School Classroom Friendship Network Model

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Abstract

In school, students form peer group social networks. Some students become isolated and disengaged from their social networks for a variety of reasons. The survey to collect such relationship information is typically from the first-person point of view. However, it is easy for an individual to provide false information. We propose information provided by the third-person point of view as well. Considering such "social health" information can support a network-aware education, we would like to examine how the theory of social networks can be used to support group learning, and identify/intervene with students who have become isolated or to make it easier to identify if the student may have developmental disabilities.

クラスの交友関係ネットワークモデル

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アブストラクト邦訳

　学校生活のなかで児童生徒は仲良しグループのソーシャルネットワークを形成する。しかし、その過程でさまざまな理由で孤立し、ソーシャルネットワークを形成できない、またはグループから離れてしまう児童生徒もいる。このような交友関係の情報を収集するための調査は通常、一人称の視点で行われる。ただ、一人称の情報だけでは偽情報も考えられる。そこで、第三者の視点による情報も検討する。このようなソーシャルヘルスの情報に基づくネットワークを意識した教育を行うことで、いじめの被害者や孤立した児童生徒を特定して介入できるようになると期待される。また、本研究の方法は、児童生徒が発達障害である可能性について検討する上でも有効である。

キーワード：social network, victimization, first-person, third-person, point of view

Introduction

In school, students form peer groups. They learn from each other about relationships, society, and about themselves. However, in the process of peer group formation, some students may become isolated and disengaged from their peers for a variety of reasons. When isolation, bullying, or victimization occurs and it is neglected, there may be non-reversible consequences. In 2022, Japan had the largest recorded number of students who took their lives, which was over 500 students [MEXT, 2023]. While the reasons for the unfortunate outcomes are varied, the more information we have to prevent it the better. School or family stress could be the cause of students' mental health situation, but it could also provide us with clues for intervention and how to help those in need of support.

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The field of social informatics was formalized by overlaying the network structure to individual and social behavior [Kitamura, 2013; Kitamura, 2015a]. In order to identify and understand the social structure and dynamics, peer group relationships can be abstracted and represented by social networks [Kauffman, 2020]. Many of the destructive social behavioral problems seen today can be coped with better by using knowledge on social networks. In the studies of school social networks, it is assumed that the students answer the surveys honestly. The students are likely instructed to do so for accurate data. In reality, students may answer the survey honestly if they find the questions non-harming to themselves. However, if a student thinks that by answering the survey honestly, or in a way that describes a bullying/victimizing situation in class, they may answer with an alternative fact to evade blame or to blame somebody else to defend someone in their peer group because of loyalty. Additionally, answering such surveys can be used to attack a student which they do not like in order to ruin their reputation.

In a multi-agent system study, some agents may deliberately lead the team to a harmful consensus by influencing the rest of the agents or mislead the consensus formation to an unintended final state. These situations may occur in diverse scenes such as socio-economic situations [Acemoglu, 2013], average consensus [Olfati-Saber, 2004], and sensor deployment [Cortes, 2004]. Gupta [Gupta, 2006] studied possible scenarios of agent "failure" in the context of distributed algorithms. The first failure condition is a stopping failure [Lynch, 1997] where an agent blacks out and stops communicating with the other agents. The second failure condition is when a single agent value becomes stuck at a fixed state. Fagnani [Fagnani, 2014] showed that if the rest of the agents are non-stubborn, then the agents would converge to this fixed value agent. The third failure condition is when an agent continuously changes its state to erroneous values at every time step, either intentionally or unintentionally [Lynch, 1997; Lamport, 1982].

In a social context of stubborn agents, Acemoglu [Acemoglu, 2010] studied the spread of *misinformation* by using "*forceful*" agents in an agent value averaging model. Forceful agents are not completely stubborn, but under particular conditions they have a strong influence on some of their neighbors such that the terminal consensus value is diverted from the original consensus value without the forceful agents. Spread of misinformation is quantified by measuring the magnitude of this divergence. Additionally, depending on where the agent is located on the network structure, the agent's influence can be greater or lesser [Kitamura 2015b]. Where the agent settles in the network could be influenced by the property of the agent.

In this paper, we propose collecting information from students from the first-person point of view and the third-person point of view in a class network, in case there are students who refuse to answer honestly to the survey compared to the rest of the students in the class network. The proposed solution is to not only ask for students about their personal experiences (first-person point of view), but also ask for witness of bullying events or gossip information that they may encounter (third-person point of view). We would consider how the theory of social networks can be used to support group learning, and identify and intervene with students who have become isolated to create a network-aware education. By collecting and visualizing opinions from multiple angles within the social network, we can verify and double check on the validity of the collected information. We will also keep the survey simple such that we can keep monitoring the student's social health on a regular basis to observe the changes over time [Christakis, 2007].

Method

In a school class relationship network, nodes represent the students and links represent the relationships between the students. Since the network represents the sentiment of each student toward other students, we will use a directional graph where the sentiment direction is from the source student to the target student. The quality of the relationship will be expressed in three levels: an affectionate sentiment (good friend), neutral sentiment (acquaintance), a negative sentiment (difficult friend). These different sentiments can be expressed by different colors of links. See Figure 1.

The first-person point of view questionnaire can ask if their relationship with each of their peers is [positive/neutral/negative]. We can use other wording such as [friendly/normal/difficult to socialize with (or not good at socializing)] or [good friends/indifferent friends/bad friends]. Depending on the question we ask, we could potentially notice other characteristic properties or developmental disabilities. The answer to the questionnaire will be something like the following.

> Toward A, I have [positive/neutral/negative] sentiments.
> Toward B, I have⋯
> Toward C, I have ⋯

and so on for the entire class. For the first-person point of view, we can also include a self-evaluation, that is, how they feel about themselves or about their self-image. If they feel "positive" about themselves, that is great. If they feel "negative" about themselves, that can be a sign of depression or they need some assistance to make them feel better. Another important aspect is for students to write the reasons why they feel negatively about their peers or about themselves. It is helpful to get qualitative information so we will know better how to intervene and assist students who are feeling negatively.

The third-person perspective questionnaire can ask similar questions as the first-person point of view. A third party's perspective may be about witnessing negative events (bullying) or rumors of such events. Some example answers to the questionnaire will be something like the following.
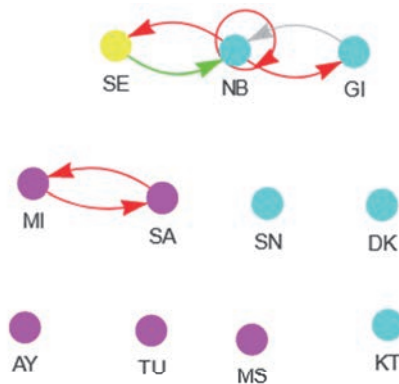

Figure 1. A peer network based on the sentiment of each student (first person point of view). The yellow circle is the school teacher SE, The pink circle is a girl student, the turquoise circle is a boy student. The impression of a good relationship is green, a neutral relationship is gray, and a bad relationship is red. Students with no connections mean they are on either good terms or neutral terms.

> A appears to have [positive/neutral/negative] sentiments towards B.
> B is [good friend, average friend, has difficulty getting along with] C.
> C is [good friendship, normal friendship, bad friendship] with D.
> D [likes/dislikes] E.
> E is [happy/unhappy] with E. (Self-referencing.)

The first-person information is for the entire class, but the third-person information is based on eyewitness information and rumors, so a student will only provide information they have. We are not concerned about happy or positive students, so we will gather information mainly about negative incidents that may require assistance. The reporting can include negative sentiments of their peers about themselves. Therefore, there can be a self-referencing answer such as "E is unhappy with E." as we see above. This may help identify peers who may have talked about harming themselves.

With regarding to the resulting social network, since we have a complete network where all students answer about the relationship with their peers, the network will become very crowded with information. We will not visualize good relationships and neutral relationships, unless the relationship is returned by a negative sentiment, because we are mainly focused on negative sentiment among the peers.

Results

Figure 1 shows a hypothetical classroom case where there is one teacher SE (yellow circle) and a total of 10 students, five girls (pink circles) and five boys (turquoise circles). Good and neutral relationships are not included in the network because the network would be flooded with directed links (arrows) and the essential information would be lost. We are interested in identifying potential relationship problems. Therefore, arrows that indicate negative sentiments (red) and arrows that reciprocate to the negative sentiments, either positive (green) or neutral (gray), are also included to understand the context of the social dynamics. We have also included a negative self-evaluation, which is indicated by a self-referencing red arrow. This represents a dissatisfaction with themselves that could be due to dissatisfaction about school or low self-esteem. This student network represents a tally of all of the first-person point of view information.

In Figure 1, the teacher SE thinks he has a positive relationship with the student NB. However, student NB feels negatively about the teacher SE. NB also feels negatively about his peer student GI. Additionally, NB feels negatively about himself. The reason why NB feels negatively about SE or GI can only be determined by comments or an interview with NB. However, we can hypothetically generate a story such as NB is intimidated by the teacher SE because he is not performing well academically and teased by his peer GI for the same reason and therefore NB does not feel good about himself. In the survey, we can also include a meta-evaluation target such as "school" or "the environment" so that we can clarify what the cause of stress may be.

There is also a reciprocating animosity (negative sentiment) between MI and SA. Although the cause of the negative sentiment is unknown unless we read their comments, the resulting fact about the mutual animosity can be identified from the social network. The remaining students' directed links are not shown because they were either positive or neutral.

Figure 2 shows a result from a third-person point of view. The peer network is based on the information provided by MS, which is marked by a rectangle in the figure. The source of information could be based on witnessing a negative event (bullying), hearing complaints from a victimized peer (bullying or depression), or hearing gossip about such events from other peers. Therefore, there should be no directed links between the peers and the student answering the survey (the informant), unless the gossip involves the informant.

In Figure 1, even through the only person who expressed negative sentiment about GI was NB, in Figure 2 many students dislike GI according to MS. Some information is common between Figure 1 and 2, such as the positive or neutral relationship of MS and DK with the rest of the peers, and the negative reciprocating relationship between MI and SA. MS is also reporting a negative reciprocating relationship between SN and KT. The negative relationship which NB has with SE and GI is not detected by MS. However, MS knows either directly or indirectly that AY has a negative sentiment about herself. Again, the reasons for the sentiments can only be known by comments or interviews.

Discussion

A social network is a good method to visualize the relationships and dynamics of students in classrooms. Not only does it provide visual clues about the sentiment among the students, but based on the structure of the network, we can identify where and between who we can intervene [Cavill, 2004; Christakis, 2008; Heaney, 2008; Moore, 2011; Valente, 2012]. Although student networks can help us visualize the structure of relationships, we can quantify the relationships by assigning values to the positive/neutral/negative relationships [Veenstra, 2005]. For example, we can assign values such as positive = +1, neutral = 0, and negative = -1. Similarly, for the first-person point of view, if you have 10 students, you will have 10 networks (11 networks if we include the teacher). Assume the link of a complete network for 10 students is 100%, if only one person has a negative claim, it can be expressed
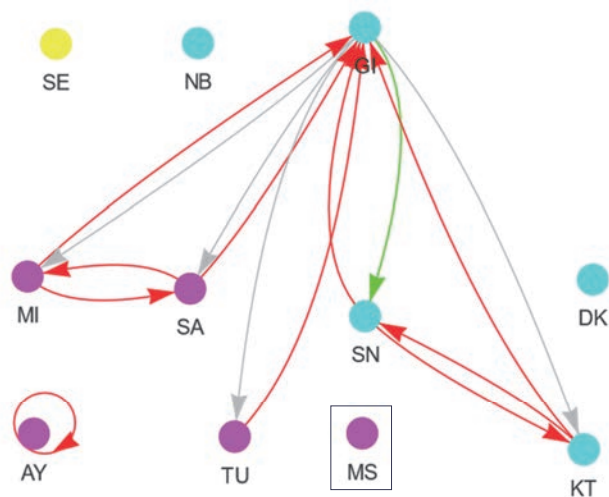

Figure 2. A peer network based on the third person point of view. This is the point of view from MS, which is surrounded by a rectangle. MS reported the negative sentiments among the peers which she is aware of (red arrows). The positive (green arrow) and neutral (gray arrows) sentiments are indicated as a response to the red arrows.

numerically as $1/10 = 0.1$. If two students' negative opinions overlap, $2/10 = 0.2$. The outcome could be normalized so that the results can be compared between different class sizes. When the sentiments are tallied, the quantitative results can be reflected in the network. For example, the greater the negative sentiment towards a particular student, the shade of the student's color or the student's node (circle) size can change.

As in the questionnaire answer example shown earlier, the questions should be simple and short so the time slice of the change in the social network over time can be obtained. It is vital to obtain qualitative data about the students' sentiments through written comments. The students need to write a comment about why they are feeling negatively about their environment or about their peer. They can give specific examples in the comment section. However, if only students with negative sentiments are asked to write comments, there may be more burden on and time consumed by students who have negative sentiments.

If the surveys are answered in class, the students who have to write more will take longer and stand out compared to the other students. Additionally, if the students fill it out in the classroom at the same time, their classmates will be able to see what they are writing. To prevent this, we could have five students write after school each day and tally the results at the end of the month. However, if there is a time difference in when the students reported the observed events, the state of relationships, and people's emotions, they may all change over the course of time. Therefore, although privacy is important, it is desirable to have a smaller time difference among the students of when to answer the survey. Since this is a time slice of the change in social dynamics, it is better to have everyone's timing as consistent as possible. The frequency can be once a month. If there is an emergency, we may want to increase the frequency of the survey. By answering inside the school, we can also avoid pressure from family and friends. It may not be a good idea for students to fill out their surveys outside of school, since the students can come together and pre-arrange their answers. The bully could pressure the victim into answering the survey to the advantage of the bully or even forcefully correct the answers of the victim to the bully's advantage to conceal any wrongdoing.

With respect to first-person point of view and third-person point of view, personal experience and witnessing information will have a higher priority and gossip information will have lesser priority. There may be bad actors in the class by intentionally providing false information. That is why it is important to consider information from different points of view. Some relationship information may agree, some may be neutral or unopinionated, and other information can disagree. This is another reason writing comments is important so we have qualitative information which we can evaluate. Another important aspect could be whether the individual students are trustworthy. Identifying prosocial students who are willing to help disadvantaged students may be important. [Kaufman, 2020].

If a student has problems with interpersonal relationships, we need to consider whether they have developmental disabilities instead of immediately treating them as a bad person. Additionally, the background or the upbringing in the family may also be a problem. To start with, we can examine the peer network within a school class. However, the scale of the social network can be expanded outside of the classroom to other classes within the grade (inter-classes), within the school (inter-grade), and to extracurricular activities, family and relatives, neighbors, etc. We can ask about the students' relationships with people in the local community. This may help identify people who put the children in danger.

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