Styles in the Fashion Social Network: An Analysis on Lookbook.nu

Yusan Lin[1(✉)], Heng Xu[2], Yilu Zhou[3], and Wang-Chien Lee[1]

[1] Department of Computer Science and Engineering, Penn State University, State College, USA
yusan@psu.edu,wlee@cse.psu.edu
[2] Department of Information Science and Technology, Penn State University, State College, USA
hxu@ist.psu.edu
[3] Schools of Business, Fordham University, Bronx, USA
yilu.zhou@gmail.com

Abstract. As birds of a feather flock together, so do people with similar interests and preferences befriend with each other. Numerous Social Network Analysis (SNA) researchers have investigated how individuals' identification affects their behaviors, such as ethnicity, education, political opinions and even musical tastes. What about one's fashion style? These days, online social networks provide rich resources for us to study these phenomena; however, no research has investigated people's styles/tastes within a social network. In this paper, we analyze the largest fashion social network, Lookbook.nu. By applying SNA techniques, we answer whether people with similar styles tend to connect with each other on the online social networks and whether people form communities based on their styles. We believe this is the first work studying people's fashion styles on an online social network empirically.

1 Introduction

Birds of a feather flock together is much more than an old adage. Our societal behavior is heavily linked to individuals' identification and association with groups, ideas, and trends, as well as visual aesthetics. We see this clearly in many forms, such as sports team loyalty [1], political ideologies, socioeconomic groups, and nationalistic tendencies [2,3] . People often join together in communities, groups, or at least via friendships to share in these common beliefs and interests.

The above-mentioned phenomenon has been widely studied in various fields of social science. However, none has done on the relationship between people's tendencies in choosing attire and their (online) social friends. Is it safe to assume that people with similar fashion tastes are also more likely to be friends? Research in the past has shown that people in the same environment affect each other's fashion taste on a small scale [4]. However, has the definition/phenomenon changed in this online social network era? And how can we observe people's fashion style in social networks? Lastly, how do people's interactions affect an individual's style? To the best knowledge of the authors, none

N. Agarwal et al. (Eds.): SBP 2015, LNCS 9021, pp. 356–361, 2015.
DOI: 10.1007/978-3-319-16268-3_43

of these questions have been addressed or explored. In this paper, we study the fashion styles identified in an online social network specifically geared toward fashion, from a data analysis perspective.

This project contributes to the field of Social Network Analysis (SNA) by studying styles on fashion social networks to determine how interaction may be connected to visual stimulation and, similarity, in personal preferences. Previous research has studied the interaction between the tastes and the interests of users in different types of social networks, e.g., how taste in music [5] affects friendship, but not in a fashion social network. In this research, we apply SNA techniques to the network of users on Lookbook.nu, the largest fashion social network. We aim to explore users' tastes and preferences of fashion styles within the social networks and study whether users' friendships/relationships are formed based on their fashion styles.

We aim to answer these questions by analyzing data we collected from an online fashion social network: (1) Are users with similar fashion styles more likely to follow each other and be more closely connected? (2) In the fashion network, how do social ties based on users' friendships/relationships and ties based on users' fashion styles relate to each other?

For the first question, we transform the network into a manageable structure, then apply community detection to visualize the result in order to answer it to some extent. As for the second question, based on the findings from answering the first question, a statistical test is conducted to show the significance level.

2 Related Works on Fashion Analysis

In the field of fashion, style is the foundation of every single design. The question is, how does one define style? Or, more specifically, how does one define style within the context of fashion? Also, how do different people behave toward different styles?

Articles within the literature discuss the potential mechanisms behind fashion trends. Pesendorfer believes that the fashion industry is driven by a fashion czar [6]. Alberti believes that fashion trends are led by the consumers selection process [7]. And Tassier proposes design models to capture the phenomenon by including information cascades [8]. However, these ideas are not verified empirically, not to mention via data analysis on a fashion social network to study the relationships and phenomenon within it.

In order to better understand how people with various styles interact with each other, we believe that performing a network data analysis based on the consumers' relationships will provide enormous value to the research community.

3 Data Collection: Lookbook.nu

Lookbook.nu, one of the largest online fashion social networks, provides a platform as a global community for users to share fashion tastes and to find inspiring fashions from others. Established in 2007, it has grown to 1.6 million users in 2014. The social function of Lookbook.nu comes from the following/follower relationship and giving hypes, loves, and comments on other users' looks.

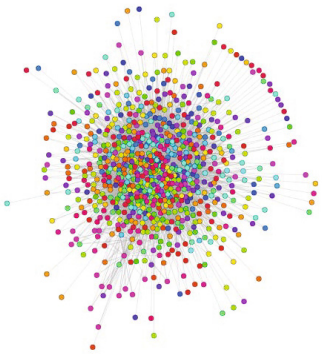
Table 1. Labeled users network's profile

(a) Networks' summary

Metrics	Value
Number of nodes	797
Number of edges	7,588
Number of styles	32
Avg. clustering coef.	0.352

(b) Centrality metrics

Metric	Mean	Std	Min	Max
Degree	20.949	36.224	0	573
Indegree	11.848	23.137	0	229
Outdegree	9.100	22.913	0	513
Betweenness	0.002	0.010	0	0.247
Closeness	0.221	0.124	0	0.688



(a) Before Simmelian Backbones transformation

(b) After Simmelian Backbones transformation

Fig. 1. Labeled user network colored by styles (a) before and (b) after Simmelian Backbones transformation

Discover, one of the different ways to browse Lookbook.nu, allows users to browse other users based on 32 different fashion styles. According to the Lookbook.nu employee whom we contacted with, the approach they use to classify users into different styles is manually picked by the staff. The total number of users in each style is 1,268, while the actual total number of users classified is only 797. This is because between styles, certain users are overlap. We call these users labeled users. These labeled users form a social network with 7,588 edges, denoting the following/follower relationships among them. The basic summary of this data set is presented in Table 1 (a), and its basic network statistics are presented in Table 1 (b). Since the collected data is a small sample of the entire Lookbook.nus network, for clarity, we call it the labeled user network. As seen in Fig. 1(a), the labeled user network is a giant component of the network on its own; i.e., all of the labeled users are connected.

4 Experiment

In order to answer the research questions raised earlier, via our data analysis, we define the two questions more specifically here: (1) Given a fashion style social network G, do users who are strongly connected together form communities

that have dominant styles? (2) Given a fashion style social network G, do the following social ties e_f and the style ties e_s correlate with each other?

Note that for question 2, if the relationship between two users is based on following/follower, we say they have a following tie e_f between them. If the relationship is based on two users belonging to the same fashion style, we say there is a style tie e_s between these two users.

In the rest of this section, we first examine question 1 by finding communities in the network and measure its quality. We then examine question 2 by using the Quadratic Assignment Procedure (QAP) correlation between the users following ties e_f and style ties e_s. Note that in order to analyze how different styles play different roles in the network due to the network structure, we ignore what fashion elements each style includes and simply focus on the network structure.

4.1 Network Transformation, Community Detection and Styles

Does the network form communities? Are those communities dominated by specific styles? To examine this, we apply a community detection algorithm on the labeled user network. Note that when encountering hairball-like networks, as shown in Fig.1(a), one should preprocess the networks with transformation algorithms to make the structure of network clearer. In our application, we choose Simmelian Backbones, which is based on the idea of local ranking and overlap calculations [9]. It can filter out redundant relations between nodes, leaving only the strong connections and amplifying the homophily structure within networks. A sample result of applying Simmelian Backbones is shown in Fig. 1(b). Since Simmelian Backbones requires two parameters for its two stages, we tune them by using grid search with objective function as the average Gini-index for assessing the impurity of the communities.

We begin by processing both networks with the transformation algorithm, Simmelian Backbones. After transforming with given α and β (the two parameters needed for Simmelian Backbones), we then apply Modularity Maximization [10] to partition the transformed network into communities. We then assess the purity of the communities by computing their Gini-index.

4.2 Correlation Between Following/Follower and Styles

For the second test, we construct another network, style-oriented network. It is purely based on styles users have in common, in which users link to all the other users who have the same styles with themselves. To distinguish from this network, here we refer to the original labeled user network as the following/follower-oriented network. The purpose of the style-oriented network is to calculate its correlation with the following/follower-oriented network. We use a Quadratic Assignment Procedure (QAP) correlation to perform this test. For our QAP test on the two networks, the null hypothesis is as follows:

H_0: The style relation and following/follower relation do not correlate among the same set of users; i.e., they have a correlation of 0.

For each network, we construct a full adjacency matrix to serve as the inputs of the QAP test, which includes two stages. In the first stage, correlation coefficients between the corresponding cells in two matrices are calculated. In the second stage, rows and columns in the two matrices are randomly permuted synchronously to recompute the correlation.

5 Result

We first present the result of our first experiment, examining whether users form communities based on their styles. Fig. 2 shows the visualization of the optimally transformed network and Table 2 shows the basic statistics of the network.

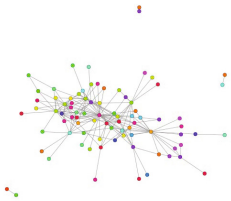


Fig. 2. Labeled user network after applying optimal Simmelian Backbones

Table 2. Statistics of the labeled network after optimal Simmelian Backbones transformation

Parameter/Metric	Value
α	16
β	9
Average Gini-index	0.6012
Number of connected nodes	83
Number of edges	188
Number of communities	10

Based on the results, we are able to answer the two questions raised earlier. As shown in Fig. 2, even though Simmelian Backbones has been applied to achieve the lowest impurity in each community, the community-like structure in such a network is still not obvious. For the generated 10 communities, 6 are dominated by the style effortless. Therefore the answer to our first question is "No."

To confirm our observation, we look into the result from the second experiment, which can be also be used to answer the second question. The result shows 0 correlation between the following/follower-oriented network and the style-oriented network. A p-value of 1 was returned by the QAP correlation test, which failed to reject the null hypothesis H_0. This contradicts our initial belief.

Why do we achieve these results? We believe it is because the labeled user network, with manually selected nodes, represents a highly biased sample of the whole Lookbook.nu's network. One of the reasons these users are labeled is because they are relatively more popular in the network; they have more followers and, therefore, more attention. This might create a phenomenon where, in the labeled user network, users tend to follow each other simply because of fame and regardless of style.

6 Conclusions and Future Work

In this paper, we explore the network structure of Lookbook.nu by looking into the role each style plays in the network. Two questions are raised: (1) Are people

with similar styles more likely to form communities? (2) Do social ties and style ties correlated with each other? We identify and answer them using a range of observation and network data analysis techniques.

In terms of the likelihood of users with similar styles to connect and follow one another, we apply Simmelian Backbones and Modularity Maximization to reveal the interactions between Lookbook.nu's users. However, at this stage of our exploration, we discover that the way users connected to each other is not strongly correlated to the styles they personally own, according to the conducted QAP correlation test. We believe this result is caused by the fact that the labeled user network is a biased network, and the users tend to follow each other simply because they are all included in this network and regardless of their styles. While some of our expectations are upheld in the research, there are clearly more areas that should be explored to understand more about social network relationship interconnectivity based on fashion tastes and interests.

For future work, we aim to expand the scope of data and include other users who are not labeled with styles in Lookbook.nu to study the relationship between a network's community and users' fashion styles.

References

1. Lusher, D., Robins, G., Kremer, P.: The application of social network analysis to team sports. Measurement in Physical Education and Exercise Science **14**(4), 211–224 (2010)
2. Thelwall, M.: Homophily in myspace. Journal of the American Society for Information Science and Technology **60**(2), 219–231 (2009)
3. Oliver, M.L.: The urban black community as network: Toward a social network perspective. The Sociological Quarterly **29**(4), 623–645 (1988)
4. Morris, T.L., Gorham, J., Cohen, S.H., Huffman, D.: Fashion in the classroom: Effects of attire on student perceptions of instructors in college classes. Communication Education **45**(2), 135–148 (1996)
5. Steglich, C., Snijders, T.A., West, P.: Applying SIENA: An Illustrative Analysis of the Coevolution of Adolescents' Friendship Networks, Taste in Music, and Alcohol Consumption. Methodology: European Journal of Research Methods for the Behavioral and Social Sciences **2**(1), 48 (2006)
6. Pesendorfer, W.: Design innovation and fashion cycles. American Economic Review **85**(4), 771–792 (1995)
7. Alberti F (2013) A note on fashion cycles, novelty and conformity. Jena Economic Research Papers
8. Tassier, T.: A model of fads, fashions, and group formation. Complexity **9**(5), 51–61 (2004)
9. Nick B, Lee C, Cunningham P, Brandes U Simmelian Backbones: amplifying hidden homophily in Facebook networks. In: 2013 IEEE/ACM International Conference on Advances in Social Networks Analysis and Mining (ASONAM), pp. 525–532. IEEE (2013)
10. Blondel, V.D., Guillaume, J.-L., Lambiotte, R., Lefebvre E.: Fast unfolding of communities in large networks. Journal of Statistical Mechanics: Theory and Experiment **10**, P10008 (2008)