# A Social Network Perspective of Lead Users and Creativity: An Empirical Study among Children

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**Generating ideas at the 'fuzzy front end' of new product development is risky and has serious consequences for all preceding development stages. One of the currently most prominent techniques in supporting this idea-generation stage is the lead user approach. Involving lead users in idea generation closely correlates to individual creativity, and both, in turn, to the provision of information in social networks. This study, guided by lead user theory, creativity research and network theory, investigates 16 school-groups of children examining the relationship between the children's social networks and their resulting creativity and lead userness. In addition, the interplay between lead userness and creativity is discussed and empirically tested. The main result of this study is that children who are positioned as bridging links between different groups in social networks reveal both a high degree of lead userness and a high level of creativity.**

## Introduction

The idea-generation stage is often called the 'fuzzy front end' of new product development because it typically lacks well-defined processes and reliable information (Dahl & Moreau, 2002). The new product development literature suggests several strategies for generating new product ideas, including such techniques as benchmarketing (Ulrich & Eppinger, 2000), user observation (Leonard & Rayport, 1997), analogical thinking (Srinivasan, Lovejoy & Beach, 1997) and lead user analysis (von Hippel, 1986). Of these techniques, lead user analysis has the greatest empirical support as a driver of commercially attractive and highly novel new product ideas (e.g., Lüthje, Lettl & Herstatt, 2003; Lüthje, Herstatt & von Hippel, 2005; Franke, von Hippel & Schreier, 2006; Schreier, Oberhauser & Prügl, 2007). However, creating new product ideas is particularly difficult when engaged in complex and uncertain markets such as markets for children (e.g., Kunst & Kratzer, 2007).

There is a growing interest in the children's consumer market both in the academic literature and from a business point of view. McNeal (1992) identified children as representing three markets in one: a primary market spending its own savings or allowances; a secondary market of 'influencers' on mainly parental spending; and a tertiary, future market of potential adult consumers. Children are very often inventors themselves, developing new product ideas at the 'fuzzy front end' that are relevant to many peer children and sometimes even for adults. More and more firms have started to leverage the fantasy and creativity of children for their new product development: children have been developing ideas for building models for LEGO and computer game features for computer game producers (Jeppesen & Molin, 2003). Acknowledging the high potential of children as idea creators, the United States Patent and Trademark Office together with the Advertising Council and the National Inventors Hall of Fame launched a national campaign in April 2007 to more systematically facilitate innovation by children (http://www.uspto.gov).

As children are lacking in previous experience and well-established cues to the quality or functionality of products, the interpersonal exchange of information becomes extraordinarily important (Hanson & Putler, 1996). This interpersonal exchange of information is the most important informal means of


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communication between consumers (Rosen, 2000; Derbaix & Vanhamme, 2003). As Burt (2004) proposes, people connected to groups beyond their own can expect to find themselves delivering valuable ideas and being more creative. Creativity may be couched in the social networks of children, because new ideas require the recombination of existing knowledge (Csikszentmihalyi & Sawyer, 1995). There is a growing body of research showing the importance of social networks for creativity (e.g., Leenders, Van Engelen & Kratzer, 2003, 2007; Burt, 2004; Kratzer, Leenders & Van Engelen, 2004). In the scope of this study, creativity is defined according to Amabile (1988), who argues that creativity is exhibited when a product or service is generated that is both novel and useful with respect to the firm.

Social networks of children may also be important for innovation activities because they may engage in developing new ideas themselves, possessing need- and use-related knowledge as consumers. A user innovator who is socially connected to other users is provided with valuable information how to improve her/his solution (Franke & Shah, 2003; Harhoff, Henkel & von Hippel, 2003). Accordingly, lead user behaviour inevitably refers to a certain degree of creativity and both lead user characteristics and individual creativity may be embedded in social networks.

This study investigates the issues raised among networks of children guided by two questions:

1. Can lead users and creative individuals among children be identified by the nature of their social networks?
2. Is there an interplay between the children's creativity and the extent to which they can be identified as lead users?

In this paper we aim to simultaneously extend and integrate lead user theory and concepts about creativity by exploring social networks of children. In this way the study adds threefold to the existing literature. First, the study contributes directly to the field of lead user research by linking individual positions within social networks and lead user characteristics. Lead users are described as users who are ahead of an important market trend and expect high benefits from innovating and will be most likely to develop attractive innovations (e.g., Urban & von Hippel, 1988; Morrison, Roberts & Midgley, 2000; Franke & von Hippel, 2003; Lüthje, Lettl & Herstatt, 2003; Lüthje, Herstatt & von Hippel, 2005). Despite these encouraging findings, there is generally still a limited understanding of who lead users are and why they are leading-edge in a given field. Second, the study attempts to integrate lead user theory and creativity research as two inevitably linked but scarcely integrated fields. Third, the study is one of the first to engage in lead user theory and creativity research concentrated on children as the study population. Our empirical study is executed among 16 school-groups encompassing 366 children.

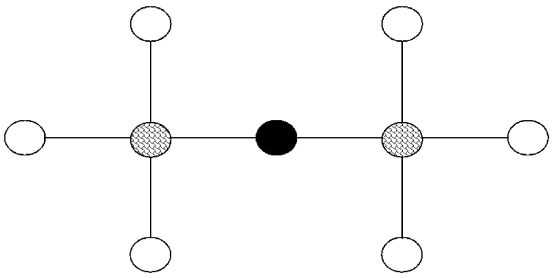

*Figure 1. Network Configurations of Degree Centrality and Betweenness Centrality*

## Social Networks, Lead Users and Individual Creativity: Hypotheses

When studying social networks, it appears that social structures comprise clustered networks of people with various ties among them (Bandura, 2001). Among others, Burt (1992, 2004), Granovetter (1973) and Freeman (1979) tried to identify and characterize the weak links in networks bridging these clusters. Freeman (1979)[1] conceptualized this structural configuration as betweenness centrality. This kind of centrality does not refer to the number of ties, but refers to the extent to which an actor facilitates the flow of information being positioned on many informational paths. In contrast to betweenness centrality, another centrality measure refers to the number of direct contacts of individuals embedded within clusters. This measure is called degree centrality (Freeman, 1979). Figure 1 depicts the differences between the two centrality measures. The shaded ovals represent actors with a high degree centrality, the black oval represents an actor with a high betweenness centrality.

Lead users are on the leading edge of an important market trend and develop radically new product concepts by applying diverse knowledge bases to a perceived problem or

[1] There are other conceptualizations such as the constraint concept of Burt (1992); however, degree centrality has proved to be the most straightforward and robust measure (Krackhardt, 2002).

need (von Hippel, 1986; Riggs & von Hippel, 1994; Lilien et al., 2002). The main incentive of lead users to innovate is to find appropriate solutions for their needs. Lead users tend to combine and reassemble any type of prior technological knowledge which leads to a solution best fitting their needs (von Hippel, 2005). Insights into archetypal lead user innovations such as the first device for gas chromatography (Riggs & von Hippel, 1994), the first surgical navigation systems, the first medical robot for neurosurgery and the first biocompatible implant for hernia surgery (Lettl, Herstatt & Gemuenden, 2006), or the first mountain bike (Lüthje, Herstatt & von Hippel, 2005) reveal that the respective lead user inventors combined diverse technological knowledge fields. Like lead users, individuals with diverse knowledge bases are expected to be more creative than individuals without (e.g., Burt, 2004). Based on insights from cognitive psychology, social network theory, creativity research and the concept of sticky information, we expect that a children's position as a bridging link between two groups makes him or her more likely to be a lead user and to be more creative.

Researchers in cognitive psychology generally agree that creativity consists in reassembling elements from existing knowledge bases in a novel fashion to produce a new idea (e.g., Ward, 1994; Holyoak & Thagard, 1995; Gentner, Holyoak & Kokinov, 2001). Therefore, the combination of diverse knowledge bases is often emphasized as a driver of truly innovative thought and radically new concepts (e.g., Ebadi & Utterback, 1984; Boden, 1994; Dahl & Moreau, 2002). Being the bridging link between two groups facilitates access to diverse knowledge bases and thus the development of radically new solutions.

Burt (1992) argues that information access and control advantages are created when relations bridge between groups, which does not necessarily indicate a high number of direct contacts as shown in Figure 1. Actors with a social network bridging different groups monitor information more effectively, and they receive information faster (Staber, 2004). Information flowing in weakly connected networks tends to be less redundant and thus of greater value to individuals seeking new information (Staber, 2004). A weak tie has a greater chance of seeing good ideas and new opportunities (Staber, 2004). As Burt (2004) suggests, people who stand near the holes in a social structure have a greater propensity to have good ideas. The argument is that opinions and behaviours are more homogeneous within than between groups, so people connected across groups are more familiar with alternative ways of thinking and behaving, which gives them more options to select from, interpret and synthesize. In addition, people whose networks bridge between groups have an advantage in detecting and developing rewarding opportunities. Information arbitrage is their advantage. They are able to see early and to see more broadly (Burt, 2004).

Crossing group boundaries may also lessen the problem of sticky information (von Hippel, 1994; Lüthje, Herstatt & von Hippel, 2005). In any kind of situation, an individual operates in a particular communication environment consisting of a number of friends and acquaintances with whom a topic is discussed most frequently. These friends are usually highly similar with the individual and with each other, and most of the individual's friends are friends of each other, thus constituting an interlocking network (Rogers, 1976). The similarity of individuals stimulates and facilitates effective communication inside such a network, but it acts like a barrier preventing new ideas from entering the network. Lüthje, Herstatt and von Hippel (2005) suggest that there is an information asymmetry which prevents the flow of information between distant units that may be caused by restricted absorptive capacities due to these information asymmetries. Individuals bridging groups may be able to interpret and process non-local and sticky information due to their permanent embeddedness in non-local network channels.

The reasoning above leads us to two hypotheses.

**Hypothesis 1:** *The higher the betweenness centrality of a child in his/her social network, the more likely a child can be identified as a lead user.*

**Hypothesis 2:** *The higher the betweenness centrality of a child in his/her social network, the higher is the creativity of a child.*

When following this discussion, the association between being a lead user and being creative becomes obvious. We assume that there is an interplay between both behaviours, because both require diverse knowledge, information advantages and bridging links to overcome communication barriers embedded in social networks. However, the extent to which someone can be characterized as a lead user requires more than scoring high in creativity and vice versa. According to von Hippel (1986), lead users are denoted by characteristics such as being ahead of a trend and recognizing expected benefits. These characteristics may also be determined by social networks but independent of individual creativity. Therefore, we are not proposing that

being creative and a lead user are one side of the same coin, but explore individual creativity and lead userness as possibly interlinked based on specific network constellations of individuals. It may even be that the children's development of their cognitive capacity results first in certain personal characteristics such as lead userness and translates with increasing age into higher levels of creativity given a specific network constellation. However, this argument is rather speculative; therefore, we are not proposing any causal relationship between the two. The reasoning above leads us to the third hypothesis.

**Hypothesis 3:** *There is an interplay between the children's creativity and the extent to which they can be identified as lead users.*

## Research Design

### *Study Design, Procedure and Participants*

To address the hypotheses empirically, we gathered data in seven randomly selected schools in the Netherlands. Piaget (1971) and Roedder John (1999) emphasized the age of 7 years as a major cognitive turning point. Around this age children make the transition from pre-operational to the concrete operational and analytic stage. This implies that children around this age become better at logical, systematic thought using multiple pieces of information. In addition, language skills develop and children learn about classifications. Selman (1980), studying the social side of child development, describes this turning point at the age of 6 years and Valkenburg and Cantor (2001) state that this stage has already been reached by the age of 5 years. We decided to select children from 2-year groups orientating ourselves at the cognitive and social development of children as suggested by Piaget (1971), Roeddder John (1999), Selman (1980), Valkenburg and Cantor (2001), and a pragmatic point – the children had to be able to read and complete a questionnaire. A pre-test carried out during the 'CineKid FilmFestival 2005' in Amsterdam suggested that children younger than 7 years had some difficulty in reading and completing the questionnaires. We decided to use a cluster sample, grouping the children into two groups: 'group 5' (age 7/8) and 'group 7' (age 9/10). These groups also contained a small minority of children of other ages (up to age 12), as a result of recidivists. Moreover, in order to collect data about social networks, which are not ego-centred (Wasserman & Faust, 1994), the boundaries of the networks have to be defined. As children spend the majority of their time in schools (around 6–8 hours a day in the Netherlands), we investigated full networks of school groups as suggested by Defares et al. (1971). The final cluster sample contained seven public primary schools, which means we had eight 'group 5' groups and eight 'group 7' groups. The total sample contained 366 children. The average size of a group was around 23 children.

### *Data Collection*

Collecting data from children is difficult because children's interpretations of questions and definitions are often ambiguous. A child's cognitive, communicative and social skills are still developing as he/she grows older, and this affects a child's ability to answer survey questions (Borgers, 2004). To collect data about children's social networks we therefore used a questionnaire and an experimental design. The questionnaires served to measure the extent to which the children could be identified as lead users and different control variables (the questionnaire was kept as clear and short as possible). The response rate was very high at 98 per cent. The children were asked to fill in the questionnaire one week before the experiment. During the experiment the children were asked to develop ideas improving an online application, labelled 'CineKidStudio', for their personal use. The online application is developed specifically for children aged 7–12 years and serves as a tool to develop different kinds of widely employed media content. This online application was introduced in advance of the experiment. A time-span of 25 minutes was set for idea development, and the children were allowed to interact with whomever and for as long as they wanted during this time. While the children were developing their ideas, the interactions were recorded by a research assistant using a matrix with all the names of the children. We also asked the children to note down their interactions during the experiment. The registrations of the children and the research assistant were very similar, so we decided to use the registration from the research assistant for our analyses, resulting in a list of all interactions taking place within all 16 groups. In addition, after the experiment, the ideas of all the children were evaluated by external experts who are familiar with this online application, and a number of ideas were considered to be potentially very valuable in improving the present version of this application.

## Operationalizations

### *Measuring the Social Networks of the Children*

The data that were gathered during the experiment resulted in a matrix containing all interactions between the children from each group.[2] These matrixes allowed calculation of the betweenness and degree centrality for each child in each group.

#### *(a) Betweenness Centrality*

Betweenness centrality may be defined loosely as the number of times that an actor needs a given actor to reach another actor or is reached by this actor. More precisely (but not quite correctly), it is the number of shortest paths (between all pairs of actors) that pass through a given actor in a network. This kind of centrality does not refer to the number of ties, but refers to the extent to which an actor facilitates the flow of information being positioned on many informational paths. In formal terms, betweenness centrality refers to the probability that a 'communication' from actor *j* to actor *k* takes a particular route. Here, it is assumed that lines have equal weight and communications will travel along the shortest routes, and therefore it is assumed that such a communication follows one of the geodesics (Wasserman & Faust, 1994). If B*jk* is the proportion of all geodesics linking actor *j* and actor *k*, which pass through actor *i*, the betweenness of actor *i* is the sum of all B*jk* where *i*, *j* and *k* are distinct (Borgatti, Everett & Freeman, 2002). So, holding a high degree of betweenness centrality does not refer to the number of direct contacts, but to the number of shortest paths that an actor facilitates. This measure, proposed by Freeman (1979), is calculated with UCINET VI (Borgatti, Everett & Freeman, 2002).

#### *(b) Degree Centrality*

Degree centrality is based on the number of units directly connected to the unit under scrutiny. The definition of actor centrality is that the most central actor must be the most active, in the sense that this actor has the largest number of direct ties to other actors in the network (Freeman, 1979). In this way, it measures the balance between having a peripheral position or a small number of direct contacts or having a central position or a high number of direct contacts. The measure is focused on the level of communication activity for internal communication within the schoolgroups of the children. The degree centrality of each child is calculated using UCINET VI (Borgatti, Everett & Freeman, 2002). Among the proposed measures of positional centrality, degree centrality is the simplest and most straightforward (Zemljic & Hlebec, 2005).

A typical interaction matrix of one group is displayed in Figure 2 using a sociogram. This sociogram illustrates that certain children score higher in betweenness centrality (e.g., numbers 18 and 22), others higher in degree centrality (e.g., numbers 11, 20 and 4), whereas certain children were extremely peripherally situated (e.g., numbers 21 and 23).

### *Lead Userness*

The item-batteries to identify the extent to which the children are lead users are derived from earlier studies. However, we had to exclude a number of items, because the cognitive capabilities of children disallowed using them, e.g., items about the monetary value of products. In addition, we had to minimize the number of items for the same reason. The pretest among 45 children justified our selections of items. Our final measure for lead userness consists of six indicators, measured on a 1-to-5 Likert-type scale. The indicators refer to the two characteristics of a lead-user suggested by von Hippel (1986). In addition, one indicator suggested by Lüthje and Herstatt (2004) was included, which refers to the dissatisfaction of a user with current market offerings. Translated into the world of children these indicators were:

1. I think that toys should be nicer and more advanced. (1 – always to 5 – never)
2. I invent toys myself. (1 – always to 5 – never)
3. I think I can better invent and advance toys than adults. (1 – always to 5 – never)
4. I invent new toys thinking that I will be somehow rewarded for it. (1 – always to 5 – never)
5. I am normally the first to adapt new toys. (1 – always to 5 – never)
6. I would prefer to be the only one having new toys. (1 – always to 5 – never)

[2] In the questionnaire 1 week before the experiment, we measured the interaction networks of all groups using a sociometric method, called SAGS (Seracuse-Amsterdam-Groningen Sociometric Scale; Defares et al., 1971). The resulting networks from the questionnaire and the experiment correlate highly between 0.7 and 0.9 using QAP correlations. We decided to use the networks of the experiment for our analyses because in this way we could clearly separate the measurement of lead-user characteristics and idea-generation interaction. In addition, the results presented would not be different using the interaction matrixes based on the questionnaires.

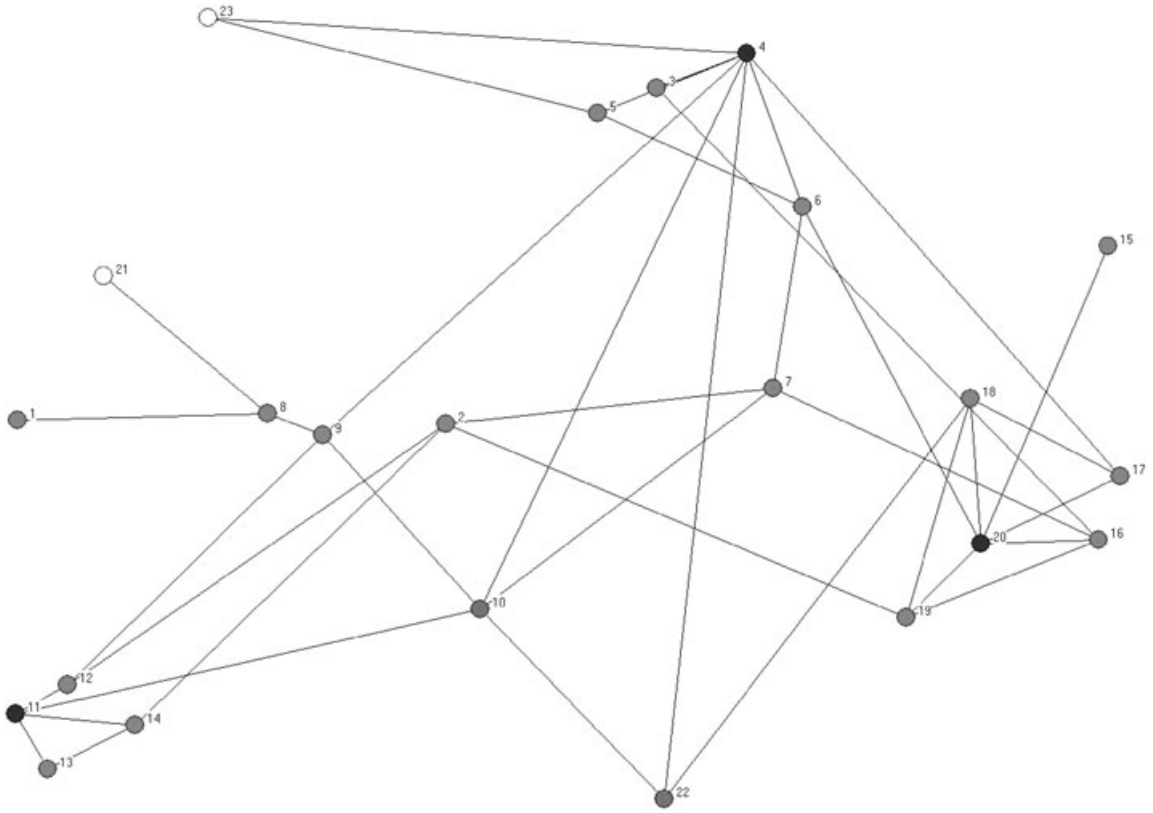


*Figure 2. A Typical Social Network of a Group of Children*

The scale achieved a Cronbach's alpha value of 0.83, which implies that the internal consistency was high enough to combine the indicators into a single measure of lead userness.

### *Creativity*

Measuring creativity is notoriously difficult. In the majority of creativity studies, creativity is measured in one of two ways. First, by the performance of (groups of) individuals on standardized creativity tests – constructed and scored similarly to tests of verbal and mathematical intelligence. Alternatively, a second group of measures entails the rating of actual products in response to open-ended instructions. Rating is then performed by outside experts. Since we could not apply standardized creativity tests, we asked external experts. These external experts were leading employees of the organization who develops and sells the online application the children were asked to improve with their ideas. The evaluation was based for each child on (a) idea quality and (b) idea quantity on a scale from 1 – very high to 7 – very low. We oriented our measurement of creativity on the nature of the design process itself, assuming that originality and number of problem solutions generated and considered directly affect the usefulness and originality of outcomes. These assumptions are supported by modern design literature (e.g., Pahl & Beitz, 1992; Dym, 1994). The two evaluation scales were combined into one scale for creativity.

### *Control Variables*

There are many other factors that have been shown to or may be affecting behavioural effects embedded in social networks. While it is not possible to include all other variables in this study, we chose to include two variables that have been suggested to affect most prominently the social networks of children. First, we included *gender* because boys and girls express and satisfy their needs and feelings differently (Del Vecchio, 2002). In addition, Kalmijn (2003) reports that gender influences social networks, since women are likely to have more frequent contacts with friends than men do. This variable is included as a dummy, where male = 0 and female = 1. Second, we included *age* because children of different ages have diverse likes and dislikes: as a child grows older the thoughts, expectations and feelings of a child change (Craig & Baucum, 2003). Additionally, research shows that social

*Table 1. Descriptive and Correlation Coefficients*[a]

| Variables | Mean | SD | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|---|
| 1. Creativity | 3.82 | 1.19 | 0.64** | 0.14 | 0.30** | 0.03 | 0.53** |
| 2. Lead userness | 2.61 | 0.82 | – | –0.13 | 0.09 | 0.29** | 0.67** |
| 3. Gender | 0.53 | 0.51 | | – | –0.15 | –0.14 | –0.09 |
| 4. Age | 10.05 | 1.21 | | | – | 0.23* | 0.11 |
| 5. Degree centrality | 37.02 | 9.52 | | | | – | 0.37** |
| 6. Betweenness centrality | 17.40 | 21.11 | | | | | – |

[a] Two-tailed tests are reported; * $p < 0.05$, ** $p < 0.01$.

*Table 2. Multiple Regressions – Lead User*[a]

| Variables | Model 1 | Model 2 | Model 3 |
|---|---|---|---|
| Constant | 2.56** | 2.72** | 3.583** |
| Gender | –0.17 | –0.14 | 0.01 |
| Age | 0.01 | –0.06 | –0.06 |
| Degree centrality | | 0.04* | –0.01 |
| Betweenness centrality | | | 0.42** |
| Adjusted $R^2$ (sig. of change) | 0.01 | 0.06 | 0.45** |

[a] Unstandardized coefficients are shown (standard errors in parentheses). Two-tailed tests are reported; * $p < 0.05$, ** $p < 0.01$.

networks are not stable over time. Stages in the life course will influence the social networks of actors (Kalmijn, 2003).

### *Analyses*

To test Hypotheses 1 and 2, we carried out multiple regressions as illustrated in Tables 2 and 3. Both tables show three models presenting a stepwise approach of, first, entering the control variables as baseline model, second, entering degree centrality in Model 2 and, finally, entering betweenness centrality in Model 3. We use this stepwise procedure to present separately the effects of the control and the two independent variables. All models were tested for violations of multicollinearity by checking the VIF (variable inflation factor) and CI (condition index) and the distribution of residuals. The distribution of betweenness centrality was moderately right skewed so we transformed this variable, using the natural logarithm, achieving a normal distribution. The descriptive information about all the relevant variables are presented in Table 1. Table 1 is also used to test Hypothesis 3.

## Results

Table 1 shows that creativity, lead userness and betweenness centrality are positively correlated. All these results are statistically significant. Creativity and lead userness correlate moderately highly with $r = 0.64$, so that we find support for Hypothesis 3. This correlation shows that there is an interplay between lead userness and creativity: children who are more creative also tend to score higher on lead user characteristics and vice versa. In Table 1 lead userness also correlates positively with degree centrality. This correlation is also statistically significant. Age correlates positively and statistically significantly with creativity and degree centrality as Table 1 illustrates. Finally, there is a positive correlation between degree centrality and betweenness centrality at a statistically significant level.

In Table 2 the results with respect to lead userness are presented. Neither gender nor age have any statistically significant impact on lead userness. This situation changes in Model 2 when degree centrality is entered. However, the explained variance of Model 2 at 6 per cent

*Table 3. Multiple Regressions – Creativity*[a]

| Variables | Model 1 | Model 2 | Model 3 |
|---|---|---|---|
| Constant | 5.32** | 4.76** | 4.31** |
| Gender | –0.11 | –0.09 | –0.09 |
| Age | 0.34** | 0.32** | 0.32** |
| Degree centrality | | 0.01 | 0.02 |
| Betweenness centrality | | | 1.03** |
| Adjusted $R^2$ (sig. of change) | 0.07 | 0.11 | 0.28** |

[a] Unstandardized coefficients are shown (standard errors in parentheses). Two-tailed tests are reported; * $p < 0.05$, ** $p < 0.01$.

is still fairly low even though degree centrality affects lead userness at a statistically significant level. In Table 2 Model 3, the positive effect of degree centrality on lead userness loses statistical significance, whereas betweenness centrality achieves statistical significance. As Model 3 shows, betweenness centrality is positively related to lead userness and increases the explained variance from 6 to 42 per cent.

As illustrated in Table 3 Model 1, age positively impacts creativity statistically significantly, but only explains 7 per cent of variance. Degree centrality and betweenness centrality are stepwise entered in Models 2 and 3 to separate out their effects. As Model 2 shows, degree centrality does not impact creativity at a statistical significant level, whereas including betweenness centrality yields a statistically significant effect on creativity and increases the explained variance from 11 to 28 per cent. This increase is also statistically significant.

In summarizing the results, the following three points can be made. First, the correlations between creativity and lead userness shown here support Hypothesis 3. Second, both creativity and lead userness are positively influenced by betwenness centrality. These results support Hypotheses 1 and 2. Third, in contrast to lead userness, creativity is positively impacted by age.

## Discussion and Conclusions

Children are increasingly interesting as a market, but also as subjects for creating ideas at the 'fuzzy front end' of product development. Since children lack past experience and well-established cues about existing products, the interpersonal exchange of information among them is extraordinarily important for them. Therefore, the perspective of social networks allows crucial insights into children's lead userness and creativity. This study attempts to reveal these patterns and finds the following results.

First, lead users can be found in the network role of betweenness centrality. This means lead users are bridges between cliques/clusters of people. Having this 'boundary spanning' position also entails having a wider reach and variety of obtaining information and overcoming communicational barriers. In this way, lead users may have a very sensitive but key position in social networks of consumers; namely, they make it possible to link people of distant clusters, translating information asymmetries into symmetries. Using this information advantage, lead users are able to and can be utilized to create highly novel ideas in the 'fuzzy front end' of new product development.

The second result is that betweenness centrality also determines the creativity of children in our sample. Similar to the effect on lead users, creativity is stimulated by a high informational diversity, by structural holes and by minimizing communication barriers. Thus, children exposed to this information advantage show lead user characteristics such as being ahead of a trend or recognizing the benefits of new ideas earlier than the majority, and at the same time they are capable of developing highly novel ideas in a creative process.

Our third result is that, not very surprisingly, we found that being creative and lead user correlate positively with each other. However, this result can only be regarded as a first step to integrate lead user theory and creativity research based on social networks. There is a circulation of a whole variety of different information in social networks. This different information may, on the one hand, stimulate characteristics of being ahead of trends and recognizing benefits in creating ideas, while on the other, also increasing the likelihood of creating many and highly quali-

tative ideas. Based on our results we are unable to pose any causal relationship between lead user and creativity. Which is the chicken and which the egg cannot be clarified because lead user characteristics and creativity exist in a circle of cause and effect. Children who stay in a favourable network position may develop lead user characteristics, which in turn stimulate them to utilize the information advantage and to be creative. Alternatively, the favourable network position may also cause individual creativity resulting in developing lead user characteristics.

Another interesting outcome of this study is that the social structure of lead users can be identified independently of the age or gender of the examined children. In contrast, age influences creativity, so with increasing age and cognitive capacity, children are able to develop more and better ideas. This result is a weak indication that children first develop lead user characteristics, which translate into increasing levels of creativity with increasing age.

The managerial implications of these findings are manifold. The most important implication is that markets for children are segmented into children who are at the leading edge of product-relevant knowledge and capabilities of being creative and children who are not. Involving children and smoothing idea generation at the 'fuzzy front end' raises the question what kind of children are appropriate. Our study implies the selection of children with diverse networks rather than children who are only locally embedded. There may be different methods of selecting particularly appropriate children, using self-reports, parents or teachers as information source. For example, as we came to realize during our research, teachers are able to rank their pupils according to their information diversity.

Like many studies, this study also has shortcomings. The study is one of the first to investigate social networks of children, which is not a deficiency in itself, but restricts our ability to generalize the results. Further research needs to apply the social network perspective to lead users as adults. To better understand the social network structures of lead users is an important, yet underdeveloped area in lead user innovation research. The embeddedness in social networks is an ever-changing process throughout the life course, and it may be that the behavioural effects of social networks may change as well. This also leads to another suggestion for future research. Social networks are dynamic, so in order to trace and follow individual changes in network configurations over a lifetime, longitudinal research designs are required. Longitudinal research would also make it possible to clarify the 'chicken and egg' problem about lead userness and creativity. The third deficiency can be derived from our study. The sample was restricted in number and to networks of certain school groups, so future research may go a step further in studying social networks of children in a more multi-faceted way. One option for a follow-up study would be to carry out research in Montesori or Jenaplan schools, were children of different ages stay together in one group. Our study is focused on children and, as such, we avoid drawing explicit predictive or prescriptive conclusions for an adult population. However, we believe that our research effort contributes to different research fields, including 'adult' research, by integrating for the first time such widely separated streams as lead user theory, creativity research and network theory.

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