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Dangerous Decor: Consumer Knowledge of Health Risks within Interior Spaces

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DANGEROUS DÉCOR: CONSUMER KNOWLEDGE OF HEALTH RISKS WITHIN INTERIOR SPACES

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ABSTRACT

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by Kaitlin E. Keith

Interior décor is an ever-present part of people's daily lives. The furnishings and finishes with which people surround themselves are part of their personal expression, but these components in people's homes and work spaces can negatively affect their health. Products such as furniture and paints can contain harmful chemicals, including volatile organic compounds (VOCs) so toxic they are pollutants regulated by the U.S. Environmental Protection Agency. With the rise in the "green" movement, healthy and environmentally safe alternatives such as low or zero-VOC paints are becoming more available. This study assessed how aware consumers and design professionals are of environmentally safe products, especially paints low in toxic VOCs. A survey was administered to 160 randomly chosen consumers at four Kelly-Moore retail paint stores in San Jose, California, to determine public awareness of and willingness to purchase low-VOC paints. In addition, 27 design professionals from interior design and architecture firms in San Jose were surveyed to assess their knowledge of and willingness to recommend healthy and environmentally safe products to their clients. The findings of this study provide insight into the factors that promote or hinder the use of healthy home furnishing products by the public and design professionals as well as provide suggestions for promoting the purchase of "green" products.

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Motivation

Anthropogenic toxins and waste are slowly poisoning this planet. The evidence is visible through global warming, polluted rivers, the increased number of endangered species, declining forests, and the swell in natural disasters. Humans are exceeding the earth's ability to support massive amounts of consumption and assimilate the waste. It is estimated that in the year 2050, 8.9 billion people will inhabit the earth (Townsend, 2003). According to the Global Footprint Network (2010), humans currently use the equivalent of 1.5 planets to supply resources and absorb waste. Overuse of these capabilities throw the earth into global overshoot (Global Footprint Network, 2010). This overshoot leads to collapsing fisheries, diminishing forests, depletion of fresh water systems, a build-up of pollution, resource conflicts, war, famine, and disease (Global Footprint Network, 2010). Unfortunately, the earth is headed in that direction. One theory explaining why people continue to over exploit the earth's resources is that environmental issues, from global warming to even toxins in our homes, are abstract, invisible, and distant to the general public (Meijnders, Midden, & Wilke, 1995).

Environmental problems are becoming very prominent. There is a move toward sustainable living and "green" products. This has been motivated by multiple factors, most recently and notably recognized by efforts in American entertainment, literature, and manufacturing. Laurie David's (2006) documentary

An Inconvenient Truth, featuring Al Gore, summarizes the current state of the earth and growing rate of global warming, which has gained a lot of attention amongst Gore's political peers, celebrities, and, consequently, the general public. The green movement has also been embraced in literature. William McDonough, an author and architect, co-wrote *Cradle to Cradle: Remaking the Way We Make Things,* which examines different strategies to encourage humans to fuse healthy living and the environment (McDonough & Braungart, 2002). McDonough has spoken at several conferences including the Technology, Entertainment, Design (TED) conferences and West Coast Green focusing on sustainable design efforts. Manufacturing may be the most visible advance in the green movement through technology-based progress such as hybrid vehicles. Toyota sold 12,190 hybrid vehicles in 2010, an increase of 11.2% over the previous year (Toyota USA Newsroom, 2010). In addition, the increased availability of organic food options at most grocery stores, the growth in eco-fashion options, and the manufacturing of non-toxic retail options such as Clorox Green Works cleaning products have become commonplace in the retail market. Green Works was introduced in 2008 and has made a major impact on American green consumerism by grossing $40 million in their first year of sales (DeBare, 2008).

However, scientific studies have shown that chemicals within standard, commonly used products, such as standard paint products, indoor materials, carpet finishes, plastics, and indoor activities related to those materials, are a risk to human health (Mendell, 2007). Chemicals used in buildings are a major

source of daily chemical exposure for Americans and a source of health problems such as asthma, pulmonary infections, allergies, temporary irritation of the nose, eyes, throat, headaches, dizziness, fatigue, and cancer (Mendell, 2007; Sharpe, 2004). In an effort to improve the earth's current state and human health, there are more non-toxic products available to consumers. But the extent to which consumers are aware of the health risks of many household products or aware of alternatives is not well studied. The degree of professional design knowledge and action regarding toxic home items is also understudied. This study takes a step toward filling that gap.

Background

The building industry consumes numerous natural resources and creates copious waste. Resources are not often recycled or reused, and generally the leftover "waste" and products are sent to a landfill. In addition to these detrimental aspects of building construction, many chemicals included in construction of residential, commercial, and industrial spaces give off dangerous toxins through "off-gassing." Toxins such as formaldehyde are found in standard paint products; finishes for wood, roofing supplies, and insulation components; and many other items used on the interior of buildings. These materials are harmful both to the inhabitants of the buildings and to general air quality. With the emergence of the green building industry in the United States, many people are becoming more aware of the deeper issues related to building and design.

In the interior design industry, consumers find out about products on their own or take advice from professionals as to what to place in their homes, offices, and other spaces. Paints are a ubiquitous part of interior decoration. In 2005, the US paint and coatings industry sold approximately 1.57 billion gallons of paint and coating products, amounting to roughly $20 billion worth of materials (American Coatings Association, 2010). The American Coatings Association (2010) states that 82% of architectural coating sales are environmentally preferable water-based paint. This information is encouraging; however, at this time there are no estimates of the number of gallons this represents. It is clear that the low or zero-VOC market is growing as most major paint companies offer both standard and environmentally friendly options.

VOCs, or volatile organic compounds, are hazardous chemicals such as formaldehyde, plasticizers, pigments, solvents, resins, and drying oils found in paint products, which are controlled in outdoor air by the U.S. Environmental Protection Agency (EPA) (EPA, n.d.; Hu & Hornbuckle, 2009). The Clean Air Act prohibits the EPA from controlling indoor air quality in households; thus, it does not regulate household items (EPA, 2008). The EPA's responsibilities under Title IV of the Superfund Amendments and Reauthorization Act are to research and to disperse information to the public (EPA, 2008). It would be difficult for the EPA to standardize indoor air quality and household chemical products because it does not have the authority to gather information on chemical components of products on the market (EPA, 2008).

Inhaling VOCs can cause minor and/or major health problems. Levels of VOCs are 2-5 times higher indoors than outdoors (EPA, 2010). During painting as well as afterwards, levels of VOCs are up to a 1,000 times higher than outdoor levels (EPA, 2010). Consumers can now avoid this hazardous compound by buying low or no-VOC paints, unless they are unaware of the non-toxic options or do not understand the severity of using standard paints. Some consumers purchase paint on their own, while others consult with design professionals.

When researching potential product purchases consumers look for ways that manufacturers communicate components of products and health risks associated with them. For example, paint companies use Materials Safety Data Sheets (MSDS), which outline the name of the product, manufacturer identification information, reportable contents (the physical and chemical characteristics), fire and explosion cautions, reactivity data, health hazard data, emergency and first aid procedures, precautions for safe handling and use, control measures, and a disclaimer (Material Safety Data Sheet [MSDS], 2010). Consumers can sometimes find MSDSs in stores, otherwise they must find them online or request them from the manufacturer. Manufacturers also communicate important information regarding products through labels and tags that generally include the name, ingredients, usages, and warnings. More specifically, any chemicals known to the state of California that contains cancer-causing agents must be listed under Proposition 65 on the product. Literature such as pamphlets and brochures are usually available for items as well as online

websites with similar information. Newspapers, books, papers sources, media and entertainment, the internet, and word of mouth are also popular sources for consumer information gathering.

As experts in design and related materials and finishes, design professionals have significant influence on what products are used in homes and buildings. Research suggests that, increasingly, consumers are choosing environmentally friendly products that are safer for people and the environment. From 1994-2003, sales of environmentally preferable water-based architectural coating paint increased from 76% to 82% (EPA, n.d.). However, little research has been conducted on whether health and environmental concerns are criteria people use for choosing interior décor. Since paint is such a common interior product and consumers have a readily available environmentally friendly, non-toxic option in low-VOC paints, this product can act as a gauge of consumer and industry professional knowledge and purchasing behavior with respect to VOCs and interior design décor.

For this research, a survey of consumers and industry professionals assessed the extent of their knowledge of health hazards in household furnishings (in particular paints), the importance of these chemicals in the home setting, and related purchasing behaviors.

Chapter 2: Literature Review

Risk Literature and Environmental Education

Environmentally harmful activities pose a risk to nature and, inevitably, to human health. The scale of personal importance of those risks determines behavior. Plough and Krimsky (1987) define risk communication as "any public or private communication that informs individuals about the existence, nature, form, severity, or acceptability of risks" (p. 6). To communicate the risk of an environmental issue, an assessment of that situation must be completed. Risk assessment is used to estimate potential harm or danger to an individual from a particular situation such as exposure to a toxic chemical (Cox, 2010). Technical risk communication translates technical data to the public in terms they can easily understand usually through numerical data with the intention of educating a target audience (Cox, 2010). Consequently, risk management is implementation of actual steps to reduce the danger to the public and the environment (Cox, 2010). Risk management can be difficult to communicate, especially regarding certain environmental threats not readily noticeable in everyday lives. For example, many toxic chemicals are invisible and their effects on people are delayed; thus, people rarely notice such toxins in everyday lives (Cox, 2010).

Risk can act as a gauge of level of importance to a particular person and situation. Risk literature supports that people are more easily mobilized against large infrequent risks rather than low-level everyday risk. According to Spangler

(1984), people identify risks through personal experience, memory, and other factors, which might ignore the probability of a particular event actually occurring. For instance, shark attacks are a risk the general public overestimates due to the media attention and personal reactions to the event (Botterill & Mazur, 2004). People may feel more of a threat from shark attacks (infrequent risks) versus inhaling VOCs on a daily basis. The visible physical and emotional damage related to shark attacks may seem scarier than breathing invisible pollutants daily. People also have a level of risk where they feel comfortable and they adjust their risky behavior if safety measures are present (Botterill & Mazur, 2004). Unfortunately, people's opinions related to a particular risk are difficult to change (Covello, von Winterfeldt, & Slovic, 1984; MacCrimmon & Wehrung, 1986). Thus, changing opinions, much less behavior, regarding everyday VOC exposure may be difficult.

Consumer risk relative to certain events or activities is closely linked to education. "The ultimate aim of education is to shape human behavior" (Hungerford & Volk, 1990, p. 8). Hungerford and Volk (1990) explain the traditional definition of environmental education (EE) as the ability to change behavior through educating humans about the environment and related issues. Hands-on activities, relevant subject matter, and topics that engage students and encourage involvement are educational methods fundamental to EE (Riordan & Klein, 2010). Environmental education includes these elements: awareness, sensitivity, attitudes, skills, and participation. Hungerford and Volk (1990) define

these terms. Awareness is used to assist social groups and individuals in becoming conscious and sympathetic to the environment and its problems. Sensitivity assists social groups and individuals in experiencing and understanding the environment and its associated issues. Attitudes help social groups and individuals gain values and concern for the environment in addition to motivating people to actively partake in environmental protective and restorative measures. Skills help social groups and individuals obtain the ability to identify and solve environmental issues. Finally, participation encourages social groups and individuals to be actively involved in working to solve environmental problems. In essence, environmental education aims to encourage pro-environmental behaviors from people (Darner, 2009; Hungerford & Volk, 1990). Research has assumed that there is a relationship between knowledge, attitudes, behavioral intentions, and actual behaviors (Darner, 2009; Hines, Hungerford, & Tomera, 1987; Hungerford & Volk, 1990; Ramsey & Rickson, 1976). Such research has examined multiple psychological variables thought to influence pro-environmental behaviors; however, a consensus has not been reached on the best model for predicting what influences result in pro-environmental actions (Cottrell & Graefe, 1997; Darner, 2009; Hines et al., 1987).

One of the most obvious sources for EE is school. Children and adults can and should be educated about the environment in a school setting. At the university level, students can earn a degree in Environmental Studies which is largely focused on EE. EE in the classroom setting is heavily dependent on the

educator. Riordan and Klien's (2010) study of professional development in EE revealed teachers should be supported in their EE practices and encourage their students to participate in active investigations of real problems as opposed to abstract ones with a focus on problem solving and decision-making. The bottom line being, professional development in EE should inspire curiosity, participation, and be practice-based (Riordan & Klien, 2010). EE programs nationwide are successfully integrating student interest and participation, for example, through political activism, environmental action, and recycling and restoration programs (Paterson, 2010). Such integration can be applied to design education for professionals through measures such as conferences.

Another factor influencing consumer behavior is the source of information. According to Cox (2010), environmental communication (EC) mediates our understanding of the environment, through multiple sources, such as popular culture, news, scientific reports, films, and political debates, which each have their own opinions and attitudes about environmental issues. Wagner (2008) states that one of the most common sources of environmental information for the public comes from the news sources, which do not relay objective information but a bias presentation of events and issues from the perspective of reporters, editors, and selected sources. This bias results in a poor relay of information which consequently impacts action. EC aims to provide the facts and remove a bias as much as possible. Cox (2010) defines environmental communication as an action that is practical, educates, alerts, persuades, mobilizes, and helps

people solve environmental problems. EC is used as a way to problem solve and debate and is generally part of public education campaigns. Cox (2007) advocates that environmental communication seeks to improve how the general public responds to environmental signs relative to the health of humans and the earth.

People gain knowledge about environmental issues, such as toxins in the home, through many different sources. Importance and meaning is then decided upon. Knowledge and importance can be deciding factors for how and if they interact with the environment. The Life-World Approach proposed by Finger (1994) focuses on information, knowledge, and learning play for an individual. Theoretically, people create meaning related to certain events from their own life and experiences. Meaning is always socio-cultural and collective in nature, which determines how people approach a specified issue or problem (Finger, 1994). Three other significant building blocks of the Life-World Approach are significant life experiences, worldviews, and behavior (Finger, 1994). According to this approach, significant life experiences related to the environment, key elements of one's worldviews, the meaning nature has for the individual, and environmental information and knowledge acquisition are the key building blocks of a person's life-world (Finger, 1994). Finger (1994) found two types of learners, "change learners" and "awareness learners" (p. 146). Change learners are exposed to environmental issues and problems at a young age and environmental information is considered another form of political activism for

them (Finger, 1994). Change learners search for environmental information and knowledge because they "want to change society" (p. 146). Awareness learners said they have been sensitized to environmental issues through the media and usually an environmental catastrophe played a large role in becoming aware (Finger, 1994). Environmental learning is a way to become knowledgeable and learn how to live within the limits of an environment. Finger (1994) suggests environmental learning is a way to cope with the fears and anxieties of a natural catastrophe that occurred earlier in their lives. Interestingly, awareness learners are not especially socially active and have minimal change in their everyday behavior (Finger, 1994).

Consumer Knowledge and Awareness

Since the inception of the U.S. citizens' environmental knowledge survey in 1992, the National Environmental Education and Training Foundation (1999) found that individuals who have little knowledge of the environment and ecosystems are less likely to report pro-environmental attitudes or to have engaged in environmentally responsible behaviors. A survey of California residents reported that individuals were more likely to engage in positive environmental actions, including water conservation, if they knew about environmental issues and believed that these problems could personally affect them (Baldassare & Katz, 1992). The Awareness-Appraisal Model suggests that many people do not respond to negative life events or change their actions because they are not aware of these events' impact on them; thus, the

importance of action is not present (Forsyth, Garcia, Zyzniewski, Story, & Kerr, 2004). The model also suggests that awareness alone is not enough for individuals to take action; they must believe there is a significant risk associated with the environmental problem. Risk assessment and proper EE are two important factors in determining the significance of an issue. Awareness-Appraisal uses four factors to determine intention, appraisal, importance, behavioral intentions, and knowledge (Forsyth et al., 2004).

Barr and Gilg (2006) also found that environmental behavior can be changed by enhancing knowledge and awareness about environmental problems. The result of this new knowledge encourages individuals to change their consumption behavior. Consumer knowledge assessment is comprised of two factors: objective knowledge and self-assessed knowledge (Park, Mothersbaugh, & Feick, 1994). Park et al. (1994) defines objective knowledge "as accurate information about the product stored in long-term memory" (p. 71). Self-assessed knowledge is defined as "people's perception of what they know or how much they know about a product" (p. 71). Park et al. (1994) states, "knowledge assessment is viewed as a judgment process in which individuals scan their memory for cues that help them evaluate their own level of product-class knowledge" (p. 72). Features associated with the memory scan include, but is not limited to, product attributes and features, usage procedures, and brand names (Park et al., 1994). Memory of relationships between the self and the product in terms of information search, product usage, and purchase

experience is another way for individuals to judge a product class. For example, consumers might infer that since they have used a certain product many times, or spent a lot of time searching for information, they are knowledgeable about the product (Park et al., 1994). Nisbett & Ross (1980) state, “personal experiences with products may also lead to an increase in perceived validity of information and an increase in the personal relevance of the information” (as cited in Park et al., 1994 p. 73).

Environmental Action

The literature suggests a model that can determine if a person is likely to be involved with environmental action. The Environmental Citizenship Behavior Model is a version of environmental education research developed by Hines et al. (1987). Responsible environmental behavior is the steppingstone towards the environmental citizenship behavior model. Responsible environmental behavior is comprised of attitudes, locus of control, personal responsibility, action skills, knowledge of action strategies, knowledge of issues, and personality factors (Hines et al., 1987). The model argues a person must possess three categories of variables – entry-level variables, ownership, and empowerment variables – to express environmental citizenship behavior. Entry-level variables enhance a person’s decision making through an empathetic perspective toward the environment (environmental sensitivity), variables associated with psychologically androgynous individuals active in helping resolve environmental issues (androgyny), ecological knowledge, and attitudes towards general

concerns such as pollution/technology/economics. Ownership variables make environmental issues extremely personal through in-depth knowledge of crucial issues which, makes people more likely to become responsible citizens and personally invested. In other words, the individual identifies strongly with the issue because he/she might have personal interest in it. Lastly, empowerment variables give humans a sense that they can make a change and help resolve environmental issues through environmental action strategies, knowledge of environmental action strategies, locus of control (a person will/will not be reinforced for doing/not doing something), and intention to act (Hungerford & Volk, 1990).

Psychological and cultural factors influencing eco-friendly behavior are key determinants of which people or groups actually purchase healthy and environmentally friendly products. Chan (2001) outlines the top determinants for consumers as a value-attitude-behavior hierarchy using the environment (ecological knowledge), attitude (ecological affect), commitment level (verbal commitment or intention), and what commitment they do make (actual commitment) as measures. Studies have found that increased ecological knowledge as been linked to increased ecological behavior (Park et al., 1994), however, adverse results have also been found in the research (Arbuthnot & Lingg, 1975; Geller, 1981; Schahn & Holzer, 1990). Chan (2001) suggests that "ecological knowledge might act as a mediating variable for ecological attitudes and behavior" (p. 394). Determinants of environmental consciousness are very

different from ecological knowledge factors. Ecological knowledge factors determine people's knowledge of the environment (Chan, 2001) whereas environmental consciousness is influenced by two sets of determinants: external determinants (media, family, culture) and extrinsic determinants (demographics and psychological variables) (Mida, 2009).

Pro-environmental attitudes, for residents of the United States, stand in stark contrast to actual environmental engagement. Even though Americans generally express very positive attitudes about the environment, very few are highly engaged in activities that protect and sustain the environment. According to Fridgen (1994), the American mindset is that environment threats will not personally affect them. Krause (1993) believes that American culture lacks in environmental consciousness. His data revealed that environmental consciousness varies very little between individuals with distinct demographic characteristics (ethnicity, income, and gender). Therefore, a divide lies somewhere between consciousness and behavior. That factor may be knowledge. For example, knowledge of harsh chemicals and their consequences could motivate modifications of purchasing behavior. That topic has yet to be studied in depth.

Interior Design and Typical Pollutants

People spend roughly 90% of their time indoors (Sharpe, 2004). Indoor air pollution, specifically in residential spaces, comes from five main sources.

1. Combustion systems such as oil, gas, and kerosene appliances, coal, or wood stoves release carbon monoxide and nitrogen oxides.

2. Building materials and furnishings are a source of pollution such as asbestos from damaged or older insulation, formaldehyde from pressed wood products, and biological agents from damp structural components and furnishings.
3. Household cleaning products, pesticides, paints, air fresheners, and dry-cleaned clothing can all off-gas organic chemicals.
4. Central heating and cooling systems are a source of ozone and VOCs.
5. Outdoor sources such as radon, pesticides, and other contaminants find their way into the home through leaks and on shoes and pets among other means. (Sharpe, 2004, p. 46)

A number of groups are particularly susceptible to the hazards associated with indoor air pollution, including pregnant women, the elderly, and children. Elderly people tend to spend more of their time indoors which leaves them constantly inhaling contaminated air (Sharpe, 2004). Children are vulnerable to indoor air pollution because they are continually physically developing and have higher breathing rates than adults (Sharpe, 2004). Studies have shown the following health conditions associated with painting or renovations: wheezing (Diez et al., 2000, 2003; Emenius et al., 2004a; Jaakkola, Ieromnimon, & Jaakkola, 2006), obstructive bronchitis (Diez et al., 2003), pulmonary infection (Diez et al., 2000), and allergies and asthma (Mendell, 2007).

Buildings in the United States are likely to contain dozens of chemicals and pesticides, some of which have been identified as endocrine-disrupting compounds (Betts, 2003). Many people may be regularly exposed to dangerous levels of toxic substances due to the contents of their furnishings. New furniture and new wall coverings have been found to be associated with increased allergies (Jaakkola et al., 2006). For example, textile wall covering research was linked to bronchial obstruction (Oie, Nafstad, Botten, Magnus, & Jaakkola, 1999).

Volatile organic compounds (VOCs) are a common component of interior paint as well as some household furniture. VOCs include any compound of carbon excluding carbon monoxide, carbon dioxide, carbonic acid, metallic carbides or carbonates, and ammonium carbonate that partake in photochemical reactions (EPA, 2010). VOCs can be 1. very volatile, 2. volatile, and 3. semi volatile. Examples include 1. propane, butane, 2. formaldehyde, acetone, 3. fire retardants, and phthalates (EPA, 2010). The U.S. EPA controls outdoor air quality and consequently has set VOC standards for outdoor air but does not have authority for indoor, non-industrial spaces (EPA, 2010). The U.S. Occupational Safety and Hazard Administration (OSHA) regulates formaldehyde and has mandated a permissible exposure level (PEL) of 0.75 parts per million (ppm) and the U.S. Department of Housing and Urban Development (HUD) has founded a level of 0.4 ppm for mobile homes (EPA, 2010).

In the past, consumers have been notified of the consequences of a few harsh chemicals previously used in structural elements of homes, such as lead paint. Heavy media attention and highly publicized health consequences of living in lead contaminated spaces has made the public very aware of this toxin. For example, the Ad Council facilitated the lead poisoning prevention public service announcements, the lead prevention website, designated a 1-800 phone number for the public to access information, supports television, radio, print, web banners, outdoor ads, and press releases that inform the public of the hazards of lead, and provides sponsoring agencies and their contact information. The

sponsors are the Environmental Protection Agency, U.S. Department of Housing and Urban Development, and the Coalition To End Childhood Lead Poisoning (Ad Council, n.d.).

In addition, the Lead Safe Practices Law was passed in 2010, which requires mandatory testing by licensed, certified professionals working on residential structures, child care centers, and schools built prior to 1978 (EPA, 2011). If material, such as walls or floors, are disturbed, a certified lead examiner must determine if there is lead present in any paint or other building materials in a home. If lead is present, lead-safe practices must be used by all trades working on the home, and every contractor must have the Lead Safe Practices Certification from the EPA (EPA, 2011). However, very little attention has been given to other indoor components, such as paint and furniture, which are health hazards as well.

Volatile Organic Compounds (VOCs)

The U.S. Environmental Protection Agency states volatile organic compounds are chemical compounds derived from carbon that participate in atmospheric reactions which release organic chemicals from certain solids or liquids in gas form (EPA, 2010). Building finishing and furnishing materials may emit large amounts of volatile organic compounds (VOCs) into the indoor air especially with warmer temperatures (Kim & Kim, 2005). The amount of gas emitted is dependent on the amount of the organic chemical being used and if it has been regulated by the EPA. For example, if the whole interior of a 1600

square foot home is painted in one day there will be a more significant chance of inhaling VOCs and becoming ill rather than if one wall in the home was painted. If the space is not properly ventilated, the probability of being affected by VOCs increases. Emissions are generally highest from newer materials such as recently applied paints and finishes. VOC levels reduce over time; thus, newly built homes and buildings as well as their contents are a larger threat than older ones (Dales, Liu, Wheeler, & Gilbert, 2008).

Paint is a very common interior design product that off-gasses VOCs due to its chemical components which include pigments, solvents, resins, and additives (Peterson, 1993). Latex (water-based) and alkyd (oil-based) paints are the most common types of paint (Scelo et al., 2009). The main difference between latex and alkyd paints is that the majority of the liquid portion of latex paint is water whereas a combination of toxins such as petroleum distillates and other organic solvents like toluene and xylene are found in oil-based paints. Latex paints are the more common type used for the interior and exterior of homes (Hu & Hornbuckle, 2009). Due to the added chemicals in alkyd based paint, they off-gas larger amounts of volatile organic compounds than water-based paints (Greene, 2000). Paint thinners, used to dilute and clean paint, also include VOCs such as toluene, acetone, methyl ethyl ketone, and methyl isobutyl ketone (Saito & Ikeda, 1988). Toluene is a potential neurotoxin and exposure has been linked to cardiac arrest in rare cases (Cronk, Barkley, & Farrell, 1985). Shakeel et al. (2007) reported a case of multi-organ toxicity and death following

acute unintentional inhalation of paint thinner fumes. An 18-year-old male in Ahmedabad, India was admitted to the emergency room where he suffered from drowsiness due to short-term exposure to numerous solvent VOCs. Over 11 days, the patient suffered central nervous system damage followed by multi-organ failure and ultimately death (Shakeel et al., 2007).

Polybrominated diphenyl ethers (PBDEs) have typically been used as flame retardants in upholstered furniture, textiles, carpets, mattresses, children's pajamas, and electronics (Zota, Ruthann, Rudel, Frosch, & Brody, 2008; EPA 2010). The flame retardant agents generally are not internally chemically bound to the material, which results in the release of the PBDEs into indoor environments via volatilization in the form of dust particles (Zota et al., 2008). Dust can then easily be inhaled or touched and transferred to people (Wilford, Shoeib, Harner, Zhu, & Jones, 2005). PBDEs have been detected in human blood and tissue, marine mammals, and sediments (She et al., 2002; EPA 2010).

The level of PBDEs in Californian's bodies are found to be two times higher than other regions within the United States which may be a result of more stringent furniture flammability standards imposed by the state (Zota et al., 2008). Three major PBDE commercial mixtures commonly used in consumer products are deca-BDE, octa-BDE, and penta-BDE (Agency for Toxic Substances and Disease Registry [ATSDR], 2004). Penta-BDEs generally are used in furniture products when mixed into polyurethane foam whereas octa-BDE and deca-BDEs

are used in electronics and other plastic products (Hale, Alaee, Manchester-Neevig, Stapelton, & Ikonomou, 2003).

Yang (2010) reported a study led by researchers at UC Berkeley that examined the link between pregnant women, thyroid hormone disruption, and PBDEs in their systems. Pregnant women need normal thyroid hormone levels because they are responsible for normal fetal growth and brain development (Yang, 2010). Chevrier et al. (2010) tested thyroid-stimulating hormone (TSH) for PBDE content, a pollutant found in the fat cells of 97% of US residents.

Studies in mice exposed to PBDEs as newborns revealed that PBDEs caused learning and motor deficits that continue to deteriorate as the mice grew older (Eriksson, Viberg, Jakobsson, Orn, & Fredriksson, 1999). Developing fetuses and infants are especially susceptible to small changes in thyroid hormone disruption (Glinoer, 1997). PBDEs have also been found to be carcinogenic in rodent studies (McDonald, 2001). The side effects of the above chemicals have been strong enough that the European Union banned the use of penta-BDEs and octa-BDEs in 2003. The United States followed suit in 2004 with 11 states including California, eliminating the use of penta-BDEs and octa-BDEs (Zota et al., 2008). Unfortunately, there is a large amount of PBDEs already in the public and the replacement time for products previously manufactured with penta- and octa-BDEs such as sofas and mattresses is slow which suggests that substantial long-term exposure will remain for some time (Harrad & Diamond, 2006).

Crown and Brown (1981) found that when some upholstered fabrics are labeled as flame retardant, this attribute is judged more important by consumers than price, care instructions, or feel of the fabric. This information demonstrates that consumers are uninformed of the consequences of the chemicals within the fire-safe furniture. Although it is important to incorporate elements that will help minimize fire risk, using toxins that have such significant health implications, is counterintuitive. Arlene Blum (as cited in Betts, 2008), a biophysical chemist and visiting scholar at University of California, Berkeley has said, “So many of the chemicals we have banned in the past were flame retardants—think about asbestos, polychlorinated biphenyls, polybrominated biphenyls, tris (2,3-dibromopropyl) phosphate, PBDEs—[and] they all ended up in the environment and in people” (p. A211).

Formaldehyde is a common VOC found in many interior features. Formaldehyde is a suspected human carcinogen notorious for being released from pressed-wood products used in home products made with urea-formaldehyde resins such as particleboard, hardwood plywood, medium density fiberboard, and paneling (Kim & Kim, 2005). Other sources include cigarette smoke, certain paints, varnishes, and floor finishes (International Programme on Chemical Safety, 2008). Due to formaldehyde’s potential health implications, the Occupational Safety and Health Administration regulated an 8-hour time-weighted average of 0.75 ppm for the legal standard for maximum exposure to formaldehyde in the workplace (Manuel, 1999). Formaldehyde is an irritant to

the conjunctiva and upper and lower respiratory tract and has been found to cause nasal cancer in animal testing (Manuel, 1999). Additional symptoms are burning/tingling in the eyes, nose, and throat, chest tightening, and wheezing (Manuel, 1999). In 1987, the Environmental Protection Agency listed formaldehyde as a probable human carcinogen (Manuel, 1999). Formaldehyde continues to permeate consumer products in various forms and amounts.

Purchasing Decisions

Consumers are not often notified of the chemicals included in furniture products. Instead, it is up to the shopper to ask sales representatives or take the time to independently research contents of items. Tags on furniture products rarely include chemicals incorporated in the manufacturing process; rather, the eco-friendly aspects and main components such as wood or metal are provided. Conversely, VOCs are labeled on paint cans in scientific terms. The average person cannot identify words such as benzene or toluene as harmful chemicals. Paint cans are labeled with the components of paint in addition to advertising the lead warning, Proposition 65 warning, and irritant warnings.

Chapter 3: Problem Statement

Interior design products, such as paint and furniture, are extremely common in every inhabited interior space. Standard paint can have high levels of VOCs but is also available as low- or zero-VOC at most paint stores. Although the market has expanded to include low- or zero-VOC paints in major name brand stores, the sale of these paints seems lower than that of standard paints. It is evident by the fact that standard paints are still on the market. For the public, having chemicals in the home is assessed by the perception of risk related to these chemicals. The importance of having them in and around the home is judged by how threatening they feel these items are to themselves and their loved ones. The importance factor is directly related to the knowledge level of the consumer. People use many different sources of information and multiple criteria to make their purchasing decisions. Education on chemicals and VOCs is directly proportional to purchasing habits. It is unknown how important VOCS are to consumers, and how knowledgeable consumers are or how they purchase with respect to VOCs. However, it is suspected that a sensitive population of female consumers with children will be particularly knowledgeable and susceptible to the risks of these chemicals and act in favor of healthier options.

In this study, industry professionals are considered experts by the mere fact that they deal with these materials and finishes on a daily basis as well as in their personal lives. Knowledge of various products and the ability to specify sound, aesthetically pleasing options to clients is a large part of their job. To the

extent design professionals are broadly educated on chemicals in various indoor components is not known, particularly with regard to their knowledge of toxins in paint and furnishings. To the extent designers inform their clients of chemical information is also not known. This study assumes that design professionals find it important to keep chemicals out of the home setting, that they are fairly knowledgeable on this topic, and that their purchasing behaviors are reflected in both their specifications for clients and their personal lives. This study examined the importance, knowledge, and purchasing decisions of consumers and industry professionals (architects and interior designers) in San Jose, California with respect to paint and furniture, in general.

Research Questions

Research questions specific to consumers and designers were examined. The questions for the consumers were:

1. How important is it to the public to have toxic-free items in their homes?
2. How knowledgeable is the public about VOCs?
3. What factors hinder or promote chemical-free purchasing behavior?

The three designer questions were:

1. How important is it to design professionals to tell clients about toxins in household items?
2. How knowledgeable are industry professionals of toxins in furnishings?

3. What factors are promoting or hindering designers' use of such products? What factors do designers believe are promoting or hindering the public's use of such products?

The above questions are the central focus of this thesis research.

Hypotheses

In addition to addressing the research questions, this research tested the following hypotheses:

H1: Age, gender, ethnicity, education, income, marital status, and children will not be factors in whether people say they will buy toxic-free products.

H2: Females with children in San Jose are not more knowledgeable of chemicals in paint products and are not more likely to buy low-VOC or non-VOC paints in comparison to consumers in general.

H3: Design professionals are not more informed of the health hazards of VOCs than the general public.

H4: Design professionals informed about VOCs are not more likely to purchase low- or no-VOC paints than consumers informed about VOCs.

Chapter 4: Methods

Data Collection

Random samples of 160 consumers, 40 people from each of four Kelly-Moore paint stores, were surveyed in San Jose, California, from July 24-August 28, 2010. The locations surveyed were De Anza Boulevard, Alum Rock, Blossom Hill, and Bascom in San Jose, California. Consumer surveys were collected on Saturdays and/or Sundays between 9 a.m. and 5 p.m. Kelly-Moore is a paint company originating in San Carlos, California in the late 1940s and has since expanded to serve not only California, but the majority of the west coast as well as parts of the mid-west (Kelly Moore Paints, 2011). A pilot study was conducted at the Bascom location on July 16, 2010; 11 surveys were completed and the survey was finalized based on pilot study results. The pilot study data was not used in analyses.

Only people who were not painting contractors and were painting their own home or living space were included in the survey. Consumers meeting these criteria were invited to fill out a survey asking for demographic information, knowledge level of health threats posed by typical paints and toxic products, the importance of those products within the home and their related purchasing behavior (see Appendix A).

To collect data from interior designers, 39 interior design and architecture firms in San Jose, California were given surveys, delivered by hand or emailed. The professionals were surveyed about the dangers posed by chemicals, such

as VOCs, their knowledge level of different products that are healthier, and whether they inform their clients of harmful chemicals and healthier alternatives (see Appendix B).

Specific survey questions for both consumers and designers were used to answer each research question (see Table 1). The hypotheses were analyzed using the consumers' and design professionals' survey responses (see Table 2). Female designers with children were not included in Hypothesis 2 nor were males.

Table 1

Consumer and Designer Research Questions and Corresponding Survey Questions

	Research Question	Survey Questions
I. Consumers		
	RQ1: How important is it to the public to have toxic free items in their homes?	1. What is the most important factor to you when buying an interior product such as paint?
		3. How important is it to you to have items in your home such as cleaning products that are chemical-free?
		10. Have you ever intentionally bought an item that was low in toxicity?
		11. If #10's answer was yes, where and what did you buy?
	RQ2: How knowledgeable is the public about VOCs?	2. What sources do you rely on the most heavily for information about potential purchases?
		5. Do you know what volatile organic compounds (VOCs) are?

Table 1 continued

	Research Question	Survey Questions
I. Consumers		
	RQ2: How knowledgeable is the public about VOCs?	6. Where did you first learn about VOCs?
		8. How harmful do you believe breathing VOCs are?
		9. VOCs are harmful to people because:
	RQ3: What factors hinder or promote chemical-free purchasing behavior?	4. What would deter you from purchasing an item with toxic compounds in it?
		7. Are you thinking about buying a low-VOC or zero-VOC paint today?
		12. Have you ever had personal experience with negative chemical reactions related to manufactured products?
		14. If you knew there were serious potential health consequences of owning and using products that contain VOCs, would that be enough to change your purchasing behavior regardless of cost?
		15. Do you think children are more likely to be harmed by pollutants such as VOCs in comparison to adults?
		16. Is indoor air quality significantly worse from a health standpoint than outdoor air quality?
II. Design Professionals		
	RQ1: How important is it to design professionals to tell clients about toxins in household items?	7. How personally responsible do you feel to inform clients about chemical that can be found in the home setting and offering safer alternatives?

Table 1 continued

	Research Question	Survey Questions
II. Design Professionals		
	RQ1: How important is it to design professionals to tell clients about toxins in household items?	14. When recommending furnishings and décor to your clients, how often do you recommend sustainable non-toxic items?
	RQ2: How knowledgeable are industry professionals of toxins in furnishings?	8. Polybrominated Diphenyl ethers (PBDEs) are a:
		9. Formaldehyde is found in:
		13. How informed are the average clients regarding materials and finishes containing health threatening substances such as paint containing VOCs?
		17a. Do you think individuals are aware of green/non-toxic interior products but are not buying them?
	RQ3: What factors are promoting or hindering the use of designer's use of such products? In their professional opinion, what is promoting or hindering the public's use of such products?	15. Are your clients asking for green/non-toxic furnishings? Why do you think they are or are not? Compared to other green items such as solar panels, what do you think the public's level of awareness is about green/non-toxic interior products and furnishings?
		16. Do you see a difference in purchasing choices with respect to green/non-toxic interior products such as paints, based on your client type-individual, corporate, or government?
		17b. If so, what reasons do your clients give for buying conventional versus green products?
		18. What do you think it would take to make buying environmentally friendly and non-toxic interior furnishings a common factor in people's choices?

Table 2

Consumer and Designer Hypotheses and Corresponding Survey Questions

Hypothesis	Survey Questions
H1. Age, gender, ethnicity, education, income, marital status, and children will not be factors in whether people say they will buy toxic-free products	**Consumers:** Age Gender Ethnicity Education Average Income Marital Status Children
	10. Have you ever intentionally bought an item that was low in toxicity?
	13b. Over the next month are you likely to buy alternatives?
H2. Females with children in San Jose are not more knowledgeable of chemicals in paint products and are not more likely to buy low-VOC or non-VOC paints in comparison to consumers in general.	**Consumers:** 5. Do you know what volatile organic compounds (VOCs) are?
	7. Are you thinking about buying a low-VOC or zero-VOC paint today? If yes, why? If no, why?
	13b. Over the next month are you likely to do the following: buy alternatives to VOCs?
H3. Design professionals are not more Informed of the health hazards of VOCs than the general public.	**Consumers:** 5. Do you know what volatile organic compounds (VOCs) are?
	6. Where did you first learn about VOCs?
	8. How harmful do you believe breathing VOCs are?
	9. VOCs are harmful to people because:
	Designers: 3. How harmful do you believe breathing VOCs are?

Table 2 continued

Hypothesis	Survey Questions
H3. Design professionals are not more informed of the health hazards of VOCs than the general public.	8. Polybrominated diphenyl ethers (PBDEs) are a:
	9. Formaldehyde is found in:
	10. Where did you first learn about VOCs?
H4. Design professionals informed about VOCs are not more likely to purchase low- or no-VOC paints than consumers informed about VOCs.	**Consumers:** 14. If you knew there were serious potential health consequences of owning and using products that contain VOCs, would that be enough to change your purchasing behavior regardless of cost?
	Designers: 2. Do you personally buy low-VOC or zero-VOC paint?
	6. Have you had personal experience with negative chemical reactions related to manufactured products?
	11. If you knew there were serious potential health consequences of owning and using products that contain VOCs, would that be enough to change your specifications for clients regardless of cost?

Data Analysis

Descriptive statistics were used to display demographic findings for both groups and to qualitatively assess responses to open-ended survey questions (consumers: 7, 11, 12, and professionals: 2, 6, 12, 13, 15, 16, 17, 18) that asked participants about purchasing behaviors. The designer's survey used multiple open-ended questions to assess personal purchasing choices and opinions on where the industry currently stands regarding knowledge and purchasing of green/non-toxic items among clientele. Such questions were coded and frequencies were run to determine which factors were most prevalent amongst the respondents. Findings from the tests were used for both consumers and designers for research questions and hypotheses.

An independent samples *t*-Test was used to compare VOC knowledge level of the designers and consumers in Hypothesis 3.

Chi-squared Cross-Tabulations were used to evaluate research questions 1, 2, and 3, pertinent to consumers. This test determined the importance of toxic-free items in the home, the knowledge level of the public, and the factors that hinder or promote pro-environmental behaviors. This test was also used to analyze how knowledgeable designers were of toxins in furnishings, and was used to address all four hypotheses.

Frequencies supplemented chi-squared tests in all three consumer research questions. Frequencies were used for the professional's research questions 1, 2, and 3. This helped to determine consumer knowledge of VOCs,

designer responsibility to inform clients of toxins, designer knowledge of toxins, and factors that hinder or promote the design industry and public's purchasing behavior. Frequencies were used on questions that were only asked of one of the sample populations to determine the average, median, and mean.

Chapter 5: Results

All 160 consumer surveys were used, but consumers did not necessarily answer every question on the survey. Of 39 design and architecture firms queried, 27 returned the survey (69%). Demographic results are presented in Table 3.

Table 3

Consumer and Design Professional Demographics

Demographic	Consumer	Design Professional
Female/Male	40.5%-Female 59.5%-Male n = 158	48.1%-Female 51.9%-Male n = 27
Age	30.7%-44-56 n = 114	42.3%-44-56 n = 26
Ethnicity	57.5%-Caucasian/White 22.2%-Asian 13.7%-Hispanic n = 153	76.9%-Caucasian/White 19.2%-Asian 3.8%-Hispanic n = 26
Education	38%-Bachelor's Degree 24%-Masters/PhD 14.7%-High School 13.3%-Associates 7.3%-Technical/Specialized n = 150	73.1%-Bachelor's Degree 7.7%-Masters/PhD 0%-High School 15.4%-Associates 3.8%-Technical/Specialized n = 26
Average Income	58.4%-$86,000+ 21.9%-$56,000-$85,000 13.1%-$25,000-$55,000 n = 137	57.1%-$86,000+ 14.3%-$56,000-$85,000 23.8%-$25,000-$55,000 n = 21
Marital Status	73%-Married n = 152	65.4%-Married n = 26
Family Size	33.8%-Children who are now adults 29.6%-No children n = 142	19.2%-Children who are now adults 46.2%-No children n = 26

Age was the only factor significant in determining if consumers would be likely to buy toxic-free products following the month the survey was completed (χ^2 = 9.781; df = 4; n = 80; p = 0.044; Table 3 #13b). However, Table 4 shows chi-square results for the influence of demographics on questions 10 and 13b, which were found to not be significant.

Table 4

Consumer Demographics of Past and Future Purchasing Behavior

Survey Question	χ^2	df	N	p
10. Have you ever intentionally bought an item that was low in toxicity?				
Gender	0.029	1	146	0.865
Age	5.166	4	104	0.271
Ethnicity	4.804	4	141	0.308
Education	3.7949	5	140	0.568
Income	3.066	3	127	0.382
Marital status	2.458	3	140	0.483
Family size	5.823	8	130	0.667
13b. Over the next month are you likely to buy alternatives?				
Gender	0.018	1	111	0.893
Age	9.781	4	80	0.044
Ethnicity	3.065	4	108	0.547
Education	7.232	5	106	0.204
Income	1.152	3	96	0.765
Marital status	3.003	3	107	0.391
Family size	7.451	8	99	0.489

Consumers

When asked how important it was to have chemical-free items in their homes, 69.4% of consumers said it was important or extremely important. Almost 50% of consumers said they intentionally bought an item low in toxicity (50.7% said no and 49.3% said yes). Products bought included non-toxic termite, pesticide, and gardening products such as Orange Planet; paint products (primer, enamel, interior paint, automotive paint); wood; cleaning products; detergents and soaps; organic food; carpets; insulation; and sunscreens and shampoos.

Five questions assessed consumer knowledge of VOCs. The majority of consumers (56.1%) did not know what a volatile organic compound was, 44.4% of consumers did not know how harmful VOCs are to humans, and 50% of consumers did not know why VOCs are harmful to people.

Thirty-five percent of consumers said they relied on word of mouth for information about potential purchases. Consumers cited newspaper/books/paper sources at 29.7% for where they first learned about VOCs, the subsequent answers are presented in Table 5. Approximately 92% of the public believed that children are more likely to be harmed by pollutants rather than adults, and 79.2% knew that indoor air quality is significantly worse from a health standpoint than outdoor air quality. But 87.5% said they had never had a negative personal experience linked to manufactured products.

Table 5

Consumers (n = 74) and Design Professionals (n = 27) Information Sources

6. /10. Where did you first learn about VOCs?	Consumer	Design Professional
Newspaper/books/paper sources	29.7%	7.4%
Television	14.9%	3.7%
Internet	14.9%	29.6%
Word of Mouth: Family/Friends/Colleagues	8.1%	0%
Trade Shows/Conferences	0%	37%
Other	9.5%	22.2%
School	12.2%	0%
Work	10.8%	0%

Questions that assessed factors promoting or hindering consumer choices regarding non-toxic products showed that when buying an interior product such as paint, 41% selected quality as the most important factor to them and only 1.9% selected the environment, the lowest category, as the most important factor to them (see Table 6). Also 65.4% of consumers said they would be deterred from buying items with toxic compounds in them if they knew those compounds were harmful to their health, their children's health, their significant other's health, their pet's health, and/or the environment's health (see Table 7). Finally, 84.1% stated they would change their purchasing behavior if they knew there were serious potential health consequences of owning and using products containing VOCs.

Table 6

Consumer Purchasing Factors (n = 156)

1. What is the most important factor to you when buying an interior product such as paint?	Chi-squared Cross Tabs Percentage
Quality	41%
Choose more than one answer:	16.7%
a. Cost and Quality	5.1%
b. Durability and Quality	4.5%
c. Quality and the Environment	2.6%
Durability	11.5%
Cost	6.4%
Aesthetics	5.8%
Health Components	4.5%
Environment	1.9%

A large majority of consumers (77.7%) said they were not purchasing low-VOC paint the day they took the survey. Of people purchasing paint on the survey day, reasons given for not purchasing low- or zero-VOC paint were: they did not know what they were, it was not important or a consideration for them, they were using the purchased paint for outdoor projects or to touch up existing paint, cost, and it was inferior to standard paints. People who were buying environmentally friendly paint said their reasons for this purchase was because of the low environmental impact, health reasons, it is the right thing to do, it is better for the overall environment and people, small kids would be in the painting area, and the smell of standard paint is foul. Some of the negative experiences consumers had due to manufactured products with chemicals included respiratory issues, headaches, dizziness, nausea, renal failure, allergies, skin irritations/rashes, breathing problems, and blacking out.

Table 7

Consumer (n =159) and Designer (n = 27) Toxic Deterrents

4. /5. What would deter you from purchasing an item with toxic compounds in it?	Consumers	Designers
My own health	6.3%	3.7%
My children's health	8.8%	3.7%
My significant other's health	1.3%	0%
My pet's health	.6%	0%
It's better for the environment	5%	88.9%
All of the above	65.4%	0%
None of the above	3.1%	0%
Other-picked more than one answer	9.4%	3.7%

Women with children were asked if they were likely to buy low-VOC paint compared to consumers, in general. Of females with children, 55.7% (54/97) did not know what a VOC was. Of female consumers with children, 97.7% stated they knew children were more likely to be harmed by VOCs than adults. Significantly more female consumers with children, compared to the general consumer, believed children could be harmed by VOCs ($\chi^2 = 7.376$; df = 1; n = 126; p = 0.0067). In addition, 84.6% of females with children said they would change their behavior if they knew VOCs were harmful to their health. Women with children were not more likely to say they would purchase low-VOC paint than the general public ($\chi^2 = 0.595$; df = 1; n =127; p = 0.440). Of the 24 women with children who said they were going to buy paint that day and knew what VOCs were, only 29% (7/24) said they would be purchasing low-VOC paint. While 33.3% of all the other respondents (males and female designers) replied yes to thinking about purchasing low-VOC paint. The most prominent reasons

for purchasing low-VOC paints included health concerns, pets, their grandchildren would be in the painted space, and it is better for the environment. The women with children who knew what VOCs were but said no to buying low-VOC paint said they were touching up old paint, it was not important to them, and they wanted durability.

Design Professionals

Designers were asked a series of questions that assessed how responsible they felt to inform clients regarding toxins found in the home setting and if they recommended avoiding those hazards. Fifty-nine percent of professionals said they felt responsible or very responsible for informing their clients, and 51.9% of the designers sometimes recommended sustainable non-toxic items for their spaces. Thirty-seven percent of them felt neutral about specifying safer alternatives, and 29.6% said they always provided environmental and human-friendly choices.

With respect to whether people in the industry were aware of two major VOCs, formaldehyde and polybrominated diphenyl (PBDEs), 63% of the sample did not know what a PBDE was and where it could be found. But 65.4% knew that formaldehyde is found in wood products, resins, and lacquers. Thirty-seven percent of professionals learned about VOCs at trade shows or conferences while 29.6% found information about VOCs on the internet. Designers believed clients were mildly informed of the health threatening substances in materials and finishes at 26.9% (see Table 8). Forty percent of interior designers and

architects thought individuals were not buying interior products because they were not aware of the issue or the products available.

Table 8

Professional Opinion on Client Knowledge (n = 26)

13. How informed are the average clients regarding materials and finishes containing health threatening substances such as paint containing VOCs?	Frequency Percentile
Very informed	15.4%
Somewhat informed	23.1%
Little knowledge on the topic	26.9%
No knowledge on the topic	11.5%
It varies	7.7%
Aware but do not care	15.4%

For 88.9% of professionals questioned, environmental impact was a factor that would deter them from purchasing products with chemicals (see Table 7). In addition, 74.1% of designers and architects said they personally purchase low-VOC paints because they believed it is healthier, it is for the good of all, indoor air quality concerns, health, the smell is repulsive, it makes them sick, they do not want their children exposed, and because he/she is a Certified Green Builder. Reasons against purchasing non-toxic paint was the cost differential and not being informed. Professionals who said they had negative chemical reactions related to manufactured products said they experienced asthma, skin reactions, headaches, and allergies.

Lastly, designers said, on average, 45% of their clients sometimes ask for green/non-toxic furnishings. The top reason consumers do not ask for such products, according to 42.1% of designers is that people are not educated (see

Table 9). However, 57.9% saw a difference in purchasing choices and green items between individual, corporate, or government clients. And 63.2% gave cost as a reason for clients buying conventional items over sustainable ones (see Table 10). Subsequently, 55.6% of designers believed a combination of education, awareness through media, cost reduction, time, and government regulation would help make non-toxic interior furnishings a common factor in people's choices.

Table 9

Design Client Requests (n = 19)

15. Are your clients asking for green/non toxic furnishings?	**Frequency Percentile**
Yes	25%
No	25%
Sometimes	45%
Other	5%
Why do you think they are or are not asking for green options?	
Cost	31.6%
Uneducated	42.1%
Do not care	5.3%
Required by CA legislation	5.3%
Corporate Responsibility	10.5%
Other	5.3%

Table 10

Design Clientele Reasons for Not Purchasing Green Items (n = 19)

17. What reasons do your clients give for buying conventional items versus green products?	Frequency Percentile
Cost	63.2%
Style/Options	15.8%
Price and Style	10.5%
Price and Durability	10.5%

Consumer vs. Design Professional Comparisons

The majority of professionals (65.4%) were cognizant of what formaldehyde is and where it can be found, while they were less familiar with PBDEs (37%). Approximately 44% of consumers knew what a VOC is. Only 13.7% of consumers knew VOCs were very harmful to human health and 14.8% of design professionals knew they were very harmful (see Table 11). Approximately 24.2% of consumers and 37% of professionals said VOCs are very harmful or harmful, a significant difference (Table 11; $\chi^2 = 22.648$; df = 4; N = 180; p = 0.000). Fifty percent of consumers did not know specifically how VOCs affect humans while 30.7% knew they were an airway irritant, cause motor deficits, and are a possible human carcinogen. Designers learned about some types of VOCs at trade shows and conferences (10/27) while the public became aware through newspaper/books/paper sources (22/74) and designers were significantly more knowledgeable than consumers about how harmful VOCs are to breath in (t = 4.065; df = 178; p = .000). However, overlapping questions were

not asked of both groups regarding their knowledge of VOCs; thus, there was not a comparable statistical test between the two.

Table 11

Consumers (n = 153) and Designers (n = 27) Opinion of VOC Harms

8. /3. How harmful do you believe breathing VOCs are?	**Consumers**	**Design Professionals**
Very harmful	13.7%	14.8%
Harmful	10.5%	22.2%
Somewhat Harmful	29.4%	63%
Not harmful	2%	0%
I do not know	44.4%	0%

The great majority of consumers (82.5%) and designers (92.6%) said they would change their purchasing choices if they knew the risks posed by VOCs, not a significant difference (χ^2 = 1.747; df= 1; n = 187; p= 0.186).

Chapter 6: Discussion

This study supports existing theory and data that education is a key factor in whether people take environmental action or not. Overall, designers were more informed than the public and more often took action. Although the public is concerned about health and environmental impacts of toxins, lack of information may be hindering action.

Consumers

The findings of this study suggest a pattern to consumer behavior that revolves around environmental education. People care about health, environment, and children but are uneducated about health hazards associated with VOCs; thus, they do not take action. Theory on environmental education supports this pattern. The goal of environmental education (EE) is to shape human behavior. Elements of EE are awareness, sensitivity, attitudes, skills, and participation. It was evident consumers were uneducated on VOCs (56.1% did not know what VOCs were), and consequently they did not take action in their purchasing behaviors. Although approximately 70% of consumers responded that it was important to them to have toxic-free items in their homes, roughly half said they had never intentionally bought an item low in toxicity, and only approximately 22% said they were thinking about buying low-VOC paint the day they took the survey.

EE is based on the premise that people with reliable information will take action. Ninety-two percent of consumers said they thought VOCs were harmful

to children, and 83% said they would change their behavior if VOCs posed a risk to people and environment. To test the possibility of behavior change due to VOC-posed risk, consumer women with children, expected to be the most sensitive population to risks, were asked about their behavior. Female consumers with children were found not to be significantly more knowledgeable than the overall general public and were not more likely to purchase low-VOC paint than the overall general public. The Awareness-Appraisal model (Forsyth et al., 2004) states that people do not respond to negative life events because they are not aware of the impact of these events on them, and individuals must believe there is a significant environmental problem to take action. Based on this study's findings, one would expect at least 83% of females with children who were knowledgeable to buy low-VOC paints over conventional paints. However, only 29% of that population said they were going to buy low-VOC paint the day they took the survey. This points to a lack of information making a lasting impact on purchasers.

Reliable sources for finding correct information about VOCs are important to expand the public's knowledge. Word of mouth was the primary form of environmental communication regarding potential purchases for the consumers surveyed. Newspapers/books/paper were the primary sources by which they learned about VOCs. Wagner (2010) cited that the news is a common source of environment-information gathering. This finding is in accordance with the definition of awareness learners in the Life-World Approach (Finger, 1994).

Awareness learners have been sensitized to environmental issues through the media, and usually an environmental catastrophe played a large role in becoming aware. Awareness learners are not socially very active and have minimal change in their everyday behavior (Finger, 1994). As Wagner (2010) suggests, the news is not an objective presentation of information, which may downplay or incorrectly present data.

People, even mothers with children, are not taking actions to avoid toxic paints. This may be because the public's information on VOCs is faulty, incomplete, or inconsistent. Environmental communication is a form of education that should be unbiased as well as properly researched so the public can form their own attitudes and opinions on VOCs. Unfortunately, 60% of the consumer population said they would not research VOCs in the month following completion of their survey, which in turn will limit the expansion of their knowledge base. With the majority of the public finding their information through unreliable sources, in addition to not researching on their own, this issue becomes unimportant in their daily lives. Without proper knowledge of these chemicals, the public cannot connect how VOCs affect their own health or the environment.

In contrast, design professionals get more accurate information, more often and, unlike the public, take action. While only 33% of the public said they were buying low-VOC paints, 70+% of designers said they do. This is a huge difference in behavior. Factors hindering or promoting the purchasing of chemical-free items can be associated with risk communication. Consumers and

designers are taking the risk of not purchasing healthier products because they are uneducated of the risks VOCs pose. The public was found to say they would stop buying items with toxins if they knew there were serious health implications associated with them (84.1%). Cox (2010) suggests that certain environmental threats, the ones less obvious on a daily basis, are a challenge when it comes to relaying risk management.

The findings of this study support the idea that the public may not be connecting paint as a harmful pollutant. Indoor air quality can be a nebulous issue because people are unable to physically see oxygen and how pollution impacts their health. People reported health issues such as dizziness, nausea, and headaches associated with painting but none of them cited long-term illness such as cancer. The short-term negatives are clearly not a reason for the public to alter purchasing choices, and 87.5% of people reported never experiencing negative reactions to chemicals (that they were aware of). Unfortunately, VOCs could be associated with serious long-term health issues, but since it is an air pollutant the human eye is unable to see, the issue is not easily acknowledged.

Consumers also stated quality as the most important factor when buying an interior product such as paint, which implies that environmentally friendly items are not viewed to be as durable as conventional ones. Still, people are buying non-toxic products. Almost 50% of consumers said they intentionally bought an item that was low in toxicity, and the majority of the items recorded were non-toxic cleaning products.

Interestingly, all Kelly-Moore paint cans ranging from 29 fluid ounces to a gallon container contain warnings to people using paint. The lead warning is generally the largest font and the detrimental aspects are capitalized referencing children, pregnant women, and serious illness such as brain damage. The cans recommend wearing respirators when handling the paint, not internalizing paint, only using the product with adequate ventilation, and keeping it out of reach of children. California's proposition 65, which notifies the public of chemicals known to the state of California as cancer causing agents is also on the backside of cans in addition to the VOC content. For a standard latex paint gallon, VOC content is <50 g/L. For Kelly-Moore Enviro coat, the VOC content is 0 g/L. Other paint companies are mandated to post these warnings and some also specify that paint is an irritant that can affect the eyes, nose, and throat. All of the above information, as well as the directions for application, are in the 12-point font range. This information is either not getting through to people purchasing these products or they do not feel affected by these provisions.

Age was the only significant factor in whether people would be likely to buy toxic-free products. The literature supports that groups susceptible to hazards associated with indoor air pollution included age and pre-existing medical conditions (Sharpe, 2004). However, of the two questions posed for each demographic variable, only one of the two age-related questions was deemed significant. Therefore, although age was significant, it is minimal in determining pro-environmental purchasing behaviors. Gender, ethnicity,

education, income, marital status, and children were not significant factors among this sampled group.

Design Professionals

Although knowledgeable and taking action themselves, designers, as the findings of this study suggest, are not regularly educating clients or offering alternatives to conventional interior products. It was expected that design professionals would feel the need to educate clients of toxins found in the home setting and alternatives during the schematic and design phase of their projects. However, just over 29.6% said they always and often provided environmental and human friendly options while almost 70% said they felt fairly responsible to inform clients of chemicals found in the home setting.

There was a misconception among designers and consumers that the costs of environmentally friendly items were more expensive than standard products. However, a cost comparison of Kelly-Moore basic premium interior paint in Eggshell white (#1610) containing VOCs came to $44.84 per gallon including tax where as the Enviro coat premium interior paint in Eggshell white (#1510) came to $43.27 per gallon with tax. This is a difference of $1.57 in favor of purchasing low- or no-VOC paints. Perhaps design professionals do not specify eco-friendly design options for fear of losing business due to incorrect cost assumptions. Another reason could be designer's lack of VOC knowledge and confidence in presenting options currently on the market.

The environmental citizenship behavior model agrees with these results (Hines et al., 1986). Variables responsible for enhancing a person's decision-making are entry-level variables, ownership variables, and empowerment variables. All of the above contribute to whether individuals will take environmental action if presented with an environmental issue. Entry-level variables are relative to how much environmental sensitivity a person has; thus, if a designer does not wish to improve the state of the environment or have any concerns for issues such as pollution, then those attitudes will not be passed along to other colleagues in their firm or their clients. Ownership variables make environmental issues very personal as a result of education on the topic, and they are then more likely to invest personal action and interest in it such as owning a green design firm. The empowerment variables give people a sense that they can make a change using their skills. In this case that would be remodeling and/or new construction for clients solely focused on implementing greener choices. Since design professionals were not significantly more educated on toxins in interior spaces, they may not be informing clients because of their lack of knowledge on the topic.

It was expected that people in this industry would be significantly more informed of VOCs on a deeper level. Professionals were reasonably informed of formaldehyde (65.4%) and much less with PBDEs (37%). The professionals believe that at the time of the study, the majority of people in the industry are learning and beginning to use low- or zero-toxicity materials and finishes. With

their knowledge of VOCs coming from conferences and trade shows in addition to information found away from the work setting, one would assume the knowledge base would be higher than that of the average person. While knowledge is not much higher, personal action is. These findings support existing theory that knowledge, attitudes, behavioral intentions, and actual behaviors are relevant in determining pro-environmental actions (Darner, 2009; Hines et al., 1987; Hungerford & Volk, 1990; Ramsey & Rickson, 1976).

Not surprisingly, education was a major factor designers cited as a determinant of consumer behavior. This is a large deterrent for healthier purchasing choices. Professionals also stated cost differentials as a reason for clients choosing conventional items over sustainable ones. However, the healthier products are not always more expensive. For example, Kelly-Moore is making an effort to encourage their customers to purchase the “greener” option. Not all companies may price environmentally friendly choices at or below standard prices but it does show there are some available. The Home Depot website sells Yolo environmentally friendly paint for $35.95 a gallon prior to applying sales tax, while their standard interior paint ranges from $30-$35 a gallon (The Home Depot, 2010). Benjamin Moore sells AURA interior low-VOC paint for $61.99 a gallon before tax, the BEN brand low-VOC interior paint sells for $33.99 a gallon and their NATURA zero-VOC paint retail price is $50.99 a gallon (Benjamin Moore, 2011). Of the design portion, 74.1% personally

purchase low-VOC paints, and 70.4% said it is important or extremely important to have chemical-free items in their homes.

Designers were found to be slightly more informed than consumers about toxins in materials. It was expected that designers would have additional knowledge of VOCs as a direct result from receiving information in both the professional and personal realms. The exposure to different types of information through trade shows and educational conferences as well as personal media influences should lead them to be worried and more active about these chemicals in the environment. The professionals were reasonably informed of certain types of VOCs such as formaldehyde (65.4%) but not familiar with newer VOCs such as PBDEs (63%). Over 50% of consumers did not know what a VOC was. In comparison, designers knew what they were as well as specific types.

Chapter 7: Recommendations

Limitations and Future Research

The limitations of this study are based on the surveyed populations. The number of design professionals versus the consumers was vastly different (consumers: 160, professionals: 27). It would have been beneficial to have more professionals answer the survey, but it was difficult getting firms to respond. Additionally, there are not a large number of reputable firms within the parameters of San Jose, California. Another limitation is that some of the consumers who answered the survey did not fall into the target audience. Great lengths were taken to ensure that the majority of the respondents were people who were not in the painting industry and were going to actually paint and/or inhabit the space that was being painted. However, there were people purchasing paint for others who took the survey, such as landlords painting rental properties where they would spend minimal amounts of time and people who used to be in the painting industry.

A follow up study would help support the findings of this thesis. If this study were to be done again, it would be helpful if there were more identical questions on the survey and if they were numbered the same in both surveys. It would also be a benefit to make sure respondents only choose one of the answer options instead of choosing multiple answers per question. An assistant would help to cut down on data collection time as would a shorter survey.

Future field research, which could supplement the findings of this study, would be to focus solely on design professionals and to further examine how, where, and what their education levels are with VOCs, and how they bridge their home and work behaviors in relation to the environment. A future project for consumers could examine what low toxic items people buy and why. An investigation of chain paint stores and their environmentally friendly options for contractors and consumers (Benjamin Moore, Sherwin-Williams, and Glidden) could focus on the involvement of paint companies and environmental business choices. Lastly, it would be helpful to study people who live in environmentally efficient homes in contrast to people living in standard homes and the reasons why, cost comparisons, and health factors associated with their decisions.

Changing Behaviors

The public needs more information and better knowledge and to have it delivered in a way that gets their attention. Education opportunities for consumers would lie in an easily accessible media awareness campaign through a company such as the Ad Council. Examples are the Truth and Above The Influence campaigns put in place to present facts regarding consequences of smoking cigarettes and using drugs mostly via magazines and television. These campaigns reach a wide variety of age groups as well as provide visual images that link toxic substances and human health. For homeowners as well as consumers, Neighborhood Association Newsletters and Home Owners

Association meetings might also be a good tool to reach this population to further educate on toxins and VOCs.

Younger people learning about environmental education, VOCs in particular, in grammar school, high school, and college is beneficial because these people will be educated starting at a young age and hopefully will carry it on into their adulthood decision-making. Colleges and design schools are generally requiring students to take a couple of green building/design classes to be introduced to this developing field. It is also necessary for more education for parents. Presentations at PTA meetings could help parents associate these hazards to their children. Publishing articles in publications that focus on parenting, for instance, *Parenting on the Peninsula* and *Bay Area Parent*, might assist in informing this sensitive population.

Design professionals are educated, but need to bring that information to clients. Trade organizations such as the American Institute of Architects (AIA) and National Association of the Remodeling Industry (NARI) have continuing education units (CEU) necessary to maintain certain certifications, which could be done through classes, webinars, and media coverage on the subject of sustainable design. Other opportunities lie in the booths at Home Shows, through presentations and literature at these events. This might prompt the industry to bring more notoriety to this issue in addition to prompting further self-motivated education actions.

Another option would be to put a state title in place. CalGreen Code became effective in California January 1, 2011, and mandates that every new structure (state owned buildings, low-rise residential, elementary through high school institutions, historical buildings, and hospitals) incorporate a certain amount of green design features (California Building Standards Commission, 2010). These features include site development, energy efficiency, water efficiency and conservation, material conservation and resource efficiency, environmental quality, and installer/special inspector qualifications areas (California Building Standards Commission, 2010). Considering that many people opt to remodel their homes rather than build a brand new home, mandating new residential remodels to be under a similar Title would be extremely beneficial. Not only does this force design professionals to be up to date on green building standards, but it also requires homeowners to learn and understand these conditions. Implementing policy at a personal residential level could motivate education for this population. Education and policymaking are the cornerstones for making sustainable living and green design flourish among design professionals and consumers.

There is a disconnect in the current system between designers and their clients (consumers). Better education and policy regulations for each respective group would lead to more informed decision-making with regard to the design and building industry. This study offers information to consumers and design professionals as well as to environmental studies scholars and educators. It

also serves as an attempt to move forward in creating healthy, mindful, sustainable environments and lifestyles.

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APPENDIX A: Consumer Survey

Consumer Knowledge of Health Risks within Interior Spaces

Age: A. 18-30 B. 31-43 C. 44-56 D. 57-69 E. 70+
Gender: A. female B. male.
Ethnicity: A. White/Caucasian B. Asian C. Black D. Hispanic E. Other:_____.
Education Highest Degree Earned*:* A. high school B. associates (AA) C. technical or specialized D. bachelor's E. master's and/or PhD F. other: _____.
Average income**:** A. under $24,000 B. $25,000-$55,000 C. $56,000-$85,000 D. $86,000-$120,000+
Marital Status**:** A. single B. married C. divorced D. widowed E. other:_____.
Children**:** A. none B. infants C. young children D. teenagers E. adults.

1. ***What is the most important factor to you when buying an interior product such as paint?***

   A. cost
   B. durability
   C. quality
   D. aesthetics
   E. health components
   F. environment
   G. other: _____.

2. ***What sources do you rely on the most heavily for information about potential purchases?***

   A. newspaper/books/paper sources
   B. television
   C. word of mouth/friends/family
   D. internet
   E. other _____.

3. ***How important is it to you to have items in your home such as cleaning products that are chemical free?***

   A. extremely important
   B. important
   C. neither important nor unimportant
   D. not important
   E. I don't know.

4. ***What would deter you from purchasing an item with toxic compounds in it?***

   A. my own health
   B. my children's health
   C. my significant other's health
   D. my pet's health
   E. it's better for the environment
   F. all of the above
   G. none of the above.

5. ***Do you know what volatile organic compounds (VOCs) are?***

   A. yes
   B. no. If no, skip to # 7.

6. ***Where did you first learn about VOCs?***

   A. newspaper/books/paper sources
   B. television
   C. word of mouth: family/friends
   D. internet
   E. other:_____.

7. ***Are you thinking about buying a low VOC or zero VOC paint today?***

   A. yes. ***If yes, why?***

   _____.

   B. no. ***If no, why?***

   _____.

8. ***How harmful do you believe breathing VOCs are?***

   A. very harmful
   B. somewhat harmful
   C. harmful
   D. not harmful
   E. I don't know.

9. ***VOCs are harmful to people because:***

   A. they are an airway irritant
   B. cause motor deficits
   C. they are a possible human carcinogen
   D. all of the above (A-C)
   E. none of the above
   F. I don't know.

10. Have you ever intentionally bought an item that was low in toxicity?

A. yes B. no. ***If no, skip to # 12.***

11. If #10's answer was yes; WHERE and WHAT did you buy?

_____

_____.

12. Have you had personal experience with negative chemical reactions related to manufactured products?

A. yes. ***If yes, please explain.*** B. no

_____

_____.

13. Over the next month are you likely to do the following:

Research VOCS	A. yes	B. no
Buy alternatives to VOCs	A. yes	B. no

14. If you knew there were serious potential health consequences of owning and using products that contain VOCs would that be enough to change your purchasing behavior regardless of cost?

A. very likely D. unlikely

B. likely E. very unlikely

C. neutral

15. Do you think children are more likely to be harmed by pollutants such as VOCs in comparison to adults?

A. yes B. no

16. Is indoor air quality significantly worse from a health standpoint than outdoor air quality?

A. yes B. no.

17. Comments/Thoughts about chemical pollutants in your environment?

APPENDIX B: Interior Designer Survey

Consumer Knowledge of Health Risks within Interior Spaces

Age: A. 18-30 B. 31-43 C. 44-56 D. 57-69 E. 70+
Gender*:* A. female B. male.
Ethnicity*:* A. White/Caucasian B. Asian C. Black D. Hispanic E. Other:_____.
Education Highest Degree Earned: A. high school B. associates (AA) C. technical or specialized D. bachelor's E. master's and/or PhD F. other:_____.
Average income**:** A. under $24,000 B. $25,000-$55,000 C. $56,000-$85,000 D. $86,000-$120,000+
Marital Status**:** A. single B. married C. divorced D. widowed E. other:_____.
Children**:** A. none B. infants C. young children D. teenagers E. adults.
Please answer the following questions to the best of your ability.

PERSONAL OPINION

1. ***What sources do you rely on the most heavily for information about potential purchases?***

   A. newspaper/books/trade magazines
   B. trade shows/conferences
   C. internet
   D. colleagues
   E. other: _____.

2. ***Do you personally buy low-VOC or zero-VOC paint?***

   A. yes. ***If yes, why?***

   _____.

   B. no. ***If no, why?***

   _____.

3. ***How harmful do you believe breathing VOCs are?***

   A. very harmful
   B. somewhat harmful
   D. not harmful
   E. I don't know.

C. harmful

4. ***How important is it to you to have items in your home such as cleaning products that are chemical free?***

A. extremely important

B. important

C. neither important nor unimportant

D. not important

E. I don't know.

5. ***What would deter you from purchasing an item with toxic compounds in it (for your home)?***

A. my own health

B. my children's health

C. my significant other's health

D. my pet's health

E. all of the above

F. none of the above.

6. ***Have you had personal experience with negative chemical reactions related to manufactured products?***

A. yes ***If yes please explain*****.**

B. no

_____

_____.

PROFESSIONAL OPINION

7. ***How personally responsible do you feel to inform clients about chemicals that can be found in the home setting and offering safer alternatives?***

A. very responsible

B. responsible

C. neutral

D. not responsible

E. completely un-responsible

F. I don't know.

8. Polybrominated diphenyl ethers (PBDEs) are a:

A. cleaning agent

B. personal product preservative

C. chemical used as a fire retardant

D. insecticide chemical ingredient

E. I don't know.

9. Formaldehyde is found in:

A. resins

B. wood products such as particleboard

C. lacquers

D. all of the above (A-C)

E. none of the above

F. I don't know.

10. Where did you first learn about VOCs?

A. newspaper/books/paper sources

B. television

C. internet

D. word of mouth:family/friends/colleagues

E. trade shows/conferences

F. other _____.

11. If you knew there were serious potential health consequences of owning and using products that contain VOCs would that be enough to change your specifications for clients regardless of cost?

A. very likely

B. likely

C. neutral

D. unlikely

E. very unlikely.

12. In your opinion, where does the industry stand today in terms of using low or zero-toxicity materials and finishes?

_____

_____

_____.

13. How informed are the average clients regarding materials and

***finishes containing health threatening substances such as* paint containing VOCs?**

_____

_____

_____.

14. ***When recommending furnishings and décor to your clients, how often do you recommend sustainable non-*toxic items?**

A. always
B. sometimes
C. rarely
D. never
E. only when they request them
F. other_____.

15. ***Are your clients asking for green/non-toxic furnishings? Why do you think they are or are not? Compared to other green items such as solar panels, what do you think the public's level of awareness is about green/non-toxic interior products and furnishings?***

_____

_____

_____.

16. ***Do you see a difference in purchasing choices with respect to green/non-toxic interior products such as paints, based on your client type-individual, corporate, or government?***

_____

_____

_____.

17. ***Do you think individuals are aware of green/non-toxic interior products but are not buying them? If so, what reasons do your clients give for buying conventional versus green products?***

_____

_____

_____.

18. ***What do you think it would take to make buying environmentally friendly and non-toxic interior furnishings a common factor in people's choices?***

_____

_____

_____.