Exploring the Antecedents and Effects of Structural Holes in Teenagers' Friendship Networks

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Abstract In the past two decades, the theory of structural holes that was proposed by Burt has become one of the most influential ideas in the field of social network analysis and has produced a great resonance in such existing literature, and yet its validity in other contexts such as that of the adolescents has yet to be systematically examined. Moreover, while scholars from the sociology of education and stratification have mainly focused on the beneficial impact of tripartite network cohesion between parents, teachers and students, the impact of the brokerage network position that adolescents occupy also remains unexplored. In this study we aim to fill this gap and conduct a multifaceted test on the idea by identifying the antecedents and effects of structural holes in teenagers' friendship networks. Our empirical data shows that structural hole levels are higher for boys, and that gender variation in this kind of network tendency appears to begin to form during adolescence. Analyses of psychological state have also found that the higher the level of teenagers' structural holes, the greater the self-affirmation, the greater the liking of being the focus of a group, the greater the sociability, and the greater the personal tendency to enjoy generating a group atmosphere. Moreover, our empirical analyses also show a positive influence of structural holes network upon academic performance and the psychological wellbeing of teenagers. All these features conform with those of the entrepreneurial social character as well as the instrumental effect of network position of which Burt spoke. Finally, we tried through path analysis on two psychological items to confirm the dialectical causal direction between structural position and personal psychological features, an issue

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that is unsettled within the literature or social networks. The evidence provides favorable but inconclusive support for the structural position. Overall, our empirical analyses largely confirm the major claims of Burt's structural holes theory in the context of teenagers, and supplement the tripartite cohesion argument of social capital from the Coleman research tradition.

6.1 Introduction

In the development of teenagers the influence of peers is often far greater than that of parents. Teenagers spend most of the time within the school environment, and especially in that of their own classes, and can spend as much as eight hours a day hanging around with their classmates (Yi and Wu 2004). In such a context, school life provides adolescents opportunities to make friends. During this period, apart from their studies, what most concerns them is how to find and keep good friends. Friendship is absolutely crucial to an individual's behavior. Because people need the affirmations and views of others of their behavior (Lindenberg 1990), and behave in accordance with other people's reactions to their behavior, most people are willing to spend a lot of time and energy managing their own social relations in order to gain the recognition of those around them. Previous research, such as that of Bukowski, Hoza, & Boivin (1993), predicted emotional adjustment among teenagers by means of such factors as the level of popularity, number of good friends, and quality of friendship, etc. Their research findings showed that friendships had a positive effect on the emotional adjustment of teenagers, and that, when teenagers' friendships were stable, their capacity for social adaptation was significantly greater. Berndt & Perry (1986), in research on children in grades two to eight, also found the external support effect of "friends" and "acquaintances" to be significantly different; friends provided greater intimacy and supportiveness than acquaintances. Also, some scholars have similarly pointed out that individuals' friendships are intimately related to their psychological well-being (Kirchleret al. 1995, Santrock 1998, Wu and Lei 2004, Wu and Huang 2011). All of these studies on teenagers' development illustrate the importance of teenagers' friendships; the friendship networks that are established in one's youth can be used not only to accumulate social capital, but often subsequently become an unconditional source of social support (Wolchik et al. 1987). Attempting to understand the nature of teenagers' friendship networks has in recent years been a central focal point in research on teenagers.

Discussion about teenagers' friendship networks, however, can be also viewed in another broader context of literature of social networks. In current theoretical debate about social networks, those who have reviewed the literature believe that the structural features in social networks can generally be divided into two types (Burt 2001, Walker et al. 1997). The first type emphasizes the cohesion of social net-

works and considers it best to occupy the central position of the network, this type of view mainly follows the traditions of social capital theory associated with the likes of Coleman and Bourdieu, holding that local social bonds will yield collective effects of trust and cooperation, and are often an important force for advancement of regional community development (Lin 2001). Another important type emphasizes occupying gaps in the overall structure of the network in order to gain the brokerage benefit of structural holes (Burt 1992). Occupation of central positions within the network is often associated with multiple relationships and the repeated interaction within small groups, while structural holes often emerge among social groups that are scattered and isolated from one another. Those who have reviewed the theories believe that these amount to two different types of social capital whose effects upon actors are also somewhat different (Burt 2001, 2005).

With regards to the formation of the youth social networks with which this study is concerned, existing literature has to a large extent explored the community-based cohesion of strong ties and the effect of such network structure in relation to the students' educational achievements. This research tradition began with Coleman's pioneering study and was later expanded upon by sociologists with extensive research in educational and social capital (Coleman 1988). This type of research usually finds that the closer the tripartite network between students, parents, and teachers, the more beneficial the effect on students' education (Chang 2008, Coleman and Hoffer 1987, Morgan and Sorensen 1999, Carbonaro, 1998). The empirical findings from such line of studies were, however, still predicated upon the perspective of cohesive social networks. Another kind of social capital effect to which the aforementioned reviewers of theories subscribed, namely the structural hole view, was nevertheless still an issue that was somewhat rarely tackled.

This study hopes to be able to expand this rarely researched issue, to explore factors influencing structural holes in teenagers' social networks and the effects that they influence in turn. This aspect will be able to complement traditional research on youth social networks only from the limited perspective of network cohesion. Moreover, through research on teenagers' friendship networks, it is also possible to add a number of issues worthy of elucidation from the existing literature on structural holes. This includes issues of the sequence of cause and effect between structurally-holed networks and personality, as well as whether validity of the structural holes theory can be extended beyond research in which mainly adult samples from large corporations are drawn, and enable us to gain a deeper understanding of the generative process of structural holes. Below, we first introduce the main arguments in research on structural holes, the major research questions raised in this study, report our research findings and finally discuss their possible contributions.

6.2 Research on friendship networks and "structural holes"

The theoretical concept of the "structural hole" on which this article focuses was first raised by Burt (1992). In related literature on social network analysis and organizational research of recent years, this concept achieved a great resonance as perhaps one of the most important classic concepts of the last two decades and is widely esteemed by scholars. Research verifying the use of the concept appears repeatedly in a wide range of fields, such as social networks, organizational research, and economic sociology. A network with structural holes is based on the premise of a social life: most social actors are used to interacting with a community with which they are well acquainted, and thus naturally form many small groups with relatives, neighbors, classmates, and colleagues, held together by close and intimate interpersonal bonds. Interpersonal relationships deriving from cohesive small groups are in fact embedded within a larger social world made up of large number of groups and interaction. Such a reality of social interaction creates many separated blocks of structural holes spaced between small groups and the dynamic process of social ties moreover, offers many opportunities for those spanning the *bridge* positions. In Burt's theories, such opportunities are located in the structural holes. If an individual's inter-personal connections are all mutually acquainted, this signifies that in the small circles in which one embeds oneself, one is always limited by the social group extrinsic to oneself. If the actors are rational actors skilled at calculating benefits of expected outcomes, their best strategy is to establish positions as bridges between the communities of different circles in order to become middlemen connecting different, small communities, and obtain the benefits of information and control. This structural advantage is what the structural holes theory expounds. The structural holes argument also echoes the so-called weak ties theory that the social actor's information advantage is usually obtained by avoiding closely connected groups (Granovetter 1973). From the perspective of empirical measurement, the lower the level of mutual acquaintance between the circles of social networks with which an individual connects, the lower the redundancy, and the greater the possibility of structural holes; proponents of the structural hole theory usually calculate the levels of such constraints upon networks through the egocentric name generator (Burt 1992).

The structural holes theory makes strong claims about instrumental effect. According to a series of studies by Burt on US society, actors with higher structural holes are not only more easily promoted, but also more likely to readily possess creative ideas within organizations (Burt 1992; 2005). There has been an increasing trend in recent years toward repeat testing of all aspects of structural holes. Apart from this, Burt investigated individual characteristics and psychological factors that affect structural holes. A notable example is gender difference. Burt discovered that in large organizations in the US, there is an issue of inequality of gender distribution in the distribution of social capital (Burt 1998). Women are usually a more vulnerable community within the organization, with somewhat limited relationships constrained within the scope of small groups. This is mainly

because female gender culture results in frequent interaction between people of the same gender, with a high degree of intimacy, but which remains somewhat closed. Burt discovered that in this kind of situation in which the genders are separated and the distribution of social networks is uneven, promotion of women usually depends on borrowed social capital, obtained from senior or power-possessing men.

Also, research by Burt, Jannotta, & Mahoney (1998) has explored the relationship between personality traits and the characteristics of social networks, especially whether personality traits differ with the network positions of each person's structural holes. In Burt's arguments, people with a broad and loose social network are not only good at maintaining strategic social relationships, but may also possess different personality traits. In his theory (Burt 1992), people stationed in the network position of structural holes usually possess the positional advantage of information and control. But this kind of structural position often also places them in situations in which ambiguity jeopardizes coordination and even causes conflicting opinions because consensus is difficult and reciprocity not promptly returned. Clearly it is a situation not characterized by the stability and security which most people desire. From the survey data of sampled students of the Booth School of Business at the University of Chicago, Burt discovered that respondents with broader and non-overlapping networks (so-called higher "structural holes") are usually more independent, more out-going in spirit, and will in changing environments actively seek organizational authority and opportunities to lead, and even encourage group morale and momentum for reform. In contrast, people accustomed to network positions within small, intimate groups, tend to obey organizational rules, seeking security and stability. To put it another way, individuals who occupy structural holes positions have more adventurous personalities (Burt et al. 1998).[1]

The research of Burt et al. (1998), however, still leaves one issue unresolved with regards to the causal direction between personality traits and network structures. In the end, is it network structural positions that affect personal psychological attitudes? Or is it personal factors that cause individuals to develop a certain specific type of network relationship? From the perspective of theoretical implications, this is a test of basic assumptions about "structural analysis," which network research has traditionally advocated the conditioning impact of social structure upon individual agency. Burt himself, however, has held ambivalent opinions in his different writings on this issue. In the research of his early years (1992: 35-7), he adopted the position of extreme structural theory, even suggesting skipping the debate on personal psychological motivations and viewed networks as, at one and the same time, personal social actions and indicators of psychological motivation. He believed that once external structures provided more opportunities for structural

[1] Kadushin (2002) discussed the personality traits behind network closure and structural holes; he considers individuals that seek security will build closed network whereas individuals who seek instrumental utility will be inclined to build structural hole networks.

holes, the possibility of personal strategic utilization of this opportunity would naturally rise. To put it another way, the two things, opportunity and motivation, are one and the same (Burt 1992: p. 37). In his later research (Burt 1998), he adopted a compromised position, holding that it was possible that there was a relationship of mutual cause and effect between the two; social networks with structural holes possibly facilitated the development of a person's adventurous personality, or, conversely, a person with an adventurous personality will establish a network with the characteristic of structural holes. His research revealed that network structures and psychological characteristics have independent effects upon the performance of managers; the results of empirical analysis imply that these two cannot substitute one another. (Burt et al. 1998: pp. 84)

6.3 The orientation of the structural holes in teenagers' friendship networks

Through empirical analysis of teenagers' friendship networks, we have the opportunity to deepen and further our understanding of structural holes. This chapter, however, is not concerned with the social networks of adults; on the contrary, through analysis of the social networks of teenagers we hope to explore the trajectory along which social networks are generated and developed. Current research on social networks usually views networks as structural forces and as holistic mechanisms possessing more constraining power upon individuals. If the development of social networks was structural in character, would the form of this social ability exhibit a generative process of development, and, if so, when would it start to germinate and become structurally fixed? Currently most existing research on structural holes is mainly concerned with adult networks and its original concept possesses a profound element of strategic calculation. Empirical research also mainly uses managers of entrepreneurial organizations as the objects of its analysis. In contrast, we are taking teenagers as the main objects of our analysis, which will help in further understanding the formative process of this kind of strategic networking ability as current studies ignore.

In this chapter we aim to answer the following two major questions: first of all, once we survey teenagers' social networks through the dynamic perspective, an interesting issue is: when teenagers construct their friendship networks, are they already able to do so rationally and through strategic calculations? Or they are still relatively naive and unable to develop friendship networks with a strategic and calculated mindset? Although the scholarly community broadly agrees that friendship networks are crucial in youth, research on structural configuration in teenagers' friendship networks remains extremely scarce (Hirsch and Renders 1986). To the extent that a convergent theoretical perspective has yet to be formed, this merits our investigation. Currently, most scholars believe that because friendships forged in one's youth are not the result of utilitarian considerations. As teenagers

make friends wholeheartedly and with no element of scheming, the friendship networks formed in one's youth are more intimate and less intended for benefit than those which one makes in one's later adult life. As such, interaction at school often breeds the strong ties of close friendship. According to this view, the "structural holes" phenomenon should rarely exist in the friendship networks of teenagers. To put it another way, such a view holds that the stage of personal development of teenagers remains in a relatively innocent state; in constructing their friendship networks, they are not yet adept at making strategic considerations. On the other hand, there are those who believe that the friendships that people construct before they become adults amount not only to games with unintended positive outcomes, but decisive, critical aspects of their experience; teenagers who mature relatively early may already have the ability to perceive the locus of the opportunities or benefits in their friendship networks, and can in a timely fashion move to occupy a relatively good structural position, and extract the benefits of the network structure. Which of these two theories is most credible is an appropriate matter for testing by the empirical analysis of the current study.

Secondly, from the perspective of the dynamic development of the social network, friendships in the course of one's life are in fact the product of a process of constant making new and breaking old ties. Each person's social network always has new friends entering it and old friends leaving, resulting in constant changes to friendships. Imagining the first meeting with a person within a constrained context, for instance, a class, one major concern of the ego is to get to know others, to achieve a friendly level of rapport with them, and on the whole, to have a good time (Van de Bunt et al. 1999). However, relationships may also dissolve having run their natural course. The complete stages of friendship may start from unknown to neutral state, then progress in different transitions from the best and closest friends, to a troubled relationship, and even to the direction of final dissolution (Van de Bunt et al. 1999), which points to the network dynamics over time and depicts the processes of how individuals within the networks decide to initiate, establish, maintain or dissolve their relational ties with one another. As a result, changes in relationships among teenagers arise along different trajectories of time and place, and the structural effects more than often play a role in the dynamic process of such friendship formation (Wu and Huang 2011, Van de Bunt et al. 1999). In such processes, we are interested in explaining the dynamic changes determined partly endogenously as a function of the network structure itself, and also partly derived as a function of the characteristics of the adolescents and of their mutual dependence, attempting to investigate into issues as follows: do structural elements of friendship networks (such as structural holes, transitivity or reciprocity) force teenagers to become tied together involuntarily, or are there certain personal characteristics causing teenagers to tend towards certain structural positions within the friendship network? Will these structural elements and personal characteristics, moreover, continue to interact with each other in the dynamic development of the teenagers' friendship networks?

In recent years, many research papers published have been devoted exclusively to investigating continuity and change in friendship networks. Degirmencioglu *et*

al. (1998) stressed continuity and change in the friendship networks of high school students. Van Duijn, Zeggelink, Huisman, Stokman, & Wasseur (2003) in their paper explore how freshmen in their first year of university blend into their individual friendship networks. These two studies observe drastic changes in friendship networks over the course of time, and are crucial to research on continuity and change in friendship networks. While in Taiwan, Hsieh, Wu, & Lei (2006) and Huang (2011a) revealed that adolescents' friendship networks were dynamic rather than stable. Hsieh et al. furthermore remind us of the crucial effect of classroom characteristics on adolescent friendship behavioral similarity. Researchers also analyzed the features of teenagers' friendship networks and how they are linked with adolescent developmental trajectories (Wu and Lei, 2001, Wu and Lei 2004, Wu and Huang 2011, Huang 2011b), showing the great affection of the reference group on the adolescent's well-being or behavior. Chen and Astor (2011) moreover concluded that Asian adolescents are more likely to be influenced by their friends' peer groups. In short, these studies adopted network and behavioral data to capture the changing and unstable nature of Taiwanese students' social relations over time, and then on the long-term relationship between friendship networks and adolescents' behavioral dynamics in bounded classrooms. These findings pointed out the fact that ongoing social relations with age-mates in school are what the individuals could select and control, rather than a structural factor of constraint upon individual's action. School life provides adolescents opportunities to make friends, and the school context is viewed by proponents of positive psychology as an important personal resource and a crucial protective mechanism for positive adaptation, which may influence and decrease the likelihood of problems or risky behavior (Fredrickson 2001, Pollard et al. 1999).

To sum up, how teenagers occupy special positions in their friendship networks, and how such network positions dynamically affect the development of teenagers' behavioral outcomes remain issues that current academic research are extremely keen to explore. Empirically, the current study explores the following main aspects from the perspective of theories on structural holes. First, which individual features, such as gender, ethnic group, family background, etc., influence the formation of teenagers' structural holes, and how? Previous research has usually used adults as its research samples, and shown that seniority within an organization, power and rank, are factors influencing the features of social networks such as structural holes. As far as this is concerned, teenagers' social-demographic attributes somewhat rarely present themselves as factors of interference compared to that of the organizational studies, and viewing the school more as a natural setting for a social experiment for teenagers' social networks helps us to understand the process by which the network capacity of, for example, structural holes is generated. Next, we are curious as to whether teenagers' social networks are related to variables in personal traits, as existing literature has already discovered. Do the teenagers with structural holes in their social networks present the characteristics of a relatively optimistic, extrovert, power-seeking, and also adventurous spirit of which the literature describes? Thirdly, we try to understand the connection between the features of the structural holes of teenagers' social networks, their

school activities and performance. In particular, do the structural positions which teenagers occupy in their friendship networks influence their academic performance and the development of their mental and physical health? Since the structural holes theory presents a strong claim about the link between network position and personal achievement, we are curious as to whether this kind of connection also exists in the school environment, in which academic results constitute personal performance. Previous research mainly follows the tradition of Coleman, placing particular emphasis on discussing the influence of network closure between parents and school teachers upon children's academic performance. Our research, however, begins from the alternative perspective of structural holes, in the hope of making good some of the shortcomings of the previous literature. Fourthly, we explore whether the features of structural holes in social networks possess long-term stability. In Burt's theory, an individual actor occupying structural holes is basically situated in the position of a middleman in his social networks, the superiority of his network position is founded mainly upon the estrangement between each community, so as soon as this actor, enjoying the benefits of brokerage, connects these communities which have no contact with each other, the estrangement within the overall structure rapidly fades away. To put it another way, just as Burt says, structural hole positions are characterized by being richly profitable but decaying rapidly (Burt 2001, 2005). As far as maintenance of social networks is concerned, this requires long-term positioning within advantageous positions, and that requires continual effort and fine calculation, which, unfortunately, is not easy. What we are curious about is whether, in the friendship networks of teenagers, occupation of structural hole positions is stable or fluid. Currently, issues of how structural hole positions change with time and of their long-term shape are still very new. We hope in the current study, using longitudinal data, to conduct a preliminary exploration. Finally, by adopting a strategy of path analysis we hope to explore possible directions of cause and effect between network position and psychological attitude. In this way, we hope to be able to shed light on what is important and what isn't in the debate about social structure and personal traits bestowed upon us by the above-mentioned theoretical literature. Does structure influence personality or does personality influence structure? We believe that a community going through the stages of personality development presents an appropriate opportunity to examine this issue. In particular, the current study's longitudinal data collection research design assists us in exploring and confirming this causal link.

6.4 Research data, methods and variables

6.4.1 Research sample

Our study used panel data on the same group of children at a junior high school over a continuous three-year period; this study included data on friendship networks, state of physical and psychological health, records of in-class and out-of-class activities and variables on the teenagers' individual psychological traits. This data came from the *Taiwan Youth Project* (TYP), a research study on the process of development of teenagers in Taiwan. The research was a longitudinal study. Its sample respondents were first-year students from junior high schools in Taipei County, Taipei City, and Yilan County in the year 2000, in which students filled out questionnaires and were interviewed in person. The study combined three waves of data, that from the sample of teenagers from year one to year three of junior high school. This generated a sample of 2,844 people. The study adopted the list-wise method to delete observations with missing values and the eventual number of observations that was analyzed totaled 2,378. The main variables analyzed by the study included the variable, structural holes in teenagers' network positions, basic demographic variables as well as variables related to individual psychological characteristics, etc. This study primarily analyzed data from the first wave. When investigating the stability of network features and the issue of the causal connection between networks and psychology, analysis was conducted using data combined from the three phases. As such, there are slight variances in the sample sizes.

6.4.2 Measurement of variables

6.4.2.1 Indicators of structural holes

With regards to the measurement of the core concepts of this study, i.e. the structural holes, Burt himself proposed three types of measurement methods: redundancy, constraint, and structural autonomy (Burt 1992: pp. 50-81). In our study we adopted constraint, the method used by Burt himself and that is used most often in research literature. The extent to which an individual is constrained within a network is mainly influenced by two factors: one is the time and effort invested in the link between an individual (*ego*) and another (*alter*) while the other is the strength of the mutual links between the *ego* and the many *alters* whom he connects. Burt

believed that the *ego*'s structural hole opportunities would be severely constrained if there were closed links between a certain *alter* (j), whom the ego had invested much effort and time, and a third person (q). In the example presented in Figure, i. represents *ego*, j. *alter* and q. a third person. Although i. and j. have a network connection, the relationship by which i. influences j. is deeply influenced by the third person, q. As in the illustration, since the three persons, i., j., and q. are all simultaneously connected, no structural holes are generated between i. and j. From the perspective of individual network deployment, if i. invests almost all of his relationship in j. and all of i's third personal relationships are ultimately connected with j., then i. can be said to have almost no opportunities to manipulate structural holes in relation to j.

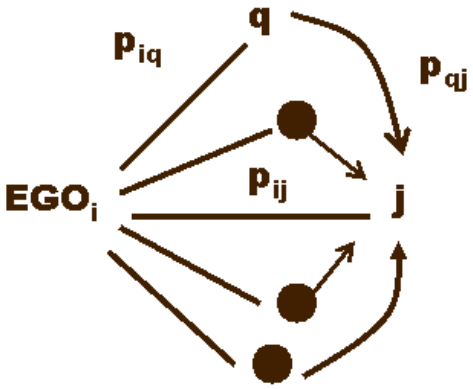

Fig. 6.1 The constrained network structure for an individual (*ego*) and another (*alter*)

On the basis of the above logic, the constraint C_{ij} of the network can be expressed as follows (Burt, 1992:55)

$$C_{ij} = \left(p_{ij} + \sum_{q} p_{iq} p_{qj} \right)^2 \tag{6.1}$$

In which q≠i, j and $\boldsymbol{P_{ij}}$ is the ego i. in the proportional strength of the relationship connections invested in j.; $\boldsymbol{P_{iq}}$ is the proportional strength of i. and q. in relationship connections, $\boldsymbol{P_{qj}}$ is the proportional strength of j. and q. in relationship connections. Burt used this indicator to judge the extent to which the network relationships invested by an *ego* in an *alter* are simultaneously constrained in existing connections given in return by a third person to the *ego* and the *alter*. The higher the numerical value of this indicator, the lower the structural hole, implying that the less opportunity the ego has for manipulation, and the more likely he is to be controlled by the requirements of others (Burt 1992: pp. 54-55).

6.4.2.1 Social demographics variables:

In order to explore the factors influencing structural holes in networks, the current study considered the following important socio-demographic variables.

1. Gender: The original options in the research question on gender were (1) boys (2) girls. In the current study, when analysis was conducted, (2) was changed to (0), with the result that (1) represents boys and (0) represents girls.
2. The household income question asking monthly household income of the respondent contained a total of 13 options, as follows: (1) Less than NT$ 30,000, (2) NT$ 30,000-49,999, (3) NT$ 50,000-59,999, (4) NT$ 60,000-69,999, (5) NT$ 70,000-79,999, (6) NT$ 80,000-89,999, (7) NT$ 90,000-99,999, (8) NT$ 100,000-109,999, (9) NT$ 110,000-119,999, (10) NT$ 120,000-129,999, (11) NT$ 130,000-139,999, (12) NT$ 140,000-149,999, and (13) over NT$ 150,000
3. Educational level of father: the original options were (1) elementary school, (2) junior high school, (3) senior high school, (4) senior vocational high school, (5) junior college, (6) university, (7) graduate school, and (8) uneducated. When the data was analyzed, these options were recoded as (1) uneducated, (2) elementary school, (3) junior high school, (4) senior high school, (5) senior vocational high school, (6) junior college, (7) university, and (8) graduate school.

6.4.2.3 Psychological traits:

As psychological trait variables, the current study used measurements of the following nine questions:

1. I am unable to resolve certain personal problems: (1) strongly agree, (2) agree, (3) disagree, and (4) strongly disagree.
2. I feel helpless having to deal with all of life's problems: (1) strongly agree, (2) agree, (3) disagree, and (4) strongly disagree.
3. I am very satisfied with myself: (1) strongly agree, (2) agree, (3) disagree, and (4) strongly disagree. In analysis, these options were changed to (4) strongly agree, (3) agree, (2) disagree, and (1) strongly disagree.
4. Sometimes I think I am worthless: (1) strongly agree, (2) agree, (3) disagree, and (4) strongly disagree.
5. I like to be the focus of attention in a group: (1) strongly applies, (2) applies, (3) doesn't really apply, and (4) strongly doesn't apply. These options were changed at the time of analysis to (4) strongly applies, (3) applies, (2) doesn't really apply, and (1) strongly doesn't apply.
6. How satisfied are you with your personal affairs?--Relationships with classmates and friends: (1) very satisfied, (2) satisfied, (3) not very satisfied, and (4) very dissatisfied. These options were changed at the time of analysis to: (4) very satisfied, (3) satisfied, (2) not very satisfied, and (1) very dissatisfied.

7. How satisfied are you with your personal affairs?--Relationships with class teacher: (1) very satisfied, (2) satisfied, (3) not very satisfied, and (4) very dissatisfied. These options were changed at the time of analysis to: (4) very satisfied, (3) satisfied, (2) not very satisfied, and (1) very dissatisfied.
8. How satisfied are you with your personal affairs?--Appearance: (1) very satisfied, (2) satisfied, (3) not very satisfied, and (4) very dissatisfied. These options were changed at the time of analysis to: (4) very satisfied, (3) satisfied, (2) not very satisfied, and (1) very dissatisfied
9. How satisfied are you with your personal affairs?--One's gender: (1) very satisfied, (2) satisfied, (3) not very satisfied, and (4) very dissatisfied. These options were changed at the time of analysis to: (4) very satisfied, (3) satisfied, (2) not very satisfied, and (1) very dissatisfied

6.4.2.4 Academic performance:

Here in the survey the original item measuring the academic performance of the teenagers was "How were your average results for the last semester?" The options were: (1) within the top five in the class, (2) between sixth and tenth in the class. (3) between eleventh and twentieth in the class, (4) between twenty-first and thirtieth in the class, and (5) below thirtieth in the class.

6.4.2.5 Depressive symptoms:

Students in the sample of respondents in all completed a depressive symptoms scale within the questionnaire. This scale was a 5-point scale, with answers from 1 to 5, where 1 represented "no symptoms," and 5 represented "symptoms present and very severe." As regards the 16 main symptom items shown on the scale: in accordance with this table, respondents answered as to whether they had been troubled by any of the 16 symptoms within the previous week. In the current study, the original item 1 was changed to 0, representing "no," and the original items 2 to 5 were changed to 1, representing "yes." Here we add up the total numbers that respondents answer positively to the 16 questions and make it a continuous variable.

6.5 Results of analysis

Table 6.1 presents the correlations between all the variables in the current study. On the basis of Table 6.1, we discovered that the positions of young males in friendship networks contain a relatively large number of structural holes. This is consistent with Burt's research findings on large business organizations (1998).

Such finding reflects the fact that boys' networks tend to be relatively open and expansive, while girls' networks are relatively cohesive but closed. Apart from this, teenagers' household backgrounds have little relationship with the structural hole make-up of their network position (which has no connection with household income or father's educational level). What is interesting is that the more good friends teenagers make, the more likely it is that they will be stationed in the positions of the structural holes in their networks. The more satisfied teenagers are with their relationships with their classmates and friends the lower the constraints presented by their network structure. What is even more interesting is that the more satisfied teenagers are with their relationship with their teacher, the higher the structural hole make-up of their position in the friendship network. Similarly, the more satisfied teenagers are with their appearance (looks, gender, etc.), the higher the structural hole make-up of their position in the friendship network. Finally, with regards to personal psychological features, the more self-assured teenagers are (the more they believe themselves to have mastered how to solve their own problems, the more satisfied they are with themselves, the more they don't believe themselves to be worthless, the more they like to be the focus of group attention, even hoping to obtain the opinions of significant others) the more easily they occupy the structural hole positions in friendship networks.

Generally, in the structural positions of friendship networks, teenagers whose structural hole make-up is relatively high are also more outstanding in the performance of social skills. Apart from the evidence we found, we also discovered some additional interesting information. If a young person serves as a class monitor, for example, the structural hole make-up of his network position is also relatively high. This resembles the positive impact of internal power positions upon structural holes within organizations in Burt's research. The data also shows that teenagers who live in the households with more family members tend to have higher structural hole make-up, that relatively more of such teenagers have higher numbers of good classmates, relatively more of them have classmates who have been to their homes, and that they have relatively good relationships with teachers, classmates, and their family members. These findings may imply that the social skills for dealing with different manifestations of social relationships may be an important reason for the formation of structural holes networks. Fundamentally, these findings conform with the personality traits expounded by Burt (1998).

Table 6.1 Correlations of network constraints and related variables (N=2378)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
(1) Constraints on network structure position	1															
(2) Gender (female=0)	-.113**	1														
(3) Approximate monthly household income	-.013	.013	1													
(4) Educational level of father	-.028	.019	.310**	1												
(5) Among the students in your class, with approximately how many are you very friendly?	.129**	.039*	-.090**	-.053**	1											
(6) How many people do you know from the other classes in your year at school?	-.010	.008	.058**	-.047*	-.163**	1										
(7) Do you often worry that you are not popular with your classmates?	-.030	.189**	.018	-.042*	-.199**	.094**	1									
(8) Relationships with classmates and friends	-.096**	.075**	.040*	-.053**	-.365**	.103**	.278**	1								
(9) Relationship with class teacher	-.077**	.022	-.007	.002	-.134**	-.024	.091**	.308**	1							
(10) Appearance	-.063**	.142**	.062**	.034	-.191**	.055**	.226**	.355**	.310**	1						
(11) One's own gender	-.048*	.208**	.048*	.033	-.092**	-.001	.087**	.263**	.211**	.333**	1					
(12) I am unable to resolve certain personal problems	-.043*	.009	-.027	.019	-.064**	.029	.133**	.058**	.039*	.072**	.054**	1				
(13) I am extremely satisfied with myself	-.055**	.091**	.051*	-.004	-.191**	.074**	.191**	.330**	.211**	.393**	.253**	.077**	1			
((14) Sometimes I think I am worthless.	-.042*	.033	.045*	.053**	-.149**	.047*	.181**	.129**	.130**	.187**	.102**	.251**	.192**	1		
(15) I like to be the focus of attention in a group	-.061**	.078**	.085**	.037	-.130**	.101**	-.024	.115**	.063**	.143**	.093**	-.033	.169**	.019	1	
(16) When I make plans, I like to obtain ideas from people I respect.	-.047*	-.072**	.065**	.086**	-.123**	.051**	-.066**	.134**	.170**	.114**	.146**	-.002	.187**	.049*	.247**	1

Note: * $P < .05$ ** $P < .01$ *** $P <$ **.00**

Regression analysis of the structural holes presented in Table 6.2 showed several important findings. First, in terms of social demographic variables, compared with those of females, the structural hole make-up of the friendship network is relatively higher for males (i.e. there are fewer constraints on their network structure, β= - .115, p<.01). The characteristics of the friendship networks of males may tend to be open and expansive, while those of females, since they are mainly small, intimate groups, tend to be cohesive and closed. Teenagers' household background, moreover, appears not significantly to affect their structural position in their friendship networks. This being so, teenagers' household income is fundamentally irrelevant, as is the father's educational level. We discovered in the regression analysis of Table 6.2 that once we had controlled for other variables, the father's educational level no longer had any influence upon teenagers' structural position in friendship networks. Table 6.2 also reveals that the more close friends teenagers have in their own class, the more likely that they will occupy structural hole positions (β= - .113, p<.01.). With regards to the regression analysis of the influence of teenagers' psychological traits upon their structural hole positions, the numbers showed that, in relation to several variables of psychological trait, only the item, "I am unable to resolve certain personal problems," had a slight influence upon structural hole position (β= - .046, p<.10). To put it another way, in our sample, the more teenagers possessed the self-confidence to resolve problems, the more able they were to occupy structural hole positions in friendship networks. Finally, when teenagers were able to maintain relatively close relations with their teacher, they were often more easily able to occupy structural holes positions in friendship networks (β= - .045, p<.10), although the effect was not as significant as those of gender or numbers of close friends.

The simple regression analysis in Table 6.3 aims to examine whether the constraints on teenagers' friendship networks have a critical effect on teenagers' academic performance. This examination is particularly significant in relation to the instrumental effect that structural holes theory claims to possess. Results of analysis of the data in Table 6.3 clearly indicate that having controlled for gender factors, the higher the constraints on the structural positions occupied by teenagers in their friendship networks (i.e., the lower the structural hole make-up) the less perfect their academic performance tends to be (β= .126, p<.01). Table 6.3 also shows: items of interaction between gender and constraints (the opposite of which are structural holes) have no significant impact. This means that the network effect for boys and girls is the same: only when the structural hole make-up is relatively high in their friendship network will their academic performance tend to be good. At the same time, Table 6.3 shows that the academic performance of boys appears to be a little better than that of girls (β= .130, p<.01). This may be that structural hole make-up of boys' in friendship networks is indeed more prominent than that of girls.

Table 6.2 Regression analysis of network constraints

	Unstandardized Coefficients		Standardized Coefficients	
	B	Std. Error	Beta	t
(Constant)	.675	.054		12.547
Gender (female=0)	-.053	.010	-.115***	-5.172
Approximate monthly household income	.001	.002	.010	.451
Among the students in your class, with approximately how many are you very friendly?	.031	.006	-.113***	4.785
How many people do you know from the other classes in your year at school?	.002	.003	.016	.723
Do you often worry that you are not popular with your classmates?	.009	.006	.034	1.465
I am unable to resolve certain personal problems	-.014	.007	-.046	-1.908
I feel helpless having to deal with all of life's problems	-.003	.007	-.009	-.368
I am extremely satisfied with myself	.003	.008	.010	.409
Sometimes I think I am worthless.	.000	.006	.000	-.004
I like to become the focus of attention in a group	-.008	.006	-.032	-1.422
When I make plans, I like to obtain ideas from people I respect.	-.009	.008	-.026	-1.157
Relationships with classmates and friends	-.011	.009	-.032	-1.269
Relationship with class teacher	-.014	.007	-.045	-1.933
Appearance	-.003	.007	-.010	-.379
One's own gender	.008	.007	.024	1.030
Educational level of father	-.003	.004	-.017	-.772

Note: * *P*<. 05 ** *P* < .01 *** *P* < **.001**

Table 6.3 Regression analysis of academic performance and network constraints

	Unstandardized Coefficients		Standardized Coefficients	
	B	Std. Error	Beta	t
Constant	2.427	.098		24.700
Constraint	.670	.148	.126***	4.543
Gender (female=0)	.324	.133	.130*	2.432
Gender * Constraint	-.071	.208	-.019	-.341
R^2=.024				

Note: N=2378 * *P* < .05 ** *P* < .01 *** *P* < **.001**

Table 6.4 Regression analysis of depressive tendencies and network constraints

	Unstandardized Coefficients		Standardized Coefficients	
	B	Std. Error	Beta	t
Constant	24.372	.609		40.034
Constraints	-.667	.912	-.020	-.731
Gender (female=0)	-3.577	.827	-.233***	-4.324
Gender * Constraint	3.130	1.289	.134*	2.428
R^2=.016				

Note: N=2378 * *P* < .05 ** *P* < .01 *** *P* < **.001**

Table 6.4 examines the relationship between constraints in teenagers' friendship networks and the tendency towards depression. The message revealed by Table. is similarly intriguing. Firstly, constraints in friendship networks appear not to affect the tendency toward depression in teenagers. Consistent with existing literature, the tendency toward depression is indeed much clearer in girls than in boys (β=-.233, p<.01). There is also a significant effect of the interaction between gender and network constraints upon depression among teenagers (β=.134, p<.05). This implies that although boys on average tend less towards depression, if they occupy friendship network positions whose structural hole make-up is relatively low, they may in fact nevertheless present stronger depressive tendencies; in girls it may be that the effect of the gender factor is so strong, such that it masks the extent of the influence of structural factors on their depressive tendencies.

In order further to elucidate the debate bequeathed by existing literature on the above theory about the cause and effect between "social structure" and "personal psychological traits," to see whether it is ultimately the social structure that influences the development of personal psychological traits or in fact personal psychological traits that influence the formation of social structures, we adopted a strategy of a multi-wave, multi-variable path analysis, seeking to deconstruct the causal link between social structure and personal psychological traits. The canonical analysis in Table 6.5 reveals some information which is critical: firstly, Burt himself stressed that since opportunities for structural holes easily decay, it is not easy to remain in a structural hole position; the features of teenage friendship networks

analyzed in our sample are similar to the sort stressed by Burt. Although the factors associated with the measurement of constraints upon teenagers' friendship networks in the three waves of data are clear, the correlations are obviously not high (between approximately 0.14 and 0.27), implying that changes among teenagers' friendship networks is high, although they tend to stabilize over the years. Also, the correlation between three repeat measurements of teenagers' self-confidence was not high (between approximately 0.12 and 0.26) and varied with the measurements of constraints, although it also tended to stabilize over the years. The results of the path analysis in Figure 6.2 show that: teenagers' self-confidence in year one of junior high school has a significant effect upon constraints in year two (i.e. the greater the teenager's self-confidence, the higher the structural hole make-up of his/her network position, although the strength of the influence is not very strong in relative terms (β= -.07, $p<.05$). This evidence seems to imply that personal psychological factors affect the formation of social structures; this phenomenon, however, did not appear in the analysis of junior high school years two and three. Also, we discovered that network constraints of the previous period had no effect upon degree of self-confidence a little while later. Our findings seem to suggest that it is still insufficient to determine the causal relationship between the two.

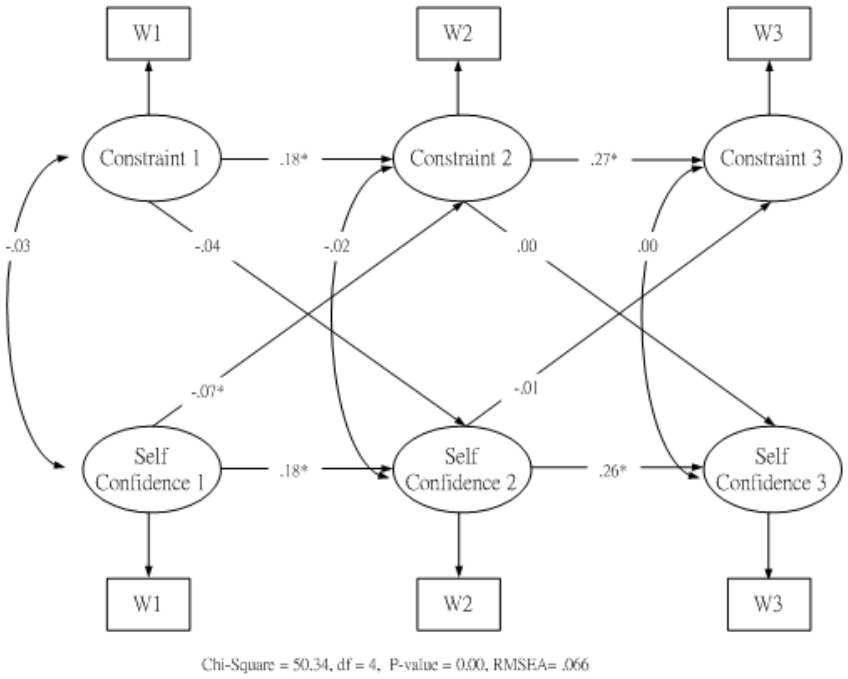

Fig. 6.2 Path analysis of network constraints upon and self-confidence

Table 6.5 Correlation of network constraints and self-confidence

	Constraint W1	Constraint W2	Constraint W3	Self Confidence W1	Self Confidence W2	Self Confidence W3
Constraint W1	1					
Constraint W2	.185(**)	1				
Constraint W3	.141(**)	.268(**)	1			
Self Confidence W1	-.043(*)	-.055(**)	-.016	1		
Self Confidence W2	-.041(*)	-.025	-.018	.190(**)	1	
Self Confidence W3	-.004	.001	-.007	.120(**)	.257(**)	1

Note: N=2378 * $P < .05$ ** $P < .01$ *** $P < .001$

Table 6.6 Correlations of network constraints and attention demands

	Constraint W1	Constraint W3	Focus W1	Focus W3
Constraint W1	1			
Constraint W3	.141(**)	1		
Focus W1	-.061(**)	-.034	1	
Focus W3	-.072(**)	-.034	.337(**)	1

Note: N=2378 * $P < .05$ ** $P < .01$ *** $P < .001$

Table 6.6 examines possible causal links between network constraints and attention-demanding personal psychological traits. Because the second wave of data did not include this personal psychological measure, the current study was able to use only the first and third waves of data to conduct a simplified path analysis. Table 6.6 shows again that the stability of network constraint measurements is not high ($r=.141$, $p<.01$). The stability of the measurement of attention demands, by contrast, is relatively high ($r=.337$, $p<.01$), reflecting teenagers' personal psychological traits may be more stable compared to their social network positions. The path analysis in Figure 6.3 reflects the fact that: the friendship network structural positions occupied by teenagers in the earlier period (junior high year one) will have an impact on their personal psychological characteristics in the later period (junior high year three) ($\beta= -.07$, $p<.05$). That is also to say that the more teenagers occupy structural hole positions, the more easily they later develop noticeable personal psychological traits. By contrast, personal psychological traits in the early period (junior high year one) will not influence friendship network structural hole positions in the later period (junior high year three). For measurement of attention demand, the findings here seem to suggest that structural hole positions may have more direct causal influence upon psychological traits than otherwise.

The results of analysis of the data in Figure, at first glance, appear to contradict the results of analysis of the data in Figure 6.2, i.e. the investigation of the causali-

ty between constraints upon network position and personal psychological traits, and thus fails to produce conclusive evidence pointing in a single direction. If we wish to accept such results, however, and to place them for consideration within a dynamic perspective, then such an analytical discovery may not be self-contradictory. The assumption of reverse consideration that we propose is: in the dynamic process of influence between personality and network position, is it possible that, at the beginning, because of some specific personal psychological traits driving teenagers to gradually tend to develop strategic behaviors, once they have occupied structural hole positions, they are conversely driven to develop other specific personal psychological traits? Of course, this kind of consideration requires testing with a more thorough and comprehensive research design and corroborative data.

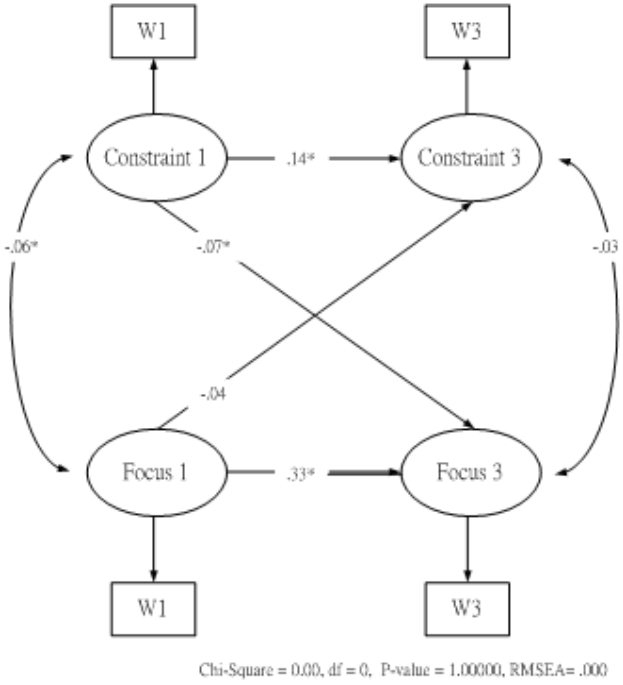

Fig. 6.3 Path analysis of network constraints and attention demands

6.6 Main findings and conclusion

From our analysis of teenagers' friendship networks, we found that the major claims of Burt's structural holes theory are largely supported in the context of our research. The data shows that, among teenagers, structural hole levels are higher among boys, which is consistent with Burt's research in relation to large-scale business organizations. The tendencies of males with regards social connections are more extrovert and who form networks that are open, while those of females who re more introvert, are cohesive but closed. Empirical data on teenagers in Taiwan proves that gender variation in this kind of network tendency appears to begin to form during adolescence. Apart from this, analyses of psychological state have found that the higher the level of teenagers' structural holes, the greater the self-affirmation, the greater the liking for being the focus of a group, the greater the sociability, and the greater the personal tendency to enjoy generating a group atmosphere. All these features conform with those of the entrepreneurial social character of which Burt spoke.

Our research discovered that there may be a correlation between structural holes in young people's friendship networks and their social interaction skills, and the germination and refinement of these skills may begin to develop during the teenage years and through many aspects of social interaction. The data shows, for example, that students with high structural holes usually have diverse and rich interpersonal relationships. They usually live in households with a relatively large number of inhabitants, have relatively good relations with their parents and teachers, implying that they are good at handling both generational and power relationships. Moreover, by means of analysis and evaluation of self-appraisal questions on psychological attitude, we also discovered that in teenagers' friendship networks, the higher the level of their structural holes, the better they usually know themselves, like being the focus of the group, being sociable, tending to like to encourage a group atmosphere, tending not to feel they can't control things that happen to them, tending to feel they are valued, useful people, being relatively satisfied with their appearance and gender, and liking being part of cozy, friendly groups, etc. This may imply that social interaction skills and associational inclination of their personality characteristics themselves may be important components for the creation of structural holes networks. Issues of this sort have been paid relatively little attention in existing literature. We believe that the mechanisms behind the generation of the features and intrinsic nature of this kind of social network structure are worthy of further exploration by future researchers.

Apart from this, we also found that structural holes in teenage friendship networks have a positive effect on academic performance. Our empirical research illustrates, in comparison with the social capital theories expounded by Coleman and others, that structural holes may capture another ignored aspect behind teenagers' academic performance. In particular, given the impact exerted by the network closure between teachers, parents, and students on students' educational skills, often stressed by scholars in the post-Coleman research tradition of social

capital theory, the current study has started from the very dimension of students' network proactive intentions and examined whether individual students' skill at connecting with parents and teachers is related to academic performance. The social capital of network closure usually possesses the structural constraints and normative power of the external community, and structural holes theory nevertheless stresses the individual's proactive preservation of the strategic techniques of social relations. Our findings imply that the function of Coleman and others' stress intimate social capital may still require the maintenance of relatively good social skills and intelligent calculation from the students to serve as a bonding bridge, in order to be able bring out the effect of network closure. In this sense, we believe, exploring from the perspective of structural holes perhaps complements the research field which begins with the research of Coleman and focuses only on the social capital of close links with parents and teachers, and further highlights the importance of the proactive skills of social interaction developed by individual students in different relationships.

Finally, we tried through path analysis to confirm the causal dialectical connection between constraints upon structural position and personal psychological features. Analysis of the data showed that the more teenagers were positioned in the structural holes positions of friendship networks, the more easily they later developed the personal psychological trait of liking attention. The evidence seems to favor the structural position. As for other psychological traits such as self-confidence, however, our data has failed to obtain conclusive evidence of a single direction. We offer one possible assumption about this analysis: possessing specific personal psychological traits drives teenagers to seek structural hole positions, and once they have stationed themselves in those positions, they conversely and gradually develop other specific personal psychological traits. To put it another way, in one's teens, the influence of personal psychological traits and network structure may be a mutually reinforcing circular relationship and our empirical data still cannot perfectly capture this process, being able only to provide preliminary insights. In which stage of young people's development do such personal psychological traits begin to emerge and at which point do they finally hone such social networking skills, is clearly worthy of further investigation. There were insufficient time points for the data in this to allow for verification, but we look forward to more definitive answers on this issue in the future.

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