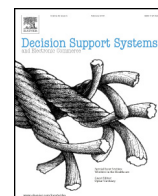




Contents lists available at ScienceDirect

Decision Support Systems

journal homepage: www.elsevier.com/locate/dss

Toy safety surveillance from online reviews

Matt Winkler^a, Alan S. Abrahams^{a,*}, Richard Gruss^a, Johnathan P. Ehsani^b^a Department of Business Information Technology, Pamplin College of Business, Virginia Tech, Pamplin Hall, Suite 1007, 880 West Campus Drive, Blacksburg, VA 24061, United States^b Center for Injury Research & Policy, Johns Hopkins Bloomberg School of Public Health, Hampton House, Room 554, 624 N. Broadway, Baltimore, MD 21205, United States

ARTICLE INFO

Article history:

Received 4 December 2015
 Received in revised form 20 June 2016
 Accepted 22 June 2016
 Available online xxxx

Keywords:

Online reviews
 Safety surveillance
 Toys
 Injuries

ABSTRACT

Toy-related injuries account for a significant number of childhood injuries and the prevention of these injuries remains a goal for regulatory agencies and manufacturers. Text-mining is an increasingly prevalent method for uncovering the significance of words using big data. This research sets out to determine the effectiveness of text-mining in uncovering potentially dangerous children's toys. We develop a danger word list, also known as a "smoke word" list, from injury and recall text narratives. We then use the smoke word lists to score over one million Amazon reviews, with the top scores denoting potential safety concerns. We compare the smoke word list to conventional sentiment analysis techniques, in terms of both word overlap and effectiveness. We find that smoke word lists are highly distinct from conventional sentiment dictionaries and provide a statistically significant method for identifying safety concerns in children's toy reviews. Our findings indicate that text-mining is, in fact, an effective method for the surveillance of safety concerns in children's toys and could be a gateway to effective prevention of toy product-related injuries.

© 2016 Elsevier B.V. All rights reserved.

1. Introduction

In 2011, a child was treated in a U.S. emergency department for a toy-related injury every 3 min [2]. As a result, toy injuries are of major concern to various stakeholders, including toy manufacturers and parents of children who play with these toys. The NPD Group, a market research company that tracks about 80% of the U.S. toy retail market, determined that the toy market consisted of \$18.11 billion of sales in 2014, a 4% increase from the 2013 number of \$17.47 billion [33]. The toy categories with the highest annual sales were: action figure/accessories/role play, arts and crafts, building sets, dolls, games/puzzles, infant/preschool, youth electronics, outdoor and sports toys, plush, and vehicles.

The U.S. Consumer Product Safety Commission issued a total of 401 toy recalls in the seven fiscal years from 2008 to 2014, resulting in significant expenses to toy manufacturers, retailers, and consumers [41]. According to the U.S. Consumer Product Safety Commission's *Toy-Related Deaths and Injuries, Calendar Year 2013* report, there were an estimated 256,700 toy-related injuries treated in the U.S. in 2013 [40], 73% of these injuries occurred to children younger than 15 years of age, 69% to children younger than 12, and 33% to children younger than 5.

A recent example of a children's toy that was recalled was the "My Sweet Love/My Sweet Baby Cuddle Care Baby Doll". Walmart recalled 174,000 of these dolls due to a burn hazard [30]. The CPSC reported

that a circuit board in the doll's chest could overheat, causing the surface of the doll to burn the user of the product [30]. Walmart received 12 incident reports which included two burns or blisters to the thumb. The CPSC advised consumers to stop using this product and immediately return the doll to any Walmart store for a refund. In separate toy recall cases, reported in the *New York Times*, Mattel recalled over eighteen million toys due to lead paint hazards, and due to the risk of small powerful magnets being swallowed [35].

The United States Consumer Product Safety Commission (CPSC) oversees the toy industry. In 2008, the Consumer Product Safety Improvement Act (CPSIA) provided the CPSC with new regulatory and enforcement powers to enhance several CPSC statutes [19]. The CPSIA maintained a particular focus on classification and regulation of children's products. The CPSC both tests toys and responds to reports of incidents in order to enforce safety violation standards. The CPSC has jurisdiction over 15,000 types of products, with toys consisting of a small portion of this jurisdiction. In 2015, the CPSC had about 500 employees directed at hazard identification and reduction. With 3000 to 5000 new toys being introduced by toy manufacturers each year, the CPSC is unable to police or test every toy and often responds to a safety issues after they have already occurred. As a result of these resource constraints, plenty of dangerous toy products arrive at stores every year. Many toy companies test their products in their own labs before offering the products to the public, but there remain a significant number of toys that are not tested. We believe that a vast amount of useful text data embedded in millions of online consumer reviews can be utilized by toy manufacturers, parents, and the CPSC, to advance safety surveillance.

* Corresponding author. Tel.: +1 540 231 5887; fax: +1 540 231 3752.

E-mail addresses: winkmat7@vt.edu (M. Winkler), abra@vt.edu (A.S. Abrahams), rgruss@vt.edu (R. Gruss), jpehsani@gmail.com (J.P. Ehsani).

Consumers rely heavily on the Internet for information about product safety and reliability, including children's toys. Consumers provide their manufacturers, sellers, and their fellow consumers with information about product safety and reliability through sources such as product reviews on retailer websites. Manually identifying and analyzing consumer reviews among millions of consumer postings that relate to product safety issues is a challenging task. Using text-mining to identify and prioritize the vast volume of online reviews regarding safety issues in children's toy products is the focus of this paper.

The rest of this paper is structured as follows. First, we motivate the need for quality surveillance research targeted specifically at the discovery of safety concerns from textual online discussion forums. Next, we discuss and contrast related work. We describe our contributions and the research questions we aim to address. We lay out a process for quality surveillance in the toy industry using analysis of online reviews, recalls, and injury reports. We evaluate our safety issue discovery approach using three experiments on a large sample data set. Finally, we draw conclusions and propose future work.

2. Background and related work

In this section, we review related work in sentiment analysis, online reviews, text mining, and social media surveillance, and explain their relationship to children's toy issue surveillance. We review the coverage and limitations of prior work, as well as the research questions raised. The research gaps associated with past studies are discussed to highlight how these methods could be improved upon.

2.1. Sentiment analysis

Sentiment analysis refers to natural language processing techniques used to quantify the type and amount of emotion expressed in text. Common dictionary sources for sentiment analysis, such as the AFINN [31], ANEW [9], and Harvard General Inquirer [23] dictionaries, assign scores or categories to words in order to assess sentiment. The SentiStrength [37,38] and OpinionFinder [42,43] sentiment analysis methods go beyond basic sentiment scoring techniques—which use constant word scores irrespective of word context—and provide for more complex, context-aware sentiment determination.

In online product reviews, a sentence or review with net positive sentiment score is taken to indicate praise of a particular product and a net negative score indicates criticism of a product. Abbasi, Chen, and Salem analyzed linguistic data in online discussion forums to quantify opinions of users [1]. Other studies have applied sentiment analysis to predict a firm's earnings and returns [26,36], the directional movement of a firm's stock price [32], or its market volatility [6].

Sentiment analysis can be a useful tool in uncovering consumer opinions regarding products, including the children's toy industry. Accessing sources such as online reviews to uncover consumer concerns, using negative scores, and consumer satisfaction, using positive scores, can provide toy manufacturers as well as regulatory agencies with useful information. However, there are limitations involved in using sentiment analysis. Firstly, the most basic sentiment analysis techniques, which use single-word markers, are not always effective in determining positive and negative tones. For example, a consumer could provide a review of a children's toy, stating "This toy is not *bad* at all, my two-year old plays with it all the time." The word *bad*, viewed alone, is assigned a negative sentiment score, leading the researcher to believe that this review was negative when in fact it revealed a positive opinion of this particular toy product. Secondly, many sentiment analysis approaches are generic and domain-independent, so domain-specific danger-words may not be recognized: consider the word "recall" which, in its typical connotation of "remember" (e.g. "I recall the time..."), has no sentiment. In online toy reviews, however, "recall" may more frequently be used in the sense of "withdraw from the market", as in "This toy should be *recalled*". Finally, even highly advanced

sentiment analysis may be imprecise and subject to many false positives when used to identify safety concerns, since safety concerns are extremely rare and consumers may express strong negative sentiment about non-safety-related concerns such as durability, instructions, price, size, color, materials, entertainment value, and other aspects of the toy.

Given these limitations in generic sentiment analysis, there is reason to believe that conventional methods would not be maximally effective in uncovering safety concerns in the toy industry, and a more targeted approach is necessary.

2.2. Online reviews

As the world becomes increasingly digital, online reviews are becoming more popular and relied upon by consumers. Online reviews provide a source of consumer feedback and provide more transparency about products than ever before. Retailers such as Amazon, Target, Walmart, and Toys "R" Us provide a platform for customers to share their product experiences with others through online feedback. In analyzing the effect of word of mouth on sales, Chevalier and Mayzlin studied consumer reviews of books on two sites: Amazon.com and BarnesandNoble.com [10]. The study suggests that customers rely on review-text more heavily than on review summary statistics for books. Duan, Gu, and Whinston [13] find that online reviews and word of mouth are influential in driving movie box office sales.

Online review sources such as Amazon.com provide a valuable platform for uncovering common user safety concerns for certain product categories using automated computation. Amazon.com contains a large dataset of online reviews in relation to major product categories, such as "Toys and Games", where over two million consumer reviews have been written. This vast trove of consumer intelligence represents a treasure-chest of potential product safety insights.

2.3. Text mining

Text mining is becoming an increasingly popular method for analyzing big data and drawing conclusions. Researchers have used text from various sources, including discussion forums, news articles, customer reviews, and media reports, to extract data and summarize results to support decision making. Text-mining provides a valuable method to analyze a large textual source of customer feedback and deliver decision makers with valuable information for business process improvement. Spangler and Kreulen [34] analyzed unstructured customer data to determine a systematic approach for identifying common customer concerns. Coussement and van den Poel [12] also used text-mining to analyze a large dataset of inbound emails in order to automatically distinguish complaints from non-complaints.

Although there have been a multitude of text-mining studies applied to subject matters such as financial market predictions and general consumer attitudes, few methods have been developed to utilize text-mining in specifically targeting product safety issues. Abrahams et al. [3–5] applied text-mining to uncover safety defects in the automotive industry and provided a framework for applying this method to other product industries. Our study adapts this process to the children's toy industry.

2.4. Web and social media surveillance for public safety

Online news sources on the web have been used for surveillance of infectious disease outbreaks [45]—a flagship application of web mining for public safety purposes. The rise of social media on the web has sparked researchers to attempt to extract quantifiable data from this new prevalent form of communication. Social media sources include discussion forums, listservs, wikis, online communities such as social networks, usenet groups, customer product reviews, visitor comments, user-contributed new articles, and more. These sources may be used to

Download English Version:

<https://daneshyari.com/en/article/4972482>

Download Persian Version:

<https://daneshyari.com/article/4972482>

[Daneshyari.com](https://daneshyari.com)