ETH zürich

Consumer Behavior

Intuitive Toxicology

Executive Summary (english)

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Abstract

From social science research, it is known that consumers consider other aspects than experts when judging risks. This can result in the risks of chemical household products being misjudged and consumers failing to protect themselves accordingly. To prevent accidents in Swiss households, it is therefore necessary to understand what knowledge consumers have, how they perceive and judge the risks of chemical household products and what behaviour they exhibit. These questions were investigated in four project phases within the "Intuitive Toxicology" project. In the four phases, different, innovative methods were used to gain insights into consumers' behaviour when purchasing and using chemical household products. The first phase, a representative survey in Switzerland, showed that consumers do not spontaneously think of risks, when they think of everyday household chemical products. However, the study also showed that consumers are aware of risks. The second phase involved the observation of consumers' behaviour in a virtual supermarket and in a virtual household. It was found that consumers are aware of and heed warnings on packaging, but only under certain circumstances (e.g., lack of familiarity with the product, high risk awareness). Otherwise, consumers tend to make decisions intuitively and based on possibly misleading attributes (e.g., claims, brands). In the third phase, the findings on Switzerland were placed in the European context within the framework of an online study in eight countries. This study revealed small differences (e.g., higher trust in regulation in Switzerland than in the other countries), but also similarities (e.g., different levels of awareness of the various GHS symbols). In the fourth, complementary phase, an online experiment was conducted to investigate which alternatives to chemical household products are known (e.g., home remedies, mechanical products) and under which conditions they are used by consumers. Overall, the project shows that providing information can lead to a higher awareness of possible accidents with chemical household products, which in turn can indeed contribute to the prevention of accidents in Swiss households. Other valuable prevention approaches are the regulation of the design of chemical household products and situational reminders or nudges. Overall, however, the project also emphasises the importance of personal responsibility on the part of consumers if certain preconditions are met (including the presence of warning labels, easy availability of risk and warning information, reduction of ambiguity in product design).

Introduction

The term "Intuitive Toxicology" was originally coined in a scientific article on the perception of toxicological principles by experts and laypeople (Kraus, Malmfors, & Slovic, 1992). This term expresses that laypeople are influenced by irrational aspects when assessing the danger of chemical substances. In a series of other surveys, this finding was also confirmed for other countries (Kajanne & Pirttilä-Backman, 1996; Kraus et al., 1992; MacGregor & Fleming, 1996; Slovic et al., 1995). Recent studies show that there are various misconceptions and gaps in knowledge about the hazards of chemical substances. For example, consumers underestimate the danger of ecological cleaning agents, while they tend to overestimate the danger of food additives (Bearth, Cousin, & Siegrist, 2014; Bearth, Miesler, & Siegrist, 2017; Scott, Rozin, & Small, 2020). Moreover, unlike experts, consumers distinguish between substances of natural and artificial origin; the preference for perceived naturalness in different consumer products has already been well documented in the literature (z.B. Bearth, Cousin, & Siegrist, 2016; Scott et al., 2020).

Consumers' knowledge and individual perceptions can have implications for the safe use of household chemical products. To prevent accidents, it is therefore necessary to understand how Swiss consumers perceive the dangers of chemical household products. The project focuses on three topics with regard to chemical household products (e.g., cleaning agents or detergents):

- **Consumer knowledge**, which includes the basic awareness of risks, the understanding of warnings and domain-specific knowledge.
- **Consumer perceptions**, which relate to specific household chemical products or product characteristics, or to individual aspects that influence consumer perceptions (risk perception, perceived barriers, or control).
- **Consumers' self-reported or observed behaviour**, which includes the purchase, storage, and handling of household chemical products.

To investigate these topics, four project phases were defined, combining different methodological approaches. Figure 1 presents an overview of the four project phases, their topics, and methods.

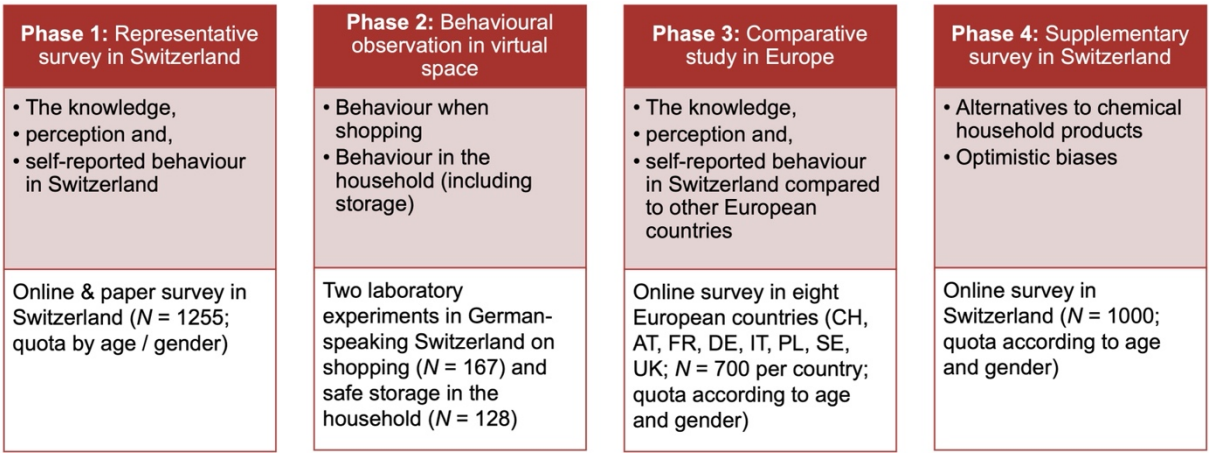

Figure 1. Overview of the four project phases (*N*: number of participants, CH: Switzerland, AT: Austria, FR: France, DE: Germany, IT: Italy, PL: Poland, SE: Sweden, UK: United Kingdom).

Phase 1: Representative survey in Switzerland

Phase 1 was used to explore the three topics of knowledge, perception, and behaviour for Switzerland. For this purpose, a written / online survey was conducted in German-, French- and Italian-speaking households. The sample was recruited via two professional market research providers. The sample comprised 1255 participants (773 German-speaking households, 295 French-speaking households, 187 Italian-speaking households). To achieve a sample that was as heterogeneous as possible, a quota design according to age and gender was applied. The key findings on consumers' knowledge, perception, and self-reported behaviour are listed below.

⇒ Consumers rarely spontaneously think of risks when confronted with various hazardous household chemical products (e.g., descaler, essential oil). Consumers more often mentioned the intended use of the product, the place of use, product properties, or specific products.

⇒ When consumers are explicitly reminded of possible accidents with chemical household products, they rate these accidents as similarly serious as experts. The awareness of possible poisonings is higher than the awareness of chemical burns.

⇒ The meaning of the GHS symbol "flammable" (GHS02) was more known to consumers (or was intuitively deduced) than the meaning of the GHS symbol "warning" (GHS07) and a fictitious symbol (cf. Figure 2).

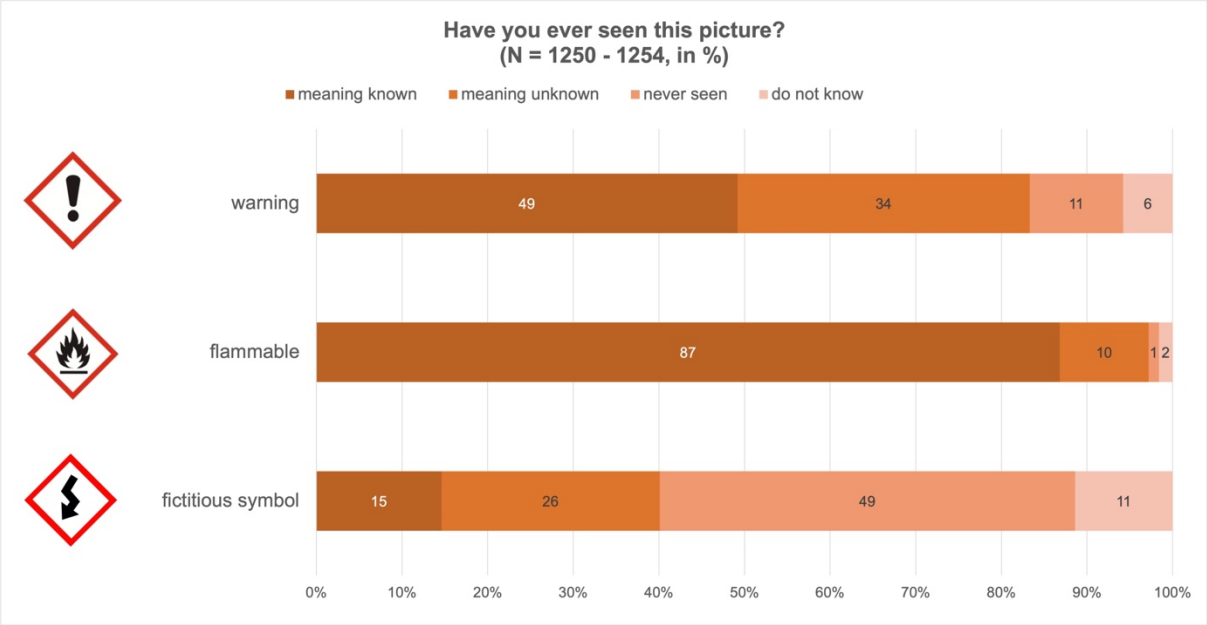

Figure 2. Awareness of selected GHS symbols (N = 1250-1254, data in %).

⇒ About one third of consumers did not find the risk and safety warnings on household chemicals to be excessive. Overall, however, participants are more concerned about the health of others than about their own health.

⇒ In addition to analytical factors (e.g., warning labels, domain-specific knowledge), potentially misleading factors (e.g., naturalness = safety) are also used by the consumers to assess the risk of household chemical products.

⇒ Consumers have a lack of risk awareness with regard to everyday household chemicals (e.g., laundry detergents) and household products that are perceived as natural (e.g., essential oil). Risk awareness is higher for specific, strong or effective chemical household products (e.g., drain cleaners, mould cleaners, descalers).

⇒ Many consumers overestimate the safety of their own behaviour compared to the general Swiss population (optimistic bias). Wearing protective equipment when using chemical household products (e.g., protective goggles or gloves) is accordingly not widespread.

Phase 2: Behavioural observation in Virtual Reality

The aim of phase 2 was to investigate how consumers behave in realistic situations. For this purpose, an innovative method of behavioural observation was chosen, as the self-report of behaviour has some limitations (e.g., response bias due to social desirability or memory gaps). In two laboratory experiments, participants were placed in a virtual shopping situation (laboratory experiment 1) and a household situation (laboratory experiment 2). Both the behaviour in the virtual space and the eye movements were recorded. In both laboratory experiments, people from the German-speaking part of Switzerland were recruited (laboratory experiment 1: $N = 167$; laboratory experiment 2: $N = 119$ people). After a test phase in which the participants could familiarise themselves with the environment, the experiment followed in the virtual supermarket or in the virtual apartment (cf. Figure 3).

Based on the findings from phase 1, it had to be assumed that the general population would generally pay little attention to warning labels. To be able to investigate the extent to which these warning labels are used to assess the risk of a chemical household product, it was necessary to make risks more salient. This was achieved in both laboratory experiments with the help of the scenario “children in the household.” In laboratory experiment 1, participants were asked to buy a detergent that was as safe as possible (risk group), a detergent that was as effective as possible (effectiveness group) or a detergent for themselves (control group). In laboratory experiment 2, participants were asked to childproof a virtual apartment with dangerous (e.g. toilet cleaner, essential oil, knife) and neutral interactive objects (e.g. toys, pillows).

Figure 3. Images of the virtual supermarket (laboratory experiment 1) and the virtual flat (laboratory experiment 2).

The key findings on the behaviour of consumers in a shopping and household situation are summarised below.

⇒ If consumers are asked to buy a household chemical that is as safe as possible, they spend more attention and time selecting products than if they are asked to buy an effective household chemical or one for themselves (e.g., they inspect more products, study the labels more closely).

⇒ To choose a safe product, consumers use the warning labels (especially the GHS symbol), but also non-risk relevant information (e.g., claims and advertising slogans, information on odour).

⇒ Most consumers (87%) put more than half of all hazardous objects out of reach of children in the virtual household (9 out of 18 items). Dangerous items were significantly more likely to be placed out of reach of children (12 out of 18 on average) than neutral items (2 out of 24 on average).

⇒ Three chemical household products were placed out of reach of children less often than others: the disinfectant, the fragrance lamp with essential oil and the dishwashing detergent (see Figure 4).

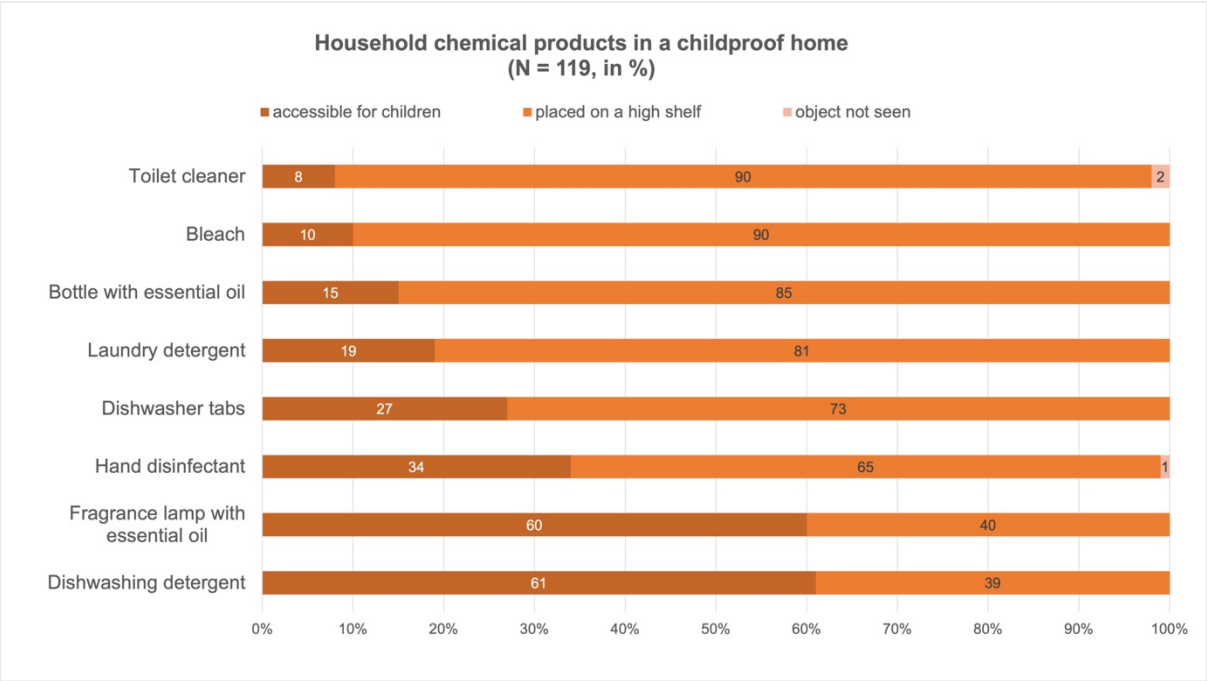

Figure 4. Handling of household chemical products in the childproof home (in %, N = 119).

⇒ Consumers inspected unknown products more closely before deciding (e.g., essential oil) than known products. Everyday and well-known chemical household products, such as detergents or toilet cleaners, were mostly put up without closer inspection.

⇒ Consumers said that they paid particular attention to the likelihood of an accident (e.g., whether the object was attractive for children to play with or could be swallowed), followed by the severity of an accident (e.g., how serious the injury or other consequences would be) and the type of item (e.g., intended use).

Phase 3: European comparative survey

Phase 3, the European comparative study, also focused on the three topics of knowledge, perception, and behaviour. Country-specific differences in knowledge (regarding GHS symbols), perception (risk perception, outcome expectancies, perceived control, trust) and the self-reported behaviour of consumers were investigated. Online surveys were conducted with consumers in eight European countries. The recruitment of participants was handled by a professional market research provider. The sample size was approximately 700 people per country. In Switzerland, German-, French- and Italian-speaking consumers were surveyed, while in the other countries only the main language was considered. In all countries, a quota design based on gender and age was applied. The questionnaire included question blocks on the topics of knowledge, perception, and behaviour

The key findings of the European comparative study are listed below.

⇒ Small to medium country-specific differences in the knowledge, perception and behaviour of consumers were found across the eight European countries.

⇒ Awareness of the symbol “flammable” (GHS02) is highest in all countries, while awareness of the symbol “systemic health hazards” (GHS08) is lowest (see Figure 5).

⇒ Consumers saw the responsibility for the safe use of household chemical products more with the manufacturer and the distributor than with themselves. This was particularly the case for Italian and French consumers.

⇒ Trust in the responsible authorities was highest in Switzerland compared to the other seven European countries.

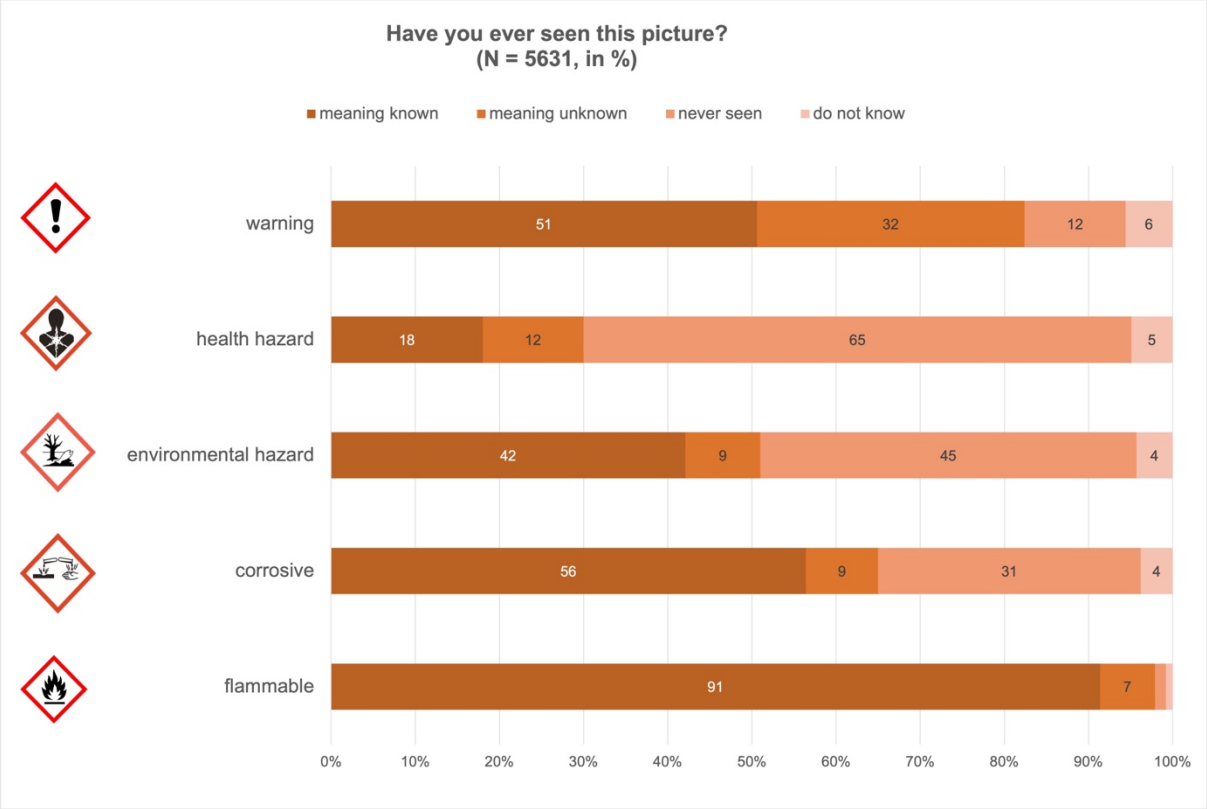

Figure 5. Awareness of warning symbols in the eight European countries (N = 5631).

Phase 4: Supplementary survey in Switzerland

Phase 4 was not part of the original research plan but was defined as an additional project phase towards the end of the project. The aim of this phase was to investigate two additional topics: 1) the awareness and use of alternatives to commercial household chemicals and 2) the optimistic bias in the assessment of one's own accident probability and behaviour. For this purpose, an online survey was conducted in German-, French- and Italian-speaking Swiss households. The participants were recruited via a professional market research provider. The sample comprised 996 participants (665 German-speaking households, 249 French-speaking households, 82 Italian-speaking households). Once again, gender and age were used in the quota design. The questionnaire included a short introduction and definition of household chemicals and questions on the two topics (alternatives, optimistic bias), as well as questions on socio-demographis. The survey also included a repeated-measures experiment to see if information provision could reduce the optimistic bias uncovered in phase 1. The information comprised a short section on the optimistic bias in two versions (experimental group EG 1: that people tend to underestimate the likelihood of an accident; experimental group EG 2: overestimate the safety of their own behaviour) and reported the annual cases of poisoning in Switzerland.

The following are the central findings on the topic “Alternatives to commercially available household chemicals.”

⇒ Acids, sodium bicarbonate, or soda were most frequently mentioned as alternatives to common chemical household products. Soaps or mechanical means (e.g., sponges, microfibre cloths, traps or fly swatters) were also frequently mentioned.

⇒ Consumers use alternatives especially when there is a specific problem (e.g., blocked drain, limescale) or when the alternative is perceived as comparably practical and effective.

⇒ Only a few consumers completely replace chemical household products with alternatives. Home remedies (e.g., vinegar or lemon acid, baking soda) are used more often than mechanical alternatives (e.g., traps, plunger).

The key findings on the topic “optimistic bias” are listed below.

⇒ Both before and after the provision of information, optimistic biases are evident in the assessments of one's own probability of an accident and one's own behaviour.

⇒ The provision of information had no significant effect on the assessment of the safety of one's own behaviour, but on the assessment of the probability of an accident in one's own household. A higher probability of having an accident was reported after the information provision (green and orange bars in Figure 6) than before (grey bar in Figure 6).

⇒ It can be seen in Figure 6, consumers more often chose the option “equally likely as in other Swiss households” after the information was provided than before the information was provided.

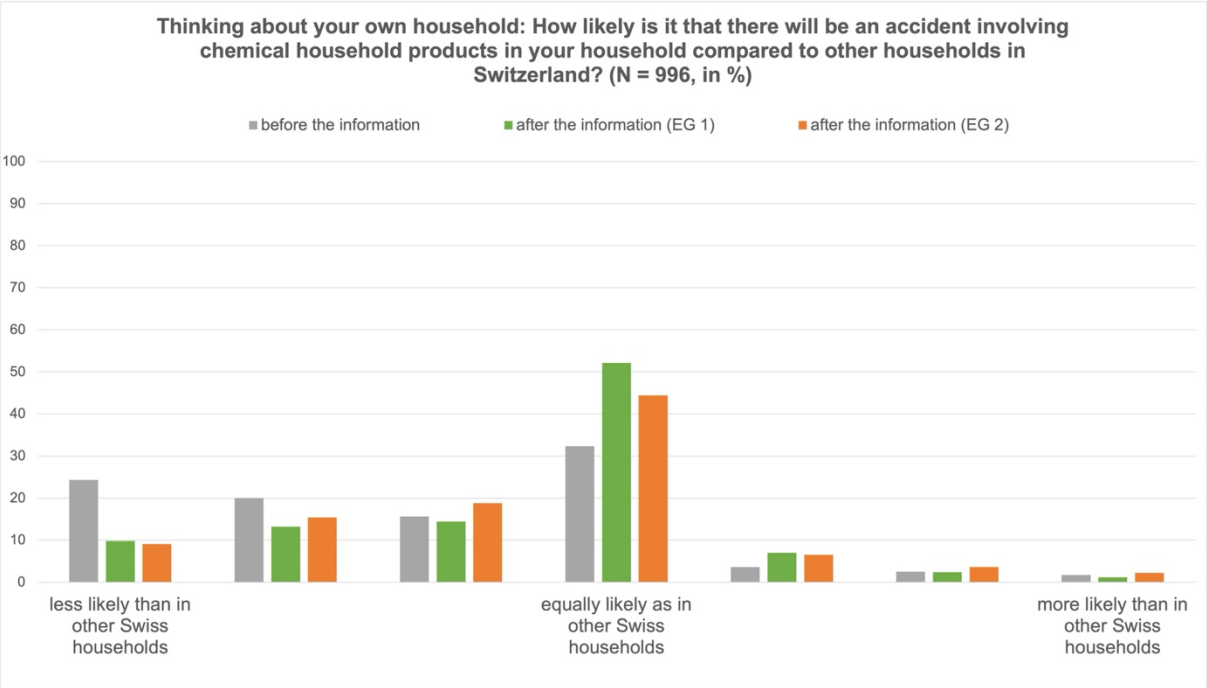

Figure 6. Optimistic bias: underestimation of the probability of an accident (*N* = 996).

Discussion and implications of the results

Even before the “Intuitive Toxicology” project, it was clear that accidents with chemical household products can have numerous causes. Not every misbehaviour during storage, transport, use, or disposal of household chemicals leads to poisoning or chemical burns. The "Swiss Cheese Model" (Reason, 1990) uses a metaphor to show that accidents can be avoided at various levels. Only when all protective measures (e.g., regulatory protective measures and individual protective measures in the household) fail does an accident occur. Accident prevention must accordingly start at the points considered below.

Knowledge transfer: Making information available to the consumers

Knowledge transfer is a frequently chosen way to make consumers aware of potential dangers. It is known from risk research (Morgan, Fischhoff, Bostrom, & Atman, 2002) that knowledge transfer is an effective preventive measure especially when misunderstandings are cleared up and knowledge gaps are filled. Consumers know that certain household chemical products can be dangerous, and they also know, for the most part, that objective information on this risk can be found on the packaging. The existing communication content (e.g., on www.cheminfo.ch) should be maintained, also for younger consumers who, for example, are running their own household for the first time. In this regard, educational initiatives in the school context should continue to be promoted. In addition, however, it could also be helpful to make information available that consumers do not have or that is not salient to them. The following concrete suggestions for such communication content emerge from the results of the project:

- **Meaning of the individual GHS symbols:** consumers should be made aware that certain GHS symbols entail specific behavioural recommendations (e.g., wearing gloves for corrosive products with GHS05 symbol).

- **Background of the different warnings**: For interested consumers, it could be helpful to make the differences between the different warnings more transparent (e.g., that the Safe Use Icons are placed voluntarily by the manufacturers).
- **Importance of concentration**: Consumers should be made aware that certain household chemicals are highly concentrated and could therefore be particularly dangerous in case of exposure (e.g., detergent tabs or pods, essences).
- **Optimistic bias**: Consumers overestimate the safety of their behaviour in the home and underestimate the likelihood that they might have an accident. This contributes to unsafe behaviour in the home. The project has provided first evidence that targeted information can at least partially reduce this optimistic bias.

Regarding the format of information transfer, it is important to note that consumers' resources are scarce (e.g., their attention span, motivation, time). This means that shorter texts, pictorial information, playful content, or an attention-grabbing design are more likely to raise the consumers' attention. In this respect, new formats (e.g., short videos, posts on social media) should also be considered. Information that is relevant to the situation and easy to access can also be promising (e.g., at the point of sale, online next to the product).

Designing products: Avoiding misleading design

This project and past studies have clearly shown that consumers also consider non-risk information when assessing the danger of household chemicals (Basso, Bouille, Le Goff, Robert-Demontrond, & Oullier, 2016; Bearth et al., 2017; Bearth & Siegrist, 2019). At the regulatory level, it is therefore essential to ensure that hazardous products do not feature misleading information or send signals that consumers interpret as safety. This issue is particularly acute in the case of ecological cleaning products (e.g. home-mixed household products, organic products, or products in biodegradable packaging), "natural" products (e.g. essential oils) and products that are perceived to be less efficient. The purposefully natural design of household chemicals leads to the underestimation of risks, which has negative implications for protective measures. It is therefore important that existing legal regulations on inadmissible product descriptions, claims, or illustrations are expanded and controlled. Raising consumer awareness of such misleading attributes could be particularly promising for individual target groups (e.g., parents of young children). More relevant than the size or placement of the warnings is to make them personally relevant to consumers (e.g., through emotional design). As the project has shown, consumers are more willing to protect others, especially children, from the dangers of household chemical products than themselves. It can be assumed that the context of "other people at risk" automatically increases the relevance of warnings and protective behaviour is more likely to be observed. This should be considered when raising consumers' awareness of potential risks due to unsafe use of household chemical products.

Changing the decision-making environment: nudging

Behaviour can most easily be influenced situationally. This can be achieved, for example, by deliberately changing the consumers' decision-making environment. An established term in this regard is nudging (Hansen & Jespersen, 2013; John et al., 2013). Nudging means that behaviour change is fostered by deliberately shaping the decision environment. However, it is important that the consumer's freedom of choice is preserved. For example, point-of-sale cues could help consumers choose a product that is less dangerous for a household with children. In the home, reminders (e.g., a postcard to hang up with the safety recommendations) could potentially lead to safer behaviour. In this regard, Hansen und Jespersen (2013) speak of automatic nudges (have a direct effect on behaviour) and reflective nudges, which are more thought-provoking. Content on optimistic biases can trigger mental processes that lead to safer behaviour in the longer term.

Conclusion

At this point, the concept of consumer responsibility should be mentioned. Even if there is a general awareness of risk and the precautionary measures are known, it is possible that consumers do not take protective measures (e.g., put on gloves, store chemical household products safely). This may be because the consumer does not perceive him or herself as personally at risk or places more emphasis on other competing aspects (e.g., convenience in storage). However, the project "Intuitive Toxicology"

shows preconditions and points where preventive approaches, and protective measures can and must start. Principally, information about risks and protective behaviour must be available to provide the basis for safe behaviour. Consumers need to know that there is a risk from household chemicals or what the warnings on the packaging mean. It must also be ensured that consumers do not come to the wrong conclusion about the risks of household chemicals on the basis of certain signals (e.g. packaging, properties of the chemical household products). Finally, it is also necessary to promote protective measures situationally (e.g., by means of reminders and awareness-raising measures for specific target groups).

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