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Identification of individuals with special qualities - Assessing the performance of pyramiding search

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Abstract

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often are important sources of information and frequently play key roles during different phases of the innovation and marketing process. As these special users are typically hidden within a considerably larger population, traditional screening searches for their identification are often inefficient. Pyramiding has been advocated as a comparatively more efficient search strategy when target persons are very rare. However, little empirical work has been done on investigating this acclaimed superiority of pyramiding relative to screening.
This study contributes to the literature on pyramiding search by empirically investigating its performance in varying settings. Firstly, we study how pyramiding efficiency is influenced by the visibility of the special quality being sought. Secondly, we examine the impact of the size of the population being searched on the efficiency of pyramiding.
We analyze data collected from some 940 pupils in 42 school classes. First, in line with previous results, we find pyramiding search to be significantly more efficient in identifying rare individuals with special qualities. Second, we analyzed the efficiency of pyramiding search for (1) search attributes of varying levels of visibility and in (2) networks of different sizes and find both variables to significantly affect the performance of pyramiding search. We find that the level of visibility of the focal search criterion is positively associated with the efficiency of pyramiding. Further, the relative efficiency of pyramiding vs. screening increases with an increasing population size.

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Abstract

Companies need to consistently gather external information in order to stay competitive. Special users and customers often are important sources of information and frequently play key roles during different phases of the innovation and marketing process. As these special users are typically hidden within a considerably larger population, traditional screening searches for their identification are often inefficient. Pyramiding has been advocated as a comparatively more efficient search strategy when target persons are very rare. However, little empirical work has been done on investigating this acclaimed superiority of pyramiding.

This study contributes to the literature on pyramiding search by empirically investigating its performance in varying settings. Firstly, we study how pyramiding efficiency is influenced by the visibility of the special quality being sought, i.e. how easy it is for people to know if and to what degree others possess a special quality. Secondly, we examine the impact of the size of the population being searched on the efficiency of pyramiding, i.e. if pyramiding performs relatively better or worse compared to screening in populations of different sizes.

We analyze data collected from some 940 pupils in 42 school classes. First, in line with previous results, we find pyramiding search to be significantly more efficient in identifying rare individuals with special qualities. Second, we analyzed the efficiency of pyramiding search for (1) search attributes of varying levels of visibility and in (2) networks of different sizes and find both variables to significantly affect the performance of pyramiding search. We find that the level of visibility of the focal search criterion is positively associated with the efficiency of pyramiding. Further, the relative efficiency of pyramiding vs. screening increases with an increasing population size.

Introduction

Companies need to consistently gather external information in order to stay competitive (Bierly et al., 2009, Narver and Slater, 1990). Acquisition and use of external information expands a firm's knowledge base (Leonard-Barton, 1995, Nonaka and Takeuchi, 1995). It is a cornerstone of the open-innovation paradigm and provides important insights for the successful generation of new products and technologies (Chesbrough, 2006, Rosenkopf and Nerkar, 2001). Aside from innovation, external expert knowledge is frequently required to learn about and understand emerging future trends and needs (Kohli and Jaworski, 1990). Important sources of external information are users or customers (Lee et al., 2011, Ruiz-Ortega and García-Villaverde, 2008, Greenley et al., 2005). They can provide companies with various types of information, such as need- and solution-related input into firms' innovation processes or by providing feedback on concepts and prototypes developed by the company. However, the lead user method (von Hippel, 1986) has shown that it is inappropriate to just use a representative sample of the existing customer base to acquire the information for these purposes. Rather, firms should search for special users and customers, who often play key roles during the different phases of the marketing process. Accordingly, in practice, marketers are often faced with the difficult task of identifying rare individuals with special qualities within a much larger population. Lead users typically represent only a fraction of the entire customer base: During a lead user study, Lüthje (2000) screened a population of 2043 individuals to identify 22 lead users, thereby achieving a sampling efficiency of 1.1%.

In order to identify these rare individuals with specific characteristics and knowledge, firms may decide to screen the population of users. This implies 1) defining the population as well as its boundaries and 2) collecting data from every member of this user population to determine if she possesses the rare special characteristics and knowledge that are sought. This is typically done by carrying out a survey. If a firm manages contacting the entire population

and also succeeds in receiving answers from all subjects, screening is an effective approach. Using this method, a company will definitely find the users displaying the pre-defined characteristics being sought. One pitfall is that these two preconditions are usually not met. In addition, the efficiency of this approach may be low. This is particularly true, if the cost of contacting members from the user population is high, if they are very hard to reach or, most important for our purposes, the characteristics being sought are increasingly rare in the population. In these situations, a traditional screening process will become more difficult and resource consuming (von Hippel et al., 2009, Prügl, 2006, Sudman, 1985).

Pyramiding has been advocated as a solution to the problem of inefficient screening searches (von Hippel et al., 2009, Lilien et al., 2002, von Hippel et al., 1999). It shares many similarities with snowball sampling (Welch, 1975, Goodman, 1961). Both are based on the observation that people tend to know or are aware of others with whom they share certain characteristics (Biernacki and Waldorf, 1981) and share the idea of searching for target persons by using references from other people to identify them. However, pyramiding additionally assumes, that "people having a strong interest in a given attribute or quality, for example a particular type of expertise, will tend to know of people who know more about and/or have more of that attribute than they themselves do" (von Hippel et al., 2009, p.1397). As such, pyramiding may prove useful, when trying to identify individuals with high levels of a special quality or attribute. This is done by asking an initial contact to provide references to one or more other persons whom the initial contact considers to exhibit higher levels of the attribute or quality being sought or to have better information regarding who such people might be. During the next step, these persons are then approached and asked the same questions. This is repeated until individuals with sufficiently high levels of the special quality have been identified.

Pyramiding is said to be superior compared to screening in terms of its efficiency, as it typically allows the searcher to identify the target person with considerably less effort that a screening search would have required. Pyramiding has been successfully applied in the identification of lead users (e.g. Lilien et al., 2002, Olson and Bakke, 2001, von Hippel et al., 1999), but with the notable exception of von Hippel et al. (2009), the acclaimed relative efficiency of pyramiding over screening has never been empirically tested. With this study we aim to contribute to the literature on pyramiding search by empirically investigating the performance of pyramiding search in varying settings. Firstly, we study how pyramiding efficiency is influenced by the visibility of the special quality being sought, i.e. how easy it is for people to know if and to what degree others possess a special quality. Secondly, we examine the impact of the size of the population being searched on the efficiency of pyramiding, i.e. if pyramiding performs relatively better or worse compared to screening in populations of different sizes.

Building on the initial work of von Hippel et al. (2009), we develop hypotheses on the efficiency of pyramiding search process under the aforementioned conditions. In order to test our hypotheses, we analyze data from a field experiment involving some 940 pupils in 42 school classes. This setting is well suited for this purpose. Children are part of well-established social networks, especially in the school context. The structure of organizational sub-units (classes) within larger organizational units (grades) bears resemblance to corporate settings and allows us to investigate search processes on different levels. In addition, interest in the children's consumer market has grown considerably over the last years and children have been identified as an important source of consumption (Kratzer and Lettl, 2009, McNeal, 1992) as well as innovation (Jeppesen and Molin, 2003, Druin, 2002).[1] Interpersonal exchange of information about brands and products plays a major role in children's

[1]In fact this research was carried out as part of a lead user project aiming at identifying lead users for presentation software in school settings with the goal of facilitating software use and integration of various pieces of software for pupils.

evaluations of products and brands as they typically lack past experience and well-established cues concerning the quality or functionality of products (Moore and Lutz, 2000, Hanson and Putler, 1996). As a consequence, children's social networks may play two important roles in the context of marketing (Kratzer and Lettl, 2009): Firstly, they may be used to involve children in the product development process itself as they possess need and use related knowledge as consumers, which may be a very valuable supplement or replacement for the experiences of adults (Druin, 2002). Secondly, due to their reliance on interpersonal information exchange, children are likely to influence each other in decisions to adopt innovations. Given this importance of social networks to children as consumers and users, these networks constitute a valuable pool of knowledge which companies may tap into.

In the next section, we develop the conceptual underpinnings for our study. We then proceed to develop our hypotheses, describe the methods used to test them and present our results. We conclude by discussing our findings and outlining opportunities for further research.

The identification of subjects with special qualities in networks of schoolchildren

Screening and pyramiding are two different search approaches to identifying subjects with special qualities within a larger population. These two strategies differ in several important ways. Like snowball sampling, also Pyramiding, is a sequential search process. The searching party begins with an initial set of a few people from a given population, who exhibit the special quality being searched for, and asks them for referrals to others. However, there is an important difference between snowball sampling and pyramiding. Snowball sampling is frequently used to identify hidden sub-populations and, therefore, asks for references to others who share the same special quality (see e.g. Noy, 2008, Heckathorn, 1997). Pyramiding,

however, aims at identifying people who exhibit a higher level of the focal characteristic– rather than staying on the same level (von Hippel et al., 2009, von Hippel et al., 1999).

Due to their reliance on references, pyramiding and snowball sampling are primarily affected by what people know about others and less by what they know about themselves (von Hippel et al., 2009). They fundamentally ask "do you know the person with the special quality we are looking for". In contrast, screening is a parallel search process. The searching party administers a questionnaire or conducts interviews with all the members of the population in order to collect information about their characteristics. Consequently, screening is primarily affected by what the people know about themselves, as it fundamentally asks "do you have the special quality we are looking for?" (von Hippel et al., 2009).

These differences have implications for the outcome of the search process. Pyramiding's sequential search approach can be understood as a series of sequential experiments, which allow the searcher to learn from one experiment to the next (Loch et al., 2001). Consequently, in the course of the search, the researchers can benefit from insights that they achieved through the previous interviews to realign the subsequent search. Researchers may decide to modify the type of questions they ask, change the search criteria or realize that there are promising networks or groups which initially have not been included into their search.

As pyramiding involves navigating through social networks, the efficiency of this search method will be influenced by the structural characteristics of the network (Reagans and McEvily, 2003, Gulati, 1998). One specific type of network that has received considerable attention in the literature is the so-called small-world network (see e.g. Watts et al., 2002, Travers and Milgram, 1969, Milgram, 1967). This type of network is characterized by high local clustering and short global separation (Fleming et al., 2007). The mechanisms by which people navigate small-world networks have been subject of extensive research (Dodds et al.,

2003, Killworth and Bernard, 1979, Killworth and Bernard, 1978, Lundberg, 1975, Travers and Milgram, 1969, Milgram, 1967). However, real-life social networks frequently do not conform to the structure of small-worlds and simulation studies have shown that the search strategies applied by members of small-world networks achieve mixed results in other types of networks (Adamic and Adar, 2005). Pyramiding differs from small-world problems in important ways: Small-world studies are based on the identification of a predetermined person in a specified. In contrast to this, pyramiding is a search without prior knowledge about the end destination, so the amount of information the searching party can rely on, when initiating the search is different (Singh et al., 2010). In addition, search processes in small-world studies have been shown to flow mainly along chains of acquaintanceship, where acquaintances are defined as personal relationships. The pyramiding search chains do not necessarily resemble the chains of personal acquaintances. Members of a network may refer the researcher to another person they do not know personally. Just consider the example of top-level researchers who are known by most members of a scientific community. The possibility of referring to subjects that are only known indirectly opens great possibilities of identifying persons displaying highest levels of the focal expertise or the target attributes. A third difference between small-world and pyramiding search is that the first is driven by the subjects themselves while the latter is stimulated by a searching party. The small-world phenomenon relies on every member in a search chain having the motivation as well as the information needed to proceed in the search chain (Dodds et al., 2003). Pyramiding, however, is driven by the researcher who follows the references given by the subjects and has herself or himself a strong motivation to follow the chain to its end (von Hippel et al., 2009).

Hypotheses

Search criteria and information-seeking strategies

Research on transactive memory has shown that members of groups develop an awareness of "who knows what" in a group (Brandon and Hollingshead, 2004, Borgatti and Cross, 2003, Wegner et al., 1991). Applied to our context, this means that students may know about personal characteristics of their fellow students, such as personal traits, motives, attitudes, preferences, use behavior, skills or expertise in a given field.

This list of search criteria already indicates that the type of attribute in question is likely to determine how easily members of a social group can locate top level persons in their context. We suggest that the likelihood that members of a social group know the others' attribute levels is widely determined by the attribute's visibility.

In case of visible attributes members of a social group can receive information about the attribute level that other persons hold by monitoring. Monitoring is a strategy of indirect information gathering by "actively attending to the information environment but not the initiation of direct inquiry to others within that environment" (Ashford and Cummings, 1983, p. 385). It involves the observation of other people's actions and the registration of their verbal communication. It also includes gathering secondary information by reading written material or by listening to comments people make about third parties. Attributes of low visibility, however, are less open to monitoring. Gathering information about those attributes often requires having close social ties to other people and is more often elicited by direct inquiry (Morrison, 1993).

Personal characteristics vary regarding their level of visibility (Funder and Dobroth, 1987, Reeder and Brewer, 1979). Consider physical attributes such as body height or hair color, which typically are readily observable. Personality traits or personal dispositions like motives,

attitudes and preferences are obviously located on the other side of the visibility continuum as they represent hypothetical constructs that cannot directly be measured through observations (Borsboom et al., 2003, Bollen, 2002). In a similar vein, also hidden variables may be difficult to measure. While hidden variables may be prone to direct monitoring they are located outside the observational areas that subjects of a social group typically can access. In a network of professional consultants, for instance, it seems easy to observe the colleagues' sense of dressing while the preferred furniture style at home is probably rather hidden.

To sum up, most personal attributes are not assessable by a direct one-time observation. They are hidden or have to be inferred by the analysis of directly observable behavior and communication. We conclude that their degree of visibility will be lower (1) the lower the variety of classes of observable behavior/communication/documentation indicating a personal attribute, (2) the lower the frequency with which the behavior/communication/documentation usually occurs, and (3) the higher number of observations needed to assess the level of the attribute (Funder and Dobroth, 1987, Rothbart and Park, 1986). For attributes of low visibility, the existence of a personal relationship which is accompanied by more frequent instances of close interaction will significantly help to assess the counterparts' attribute level through monitoring. Even more strikingly, a personal relationship also increases the likelihood that one will receive the required information from the other party through inquiry and repeated conversation about the focal attribute. A targeted inquiry seldom happens across individuals lacking social ties. Prior research indicates that individuals tend to use overt information seeking behaviors only to the extent that they feel comfortable in approaching information sources (Miller and Jablin, 1991). In the same way, familiarity has been found to be an important determinant when people decide whom to ask for specific information (O'Reilly, 1982, Beach et al., 1978).

On the one hand, the chance to know about less visible attributes is closely tied to the existence of acquaintance. To gather information on highly visible attributes, on the other hand, does not necessarily require that the members of a social network maintain personal relationships. This implies that the visibility of attributes should determine the efficiency of pyramiding. The less visible an attribute actually is, the less likely it becomes that members of a social entity can assess the level of that attribute for all other members and will therefore lack reliable information on the distribution of the attribute levels across the group members. Consequently, individuals should find it more difficult to provide direct references to the target persons exhibiting extreme levels of a variable with low visibility.

We therefore suggest that

H1: The efficiency of pyramiding search is positively associated with the visibility of the focal search attribute. Attributes of high visibility will be linked with shorter search chains than attributes of low visibility.

Searching within networks of different sizes

When navigating through social networks to acquire knowledge, the searching party often does not know the exact identity of the target person with the focal quality being sought. This problem is likely to be especially severe when searching for individuals amongst consumers. Therefore, search processes in this context are often best understood as search without prior knowledge about the end destination (Singh, 2010). This is also true for pyramiding searches that are usually not limited to one department in a company or one community or group of consumers. In fact, pyramiding "allows (or even invites) referrals to potential problem solvers outside of a predefined population" (Poetz and Prügl, 2010, p.898). This has important implications for the size of the network being searched, which may actually increase during

the search process if references to persons outside the boundaries of the initial population are given.

Singh (2005) has shown that the diffusion of information between two individuals in any network can be expected to fall as the network distance between the two increases. Already within the same firm, information from an employee diffuses more easily to her direct collaborators than to others (Singh and Agrawal, 2011). Obviously, with an increasing network and increasing distances therein, there exists a "horizon of observability" (Friedkin, 1983) beyond which people cannot reliably evaluate other people's attributes or may even be entirely unaware about other people's existence. As a consequence, the likelihood that members of a social group know about all the others' attribute levels or can easily observe them decreases with an increasing size of the network, thus making accurate references more difficult. This implies that the size of the social network being searched should determine the efficiency of pyramiding. Pyramiding should be associated with longer search chains in larger networks as (1) people may not be aware of all members in the network and (2) only a comparatively small number of highly central subjects may have reliable information on the distribution of the attribute levels across the group members. Consequently, individuals should find it more difficult to make direct references to the target persons exhibiting extreme levels of the focal variable or are more likely to make mistakes in the references they provide (Killworth et al., 2006, Pool and Kochen, 1978).

Yet, research has shown that even very large networks exhibit a surprising efficiency in moving information between their members (Baum et al., 2003). For example, the commonly held belief of six degrees of separation holds that "any two individuals, selected randomly from almost anywhere on the planet, are "connected" via a chain of no more than six intermediate acquaintances" (Watts, 1999, p. 493). Results of empirical small-world research support this contention and find chain lengths of about six to seven steps (Dodds et al., 2003;

Travers and Milgram, 1969) for completed search chains. This is remarkable, as the experiment carried out by Dodds et al., for example, took place on a global scale and required the identification of 18 target persons from 13 different countries. These small-world networks benefit from the fact that an increasing network offers an exponential growth of ties among the actors through which information may flow, thereby potentially outweighing boundaries of observability for individuals (Adamic and Adar, 2005). In all cases mentioned above, the population sizes from which these target persons were selected were much larger and may even have been impossible to search with a screening approach. The results obtained from these studies suggest that a network-based search approach is likely to be much more efficient that a screening search of the respective population.

However, an important difference between pyramiding and these small-world studies is, that the latter are based on the identification of a predetermined person in a specified location and therefore have an a priori defined target. Thus, their results as well as most of the studies on search strategies are based on clues about the target (Adamic and Adar 2005, Dodds et al. 2003, Bernard et al., 1982, Killworth and Bernard 1978, Travers and Milgram 1969). In contrast to this, recall that pyramiding is a search without prior knowledge about the end destination. As such, it may be more strongly affected by the horizon of observability than the searches carried out in the aforementioned small-world experiments.

Taken together, these findings suggest that there is an absolute as well as a relative effect of network size on the efficiency of pyramiding searches. In absolute terms, pyramiding search chains are likely to increase in length as the size of the network being searched increases, due to increasing difficulties in observability. However, also screening will become more difficult and time as well as resource consuming the larger population to be searched becomes. The comparative efficiency of networks in disseminating information suggests that a network-

based search approach, such as pyramiding, is very likely to be less adversely affected by this increase in network size.

We therefore suggest that

H2a: The average absolute chain length required to identify the target person will increase with an increasing network size.

H2b: The relative efficiency of pyramiding as compared to screening will increase with an increasing network size.

Research Methodology

The present research aims at investigating the efficiency of pyramiding for different types of search criteria and in networks of different sizes. In order to evaluate the potential of pyramiding, in this empirical analysis we asked the members of well-defined social entities to refer us to the subjects that they believed to exhibit the highest levels on the respective search attributes. In addition, the subjects had to evaluate their own level for the search attributes. Using this information we simulated the search chains that would have resulted if we conducted a sequential search following the referrals of the group members. The benchmark to assess the relative efficiency of pyramiding consisted in the costs of screening. When calculating the search costs associated with pyramiding we account for non-successful search chains, i.e. search chains that, at the end, do not lead to the persons with the highest attribute values. This approach is based on the procedure described by von Hippel et al. (2009).

Participants

In order to address our hypotheses empirically, we gathered data from a public school in Denmark. We surveyed 42 classes with a total of 942 pupils. Classes surveyed ranged from grade 6 (approximately 11 years old) to grade 9 (approximately 14 years old). Children of the respective ages are among the age groups marketers are most interested in (John, 1999). They are capable of assessing others by behavioral as well as psychological descriptors and carrying out interpersonal comparisons as well as making inferences about people based on observations of their consumption of products and brands (Chaplin and Lowrey, 2010, Shaffer, 2009, Barenboim, 1981). They are also well beyond the age of 7, which Piaget (1971) emphasized as a major cognitive turning point: around this age, children make the transition from the preoperational stage to the concrete operational stage; they become better at logical, systematic thought using multiple pieces of information. In addition, language skills develop and children learn about classifications. Regarding marketing initiatives, children aged 10 years plus have been shown to react much in the same way as adults do (Bakir and Palan, 2010, Moore and Lutz, 2000, Phelps and Hoy, 1996). As children spend a considerable part of their day at school, we investigated full networks of school classes, as suggested by Kratzer and Lettl (2009).

Search Topics

Search topics were chosen to reflect a range of characteristics which are typically of interest to marketers. Several rounds of discussions with teachers, pupils and researchers were carried out to collect a list of search topics. These were derived by combining person characteristics (e.g. lead userness, achievement orientation, spending behavior) with products or services considered to be relevant to pupils. The resulting list contained 26 search topics. For a

complete list of these topics see Appendix 1. Based on the discussion in Funder and Dobroth (1987) and Rothbart and Park (1986), we developed two dimensions influencing visibility. The variety of informational sources as well as the frequency with which they can be used were grouped to reflect informational availability. The second dimension considered the number of observations needed to assess the attribute level. All search topics were evaluated along these dimensions. For example, inferences about the number of books that a person owns may be made based on observations of how frequently, a pupil brings a new book to school, the degree to which she is well-read that shows during discussions in class, conversations about books, as well as a visit to her room among others. Very few of these instances will suffice to infer if that person is a book worm and may own a lot of books. In sum, the number of books that a person owns is therefore a highly visible topic in our context. In contrast to this, a persons' tendency for variety seeking is more difficult to ascertain. Observations in school will yield little information about brand switching and exploratory buying behavior. To this end, conversations and observations outside of school in a shopping environment may be more fruitful. To infer that a person consistently exhibits a tendency of switching brands and exploratory buying, will require information on several shopping episodes to determine that this is actually a habit. Consequently, variety seeking is a topic with low visibility in our context. We focused on topics that were clearly of high or low visibility and discarded those that were rated to be in between. Following discussion with teachers showed, however, that even for these topics special circumstances in individual classes could arise that would adversely affect our results. Some teachers for example, reported that they recently had discussions about unacceptable in-class use of MP3-players and mobile phones and frequently confiscated them temporarily from pupils if they were caught using them in class. Therefore, students were artificially aware of these topics and positively biased in their level of information regarding their fellow students. To eliminate

such unwanted class-level influences, we followed the idea of Thurstone (Wrenn, 1997, Likert et al., 1993, Thurstone and Chave, 1929) and asked a control group of 90 students in four classes from similar grades to assess the visibility of the search topics. The results were used to identify 7 search criteria that were consistently perceived as having a high or low visibility respectively. Specifically, we chose to search for

- The person who owns most books
- The person who spends most money in the school cafeteria per week
- The person with the highest lead userness in computer-assisted presentations
- The person with the highest achievement orientation

as topics which we classified as having a comparatively high visibility and

- The person who most strongly seeks variety
- The person with the highest involvement in energy saving
- The person with the most pieces of furniture in her room

which were classified as having a low visibility in our context.

Data Collection

All in all, we collected data on 7 search topic in 42 classes equally spread across grades 6 to 9. As we searched for each topic within each class as well as the respective grade, we were able to simulate a total of 13188 search chains.

Data collection was carried out using written questionnaires. Participants were asked to provide two types of information for 7 topics: For each topic and person, we collected data on their own information regarding the topic in question as well as references to the person in the

entire grade and the participant's class whom the participant considered to be the target person we sought for this topic. As search chains are embedded in a social network structure, we also asked every participant to provide information on their social networks in their grade and class.

When collecting data from children, it is important to consider their cognitive, communicative and social skills to make sure that questions are properly understood (Borgers, 2003). To ensure reliable and valid measures of the constructs related to the 7 search topics, we followed the expert appraisal coding schedule for questionnaires for children and adolescents (Borgers, 2003): We employed items from well-established earlier studies whenever possible and adapted their wording to better meet the requirements of our target group. In addition, we tried to keep the total number of items in the questionnaire as low as possible to avoid overburdening the children's cognitive capabilities. A pre-test with 80 pupils of the same age was carried out to ensure that the questions were comprehensible.

To avoid potential biases, each group was briefed with identical instructions and we ensured that all participants filled out the questionnaire simultaneously and completely independently to ensure independence of referrals.

Measures

We employed items from well-established earlier studies whenever possible and adapted their wording to better meet the requirements of our target group. The questions pertaining to the number of books, the amount of money spent in the cafeteria as well as the number of pieces of furniture in a pupil's room directly asked for a respective quantification.

Efficiency of pyramiding search - Following von Hippel et al. (2009), we measured the efficiency of a search as the number of interview contacts (links in the search chain) that must be made before that target person is correctly identified. For the screening search, the number of contacts that must be made will equal the number of individuals in the class/grade. A pyramiding ended if a person identified is the target person – i.e., he or she has the highest level in the group of the special quality being sought.

Lead Userness - Lead users are members of a user population who a) anticipate obtaining relatively high benefits from obtaining a solution to their needs and so may innovate and b) are at the leading edge of important trends in a marketplace under study and so are currently experiencing needs that will later be experienced by many users in that marketplace (von Hippel, 1986). We measured lead userness drawing on a recent operationalization by Franke et al. (2006), which reflects these characteristics.

Achievement orientation - Achievement orientation may be understood as the tendency of an individual to strive for competence in her work (Hirschfeld, 2002). Researchers have repeatedly theorized that the degree to which people are psychologically involved in their job tasks has important implications for creativity and innovation (Amabile, 1988). We measured the tendency to strive for competence in one's work using five items from Steers and Braunstein (1976).

Variety seeking - According to Raju (1980), variety seeking aims at maintaining optimal stimulation levels and may lead to attempts to adjust stimulation from the environment. Such behavior, aimed at modifying stimulation from the environment will often lead to brand switching and exploratory buying behavior. We measured variety seeking drawing on items from the ETCBS scale developed by Raju (1980).

Involvement - An individual's choice of information processing strategy is directly related to her involvement, i.e. her "perceived relevance of the object based in inherent needs, values, and interests" (Zaichkowsky, 1985, p.342). We measure involvement based on a scale developed by Chandrashekaran (2004), which has been shown to be highly correlated with the Personal Involvement Inventory (Zaichkowsky, 1994, Zaichkowsky, 1985), a much longer scale very commonly used in consumer research.

Construct	Items	Squared Multiple Correlations	Factor Loading	Item-to-Total Correlation	Cronbach's Alpha	Explained Variance of First Extracted Factor (%)
Lead userness	d11	0,68	0,88	0,70	0,81	72,82
	d12	0,59	0,85	0,66		
	d13	0,50	0,83	0,63		
Achievement orientation	e11	0,27	0,66	0,44	0,73	55,25
	e12	0,46	0,77	0,55		
	e13	0,41	0,76	0,54		
	e14	0,50	0,78	0,55		
Variety seeking	f13	0,46	0,80	0,53	0,71	63,21
	f14	0,61	0,84	0,59		
	f15	0,33	0,74	0,46		
Involvement in energy saving	g11	0,67	0,89	0,76	0,88	81,30
	g12	0,87	0,93	0,83		
	g13	0,63	0,88	0,74		

Table 1: Tests of Latent Construct Measurement

We conducted both, exploratory and confirmatory factor analyses to assess reliability and validity of measurements (see Table 1). For each latent variable, the first factor extracted explained more than 50 percent of the variance in an exploratory factor analysis. Furthermore, Cronbach's alpha clearly surpassed the 0.7 threshold. One item of lead userness (d14) was dropped due to low item-to-total correlation of 0.23 and two items of variety seeking (f11, f12) were dropped for the same reason (0.31 and 0.38). Next, overall measurement quality

was assessed by employing confirmatory factor analysis (Ahire and Devaraj, 2001). Items e11 and f15 were retained despite low squared multiple correlations, as the factor loadings in both cases exceeded the critical value of 0.5 (Babin and Boles, 1998).

Analytical Techniques

The expected number of people to be contacted when searching for a target person via pyramiding cannot be obtained analytically. Therefore, in order to calculate this number, we employed a Monte Carlo simulation of a real search specifically programmed for this purpose in C++.[2]The software randomly selects a starting subject, X1. If X1 already is the target person, the number of subjects necessary to ask equals 1. If not, the software follows her referral to subject X2. If X2 is the target person, the number of persons necessary to ask equals 2, and so on. If a chain brakes or reaches an end which is not the target person, another starting subject (other than X1 or any of the subjects in the referral chain starting with X1) is randomly selected and the procedure goes on. The process does not end until the target subject is reached. If the target person does not refer to herself, an extra step (the "let's see if it still improves" step) is added (see von Hippel et al., 2009). In each system (i.e. each group and topic), 1,000 simulations of searches were conducted. For a few searches, not one but two people emerged as the target persons in a group. To allow for comparisons among the different search topics we ran simulated searches for each target person separately and used the average number of steps for comparison with other topics, as deviations from the mean were comparatively small. We also performed the analyses separately for each of these search chains and found no differences in the results.

[2]We are very thankful to Reinhard Prügl who granted us access to this software which was specifically developed for his research (Prügl, 2006; von Hippel et al., 2009)

We use ANOVA to test for differences between search chains for high vs. low visibility search topics as well as search chains with classes vs. within grades.

Results

To assess the relative efficiency of pyramiding search vs. screening, we compare the expected number of persons to be contacted when doing a pyramiding search, which we obtained from the simulation, with the effort of a screening search, which by definition equals the number of subjects in the population.

Across all classes and search topics, we find pyramiding to require on average only 31% of the effort of screening. In 93% of all cases, pyramiding consistently involves less than half the effort of a screening search. For a detailed summary of these results see Appendix 2. This ratio is comparable to the results of von Hippel et al. (2009) who calculated pyramiding efforts to be on average 28.4% of the effort of screening.

	high visibility search topics n = 168 searches	low visibility search topics n = 126 searches	
	Mean (SD)	Mean (SD)	F-value (p-value)
Pyramiding efficiency (number of chain links)	6.62 (2.62)	8.62 (2.48)	44.12 (<0.001)

Table 2: Findings pertaining to the visibility of the search topic

The findings of the ANOVA support hypothesis H1 (see Table 2). In H1 it is stated that pyramiding searches will be more efficient for high-visibility topic searches than for low-visibility topic searches. In line with this prediction, we find that the number of chain links to be contacted in order to identify the target person being sought is lower (mean = 6.62) for highly visible topics than for topics with a low visibility (mean = 8.62; $p<0.001$).To check if

participants actually perceived giving a reference in a low-visibility topic search as more difficult than in a high-visibility topic search, we additionally asked them to indicate the difficulty they had in providing a reference (on a scale from 1 = very easy to 7 = very difficult). We find a strong correlation of 0.45 (p=0.01) between the number of chain links needed to identify the target person and the perceived difficulty of giving a reference.

Hypotheses H2a and H2b (see Table 3) were analyzed in the same way. H2a states that pyramiding chain lengths will increase when searches are carried out on the grade-level as compared to the class-level. Corroborating this prediction, we find that the number of chain links necessary to identify the target person being sought is lower (mean = 7.47) for in-class searches as compared to in-grade searches (10.22; p<0.001). H2b states that the relative efficiency of pyramiding vs. screening will increase when searches are carried out on the grade-level as compared to the class-level. Supporting this hypothesis, we find that the relative efficiency of pyramiding almost doubles in relation to screening as the size of the network increases (33.78% vs. 17.77%; p<0.001).

	in-class searches n = 294 searches	in-grade searches n = 112 searches	
	Mean (SD)	Mean (SD)	F-value (p-value)
Pyramiding chain length (average number of chain links)	7.47 (2.74)	10.22 (4.10)	60.42 (<0.001)
Relative efficiency of pyramiding (pyramiding effort/screening effort)	33.78% (12.47%)	17.77% (6.53%)	167.06 (<0.001)

Table 3: Findings pertaining to the type of network being searched

We carried out further analyses to check for differences in chain lengths between grades and found them to be non-significant (p=0.346).

Discussion

Existing research has demonstrated the potential of pyramiding to identifying individuals with special qualities and extreme attributes levels (von Hippel et al., 2009). This paper extends these first empirical findings in two ways. In a field experiment we analyzed the efficiency of pyramiding search for (1) search attributes of varying levels of visibility and in (2) networks of different sizes.

In an empirical setting of school classes we find that the level of visibility of the focal search criterion is positively associated with the efficiency of pyramiding. We categorized the personal attributes under investigation according to the extent to which they may be assessed by observation of other people and by using secondary information about others. The findings of this study confirm that this type of visibility is an important factor determining to what extent pyramiding will have a comparative advantage over a screening search approach. It is important to note, that the findings do not imply that pyramiding should not be the preferred search procedure for search topics and personal attributes of low visibility. Even for these cases, pyramiding is still clearly more efficient than screening. The results, however, indicate that the initiators of search activities should consider the level of visibility in the design of the search and the interpretation of the search results. The less visible the focal properties are the more the referrals to other persons will be based on a direct and personal relationship between the referring subject and the named person. The risk of missing promising individuals that are located at the edges of groups and networks is higher for low than for high-visibility attributes. Researchers would therefore need to consider the network structure when designing the search strategy. For instance they could decide to deliberately start search chains in isolated sub-clusters of networks or with individuals located at the periphery of social groups.

We also find pyramiding's relative efficiency vs. screening to significantly increase with an increasing size of the population being searched. In increasing networks, the exponential growth of links among the members offers a host of conduits for information to travel through the network. As screening does not benefit from these social relations but at the same time has to deal with an increasing population size to be surveyed, it efficiency suffers more than the efficiency of pyramiding, as populations grow. When conceiving of a search, the initiators should keep this in mind and weight the relative benefits of screening (guarantee to identify the target person) vs. pyramiding (higher efficiency in terms of search effort). In situations, were the size of the population to be searched is small or where it is actually crucial to really identify the top person with respect to the focal attribute, the guaranteed success of screening may be preferable to the efficiency gains pyramiding offers. In real-world applications and in a consumer setting specifically, however, population sizes are likely to be comparatively large and oftentimes it will not be paramount to identify the top person, as a "really good" one will suffice. Therefore pyramiding should be more attractive in these situations.

Given the comparatively high efficiency of pyramiding vs. screening across search topics with differing degrees of visibility as well as networks of differing sizes, our findings should encourage marketers to apply pyramiding when searching for individuals with rare, special qualities, especially when costs per contact are high. Also, note that our results are likely to be conservative estimates of the relative efficiency of pyramiding vs. screening, as our simulations are based on an average of all possible starting points in each given population. This corresponds to a situation in which a searcher carries out pyramiding without any prior knowledge regarding the level of the special quality being sought in any of the members of the population. In practice, marketers are likely to be aware of some differences between individuals and could therefore select more promising starting points when initiating a pyramiding search. Evaluating data from customer hotlines or complaints may directly

provide the marketer with specific names of promising starting points. But even more general practices such as market segmentation will provide valuable insights into criteria for selecting potentially more attractive starting points for a pyramiding search than just randomly selected members of the population. Applications in real-world settings therefore hold the potential of being even more efficient than our results indicate.

Considering the previous findings of von Hippel et al. (2009) as well as our field experiment, the relative efficiency of pyramiding is affected by properties of the social network within which the search is taking place, personal characteristics of the individuals in the social networks, as well as properties of the search topic. Given the variation in search efforts we found within groups (and across topics) as well as within topics (and across groups), these are likely to have an additional impact on pyramiding search.

Our findings suggest that pyramiding becomes comparatively more efficient with an increasing size of the social network to be searched. This makes pyramiding even more attractive as compared to screening that becomes increasingly expensive and time-consuming with an increasing size of the population to be searched. Pyramiding therefore seems to be especially well-suited for the identification of individuals with rare, special qualities among users or consumers. Future research should hence focus more on the structure of these social networks and its effect on pyramiding. Marginal efficiency gains relative to screening are likely to decrease with an increase in the size of the social network being searched. Thus, an interesting topic of research would be to discover the performance frontier of the efficiency of pyramiding as network size increases. Simulations have shown that - regardless of its size - the searchability of a network is affected by its structural characteristics (see e.g. Watts et al., 2002). Empirical research enriching these findings would be valuable.

As von Hippel et al. (2009) have shown, personal interest in the topic being searched via pyramiding affects search efficiency. Additional characteristics such as a person's openness or her social comparison orientation (Buunk and Gibbons, 2006, Gibbons and Buunk, 1999) could help explain some of the variance in the differences we found. Discussions which emerged in our initial conversations with teachers and students as well as anecdotal evidence from data collection suggest that this could be fruitful area of further research.

Finally, a more complex assessment of the efficiency of pyramiding would appear valuable. As the searcher does not ex ante know the maximum level of the special quality she is searching for, she always risks terminating her search too early, as she may not yet have discovered the real target person. While real-life applications may not always require the identification of the most expert person in a population and a "very good" person usually suffices (von Hippel et al., 2009) searchers would benefit from information on how sure they can be about the suitability of the person at hand as a target for the given search. Incorporating probability assessments based on the percentage of people already searched during the pyramiding process as well as their attribute levels on the search topic could potentially be applied to develop such measures.

This research is subject to some methodological limitations that might also stimulate further research. First, the authors simulated pyramiding searches based on data from a field experiment. To a certain extent, this does not address the sequential nature of the search process, as it precludes incorporating learnings for example, which may arise during the various search steps and may alter the following search process. The external validity of the findings could be enhanced by observing ‘‘real’’ pyramiding search processes (i.e., conducting truly sequential searches). Second, the experimental setting required the participation of pupils, which always involves the risk of limited external validity as this

group might differ from the overall population. Scholars following this line of research should therefore involve larger samples composed of different user segments.

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Appendix 1: List of initially considered search criteria

Product Ownership	• Who was the first to have his own laptop? • Who owns the highest number of books? • Who spends the most money in the school cafeteria? • Who was the first to own a cell phone with a touchscreen? • Who owns most pairs of sneakers? • Who spends the most money on video games /DVDs? • Who was the first to open a savings account? • Who has the highest number of pieces of furniture in his room? • Who spends the most money on perfume?
Product Use	• Who uses the library and the internet best for the preparation of presentations? • Who goes to the restroom most often during class? • Who uses the most functions on Facebook? • Who spends the highest number of vacation days in foreign countries / who made the longest vacation trip during the last year? • Who goes to the museum most often? • Who informs himself most extensively about daily news?
Product-specific Attitudes	• Lead userness computer-presentations • Involvement mathematics • Lead userness cell phones • Involvement fashion • Lead userness healthy nutrition/food • Involvement environment
General Attitudes	• Achievement orientation • Variety seeking • Tolerance for ambiguity • Smart shopping • High information requirements

Appendix 2: Relative efficiency of pyramiding vs. screening in identifying the person with the highest level of a given attribute in a population

In cells: Pyramiding efficiency (expected value [standard deviation] of persons asked in order to identify target person, as obtained from the Monte Carlo simulation); in parentheses: efficiency relative to screening

Group	Topic																					Total
	Achievement orientation			Lead userness			Cafeteria			Books			Variety seeking			Involvement in e.s.			Furniture			
6a (n=16)	6,654	[2,083]	(42%)	8,665	[2,046]	(54%)	6,790	[2,801]	(42%)	6,143	[1,773]	(38%)	5,913	[2,717]	(37%)	7,645	[3,314]	(48%)	4,814	[1,636]	(30%)	(42%)
6b (n=21)	4,902	[1,724]	(23%)	6,796	[2,107]	(32%)	4,392	[3,034]	(21%)	8,860	[2,762]	(42%)	7,225	[2,248]	(34%)	9,225	[2,687]	(44%)	8,075	[2,453]	(38%)	(34%)
6c (n=24)	4,162	[1,152]	(17%)	6,008	[1,481]	(25%)	6,947	[1,596]	(29%)	6,990	[3,488]	(29%)	9,723	[2,811]	(41%)	9,795	[3,644]	(41%)	5,745	[2,890]	(24%)	(29%)
7x (n=27)	10,155	[2,225]	(38%)	8,348	[3,628]	(31%)	8,958	[3,694]	(33%)	3,011	[1,205]	(11%)	9,291	[2,331]	(34%)	11,567	[3,191]	(43%)	12,507	[3,889]	(46%)	(34%)
7y (n=27)	5,200	[2,47]	(19%)	10,83	[3,225]	(40%)	5,303	[2,770]	(20%)	9,101	[2,608]	(34%)	12,868	[3,332]	(48%)	5,875	[2,625]	(22%)	9,692	[4,106]	(36%)	(31%)
7z (n=26)	7,240	[2,23]	(28%)	6,576	[1,718]	(25%)	8,215	[3,019]	(32%)	11,151	[2,096]	(43%)	9,925	[2,543]	(38%)	11,129	[3,228]	(43%)	13,996	[4,189]	(54%)	(37%)
8u (n=24)	3,449	[1,715]	(14%)	4,059	[1,885]	(17%)	3,282	[1,451]	(14%)	2,104	[0,409]	(9%)	10,367	[3,266]	(43%)	7,666	[1,964]	(32%)	9,863	[4,722]	(41%)	(24%)
8x (n=26)	6,621	[2,348]	(25%)	8,809	[1,584]	(34%)	10,232	[3,634]	(39%)	5,644	[1,412]	(22%)	10,720	[2,890]	(41%)	11,524	[3,185]	(44%)	11,057	[2,577]	(43%)	(35%)
8z (n=22)	2,720	[1,096]	(12%)	5,355	[2,477]	(24%)	2,510	[0,821]	(11%)	7,123	[1,857]	(32%)	8,267	[2,359]	(38%)	6,037	[2,291]	(27%)	8,754	[2,697]	(40%)	(26%)
9u (n=24)	7,967	[1,921]	(33%)	6,337	[2,791]	(26%)	6,580	[2,141]	(27%)	7,621	[3,029]	(32%)	8,048	[2,335]	(34%)	7,698	[2,152]	(32%)	4,934	[2,266]	(21%)	(29%)
9x (n=24)	7,840	[2,179]	(33%)	7,064	[1,581]	(29%)	6,348	[2,550]	(26%)	7,048	[1,876]	(29%)	9,281	[2,324]	(39%)	10,163	[3,606]	(42%)	7,874	[2,995]	(33%)	(33%)
9y (n=24)	6,187	[1,503]	(26%)	9,199	[2,695]	(38%)	8,268	[2,496]	(34%)	6,435	[2,253]	(27%)	7,293	[2,828]	(30%)	6,672	[2,281]	(28%)	6,462	[3,360]	(27%)	(30%)
Total			(26%)			(31%)			(27%)			(29%)			(38%)			(37%)			(36%)	(32%)

Group	Topic																					Total
	Achievement orientation			Lead userness			Cafeteria			Books			Variety seeking			Involvement in e.s.			Furniture			
6u (n=25)	3,736	[1,583]	(15%)	6,817	[1,609]	(27%)	6,690	[1,800]	(27%)	2,209	[0,489]	(9%)	8,532	[2,224]	(34%)	7,064	[2,011]	(28%)	6,356	[3,284]	(25%)	(24%)
6v (n=25)	3,835	[0,052]	(15%)	6,693	[1,670]	(27%)	4,636	[2,042]	(19%)	6,056	[1,327]	(24%)	12,283	[3,053]	(49%)	10,032	[3,581]	(40%)	7,461	[3,264]	(30%)	(29%)
7u (n=23)	9,772	[2,673]	(42%)	1,947	[0,224]	(8%)	3,157	[0,934]	(14%)	2,102	[0,563]	(9%)	10,510	[2,617]	(46%)	2,030	[0,342]	(9%)	11,377	[3,682]	(49%)	(25%)
7v (n=23)	13,869	[3,812]	(60%)	9,965	[2,788]	(43%)	8,941	[2,056]	(39%)	7,954	[2,531]	(35%)	7,481	[3,608]	(33%)	10,449	[3,685]	(45%)	7,608	[3,732]	(33%)	(41%)
8u (n=27)	6,475	[1,352]	(24%)	7,986	[1,928]	(30%)	8,137	[2,781]	(30%)	10,026	[2,576]	(37%)	11,616	[3,900]	(43%)	5,797	[3,669]	(21%)	11,395	[2,943]	(42%)	(33%)
8v (n=28)	3,087	[0,491]	(11%)	2,086	[0,469]	(7%)	7,449	[3,284]	(27%)	2,333	[0,712]	(8%)	11,730	[4,201]	(42%)	10,056	[2,811]	(36%)	12,874	[4,126]	(46%)	(25%)
9u (n=14)	5,437	[1,432]	(39%)	7,593	[2,962]	(54%)	2,078	[0,466]	(15%)	5,261	[1,745]	(38%)	6,548	[2,295]	(47%)	7,968	[3,090]	(57%)	8,855	[3,714]	(63%)	(45%)
9v (n=23)	7,137	[3,009]	(31%)	9,621	[2,944]	(42%)	5,989	[1,395]	(26%)	8,996	[4,392]	(39%)	9,378	[2,774]	(41%)	8,305	[2,580]	(36%)	8,229	[4,099]	(36%)	(36%)
Total			(30%)			(30%)			(24%)			(25%)			(42%)			(34%)			(41%)	(32%)

Group	Topic																					Total
	Achievement orientation			Lead userness			Cafeteria			Books			Variety seeking			Involvement in e.s.			Furniture			
6a (n=22)	11,304	[2,74]	(51%)	2,136	[0,444]	(10%)	7,071	[1,961]	(32%)	5,017	[2,063]	(23%)	4,024	[1,71]	(18%)	5,031	[3,094]	(23%)	12,078	[4,497]	(55%)	(30%)
6b (n=21)	8,817	[2,394]	(42%)	6,493	[2,906]	(31%)	4,790	[1,391]	(23%)	5,609	[1,472]	(27%)	12,129	[3,199]	(58%)	11,780	[3,135]	(56%)	5,934	[1,849]	(28%)	(38%)
6c (n=23)	7,274	[3,168]	(32%)	6,526	[1,559]	(28%)	8,575	[1,278]	(37%)	10,002	[2,167]	(43%)	12,166	[2,949]	(53%)	11,268	[3,988]	(49%)	14,827	[4,343]	(64%)	(44%)
6d (n=20)	3,249	[0,545]	(16%)	6,572	[1,52]	(33%)	3,602	[1,841]	(18%)	2,568	[0,83]	(13%)	10,273	[2,784]	(51%)	7,954	[2,355]	(40%)	8,226	[2,321]	(41%)	(30%)
7a (n=21)	9,156	[2,58]	(44%)	5,476	[1,506]	(26%)	10,645	[2,455]	(51%)	11,332	[2,431]	(54%)	7,826	[2,161]	(37%)	6,891	[1,789]	(33%)	5,556	[2,405]	(26%)	(39%)
7b (n=25)	8,532	[2,975]	(34%)	5,520	[1,069]	(22%)	3,995	[1,026]	(16%)	11,985	[3,907]	(48%)	8,011	[1,742]	(32%)	8,388	[3,339]	(34%)	12,393	[4,737]	(50%)	(34%)
7c (n=22)	9,262	[2,061]	(42%)	9,311	[1,981]	(42%)	4,464	[1,451]	(20%)	8,715	[1,773]	(40%)	10,709	[2,463]	(49%)	9,360	[2,754]	(43%)	12,821	[3,432]	(58%)	(42%)
7d (n=22)	7,294	[0,908]	(33%)	8,615	[1,808]	(39%)	7,094	[3,216]	(32%)	6,945	[1,841]	(32%)	9,887	[2,065]	(45%)	6,090	[3,014]	(28%)	10,424	[2,541]	(47%)	(37%)
8a (n=21)	2,331	[0,67]	(11%)	11,331	[3,122]	(54%)	7,680	[1,927]	(37%)	6,172	[2,038]	(29%)	9,520	[4,207]	(45%)	3,894	[0,81]	(19%)	6,855	[2,467]	(33%)	(33%)
8b (n=23)	10,838	[1,981]	(47%)	3,039	[0,44]	(13%)	5,962	[3,794]	(26%)	10,112	[2,373]	(44%)	13,060	[3,288]	(57%)	10,904	[2,146]	(47%)	9,558	[3,724]	(42%)	(39%)
8c (n=21)	5,858	[1,342]	(28%)	5,704	[1,665]	(27%)	3,671	[1,351]	(17%)	2,248	[0,495]	(11%)	9,504	[2,422]	(45%)	8,320	[3,58]	(40%)	5,730	[2,591]	(27%)	(28%)
9a (n=22)	5,799	[1,349]	(26%)	8,829	[2,296]	(40%)	7,923	[2,051]	(36%)	5,713	[1,442]	(26%)	8,051	[2,752]	(37%)	2,840	[0,983]	(13%)	5,767	[3,358]	(26%)	(29%)
9b (n=23)	7,144	[2,882]	(31%)	6,909	[1,55]	(30%)	12,865	[2,926]	(56%)	5,035	[1,435]	(22%)	9,890	[3,251]	(43%)	8,626	[2,546]	(38%)	8,288	[3,237]	(36%)	(36%)
9c (n=25)	4,219	[0,909]	(17%)	3,080	[1,301]	(12%)	8,069	[1,931]	(32%)	4,973	[2,403]	(20%)	7,914	[2,214]	(32%)	6,680	[2,518]	(27%)	10,750	[2,708]	(43%)	(26%)
Total			(32%)			(29%)			(31%)			(31%)			(43%)			(35%)			(41%)	(35%)

Group	Topic																					Total
	Achievement orientation			Lead userness			Cafeteria			Books			Variety seeking			Involvement in e.s.			Furniture			
6a (n=19)	2,546	[0,637]	(13%)	4,67	[1,75]	(25%)	9,006	[3,174]	(47%)	7,962	[2,277]	(42%)	6,898	[2,058]	(36%)	4,264	[2,357]	(22%)	3,428	[1,991]	(18%)	(29%)
6b (n=23)	11,352	[2,299]	(49%)	8,635	[2,02]	(38%)	11,3	[5,139]	(49%)	5,836	[1,31]	(25%)	11,157	[3,02]	(49%)	6,454	[3,908]	(28%)	9,289	[3,825]	(40%)	(40%)
7a (n=23)	3,103	[0,528]	(13%)	7,891	[2,211]	(34%)	8,806	[1,941]	(38%)	3,076	[0,514]	(13%)	6,359	[2,118]	(28%)	4,976	[2,029]	(22%)	7,981	[1,7]	(35%)	(26%)
7b (n=21)	4,008	[1,122]	(19%)	7,538	[2,053]	(36%)	6,383	[1,541]	(30%)	2,435	[0,869]	(12%)	7,943	[3,99]	(38%)	10,471	[3,119]	(50%)	10,622	[3,087]	(51%)	(34%)
8a (n=20)	3,156	[1,607]	(16%)	8,419	[1,704]	(42%)	10,519	[2,693]	(53%)	9,069	[1,87]	(45%)	9,92	[2,278]	(50%)	7,286	[1,766]	(36%)	10,344	[3,675]	(52%)	(42%)
8b (n=22)	7,212	[2,029]	(33%)	5,248	[2,279]	(24%)	11,433	[4,53]	(52%)	2,131	[0,462]	(10%)	8,529	[4,368]	(39%)	9,732	[2,47]	(44%)	6,377	[2,37]	(29%)	(33%)
9a (n=15)	4,929	[1,515]	(33%)	6,835	[1,944]	(46%)	6,186	[1,794]	(41%)	7,299	[2,286]	(49%)	7,244	[2,337]	(48%)	7,382	[2,879]	(49%)	9,124	[2,613]	(61%)	(47%)
9b (n=15)	5,32	[1,223]	(35%)	7,598	[2,225]	(51%)	3,935	[1,781]	(26%)	6,848	[2,019]	(46%)	9,725	[2,522]	(65%)	4,317	[1,885]	(29%)	5,526	[1,726]	(37%)	(41%)
Total			(27%)			(37%)			(42%)			(30%)			(44%)			(35%)			(40%)	(36%)