothing], I hadn't had a single news media call me. – No. 4

If it's not a problem, you don't worry about it. In [my town] it simply isn't a problem. – No. 12

Some dry cleaners brought up attention to environmental concerns as a marketing tool for those dry cleaners who have taken extra steps to be environmentally responsible, such as offering wet cleaning or using the latest generation of dry cleaning equipment.

Before we changed machines, I didn't make a big deal about anything concerning this. But when we changed over to this machine, I did make a big deal of the fact that we were. What we did to the floor, we added containment, we were doing everything possible to make sure the environment is protected. – No. 1

We have gone into a wet cleaning alternative. And, any concerns [raised by] my customers [about] residual in their cleaning, then we offer them, the aqua clean system which we have had for over a year. . . . We pick up from health food stores that push this because they're more aware of, they read more articles about chlorinated, anything that has to do with chlorine, they are very concerned. – No. 2

3.2. CUSTOMERS

3.2.1. Dry cleaning process. Twelve of the 30 customers answered (correctly) that dry cleaning uses a machine similar to a normal washing machine. Most of the rest had no specific knowledge, with several offering guesses, including:

. . . not something that's done in a batch like a washing machine . . . the article of clothing is put on some sort of form, something that mimics the shape of an upper torso or your legs, that they can then press the garment when the chemical process is complete.

I don't know if it's just steam cleaning, . . . hung on a rack and then steam is shot through them.

. . . some kind of hanger system, drop them in the tank . . .

. . . put in a room with steam and chemical, something like a car wash.

Despite this limited knowledge, 26 customers spontaneously expressed a belief that some sort of chemical is used. Only five understood that clothes are actually soaked in it, compared to 12 who believed that the chemical was applied by a spraying process.

3.2.2. Perceptions of health concerns. More than half of the customers (17) reported no knowledge of any concerns about dry cleaning. Six of these qualified that response by saying that, because dry cleaning uses chemicals, they would not be surprised if some concerns had been raised. Of the 13 who were aware of some concerns, only five expressed any specific beliefs. Two knew about the Consumers Union study of indoor air contamination in apartments above New York City dry cleaners.

When asked who was most at risk, customers most frequently mentioned store employees (19); individuals sensitive to chemicals, such as children, the elderly, or the sick (13); people who wear dry cleaned clothes (8); and people who live or work near dry cleaners (7).

3.2.3. Management of PCE exposure. When asked how they might respond to increased concerns, customers' most frequent responses were: assessing the concern before doing

anything (12), using dry cleaning (11), reviewing and buying fewer clothes

When asked how a customer thought that the dry cleaner cleaning process could be improved, better information.

4. Discussion

4.1. DRY CLEANERS

Dry cleaners showed more concern with specific explanatory arguments reflect a position presented in the expert model with only superficial knowledge of the more knowledgeable ones. Currently, dry cleaners' customers, such that customers arise. Those relationships as inaccurate, incomplete further reflections of their consumers.

4.1.1. Health effects and evidence to illustrate that who's been killed by dry cleaning argument, such anecdotal chemical risks to consumers exposed individuals, a claim of having not a risk levels, it is unlikely exposure. A knowledgeable environmental group) might

4.1.2. Release processes by many dry cleaners wet cleaning, eliminating PCE use has dropped significantly of PCE purchased, leaving individuals. Although the reduction in clothing transfer and dry cleaning not demonstrate that e

Even when the volume of purchases, some PCE (such as water) may account for small amounts of lost dry cleaned clothes. I

anything (12), using dry cleaning less frequently (12), seeking an alternative to dry cleaning (11), reviewing their choice of dry cleaner (and possibly changing stores) (9), and buying fewer clothes that must be dry cleaned (5).

When asked how a dry cleaner could respond to increased concern, half believed that the dry cleaner could use an alternate chemical or process, 9 that the current process could be improved, and 7 that the dry cleaner should provide customers with better information.

4. Discussion

4.1. DRY CLEANERS

Dry cleaners showed relatively little concern regarding PCE use and were prepared with specific explanations to dismiss any issues that arose. However, many of these arguments reflect a poor understanding of release and exposure processes, as represented in the expert model. As a result, even if such answers might satisfy customers with only superficial knowledge, they could erode credibility among more knowledgeable ones. Currently, dry cleaners appear to have fairly good relationships with their customers, such that customers would turn to them for information should concerns arise. Those relationships might be threatened if dry cleaners' responses were perceived as inaccurate, incomplete, or self-serving. Now, some of these beliefs are reviewed, as further reflections of the dry cleaners' mental models and potential inputs to those of their consumers.

4.1.1. Health effects and anecdotal evidence. Dry cleaners often relied on anecdotal evidence to illustrate their belief that dry cleaning is safe (e.g., 'Do you know anyone who's been killed by dry cleaning? Because I don't.'). Although a common form of argument, such anecdotes obviously carry little weight as evidence. In many domains, chemical risks to consumers are regulated at a level of one cancer death per million exposed individuals, a level that would allow many, if not most dry cleaners to make a claim of having not observed any health effects. Moreover, even with much higher risk levels, it is unlikely that any individual death could clearly be attributed to PCE exposure. A knowledgeable consumer (perhaps one educated by a consumer or environmental group) might legitimately wonder how this claim could be supported.

4.1.2. Release processes and new technology. A process-based argument often made by many dry cleaners was that new technologies have increased the efficiency of dry cleaning, eliminating PCE emissions and any exposure concerns. Many stated that their PCE use has dropped significantly, with waste shipments now often equalling the volume of PCE purchased, leaving no PCE available for process emissions or as clothing residuals. Although the reduction in overall PCE use (mainly from eliminating the need for clothing transfer and dryer venting) is an indicator of reduced process emissions, it does not demonstrate that exposure concerns have been eliminated.

Even when the volume of waste shipments equals (or exceeds) the volume of PCE purchases, some PCE may have been lost and available for exposure. Contaminants (such as water) may add volume to waste shipments, making up for lost PCE. Even small amounts of lost PCE can measurably contaminate large volumes of air or dry cleaned clothes. In addition, the level of clothing residual depends solely on

how completely the clothes are dried (Kawauchi and Nishiyama, 1989). This is directly controlled only with the very latest technology, which incorporates a sensor that locks out the operator until PCE in the air above the drying clothes falls below a preset limit. Without a sensor, dry cleaners rely on smell to ensure that clothes are dried completely.

Many dry cleaners added that, even if some PCE residual remained in clothing after drying, it would evaporate quickly; thus, the absence of PCE odour either in the store or in dry cleaned clothes demonstrates that there is no PCE residual. Unfortunately, there is little empirical evidence on evaporation rates to evaluate this argument. Moreover, even as PCE evaporates, it may still result in exposure because PCE vapour is heavier than air, hence can accumulate in areas where people can be exposed to it, especially in places with little ventilation, such as bedroom closets (Tichenor *et al.*, 1990; Thomas *et al.*, 1991). Exposure can occur even when PCE concentrations are lower than the threshold for detection by smell.

New technologies may even create an incentive for dry cleaners to shorten the drying cycle (taking clothes out before they are dry), actually increasing PCE residuals in clothing and subsequent emissions to the store or other environments where the clothes are stored. With older transfer machines, the dry cleaner could begin washing a new load of clothes, while the previous load was in the dryer. With a single vessel, this is no longer possible. Whether new technologies eliminate fugitive emissions into stores or residuals in clothing depends on equipment operation and maintenance (Moschandreass and O'Dea, 1995), as well as the incentives created by regulation, capital costs, competitive pressures, and so on.

4.2. CUSTOMERS

Interviews with dry cleaning customers were initially intended to focus on their beliefs and concerns regarding exposure pathways and possible health effects. However, pretests revealed that most held very few such beliefs with any confidence. As a result, customers were encouraged to make inferences where they lacked knowledge. This was intended to simulate the thought processes that customers would use, were PCE exposure to become an issue.

4.2.1. Dry cleaning process. These somewhat speculative beliefs seemed to depend heavily on how participants interpreted the 'dry' part of dry cleaning. Those customers who provided the correct interpretation, that 'dry' simply means the absence of water, imagined clothes being soaked in a chemical. The belief that 'dry' meant no liquid-phase chemicals led to explanations such as a spraying process. Envisioning such uncontrolled spraying, customers might believe that dry cleaning has emissions that are difficult to control, perhaps suggesting much greater chemical exposure than is actually the case. However, it is unclear how customers would react to learning that their clothes are immersed in a chemical, even if it is an enclosed and controlled process. Such soaking might make it easier to visualize PCE residuals in the clothing, whereas the more enclosed process may make it easier to visualize controlling vapour emissions.

Whether consumers are prompted to make these inferences will depend on the results of future PCE studies and the attention they attract. The fragmentary and episodic character of media reports regarding PCE may keep consumers from creating stable

mental models. They might write the issue off, as just more information becom-

4.3. STUDY LIMITATIONS

Use of opportunity sampling and nonrepresentativeness. In particular, the respondents, altogether were unlikely to view dry cleaning as an incentive to change. They do not want to give us a piece of their business, or any drop in business as a result of a higher rate of principled nonuse.

Our relatively small sample size. If greater precision were needed, more materials, for estimating population parameters from the results of the survey (1998a, 1998b) and Mor-

Finally, the results of the survey are in English. The US dry cleaning industry is a multilingual and language barrier. If so, then different approaches might be more effective.

5. Conclusions

Although the dry cleaning industry is a major potential source of emission, the public's knowledge of PCE transport and potential health effects. On the other hand, the public knew next to nothing. They expressed little concern about the possibility of such concerns, largely due to gaps in knowledge providing relevant information.

Such information provides a basis for dry cleaning. For the former, the public, by understanding how to evaluate the actions of dry cleaners to improve their operations, concerns by highlighting their management practices. The research suggests several areas for further study between the determinants of risk communication as draft risk communication.

a, 1989). This is directly incorporates a sensor that the falls below a preset that clothes are dried

ained in clothing after our either in the store residual. Unfortunately, value this argument. re because PCE vapour le can be exposed to it, ts (Tichenor *et al.*, 1990; concentrations are lower

rs to shorten the drying using PCE residuals in nents where the clothes d begin washing a new 1 a single vessel, this is ve emissions into stores l maintenance (Mosch-regulation, capital costs,

to focus on their beliefs alth effects. However, confidence. As a result, ed knowledge. This was ld use, were PCE expo-

iefs seemed to depend aning. Those customers is the absence of water, 'dry' meant no liquid-cess. Envisioning such g has emissions that are xposure than is actually arning that their clothes ontrolled process. Such e clothing, whereas the ing vapour emissions. ill depend on the results gmentary and episodic rs from creating stable

mental models. They might become unduly alarmed or their confusion lead them to write the issue off, as just another possible long-term threat, which can be ignored until more information becomes available.

4.3. STUDY LIMITATIONS

Use of opportunity samples such as those used here, restricts any claims of representativeness. In particular, customers whose concerns had led them to avoid dry cleaning altogether were unlikely to have participated in our study, which offered free dry cleaning as an incentive (unless, of course, they felt strongly enough about the topic to want to give us a piece of their mind). None of the dry cleaners in the study mentioned any drop in business as a result of media reports. If that is, in fact, the case, then the rate of principled nonusers might be stable and relatively small.

Our relatively small samples restrict the precision of estimates of belief prevalence. If greater precision were needed (e.g., for the targeted design of informational materials, for estimating population exposure levels), structured surveys could be derived from the results of the present interviews, following the examples of Fischhoff *et al.* (1998a, 1998b) and Morgan *et al.* (2001).

Finally, the results of this study may be less applicable to the roughly one-third of the US dry cleaning industry that is operated by Korean immigrants. Cultural differences and language barriers may significantly affect their perceptions of concerns. If so, then different approaches for risk communication and exposure avoidance may be more effective.

5. Conclusions

Although the dry cleaners in this study knew a lot about process operations and potential sources of emissions, they demonstrated less understanding of the mechanics of PCE transport and potential health effects of exposure. Dry cleaning customers, on the other hand, knew next to nothing about the dry cleaning process. Although they expressed little concern about PCE exposure, they were, however, open to the possibility of such concerns, knowing that some sort of chemical process is involved. These gaps in knowledge provide opportunities to reduce exposure by providing behaviourally relevant information.

Such information provision should appeal to both opponents and defenders of dry cleaning. For the former, providing information allows customers to reduce their exposure by understanding how their behaviour affects exposure and by allowing them to evaluate the actions of their dry cleaners, thus creating an incentive for dry cleaners to improve their operations. For the latter, dry cleaners are empowered to respond to concerns by highlighting their knowledge of and adherence to efficient emission and exposure management practices, possibly forestalling additional regulation. The results of our research suggest several potential messages that focus on the most significant gaps between the determinants of risk and current beliefs. These messages are presented below as draft risk communications suitable for empirical evaluation.

5.1. INFORMATION FOR DRY CLEANERS

5.1.1. Health effects and anecdotal evidence. Not having observed adverse effects of dry cleaning does not prove that there is no cancer risk. For small risks (i.e., below one in ten thousand), the causal link between exposure and effect can hardly be established through studies, much less through personal observation. One can, however, establish that some actions reduce exposure, whatever the associated carcinogenicity.

5.1.2. Release processes and new technology. New dry cleaning technologies are sure to reduce significantly, but not eliminate completely PCE emissions and the associated exposure potential. Although no odour is better than some odour, not smelling emissions does not guarantee their absence, only that they are below the 50 PPM detection limit. Proper equipment operation and maintenance are required to ensure continued minimal emissions. The use of more advanced equipment is likely to increase as a result of regulatory pressure, additional PCE sales taxes, economic efficiency concerns, and increased customer environmental awareness.

5.2. INFORMATION FOR DRY CLEANING CUSTOMERS

5.2.1. Dry cleaning process. In standard dry cleaning, garments are completely immersed in a liquid chemical, PCE, in a process like that of a standard water-based washing machine. There are several generations of dry cleaning equipment. With the earliest machines, washing and drying are done in separate vessels, so that PCE-soaked clothes must be transferred from one vessel to the other, creating high levels of PCE emissions within the store. With the newest dry cleaning machines, washing and drying are done in the same vessel, eliminating the need for wet clothing transfer, and PCE sensors control drying cycle time, minimizing residual in clothing. 'Wet cleaning' technologies, which do not use PCE, are available at some locations, but have not been demonstrated to be as effective for all garment types.

5.2.2. Health effects associated with PCE dry cleaning. The EPA and the International Agency for Research on Cancer classify the chemical used in dry cleaning as a suspected carcinogen. That label implies that health effects, while possible, are rare enough to make a statistical link between exposure and effect difficult to prove, and a direct link impossible to establish for any individual.

5.2.3. Release processes. Some PCE residual remains in all newly dry cleaned clothes. The level depends on the clothing material, as well as the dry cleaner's equipment and operating practices. Over time, residual PCE evaporates into the air, where it can be inhaled. Some PCE vapor may remain, even when it cannot be smelled.

5.2.4. PCE exposure management. In addition to reducing their amount of dry cleaning, customers can reduce PCE exposure in two main ways: (1) Choose a responsible dry cleaner. That is, patronize a store that is well kept and operated, has no noticeable PCE odour, and uses the most advanced dry cleaning technology. (2) Handle newly dry cleaned clothes in ways that minimize the PCE vapour in places where it can be inhaled. Because PCE vapour is heavier than air, it will sink to the floor and accumulate in poorly ventilated areas. Air out and store newly dry cleaned clothes in a well-ventilated area, away from where people spend their time.

5.3. POSSIBLE FUTURE

The expert model in I levels. Subsequent anal by individuals' mental behavioural changes wi among risk communicati targeted at specific beha alternative to regulation sure reductions can b behavioural responses c ioural interventions can and Riley *et al.* (2000).

Acknowledgements

We would like to thank Halogenated Solvents Ir to this project, as well Association. We would support of the Center Change. The opinions e

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5.3. POSSIBLE FUTURE WORK

The expert model in Fig. 2 is compatible with quantitative analyses of exposure levels. Subsequent analyses could allow calculation of the exposure levels implied by individuals' mental models and, hence, be used to identify the most critical behavioural changes with greater confidence. Analyses could not only set priorities among risk communications, but also evaluate the overall effectiveness of interventions targeted at specific behavioural changes. Such interventions have been proposed as an alternative to regulation. However, such proposals only have merit if adequate exposure reductions can be expected, making reasonable assumptions regarding the behavioural responses of consumers and operators. Quantitative analyses of behavioural interventions can be found in Fischhoff *et al.* (1998a, 1998b); Casman *et al.* (2000) and Riley *et al.* (2000).

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Appendix 1. dry cleaning

In this study, we are interested in the factors affecting employment in dry cleaning used in dry cleaning.

To start off, could you describe the area in which you work? How long have you been working there? How many stores are there in the area? What type of work do you do? How much time do you spend working? Are there other kinds of work? Have you ever had any training?

Store:

Describe the area in which you work, residential neighborhood, etc.

Which of the following types of stores do you work in?
Apartments? Do you work in a Grocery Stores

In the store that you work in, what is the location?

(If cleaned on-site)
How many cleaning machines do you have?
What type of machine (ventilated or dry to dry vented)?

Do you know the brand name of the machine?

How many hours is it open per week?

Can you give me some information on the amount of clothing cleaned per week? amount of perc used per week?

Could you sketch a layout of the store?
Could you please locate the cleaning machines?

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Appendix 1. dry cleaner interview protocol

In this study, we are trying to characterize dry cleaning operators' knowledge of the factors affecting employee and customer exposure to perchloroethylene, the chemical used in dry cleaning.

To start off, could you tell me about yourself, are you an owner or an employee?
 How long have you worked in the dry cleaning business?
 How many stores are you associated with?
 What type of work do you do? Describe a typical day.
 How much time do you spend on each activity?
 Are there other kinds of work that you do on a less frequent basis?
 Have you ever had other responsibilities in the past? What? When?

Store:

Describe the area in which your store is located?

residential neighborhood commercial area industrial area

Which of the following are near your store?

Apartments? Do you have apartments above the store?
 Grocery Stores Other Commercial Stores

In the store that you work/own, are clothes cleaned on-site or sent to a central location?

(If cleaned on-site)

How many cleaning machines do you have on site?

What type of machine(s) are they?

dry to dry vented? dry-to-dry refrigerated? transfer?

Do you know the brand name and model? How old is the unit?

How many hours is it typically operating every day?

Can you give me some idea of the amount of business your store does?

amount of clothing _____ pounds per day, _____ pounds per month

amount of perc used _____ gallons per month, _____ gallons per year

Could you sketch a layout of your store?

Could you please locate the following on your sketch:

entrance	ventilation	counter
clothing storage	walls and doors	rough dimensions
dry cleaning machine(s)		

Operations:

Can you describe to me how the dry cleaning process works? Walk me through what happens to clothes between the time they are dropped off and picked up.

Can you smell the perc in your store? Ever?

When or where do you notice that smell in particular?

Are there specific places in the store, or job duties where you particularly notice the smell?

Where do you think that vapor emissions come from?

in the process	in maintenance	in the clothes
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Do you think customers and employees notice the vapors?

Do you have any specific responses for when perc can be smelled?

Can your customers notice the smell of perc in their clothes?

What conditions or actions might affect the level of perc in the air?

What actions might affect the amount of perc breathed?

Does your store have any specific operating procedures which are designed to reduce the amount of perc in the air or being breathed by employees and customers?

How does it/they work?

What technologies do you have in your store or on the machine to control the amount of perc in the air? How does it work?

If you had to, what could you do to reduce the level of perc in the air or being breathed?

Prompt using sources above, e.g.:

If customers' exposure comes from clothing, what factors might lead to a higher or lower exposure?

If employees' exposure come equipment operation, what factors . . .

Concerns:

What do you know of environmental concerns that have been raised about dry cleaning? where did you hear it? from what source?

Have you heard of the specific concerns raised by
the Consumers Union? the EPA? Greenpeace?

What do you think that the public knows of these concerns?

What have customers asked you about concerns?

Do you have an established response regarding environmental concerns?

What did you tell them?

(if employee) Has you
ronmental concerns or
(if owner) Have you
concerns or given spec
(both, if so) What was

Based on what your k
how do you think that
or will it be essentially

Are there specific cha
clothing manufacturers

Appendix 2. Custom

This study is intended
off, I'd like to ask you

Demographics/User C

Can you tell me what p
to the cleaners?

When else? Are there
How regular is that? I
What kinds of clothes

How often do you we

Do you go to the dry

Associations

Describe the ways in
dry cleaners.

What do you look for

What associations do

Have you ever been c

Dry Cleaning Process

I'd like to know what
in a step-by-step fashi
off, until you pick the

After your clothes are

What did you tell them in response? – or – What would you tell them if asked?

(if employee) Has your management or owner ever talked to you about health or environmental concerns or had specific training?

(if owner) Have you ever talked to your employees about health or environmental concerns or given specific training?

(both, if so) What was said/taught?

Based on what your knowledge of the industry and concerns that have been raised, how do you think that the dry cleaning industry might be different in five to ten years? or will it be essentially unchanged?

Are there specific changes that you would like to see? from regulators? vendors? clothing manufacturers? customers? dry cleaning organizations?

Appendix 2. Customer Interview Protocol

This study is intended to identify what people know about dry cleaning. So, to start off, I'd like to ask you a few questions about your dry cleaning habits.

Demographics/User Categorization

Can you tell me what prompts you to take clothes which are supposed to be dry cleaned to the cleaners?

When else? Are there special times that you go during the year?

How regular is that? How often?

What kinds of clothes do you take there? Any others?

How often do you wear clothes that are dry cleaned?

Do you go to the dry cleaner for other services? Tailoring? Laundering?

Associations

Describe the ways in which your clothes are different when they come back from the dry cleaners.

What do you look for to assess their performance?

What associations do you have with clothing that has just been dry cleaned?

Have you ever been dissatisfied or changed dry cleaners? What prompted that?

Dry Cleaning Process

I'd like to know what people know about the dry cleaning process, so walk me through in a step-by-step fashion, what you think happens from the time you drop your clothes off, until you pick them up.

After your clothes are ready, how long is it usually before you pick them up?

How long do you usually have to wait when you're in the store to pick things up?

What do you do with your clothes after you pick them up? How do you handle them?

Once you get them home?

How do you think the dry cleaning process works? How does the dry cleaner actually clean your clothes?

How are the chemicals contacted with the clothing?

Do you know anything about the machine used?

Do you know anything about the cleaning materials used?

If you had to guess, what do you think might be going on?

Perchloroethylene Exposure

Do you know of any concerns that people have expressed about dry cleaning?

Environmental concerns?

Safety concerns?

Health concerns?

What do you think about these concerns?

How would you rate these risks on a scale of 1 to 10 with 1 being little or no concern and 10 being a very serious concern?

Have you ever done anything because you were concerned about any of these effects? What kinds of actions do you think you could take if you had any concerns?

What kinds of actions do you think that the dry cleaner could take?

Have you ever noticed a smell that is associated with dry cleaning or dry cleaned clothes? – or – You mentioned that you noticed a smell associated with dry cleaning . . .

How would you describe the smell?

When do you notice the smell? In what places?

Do you know what causes that smell?

Do you know kinds of activities might create it; spread it?

Again, if someone were to raise health concerns about the chemicals used in dry cleaning, who do you think should be especially concerned? Who might be most at risk

Perceptions of perchloro.

or especially sensitive?

What is the name of you

Is it a drop-off store wh
at the same location as

If your normal cleaner i
their cleaning on-site? a

pick things up?

or especially sensitive?

do you handle them?

What is the name of your normal dry cleaner? _____

dry cleaner actually

Is it a drop-off store where the clothes are sent out to be cleaned or are they cleaned at the same location as the drop off store?

If your normal cleaner is a drop-off store, have you ever been to a cleaner that does their cleaning on-site? and how long ago was that?

dry cleaning?

little or no concern

any of these effects?
concerns?

;

dry cleaned clothes?
cleaning ...

chemicals used in dry
might be most at risk