

## Article

# Do Claims about the Naturalness and Dose of Cosmetics Ingredients Affect the Public's Perception of Their Safety?

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**Abstract:** Media articles have claimed that “synthetic mineral oil saturated hydrocarbons (MOSH)”, which are used in many cosmetics such as lip balms, are unsafe at any dose and should be replaced with natural alternatives. This paper examines whether these claims are correct and whether the perceived safety of these substances is influenced by the language used in the media. To achieve these goals, it first provides an extensive review of the toxicology literature, finding no support that MOSHs are unsafe at current usage levels. It then reviews the psychology literature to examine the effects of labelling a cosmetic ingredient as “natural” rather than “synthetic” and the effects of dose information. A  $2 \times 2$  between-subjects experiments involving adult lip balm users shows that, as hypothesized, the perceived safety of lip balms increases when they are described as containing “naturally sourced mineral oil” rather than “synthetic mineral oil saturated hydrocarbon (MOSH)”, which are both correct descriptions. In addition, the perceived safety increases when the substance is described as being present in a low vs. a high dose, regardless of whether it was described as natural or synthetic. Overall, safety perceptions for common cosmetic substances can be significantly influenced by the language used in media reporting.

**Keywords:** safety; perception; cosmetics; media; claim

## 1. Introduction

A large number of media articles have recently alerted the public about the safety of some of the synthetic substances used in cosmetics. These articles have often used sensational titles, such as “Is your makeup bag making you sick? The hidden dangers lurking in your cosmetics—from toxic beauty blenders to cancer-causing nail polishes” in the *Daily Mail* [1] or “‘Toxic Beauty’ Reveals the Hidden Poisons in Cosmetics—and the Legal Battles to Expose Them” in *The Daily Beast* [2]. Even more traditionally restrained newspapers such as *The New York Times* or *The Washington Post* have linked certain chemicals found in cosmetics with short-term and even long-term health issues [3,4]. For example, an article in *The Guardian* speculated that the rise in infertility and in certain specific types of cancers may be due to the daily use of cosmetics [5]. Safety concerns are particularly severe for lip balms because, unlike most cosmetics, they may be ingested involuntarily and because some of them contain mineral oil saturated hydrocarbons (MOSHs), a substance described as “toxic” in *Metro* [6] and as “poison” in *The Independent* [7] based on a report from a consumer association.

Nonscientific news reporting about the safety of cosmetics has aggravated the distrust of the cosmetics industry [8]. This distrust is probably contributing to “chemophobia”, the irrational fear that synthetic chemical ingredients are necessarily toxic and the belief that ingredients extracted from natural sources with minimal human intervention are necessarily safer [9]. These news reports have stimulated interest for “clean” or “natural” beauty, which replaces synthetic ingredients with natural

ones. Backed by powerful brands and celebrities, “natural skincare” accounted for more than a quarter of the category sales in 2018 [10]. Its success is undeterred by the safety issues that plagued prominent natural products such as Jessica Alba’s baby wipes and baby powder, which were recalled in 2018 because of mold and contamination by microorganisms [11]. The success of “natural” and “clean” cosmetics is also unaffected by the fact that these claims are not regulated [11] and from the evidence that cosmetic ingredients described as natural are not necessarily safer [12,13].

The objective of this article is to examine how the language used in science reporting in the media influences the public’s perception of the safety of cosmetic substances. To achieve this goal, this article provides an extensive review of the toxicology literature and finds no support for the claim that the mineral oils contained in some lip balms are unsafe at any dose. The article then reviews the results of conceptual and empirical studies on safety perceptions in psychology to examine the effects of labelling a substance as “natural” rather than “synthetic” and to investigate why safety perceptions may be insensitive to information about the dose of the substance. Drawing on this literature review, it is hypothesized that describing lip balms as containing “naturally sourced mineral oil” rather than “synthetic mineral oil saturated hydrocarbon (MOSH)”, which are both correct descriptions, improves safety perceptions and reduces attention to dose information. This hypothesis is tested in an online survey of 180 adult lip balm users. Its results show that claims about the dose and the origin of mineral oils influence its perceived safety, suggesting that safety perceptions for common cosmetic substances can be significantly influenced by the language used in media reporting.

## 2. The Safety of Mineral Oil Saturated Hydrocarbons

Mineral oil saturated hydrocarbons (MOSHs) are  $C_{10}$ – $C_{50}$  open-chain hydrocarbons such as paraffin and naphthene. They are distilled and purified from petroleum to remove impurities and separate them from mineral oil aromatic hydrocarbons (MOAHs), which are carcinogenic [14].

Mineral oils are used in lip balms to inhibit water loss, thereby creating a protective layer on top of the skin [15]. Mineral oils have been used for over one hundred years. Until the 1990s, mineral oils were not perceived as harmful by the general public nor by the scientific community. Indeed, they were often classified with vegetable oils and some doctors even used to recommend their consumption as a way to treat obesity [16]. Today, the literature on the safety of MOSHs is less sanguine.

Exposure to MOSHs can come from cosmetics but is estimated to come mostly from foods, where it is used either directly as an additive (e.g., a glazing agent) or by contamination from recycled paper and cardboard packaging. The dietary intake of MOSHs in Europe is estimated to range from 0.03 to 0.3 mg/kg of body weight per day [14], which corresponds to 2.1 to 21 g per day for someone weighing 70 kg. Because of changes in usage and composition over time, this is one or two order of magnitudes smaller than the intake estimated in the United States in the 1960s [17].

### 2.1. Effects of Exposure to Mineral Oils in Animal and Human Studies

Several studies support the claims made by *Metro* [6] that the MOSH in lip balms may be unsafe. All the concerns are related to oral ingestion, as there is no evidence of toxicity from cutaneous exposure [18]. Rodent studies found that absorption of MOSHs is up to 90% for  $C_{14}$ – $C_{18}$  MOSHs and decreases with the increase in carbon numbers (25% for  $C_{26}$ – $C_{26}$ ) and negligible absorption above  $C_{35}$  [14]. There is evidence of MOSH accumulation in human tissues, especially in older studies conducted in North America, and less so in more recent studies conducted in Europe [19,20]. Still, a study of 142 Austrian women found accumulations in human fat tissues of about 1 g per person, increasing with the age and use of hand cream and lipstick, but independent of nutritional habits [21].

Feeding studies in rats found that  $C_{16}$ – $C_{35}$  MOSHs can cause the formation of granulomas in the mesenteric lymph nodes and in liver, in which case they caused inflammations [20,22–26]. The European Food Safety Authority considered that liver microgranulomas found in rats could be relevant to humans and were the critical effect when assessing the risk of MOSHs [14].

However, the relevance of animal studies to determine the safety of mineral oils for humans is not established. First, the toxicity of MOSHs varied depending on whether the studies relied on Fischer 344 rats or Sprague–Dawley rats, strains derived from *Rattus norvegicus* which are commonly used in carcinogenicity studies [27]. One study [20] incorporated three mixtures of MOSHs (paraffin waxes above and below  $n\text{-C}_{25}$  and of different viscosity) in the diet of 344 female Fischer rats for 120 days. After euthanization and sampling of the spleen, abdominal adipose tissue and liver, the MOSH concentrations were determined by gas or high-performance liquid chromatography. In the absence of data on human sensitivity to MOSHs however, these results cannot be readily extrapolated to humans [21,28].

Second, one study in human volunteers found no measurable concentration of MOSHs in blood following an oral dose of 1 mg/kg of body weight, which corresponds to a daily use of lip care [29]. In addition, the granulomas in human tissues are not associated with inflammations, indicating that they are different from those occurring in rodents [14,30].

More generally, MOSH is a generic term that encompasses a wide variety of complex compounds with varied molecular masses. The kind of highly refined mineral oils recommended for use in lip care products sold in Europe by Cosmetics Europe [31] did not cause granulomas or inflammatory lesions in rodents [17].

These results have led safety authorities to conclude that mineral oils are safe as a cosmetic ingredient at the current concentrations of use. This was the conclusion of the US Cosmetic Ingredient Review Expert Panel [32] and of the German Federal Institute of Risk Assessment, which underscored that the safety of these products is indirectly attested by their long availability and use, and by the lack of evidence, clinical or epidemiological, for negative health effects [17,30].

## 2.2. Acceptable Daily Intake of Mineral Oils

Of course, the safety of MOSHs depends on how much is ingested. A recent study of 175 cosmetic lip products available on the Swiss market found that one-quarter of lip balms had a concentration of MOSHs or synthetic polyolefin oligomeric saturated hydrocarbons (POSHs) above 50%, with a maximum of 77% [22]. Although this study combined MOSHs and POSHs, it suggests that some lip balms exceed the recommendations of Cosmetics Europe [31] to limit the concentration of low molecular MOSHs below 5%.

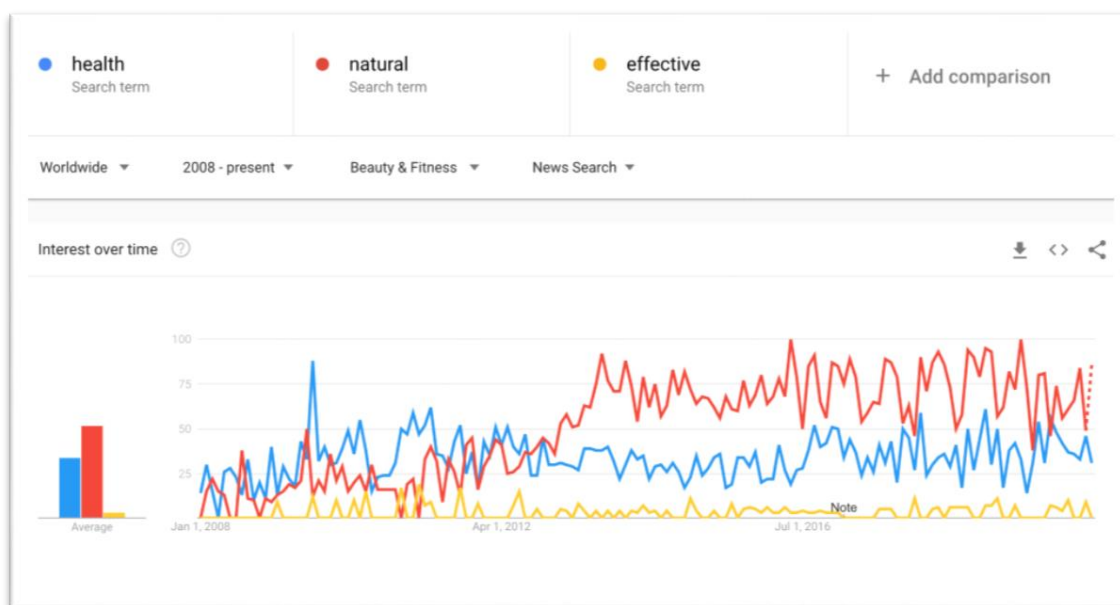
Still, European consumers use about four lip balms a year, which is equivalent to 20 g [15]. Even considering the worst-case scenario of a lip balm containing 77% MOSHs, this amounts to 42.2 mg of MOSHs per person per day, i.e., 0.6 mg/kg/day for a 70 kg person. This level only represents 5% of the acceptable daily intake (ADI) of 12 mg per kg of body weight set by the European Food Safety Authority set [33].

Overall, the scientific literature shows that news reports claiming that lip balms may contain toxic substances or poison are exaggerated [15]. Despite the worrying results of studies conducted with rats, there is no indication that lip balm usage poses a significant safety risk at current doses. Why then are MOSHs described as unsafe by the media? One possibility may be that their name “Mineral Oil Saturated Hydrocarbons” is perceived to be synthetic and not natural. Yet, since they are derived from petroleum, a natural ingredient, mineral oils could truthfully be described as “naturally sourced mineral oil”. The next section reviews the literature examining the actual and perceived safety of cosmetic ingredients described as natural, to examine whether the language used to describe these cosmetic substances may influence its perceived safety.

## 3. Actual and Perceived Safety of Natural Ingredients

Concerns about the safety of cosmetics are understandable given that these products are applied on the skin every day and for most of people’s adult life. For example, a recent survey found that American women use about 12 skincare products per day [34]. Cosmetics use is also increasing in men, although they still use fewer cosmetics than women [35].

In the beauty domain, concerns about health and interest in natural solutions, as opposed to simply effective ones, appears to be increasing. A Google Trends analysis of keyword searches shows a strong increase in the number of searches for “natural” and, to a lesser extent, “health” in the “beauty & fitness” category in the last 12 years (Figure 1), whereas in comparisons, searches for “effective” remained stable. These data, and particularly the fact that the increase in searches for “health” preceded that for “natural” is consistent with the notion that people are expecting natural ingredients to be healthier than artificial ones. The literature on the psychology of naturalness shows why that may be the case.



**Figure 1.** Increasing frequency of internet searches for “health” and “natural” compared to “effective”. Source: keywords searches on Google News in the beauty and fitness category [https://trends.google.com/trends/explore?cat=44&date=all\\_2008&gprop=news&q=health,natural,effective](https://trends.google.com/trends/explore?cat=44&date=all_2008&gprop=news&q=health,natural,effective). (Retrieved 1 September 2020).

### 3.1. Misconceptions about the Meaning of Chemical and Natural in the Media

There are profound misconceptions in the media and in the general public about the meaning of chemical and natural, which can be defined as “extracted from natural sources with minimal human intervention”. One misconception equates chemical with being synthetic or artificial. For instance, a program on National Public Radio argued that nitrogen is not a chemical but a natural element [9]. Of course, nitrogen, the same as water, is both natural and chemical. In fact, anything made of matter is a chemical in the sense that it is made of atoms. This misconception may be caused by lax definitions available to the public. For example, Google, using the Oxford dictionary [36], defines a chemical as “a distinct compound or substance, especially one which has been artificially prepared or purified”, neglecting naturally occurring chemicals such as nitrogen.

A second misconception is that chemical is synonymous with toxic. For example, people in Florida called their local water utility in panic after a host on *WWGR/Gator Country* FM radio announced, as a joke, that dihydrogen monoxide was coming out of their taps [37]. Although this was technically correct, the radio had to issue a clarification that it was a joke [38]. The association between chemical and toxic is particularly strong in cosmetics, spread by news reports linking synthetic ingredients such as parabens with serious health conditions, such as cancer, antibiotic resistance, or skin damage [39]. In reality, parabens, as preservatives, help prevent microbial infections and are among the preservatives with the lowest rates of allergic reactions [40] and no studies have shown any direct link between parabens and any health problems [41]. These preservatives have also helped prevent potential severe health issues

such as the *Pseudomonas*-induced corneal ulcers reported in the 1970s due to an inadequately preserved mascara [12].

A third misconception is that natural ingredients are safer. For example, one article in *Allure* recommends “nine non-toxic, natural products” [42]. Similarly, *Harper’s Bazaar* [43] mentions a brand of lip balm that only uses “organic, wild harvested” ingredients that “safely nourish the skin”. In reality, many popular botanical extracts, such as those of *Aloe*, *Salvia* or *Lavandula* genera can create contact dermatitis [13]. In a misguided attempt to go completely “chemical-free”, a company had developed a conditioner without sulphates, which had to be recalled because of 21,000 consumer complaints, ranging from hair loss to itching [11]. A study of 350 hazardous compounds found that those that have a natural origin have a lower probability of being regulated by the US Food and Drug Administration than those that are synthetic, even after controlling for risk potency [44]. This further shows that one should not assume that natural cosmetic substances are necessarily safer.

### 3.2. General Beliefs about the Safety of What Is Natural

The belief that natural ingredients are safer can be linked to a more general belief that natural alternatives are superior to artificial ones. For example, people expect organic tobacco to be safer [45], natural perfumes to smell better [46], or organic food to have fewer calories [47]. Similarly, there is a general belief that human tampering with nature is risky [48]. One study [49] found that a harmful event (e.g., a factory accident or a campground fire) is judged as more severe when it is caused by humans than when it is caused by nature (e.g., a factory accident vs. a volcano eruption). In addition, people feel worse emotionally when they think that the harmful event was caused by human rather than a natural cause. This explains why people are willing to pay more to remedy environmental threats, such as species extinction or forest fire, when they are caused by humans rather than when they have a natural origin [50].

Overall, there is clear evidence that people expect natural ingredients used in cosmetics, just like natural products, or even natural catastrophes, to be safer than similar ingredients, products, or catastrophes created by people. This preference for what is natural is emotional, more than rational, because it persists even in the absence of any utilitarian benefit for the respondent. This suggests that it is an ethical preference, due to the view that nature is sacred [51]. Some have even argued that the preference for nature is innate, the product of human evolution [52]. These insights suggest that the safety perception of substances may be less dependent on their dose when they are perceived to be natural rather than synthetic. The next section reviews research on the effects of the quantity of substances on safety perceptions.

## 4. Dose Insensitivity

A fundamental concept in toxicology is that the dose makes the poison [53]. This is why American or European authorities tasked with evaluating the safety of mineral oils only provided recommendations in the form of an acceptable daily intake, computed in relation to the body weight of the user [30,32,33]. Yet, this basic principle is rarely mentioned by the media or taken into account by the general public.

### 4.1. Media Reporting about the Amount of Cosmetic Ingredients

Among the 12 articles from the nonscientific media cited in this paper, only two [54,55], both critical of the “natural” beauty movement, mentioned that the amount of the ingredient influences its safety. This concept was not discussed in any of the articles mentioning natural ingredients positively. This is also the case for rating sites, like the one maintained by the Environmental Working Group and apps like Yuka, that have become very popular [56]. These sites and apps rate the safety of cosmetics and of their ingredients without taking into account the quantity of the ingredients in the products.

Research has shown that some individuals are dose insensitive, which means that they believe that the safety of a substance depends on its nature, not on its dose. A survey of 393 Americans with different education levels found that 20% agree with the claim that “if something is harmful at



high levels then it is harmful at low levels” [57]. This survey also found that 36% of the respondents disagreed with the claim that “useful prescription drugs can be harmful in high amounts”. Although these data show that the majority of the respondents were in fact dose sensitive, the fact that even a minority are dose insensitive is concerning given how fundamental the principle of dose sensitivity is when assessing the safety of an ingredient.

#### 4.2. General Beliefs about Quantity Insensitivity

Quantity insensitivity is a general phenomenon that is particularly prevalent in the food domain. Studies have shown that the perceived healthiness of a diet depends more on the categorization of the food than on the amount of food being eaten [58]. For example, one study found that people expected to gain more weight from eating “one mini Snickers” than from eating “one cup of 1% fat cottage cheese, three carrots and three pears”, even though the latter portion contains 12 times more calories [59]. When judging the healthiness of a meal or food portion, people consider first its content, and only in a second step the size of the portion [60].

Quantity insensitivity is more likely to occur when individuals make feelings-based judgments rather than more rational judgments. For example, people who were in a rational mindset (as a consequence of being asked to solve simple calculus questions) were willing to pay more for 10 than for 5 CDs. However, the willingness to pay of those put in an emotional mindset (as a consequence of being asked about their feelings about babies and politicians) was almost not sensitive to the number of CDs [61]. Similar results were found when comparing people who are opposed to genetically modified food as the result of a cost/benefit analysis and those who are opposed to it because they want to protect nature for ethical reasons, no matter the risks and benefits [62]. Given that individuals are more emotional when it comes to events created by nature rather than by people, dose insensitivity should be more pronounced for natural ingredients than for synthetic ones.

### 5. Do “Natural” Claims Influence the Perceived Safety and Dose Sensitivity Dose for Lip Balm Ingredients? An Empirical Study

The review of the literature suggests that the media reporting that certain cosmetics contain synthetic ingredients reduces their perceived safety, even for ingredients such as mineral oils that have been judged to be safe at their current concentration levels. It further suggests that describing a cosmetic ingredient as natural would improve its perceived safety. Finally, the literature suggests that safety perceptions are insensitive to the dose of the ingredient, especially for natural ingredients. These predictions were tested in an online experiment.

#### 5.1. Materials and Methods

The study used a 2 (description: nature vs. synthetic) by 2 (dose: high vs. low) between-subjects design. A total of 180 adult UK residents using lip balm were recruited from [www.prolific.co](http://www.prolific.co) and were paid GBP 0.35 for the 4 min long survey created on Qualtrics. The data from one respondent were not recorded by Qualtrics, yielding 179 observations. The survey, data, and code are available on the Open Science Framework [https://osf.io/rjx2b/?view\\_only=23cfaab7d4404b2f8fae27fc8a4dd883](https://osf.io/rjx2b/?view_only=23cfaab7d4404b2f8fae27fc8a4dd883).


After consenting to participate, respondents were asked to read a slightly edited version of an article in *Metro* about the safety of lip balms [6]. The four versions were identical except for the last paragraph which stated that half the lip balms contained “synthetic MOSH (mineral oil saturated hydrocarbons)” or “naturally sourced mineral oils” in “low” or “high” doses (see Figure 2).

**METRO** NEWS SPORT ALL

### Lip balm could contain toxic substances, consumer group warns

Ellen Scott  
Friday 29 Sep 2017 8:32 am

f t m



(Picture: Carmex)

**Alright, time to root through your makeup bag and get a little concerned about what you're smothering on your skin.**

A new report from a French consumer group has warned customers that their lip balms may contain toxic substances.

Before you feel all safe and smug, be warned – some of the products they found to contain carcinogens are sold in the UK, too.

UFC Que-choisir tested 21 popular lip nourishing products, and found that half of them contained synthetic MOSH (mineral oil saturated hydrocarbons) in low doses.


(a) Synthetic description, low dose

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(b) Natural description, low dose

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(c) Synthetic description, high dose

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(d) Natural description, high dose

**Figure 2.** Stimuli. Each participant randomly received one of the four stimuli, presented as news report warning about a toxic substance in lip balm either described as “naturally sourced mineral oil” or “synthetic MOSH (mineral oil saturated hydrocarbons)” and present in “high” or “low” dose.

The perceived safety was measured by asking respondents to rate how safe it is to use one tube of lip balm per month on a 7-point Likert scale anchored at 1 (very unsafe) to 7 (very safe). They were also asked to indicate whether they agree or disagree with the statement that “the mineral oil used in lip balms is safe” from 1 (strongly disagree) to 7 (strongly agree). These measures were derived from the literature on safety perceptions for cosmetics [63].

Respondents were then asked to directly rate the safety of lip balms containing each of the four descriptions. They then provided information about their usage frequency of lip balms (“daily”; “once a week”; “once a month”; or “less than once a month”), year of birth, gender (“male”; “female” or “other or prefer not to answer”) and the highest level of school completed or the highest degree received (“no qualification”; “GCSE or equivalent”; “A Levels or equivalent”; “University degree”). They indicated their perception of how accurately scientific evidence is reported in newspapers like Metro (from 1 “not accurately at all” to 5 “extremely accurately”). Finally, they rated their agreement with three sentences, derived from earlier work [51,57]: “Natural ingredients are safer than synthetic ones”, “If an ingredient is harmful at high quantity, then it is harmful at low quantity”, and “for safety, the type of ingredient matters more than the quantity of the ingredient” from 1 (strongly disagree) to 7 (strongly agree). The last two ratings were highly correlated ( $r = 0.45$ ) and were therefore averaged to form an index of general belief in dose insensitivity.

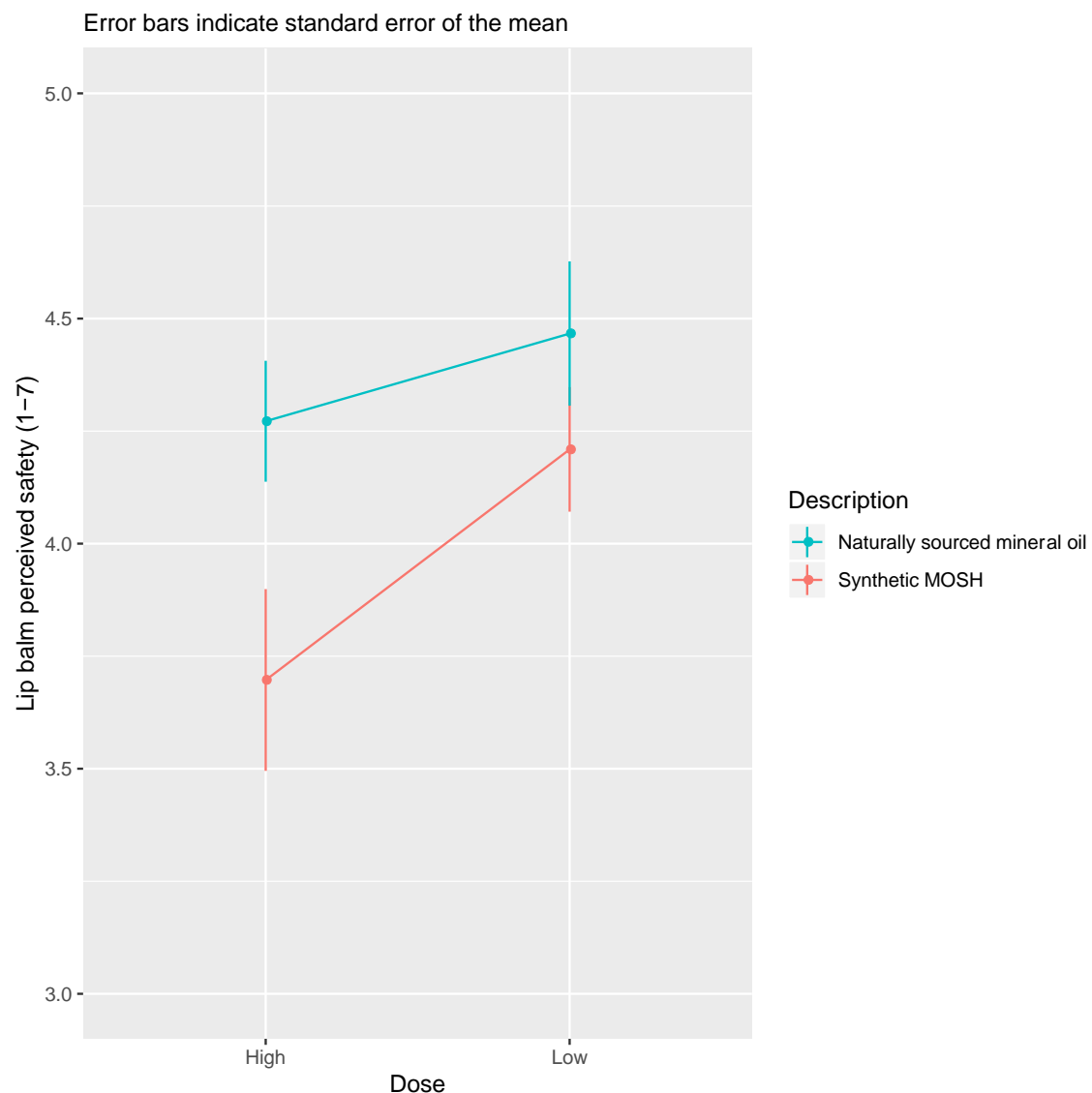
The respondents were 73.7% female and 25.7% male (one respondent selected the “other or prefer not to answer” category). Their average age was 35.6 years ( $Q1 = 27$ ,  $Q2 = 32$ ,  $Q3 = 44.5$ ). The highest level of school completed was “GCSE or equivalent” for 56.4% of the respondents, “A Levels or equivalent” for 15.1%, “university degree” for 27.9%, and “no qualification” for 0.6%. Finally, 48% of the respondents used lip balms daily, 25.7% used them once week, 14% used them once a month, and 12.3% used them less than once a month.

The two measures of perceived safety were highly correlated ( $r = 0.53$ ) and were thus averaged to create a composite index which was used as the dependent variable in a linear analysis of variance (ANOVA) with two indicator variables, NATURE (=1 in the natural condition and =0 in the synthetic condition), LOWDOSE (=1 for low and =0 for high), and their interaction [64]. As the dependent variable was measured on an interval scale, the effects were also estimated via an ordinal ANOVA [65].

## 5.2. Results

Figure 3 shows that the perceived safety of lip balms was higher when they were described as containing “naturally sourced mineral oil” compared to “synthetic mineral oil saturated hydrocarbons (MOSH)” and when the dose was described as low rather than high. Despite the alarmist title (“Lip balm could contain toxic substances”) and of the first three paragraphs, when the substance was described as being naturally sourced, the average safety perception was always above the midpoint of the 1 to 7 point scale, and thus on the “safe” side of the scale.





**Figure 3.** “Natural” and “low dose” descriptions of the mineral oil contained in lip balms improve safety perceptions.

As expected, the main effects of NATURE and LOWDOSE were statistically significant (see Table 1). Their interaction was not statistically significant. The ordinal ANOVA yielded the same conclusions ( $\chi^2(1) = 6.8, p < 0.01$ ;  $\chi^2(1) = 5.4, p = 0.02$ ;  $\chi^2(1) = 0.8, p = 0.38$ , respectively, for NATURE, LOWDOSE, and their interaction). Table 1 further shows that the effects of NATURE and LOWDOSE were the same after controlling for individual differences. The analysis with covariates further showed that perceived safety increased with usage and was higher among respondents who believe that natural ingredients are generally safer (NATSAFER) and who are dose sensitive (NOTDOSESENS). However, the effects of nature and dose did not interact with any of the covariates, showing that they are robust across individual differences.

Table 1. ANOVA results.

	Without Covariates	Without Covariates	With Covariates <sup>1</sup>	With Covariates <sup>1</sup>
	<i>F</i> (1,175)	<i>p</i> -Value	<i>F</i> (1,152)	<i>p</i> -Value
NATURE	5.14 *	0.025	5.77 *	0.018
LOWDOSE	4.83 *	0.029	5.25 *	0.023
NATURE×LOWDOSE	1.01	0.315	0.53	0.466
AGE			1.97	0.162
FEMALE			3.84	0.052
UNIDEGREE			1.29	0.259
USAGE			5.30 *	0.023
NATSAFER			4.11 *	0.044
NOTDOSESENS			17.75 *	0.000
TRUSTMEDIA			0.55	0.458
NATURE×AGE			0.08	0.783
LOWDOSE×AGE			0.11	0.738
NATURE×FEMALE			0.31	0.581
LOWDOSE×FEMALE			0.04	0.839
NATURE×UNIDEGREE			3.36	0.069
LOWDOSE×UNIDEGREE			2.55	0.112
NATURE×USAGE			2.34	0.128
LOWDOSE×USAGE			1.92	0.167
NATURE×NATSAFER			0.08	0.779
LOWDOSE×NATSAFER			0.49	0.483
NATURE×NOTDOSESENS			0.09	0.760
LOWDOSE×NOTDOSESENS			1.08	0.300
NATURE×TRUSTMEDIA			0.54	0.465
LOWDOSE×TRUSTMEDIA			1.47	0.227

<sup>1</sup> \*  $p < 0.05$  (two tailed). Analyses with covariates exclude one respondent who answered “other or prefer not to answer” to the gender question and one respondent who did not answer the question about whether natural ingredients are generally safer than synthetic ones.

## 6. Conclusions

Scientists often bemoan the poor quality of scientific reporting in the media [66]. Reporting about the safety of cosmetics is no exception: hyperbolic media headlines incorrectly proclaimed that mineral oils were “toxic” and “poison”, inappropriately supported by replacing synthetic ingredients with natural ones, and ignored the important role of ingredient quantity when judging safety. This is crucial because as shown in this study, describing a compound as synthetic or natural impacts the public’s perception of its safety, even though it did not influence the effects of dose on safety perceptions.

Still, it would be unfair to lay the blame solely on the media. First, some articles accurately reported the key scientific facts. This occurred in reputed newspapers like *USA today* [54] but also in online-only media like *Bustle* [67] and *Vox* [55]. Second, journalists did not create the controversy about mineral oils alone. All the articles were based on a report issued by the French consumer group and magazine *QueChoisir* [68]. Given the limited amount of time and resources available to journalists [69], it is understandable that many did not confront the claims of this report with the conclusions of the scientific literature.

In addition, it is important to note that the study was conducted in the context of news reading. It remains to be seen how claims about the naturalness and dose of cosmetic substances would influence people’s choices in a shopping context. On the one hand, shoppers are less likely to focus on product safety. On the other hand, they probably process less information in this context and may therefore be more influenced by a “natural” or “low dose” claim on the product’s packaging. Future research is therefore needed to examine the effects of dose and naturalness in a larger variety of natural settings.

These results raise the more general issue of accessing sound scientific information about the safety of cosmetics ingredients and about their regulation, which is much lighter than people expect.

For example, 45% of people erroneously think that the label “natural” is verified [70] when actually, “natural” or “clean beauty” have no legal definitions [11]. These concerns are particularly strong in the USA, where regulations are lighter than in Europe [71]. For example, only 11 cosmetics ingredients have been banned in the USA, compared to 1300 in the EU [72]. Consumer advocates and cosmetics companies are actually aligned in calling for more regulation, including setting up an independent authority to assess the safety of cosmetics ingredients in order to restore consumer trust [55]. In the meantime, people seeking an informed opinion about the safety of cosmetics ingredients should remember that what they hear or read in the media is only skin deep.

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