



Linguistic characteristics of shill reviews



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ABSTRACT

This exploratory study investigates the linguistic characteristics of shill reviews and develops a tool for extracting product features from the text of product reviews. Shill reviews are increasingly used to manipulate the reputation of products sold on websites. To overcome limitations of identifying shill reviews, we collected shill reviews as primary data from students posing as shills. Using semi-automated natural language processing techniques, we compared shill reviews and normal reviews on informativeness, subjectivity and readability. The results showed evidence of substantial differences between shill reviews and normal reviews in both subjectivity and readability. Informativeness appears to be a mixed separator of shill and normal reviews so additional studies may be necessary. Overall, the study provides improved understanding of shill reviews and demonstrates a method to extract and classify features from product reviews with an eventual goal to increase effectiveness of review filtering methods.

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1. Introduction

The availability of product reviews brings great benefits to consumers and sellers using online marketplaces. Consumers use product reviews as a channel to gather information about the quality and performance of products (Forman et al. 2008). The product information provided in reviews usually comes from actual users of the product. This experience from actual product users helps consumers reduce the risks associated with buying products they have never used before (Ba and Pavlou 2002). However, the positive impact of product reviews on product sales provides a strong incentive for sellers to manipulate reviews using fake reviews.

In this study, we regard fake reviews as *shill reviews*. The terms *shill* and *shilling* are used in studies about reputation manipulation. Lam and Riedl (2004) defined shills as users “whose false opinions are intended to mislead other users.” We extend this definition by specifying that a shill is a person who writes a review for a product without disclosing the relationship between the seller and review writer. A shill can be the seller or someone compensated by the seller for writing a review. Thus, shills can be agents of sellers, distributors, manufacturers and authors who benefit from the sales of a product. Wu et al. (2010) defined *shill reviews* as reviews that “distort popularity rankings given that the objective is to improve the online reputation.”

Some anecdotal evidence has emerged about the prevalence of shill reviews. Review manipulation was found on reputable online marketplaces such as Amazon.com and BarnesandNoble.com (Hu et al. 2011a, 2011b). For example in 2009, Belkin, a networking and peripheral manufacturer, was reported to be hiring people to write fake positive reviews for their products on Amazon.com (The Daily Background 2009). Later, Belkin management issued an apology for this action (Meyer 2009). The review system on Google search engine has also been attacked (Kost 2012). An investigation by Denver 7News channel discovered that a woman created more than 50 Google accounts and published 5-star reviews for multiple local businesses. In the music industry, marketers disguised as consumers, promoted newly released CDs on online communities such as discussion forums or fan sites (Mayzlin 2006). Not all fake reviews are positive. BBC News (2010) reported that Gary Beal, a business owner, was a victim of review manipulation. Gary found that a local competitor posted a negative review about his company to damage his reputation and steal his customers. According to Gartner (2012), an IT research and advisory company, by 2014, 10–15% of media reviews will be fake reviews.

There are several factors that allow shill attacks to be effective. First, the most important part of a product review is its overall rating. In current reputation systems, the overall rating of a product is the simple average of all of its reviews. So a direct way to impact the average rating of a product is to submit a review. The fewer reviews a product has, the more impact a new review has on the overall rating. Therefore, thinly reviewed products, such as new products or specialized products, can benefit from shill attacks.

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Second, it is very simple to submit a review for a product. Normally, an account is required for a reviewer to submit a review, but the account registration process usually only requires the reviewer to have an email address, which can easily be obtained for free. Third, the identification of reviewers is often anonymous so reviewers do not have to be responsible for the content of their reviews. Finally, unlike reviews for sellers, many product review sites do not require reviewers to demonstrate product ownership prior to submitting a review.

Although the existence of review manipulation is known, researchers have had difficulty developing effective methods to detect fake reviews. Researchers have identified product groups whose reviews are more likely to be manipulated (Hu et al. 2011a, 2011b). However, the results of these studies have been limited to verifying the existence of review manipulation instead of identifying individual fake reviews. It is difficult to identify fake reviews even when a fake review identification process is done manually (Jindal and Liu 2007). We argue that to effectively detect fake product reviews, better understanding about the linguistic characteristics of fake reviews must be developed. In this study, we explore the linguistic characteristics of informativeness, subjectivity and readability in fake and normal reviews by analyzing text comments using natural language processing (NLP) techniques.

To report the differences between shill reviews and normal reviews, one set of shill reviews and one set of normal reviews were collected. Shill reviews were collected from students posing as shills. Normal reviews were collected on Amazon.com. To compare shill and normal reviews, we developed a novel method to extract product features included in the content of product reviews and classify them.

The results of the feature extraction method give useful information about the official features and unofficial features discussed in the reviews. Comparing these product features shows that linguistic characteristics can be used as separators to differentiate shill reviews from normal reviews. The findings indicate that informativeness, subjectivity and readability can be used as part of an effective shill review detection method.

The rest of the paper is structured as follows. In Section 2, related studies about reputation systems, reputation shilling and shill review detection methods are discussed. Section 3 develops research questions and related hypotheses. Section 4 describes the data and the data collection process. Section 5 explains research methods and measures supporting the linguistic characteristics including details about the *description-based feature extraction method* (DFEM). Section 6 reports the results of the study while Section 7 provides some discussion about the results and concludes the paper.

2. Related work

Review systems face two common challenges, a lack of incentive to leave feedback and the existence of dishonest feedback (Resnick et al. 2000). Leaving detailed feedback is a time consuming process. Many buyers do not leave feedback unless provided a reward (Gao et al. 2006). Lack of feedback can leave products thinly reviewed and susceptible to attacks (Prawesh and Padmanbhan 2012). The second challenge, shill reviews, threatens the effectiveness of reputation systems. Shill reviews may trick consumers to buy poor products and negatively impact sales of honest sellers. If a shill attack is successful, honest sellers cannot sell their product and may be eliminated from the market. The market will be filled with lemon products possibly leading to a collapse (Akerlof 1970).

2.1. Review manipulation

Several attempts have been made to provide evidence about the prevalence of review manipulation. Hu et al. (2011a) define review

manipulation as “vendors, publishers or writers consistently monitoring consumer online reviews, posting non-authentic messages to message board, or writing inflated online reviews on behalf of customers when needed, with the goal of boosting their product sales, in the online review context.” By exploring book reviews on Amazon.com, the authors revealed that review manipulation exists with several groups of books including non-bestseller books, popular books, high-priced books and books whose reviews have high divergence in helpfulness votes. Using the reviews on Amazon.com as a sample, Jindal and Liu (2007) found that the problem of review manipulation was widespread.

A recent study focusing on private retailer websites reveals that many product reviews are submitted by people who did not actually buy the product (Anderson and Simester 2013). Exploring the reviews using linguistic cues, the authors found that fake reviews usually do not include the “item feel.” The explanation for the lack of personal expression is that some product experience can only be obtained via physical contact with the product.

The downside of review manipulation is that the action can be very costly if detected (Dellarocas 2004). As an example, the Huffington Post (2012) reported that “[b]estselling, award-winning crime author R.J. Ellory was caught faking Amazon reviews for both his own books and the books of his competitors.” The author later issued an apology for this action. Such negative publicity has the potential to create long term damage to the reputation of the person caught faking reviews, potentially causing online stores to refuse to sell the product or consumers to be reluctant to purchase it. As another example, Legacy Learning Systems was fined \$250,000 by the Federal Trade Commission (FTC) (2011) for hiring affiliate marketers to write positive reviews. The FTC caught Reverb Communications, a public relations firm, posting phony positive reviews on iTunes without revealing it was being paid to do so (Rubin 2010). Despite the existence of review manipulation, there has been little research to understand or ameliorate it (Dellarocas 2004; Hu et al. 2011a; Mayzlin 2006).

Exploring the Chinese C2C market, a study by You et al. (2011) showed that reputation manipulation can be detected by examining positive reviews. According to the authors, fake buyers were paid to conduct fake transactions to be eligible to write the reviews. The authors concluded that fake transactions usually produce detailed and positive reviews among the involved buyers and sellers.

2.2. Shill review detection

A few methods have been developed for shill review detection. One study combined psychological and linguistics analysis methods to classify fake reviews (Ott et al. 2011). The authors collected 400 fake reviews via Mechanical Turk (www.mturk.com), an online marketplace for work, and paired those reviews with 400 normal reviews. The target product of this study was hotels. The authors claimed that their classification method successfully identified 90% of the fake reviews. Another method to detect shill reviews is to compare the popularity of a product before and after the removal of a group of reviews (Wu et al. 2010). If the popularity of the product was significantly distorted after the removal of the reviews, these reviews were classified as shill reviews. The authors argued that rating behavior of shills was unusual in comparison to normal reviewers. An example of unusual rating behavior would be a reviewer posting positive reviews for a brand when other reviews of that brand are negative.

Cases like the previous example can be incorporated into rules which are used to detect unusual rating behaviors (Jindal et al. 2010). One study found that the rank score method can outperform other methods that use only the helpfulness score of the review (Lim et al. 2010). However, during this study the authors excluded

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