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Polyvore Collaboration: Innovation in Informal Online Affiliation Networks

Andrew Feldstein[1], Brent Wilson[2]

Virginia State University, Petersburg,VA,23806, USA
Pennsylvania State University,University Park, Pa, 16802, USA

Abstract

Online communities engaged in collaborative exchange exhibit characteristics of spontaneous communitas as defined by Victor Turner (1982). Interactions taking place in these communities also correspond to Harrison White's (2008) concept of network formation as a tension between identity and control. A social network analysis of activities in the Polyvore community maps the behavior of members as they oscillate between liminoid transactions and structured integration; between creativity and conformity. An affiliation network is a two-mode network consisting of a set of actors and a set of events. This paper studies an affiliation network as it develops within the Polyvore community.

1. PolyvoreWorld, Words, and Community Construction

Polyvore is a website that bills itself as "a vibrant community of creative and stylish people". The community's web platform has been designed to facilitate three primary activities; shopping, exploring, and creating. The creation part involves the use of a proprietary web-based application that allows users to clip images and create collages based on these images. Most of the images are articles of clothing or other style accessories hence the popularity of the site with teenage girls. It is like a 21st century version of colorforms with an unlimited number of pieces.

These clipped images enhance the shopping activity since each image used in a collage is linked directly to a source where someone can actually purchase the item. And exploration is certainly necessary when you have a site with over 900,000 registered users creating millions of collages; Polyvore calls these collages 'sets'. Although Polyvore is primarily a visual medium, it is also a social network where collage sets are supplemented by verbal descriptions, praise, judgments, and discussion within the community of creators. In actuality, the communication occurs within many sub-communities within the PolyvoreWorld. Polyvorians title their sets and explain the sets they have just created. Other members tag sets to indicate their approval and, if they wish, they may post comments and interpretations. Within the system a user may

communicate privately and engage in ongoing conversations with other Polyvorians whose sets interest them. Through these activities, communities are built.

Polyvore is, in fact, a digital world made from many affinity groups. Polyvorians join groups that represent their tastes and interests. But in addition, each Polyvorian creates her own community of contacts that extends across formally designated groups. A Polyvorian's community consists of members that she has chosen because she likes their collages—or because they like hers. These preferences are based on a variety of criteria: things such as style, content, inventiveness, design, meaning, and similarity of interests.

Polyvore is typical of many online communities in that there is almost no information for newcomers regarding how to function within the community. There is no guidebook for finding one's way around PolyvoreWorld, but there is a complete record of each member's creative and community-building activities. Polyvore is a transparent and self recording system. It is possible to go to an individual Polyvorian's website and view sequentially every set the member has created from first to last. Each Polyvorian's profile also contains a record of sets favored, contest wins, collections created, groups joined, and items selected as the materials with which to create collages, as well as the member's contacts. This documentation shows how each member has constructed her individual Polyvore community.

1.1. Anti-structure, Communitas, and Liminality

The purpose of this study is to observe and chart the formation of a network within the Polyvore community. The opportunity presented itself when the second author of this paper decided to join Polyvore. "I became a Polyvorian because I wanted to create digital collages—and in doing so, I wanted to test the boundaries of the acceptable, to try, subtly, to subvert the system, if possible, and I even wanted to see if I could break existing boundaries of style and meaning" (Wilson 2009). This paper maps the first 36 days in the life of Polyvorian 'Harry Lyme'.

The anthropologist Victor Turner first studied relationships between normally structured activities and anti-structural events in an African tribal society. He found that within tribal villages innovation and change occurred during rituals and times of chaotic unpredictable events. These anti-structural times, Turner concluded, were the source of innovation, new symbols, and new ways of behaving. During anti-structural times individuals are separated from every-day activities, there is a leveling—where the usual hierarchies of social standing are dissolved, and liminality prevails. Liminality is not easily defined. In characterizing ritual states in which novices' status has been leveled, Turner states,

> The novices are, in fact, temporarily undefined, beyond the normative social structure. This weakens them, since they have no rights over others. But it also liberates them from structural obligations. . . In liminality, profane social relations may be discontinued, former rights and obligations are suspended, the social order may seem to have been turned upside down (Turner, 1982, p. 27).

In these betwixt-and-between liminal states, tribal initiates are instructed in the lore of their society's myths, secret language, and various non-verbal symbolic genres such as dancing, painting, clay-molding, wood-carving, etc. "Liminality may involve a complex sequence of episodes in sacred space-time, and may also include subversive and ludic (or playful) events." Consequently, Turner claims, in these liminal ritual events, "Novelty emerges from unprecedented combinations of familiar elements" (Turner, 1982, p. 27).

Interestingly, Polyvore has some of the features found in tribal rites of passage. Each member has his or her Polyvorian name and identity marker. Actual identities may remain hidden—hence a leveling. Young and old, male and female, gay and straight, novice and sophisticated interact as equals. Situations such as this foster what Turner calls communitas. He defines three types: Spontaneous communitas occurs when a group of individuals is thrown into an unexpected situation of intense interaction where they develop a feeling of closeness pervaded by a magical quality and where "subjectively there is in it a feeling of

endless power" (Turner, 1982, pp 47-48). Ideological communitas is when those who participated in a spontaneous communitas event, at a later time—or on repeated occasions—attempt to reorganize themselves in order to remember and capture the spirit and quality of the original event (Turner, 1982, p. 48). Normative communitas is a situation in which "a subculture or a group . . . attempts to foster and maintain relationships of spontaneous communitas on a more or less permanent basis." (Turner, 1982, p. 49)

1.2. Identity and Control

The liminal state described by Turner strongly relates to White's ideas on how identity is established. The Polyvore community consists of almost 1 million members and to establish an identity within, even a small subcommunity involves certain actions. The primary actions in the Polyvore community are set creation, set tagging, and shopping. Of these three activities set creation and set tagging are of interest to the process of community building. Although the shopping activities are certainly of interest to the Polyvore organizers and the companies whose products are included in sets and available for sale.

When a member creates a set he/she is asserting an identity. According to White; "The triggering of one identity activates control searches by other identities" (White 2008). The control efforts are manifest in the tagging of one community member's set by another. A tagged set means that some other member has identified that particular set as a 'favorite' set. This signifies that the set has been recognized by another member of the community. Tagging influences the creation of subsequent sets. If, as is the case here, one reason for creating sets is to "test the boundaries of the acceptable" the act of being tagged makes a set acceptable and not being tagged makes it unacceptable. Thus it is a recursive process where a member will attempt to project an identity through the creation of a set, the community will respond by specific tagging behaviors and the member will create another set based, in part, upon the reaction to the previous set.

1.3. Polyvore as an Affiliation Network

The process of creation and tagging in the Polyvore community establishes a dynamic through which one member is indirectly related to another through the sets they create. This dynamic creates an opportunity to analyze the Polyvore community as an affiliation network. "The importance of studying affiliation networks is grounded in the theoretical importance of individuals' memberships in collectivities." (Wasserman and Faust 1994) "Consider a set of individuals and a set of groups such that the value of a tie between any two individuals is defined as the number of groups of which they are both members. The value of the tie between any two groups is defined conversely as the number of persons who belong to both." (Breiger 1974)

In an affiliation network, actors are joined together by their shared participation in events. At the most basic level, in the Polyvore community, events are represented by the collage 'sets' that each member creates. The actors are other community members who indicate their approval of specific sets by 'tagging' them as 'favorites'. In our analysis of Harry Lyme's Polyvore network two individual members are linked if they both tag the same set, and two sets are linked if they are tagged by the same member.

2. Method

For the purposes of this study, the sets created by Harry Lyme in his first 36 days as a contributing member of the Polyvore community will be the events and any Polyvore member who tags one of those sets as a 'favorite' will be considered to have attended that event.

It was through fortuitous happenstance that the first author of this paper was able to track the development of this network from its inception. The initial plan was to track the creation of sets and subsequent tags over a period of 30 days. 5 six day time periods were designated for study. As the end of

the 30 day period approached it was determined by the authors that the level of activity surrounding Harry Lyme's work required an additional observation period. Thus 6 six day time periods (T1 - T6) were documented. In this time Harry created 76 sets and was tagged 1079 times by 145 Polyvorians.

The resulting Pajek data set describes a two-mode network of 'sets' and 'members' which links the members to the sets and not directly to other actors. It is a binary affiliation network since a member has either tagged (1) a set or not (0). The vertices heading in Figure 1 shows the total number of vertices (221) and the number of sets (76) that comprise the first partition in the network. Lines 1-9 are a partial list of sets and line 91-97 are a partial list of Polyvore members who have tagged the sets.

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*Vertices     221    76
      1 "Yoko & Koko"              0.0000    0.0000    0.5000    [1-6]
      2 "Eva& Ava"                 0.0000    0.0000    0.5000    [1-6]
      3 "Yesko & Knoko"            0.0000    0.0000    0.5000    [1-5]
      4 "Kiko & Niko"              0.0000    0.0000    0.5000    [1-4]
      5 "Monkey Buisness"          0.0000    0.0000    0.5000    [1-6]
      6 "Twin Interior Designs"    0.0000    0.0000    0.5000    [1-6]
      7 "Lili & Lily M."           0.0000    0.0000    0.5000    [1-6]
      8 "Madame Butterfly Twins"   0.0000    0.0000    0.5000    [1-6]
      9 "Modern Madam Butterflies" 0.0000    0.0000    0.5000    [1-6]
      .
     91 "deuxS"                    0.0000    0.0000    0.5000    [1-6]
     92 "lilsav320"                0.0000    0.0000    0.5000    [2-6]
     93 "lagomera"                 0.0000    0.0000    0.5000    [2-6]
     94 "Mythical (believe)"       0.0000    0.0000    0.5000    [2-2]
     95 "sneakersymphony"          0.0000    0.0000    0.5000    [2-2]
     96 "little-flower"            0.0000    0.0000    0.5000    [2-6]
     97 "Mistinguette"             0.0000    0.0000    0.5000    [1-1]
*Arcs
*Edges
      1                77    1    [1]
      1                78    1    [1]
      1                79    1    [1]
      1                81    1    [1]
      1                82    1    [2]
      1                83    1    [2]
      1                84    1    [2]
      1               171    1    [4]
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Figure 1. Partial Listing of PolyvoreT.net

Each set line ends with a time marker ([1-6]) indicating during which time period a set was created and also which time period or periods members tagged that particular set. Each member line ends with a time marker indicating which time period or periods a specific member was actively tagging sets. [2-5] indicated a member who first tagged one of Harry Lyme's sets in T2 and last tagged a set in T5. The 'Edges' note the number of the set, the number of a member who tagged that set, and the time period that particular member tagged the set.

Studying Harry Lyme's Polyvore network as an affiliation network acknowledges the duality of sets and members within the network. "There are two complementary ways to view an affiliation network; either as actors linked to events, or as events linked by actors" (Wasserman and Faust 1994). In this study we look at both aspects; examining patterns of co-membership (patterns between members who have tagged

Harry Lyme's work), and aspects of interlocking events (the development of new sets in response to member actions).

2.1. Hubs and Authorities

One of the most basic ways to measure the relationship between sets and tags is by using degree centrality. Degree centrality is certainly useful as a measure of popularity. It identifies the most popular sets as well as the most prolific taggers. One motivation for this study is to look past measures of popularity such as degree centrality and explore the process that leads to some affiliation networks growing and others not. "It is not simply the number of memberships that an actor has that is important. An actor that belongs to few events may nevertheless create a critical tie between two or more events that otherwise would not be linked." (Faust 1997) To do this we have chosen to measure betweenness centrality and to identify hubs and authorities (representing eigenvector centrality) to measure the interaction between members and sets.

Hubs and Authorities is a model introduced by Kleinberg to determine how important a specific vertex is to a network. He used this model to measure the value of interconnected web documents. (Kleinberg 1998) Implicit in this model is the assumption that it's not just the number of web pages that are linked to a given page that creates value, the number of pages connected to those other pages must also be taken into consideration in the calculation. "A vertex is a good hub, if it points to many good authorities, and it is a good authority, if it is pointed to by many good hubs"(Zaversnik and Batagelj 2001). In our design we have a similar structure in the two-mode network consisting of Polyvore sets (authorities) and Polyvore members (hubs).

3. Results

The results of this study show an interesting combination of the obvious and the subtle. In this relatively small affiliation network it isn't surprising that the vertex (#77) with the highest degree centrality (74) and the highest betweenness centrality score (.1868308) is also a hub in this network. Of the 10 identified hubs, the degree centrality ranged from 26 (Sweet Firefly) to 74 (Maia-Arts) and the betweenness centrality ranged from .0235326 (LatsyAway) to .1868308 (Maia-Arts). In the 10 identified authorities the degree centrality ranged from 19 (**Wolfgirl**) to 34 (**Other side of the Mirror**) and betweenness centrality ranged from .0142736 (**Wolfgirl**) to .064656 (**Other Side of the Mirror**).

Some of the more interesting findings become apparent when we identify sets and Polyvore members with relatively high degree and betweenness centrality that are not also identified as hubs or authorities. For instance vertex 23 (**Love and Death in Mickeyland**) has a degree centrality of 23 and a betweenness centrality of .0510046 but does not have sufficient weight to be identified as an authority. Similarly vertex 31 (**New Mickey same old Minnie)** has higher degree and betweenness centrality than some vertices that have been identified as authorities. Cherry Lux (degree 32 betweenness .0242454) has not been identified as a hub and yet these scores are higher than some of those identified as hubs.

This apparent inconsistency is better understood when the dimension of time is accounted for. Figure 2 is a Pajek visualization of Hubs and Authorities in Time 1 (the first 6 days of the network). Three of the 10 identified hubs have been formed in this time period, while no authorities have yet been formed. Other than the early appearance to three hubs (in red) Cherry Lux a Polyvore member who showed early interest in Harry Lyme's work also appears in T1. All 4 showed interest in the set **Love and Death in Mickeyland.**

Figure 3 depicts the activity of Hubs and authorities in T2. The fact that Cherry Lux appears jn this time period is indicative of tagging activity. However, the lack of edges linking her to other vertices indicates that she has linked to sets that would turn out to be less popular. Time 2 also marks the appearance of **Mousetrap**; the first set to be identified as an authority. Two new hubs appear in Time 2 and neither is

tagging **Love and Death in Mickeyland** which might account, in part, to the fact that it never reaches the status of an authority.

4. Discussion

Implicit in both Turner's liminal state-- characterized as a"complex sequence of episodes"-- and White's recursive process of identity and control, is the dimension of time. As has been suggested the set creation process in Polyvore is a recursive one. The network of sets and Polyvore members comprising Harry Lyme's Polyvore community continues to grow. In the 36 days over which the growth of Harry Lyme's network was tracked he created 76 sets that were tagged as favorites 1079 times. In the two months since that time Harry was been prolific. Harry has now created a total of 181 sets which have been tagged 3705 times.

For all of this there some interesting continuities. For instance Harry's most recent set; History of Rodent Cinema has been tagged 11 times thus far. 9 of the 11 members tagging that set had begun tagging Harry's work in the first 36 day period as well (one member in T1, three in T2, three in T3, and two in T5). Of those nine, three were identified as hubs. This seems to indicate that relationships that form early seem to last. Maia-arts, iDolly, and LatsyAway are all members who began tagging Harry's work in the first 6 days. They have also consistently been among the earliest members to tag Harry Lyme's new sets.

This is significant since, at the rate that Harry Lyme creates new sets, he is only seeing the early feedback before he produces the next set. A question that should be asked at this point is whether the time factor should be considered when designating someone as a hub. For instance Whitewolf (vertex 172) tagged 30 sets all in T4. By definition, for Whitewolf to be a hub, the 30 sets she has tagged need to have enough weight to be designated as authorities. She meets that requirement but her influence on Harry Lyme might be mitigated by her tendency to cluster her tags. The 30 sets she tagged in T4 had been created by Harry Lyme over the period of T1 to T3. For this reason Harry may not have been influenced by her tags in the same way he was by Maia-arts who tagged consistently within a short period after the set was created. On the other hand, by virtue of her flurry of tagging activity, whitewolf might be influencing other Polyvore members to take a closer look at Harry Lyme's sets.

5. Implications

The transparency of online community activities gives us unprecedented access to interactions between community members and, in the case of Polyvore, interactions between members and the creative process of developing Polyvore sets. Being able to track events in real time, we can incorporate the temporal dimension into an analysis of this process. It is clear that popularity-based measures such as degree centrality only provide part of the picture. The addition of betweenness centrality and the ability to identify hubs and authorities fine tunes the process and points to influential aspects of a network that may not be obvious when overshadowed by the most popular sets and the most prolific taggers.

Ultimately incorporating the dimension of time adds real insights into the interpretive and explanatory elements of the network. While building this data set I had the opportunity to remain close to the interactions that were taking place. Some events can only be explained by understanding that context in which the events take place, but as researchers we don't always have the luxury of watching a community grow from the ground up. The identification of events and interactions in time gave us the ability to identify inconsistencies that might not otherwise have been apparent.

Node #	Name	Time	Degree	weight	betweenness	hub/auth	closeness
23	Love & Death in Mickeyland	[1-6]	**22**	0.130786	**0.0510046**		0.4023577
31	New Mickey Same old Minnie	[2-4]	**23**	0.1248237	0.0369515		0.403876
34	Mousetrap	[2-5]	**25**	0.1617062	0.0295855	1	**0.4069473**
38	Mickey's DileMMA	[2-5]	19	0.1535374	0.0145607		0.3978704
40	Poor Mickey Lost	[2-6]	19	0.1436338	0.0199117		0.3978704
44	Shanghai Minnies	[3-6]	21	0.1431196	0.0310017		0.4008507
45	Minnies Boudoir	[3-6]	**24**	0.1618708	**0.0447133**	1	**0.4054059**
46	OK Mice	[3-6]	**23**	0.1541729	0.0323388	1	0.403876
47	Mirror Mirror	[3-5]	17	0.1422437	0.0146825		0.3949341
48	Other Side of the Mirror	[3-6]	**34**	0.2103205	**0.064656**	1	**0.4213677**
50	MinnieGirl for iDolly	[3-6]	**24**	0.1644409	**0.04371**	1	**0.4054059**
53	Letter Not Scarlet	[3-6]	25	0.1716525	0.0333584	1	**0.4069473**
54	WolfGirl	[4-6]	19	0.1554436	0.0142736	1	0.3978704
55	Minnies Going GaGa	[4-6]	23	0.1695532	0.0307412	1	0.403876
56	Will Minnie/Gaga Tarnish Reputation	[4-6]	18	0.1469967	0.0188099		0.3934822
58	Young Girl Before Mirror	[4-6]	18	0.1522606	0.0093354		0.3963968
67	Minnie Stop Trying	[5-6]	20	0.1386892	0.0190701		0.399355
70	This Relationship isn't working	[5-6]	22	0.1531844	0.0231245	1	0.4023577
73	Hate your looks	[6-6]	21	0.1122271	0.0384343		0.4008507
75	So Many Things Chair	[6-6]	15	0.0975325	0.0339175		0.3930408
77	Maia-Arts	[1-6]	**74**	0.409341	**0.1868308**	2	**0.5816693**
79	Cherry Lux	[1-4]	**32**	0.1468726	0.0242454	2	0.3808795
81	iDolly	[1-6]	**60**	0.343834	**0.1257535**	2	0.5324734
85	LatsyAway	[1-6]	29	0.1769776	0.0235326	2	0.3963968
92	lilsav320	[2-6]	24	0.1458020	0.0170279		0.3768562
93	lagomera	[2-6]	25	0.1654865	0.0155917		0.3836099
105	Amy-Kakes	[2-6]	23	0.1446433	0.0122530		0.3665313
105	happynes	[2-6]	20	0.1425376	0.0141569		0.3877795
113	Sarah -)(	[2-6]	**31**	0.2065483	0.0242435	2	**0.4054059**
124	Sabaa	[2-6]	19	0.1424070	0.0115080		0.3836099
134	Ingogneato	[3-6]	**54**	0.3368001	0.1023208	2	0.5145536
147	Lucy's Valentine	[3-6]	28	0.1911974	0.0226852	2	0.3963968
152	Sweet Firefly	[3-6]	26	0.1830001	0.0185222	2	0.3877795
172	whitewolf	[4-4]	30	0.1991689	0.0294371	2	**0.4132322**
181	Demented Bunny	[5-5]	28	0.1869164	0.0266973	2	**0.4100657**
183	Sly Kitten	[5-6]	32	0.2193973	0.0290911	2	**0.4132322**

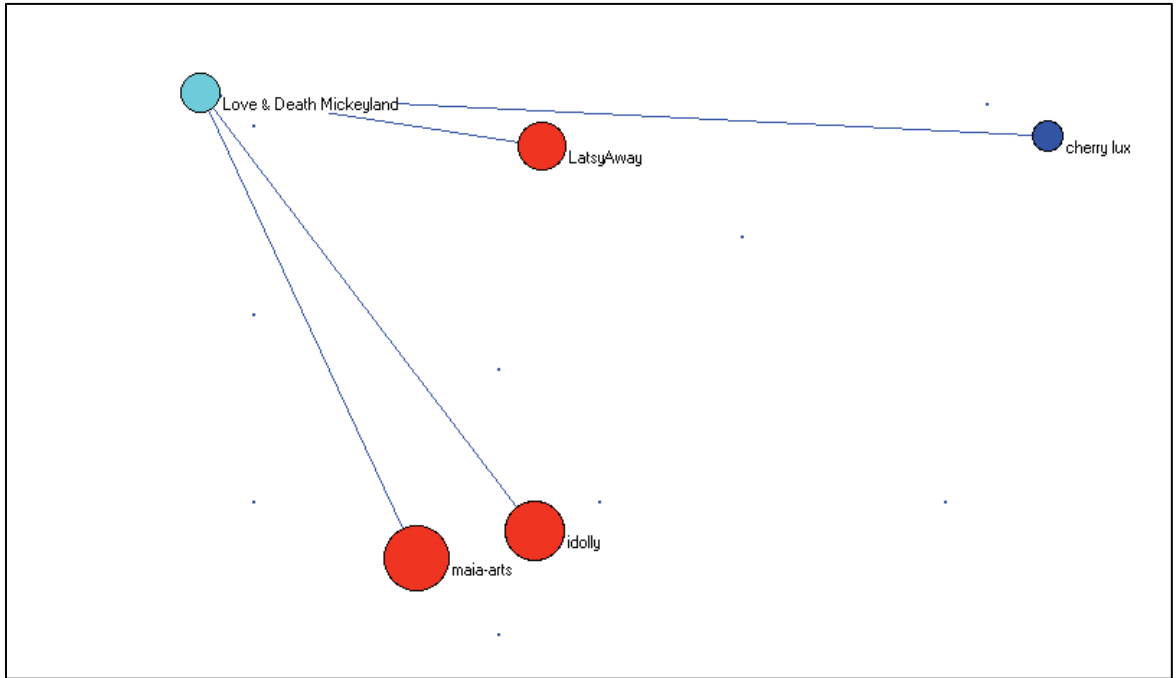Table 1. Centrality Results for most heavily weighted vertices.
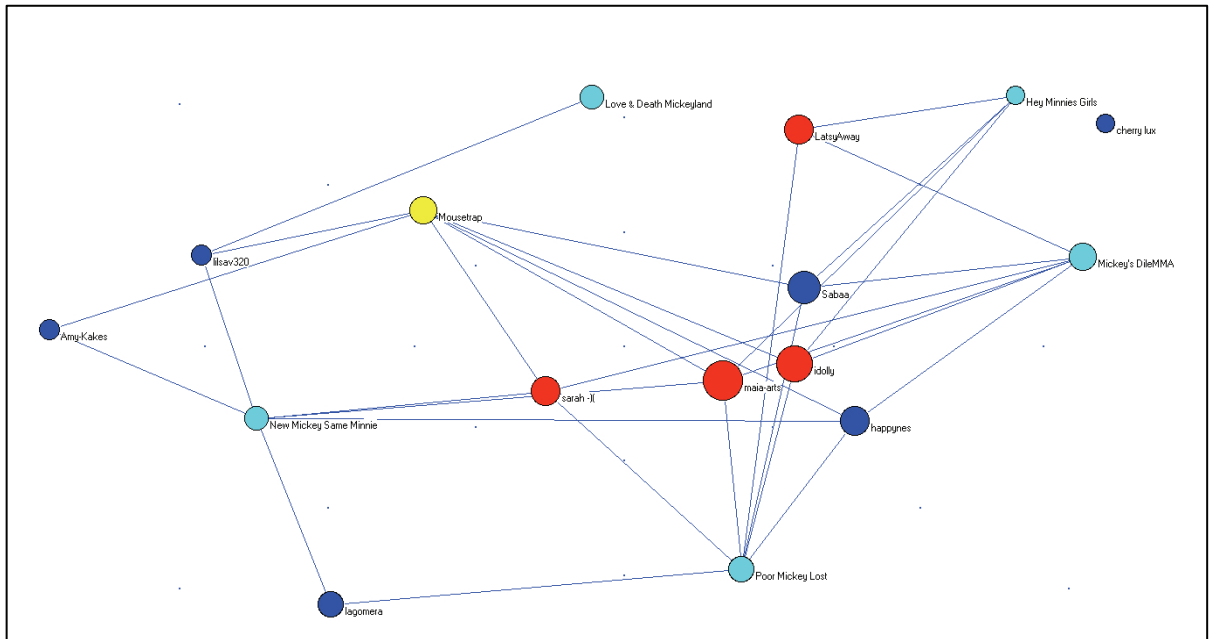
Figure 2 Hubs/authorities_T1

Figure 3 Hubs/authorities_T2

Figure 4 Polyvore sets: Top Left- a typical Polyvore collage (not Harry Lyme), Top Right - Harry Lyme's first collage set, Bottom Left- Influential Harry Lyme set created in T1, Bottom Right- Authority set created in T3 by Harry Lyme.

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