

Effects of Psychological Style on On-line Network Connectivity

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Key Words : psychological type, network connectivity measures, whom-to-whom matrix, communication mode, MBTI

Abstract

The use of electronic mail and messenger software tools has been increased rapidly over a decade. Compared to the variety of research related to the relationship between personal psychological traits and communication modes, effects of human psychology on online activities have only recently become a focus of interest. This research analyzed the relationship between personal psychological type and online connectivity. We employed network analysis methodology and collected and analyzed data from 146 subjects. Significant differences in network measures were found among groups with different psychological style. Findings of the research can provide several implications for managerial activities regarding social connectivity.

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I . Introduction

A cyber community where participants enjoy certain type of membership is generally established by people with similar interests. Such a community tends share tight and close relationship among its members (Williams and Cothnel, 2000). The strength of a community is related to the intensity and length of the relationship among members. In a cyber community, members generally correspond to each other in a specific manner common in that group.

Despite the natural intuition that individual psychology should affect human behavior in cyber space and the results from behavioral science on the role of psychology in determining the strength, depth, and persistence of human relationships, the effects of human psychology on activities in on-line communities have not been explored systematically nor seriously in management research.

This research specifically focuses on the relationship between psychological type and on-line social contact. For this purpose we employed the methods and theory of network analysis. We also tried to compare two different mode of on-line medium: the electronic mail as an asynchronous medium

and the chat/messenger service as a synchronous medium. We expect that findings from this research would provide some useful insights into managerial activities related to the social connectivity.

II . Theoretical Background

1. Psychological Styles and Communication Modes

Psychological style is related to the preference to the mode of communication such as FTF (face-to-face) and STF (screen-to-face). Further, the psychological style could mitigate the influence of communication mode (Barkhi, 2001). This implies the existence of a potential interaction between communication mode and cognitive style. Myers-Briggs Type Indicator (MBTI) originally developed by Carl Jung (1923) was used to measure psychological style in Barkhi's research. MBTI classification is based on the way people perceive, think, and judge. Major dimensions for classification in this approach include sensing-intuition, thinking-feeling, and introvert-extrovert. He specifically examined the effect of cognitive style on the levels of trust and frustration.

According to our previous exploration, media characteristics such as synchronicity and certain psychological traits affect the patterns of media usage and the perception of the media (Cho & Park, 2001). We employed process analysis approach and semi-experimental setting to study how the perception of technology and personal psychological trait affect the behavioral involvement of members in on-line group.

Moreover, cognitive involvement or absorption is also considered to have some relationship with the mode and level of the use of on-line technology. The level of cognitive absorption of an individual is defined as the state of attention and engagement and is considered to have five sub-dimensions: temporal dissociation, focused immersion, heightened enjoyment, control, and curiosity (Agarwal and Karahanna, 2000).

In a research on the behavior of on-line game players, we found that factors that influence the amount of loyalty include impulsiveness and motivation (Cho, Baek, and Ryu, 2001). The impulsiveness and motivation in computer-mediated communication might, in turn, be influenced by the degree of interactivity of a media and the level of perceived usefulness of the information contents provided (December, 1996).

The complexity and strength of a social network can be measured by the degree of personal connectivity within the community (Rogers and Kincade, 1981). Personal connectivity has been studied in various settings such as families, friends, sub-groups, organizations, and society in general. The concept is considered closely related to the span of political relationship, decision-making process within a society, and organizational structure. (Wellman and Berkowitz, 1988; Scott, 1991). Jun (1993) suggested that personal traits, the strength of social network, and the characteristics of a group itself could affect the performance of the members as well as the group as a whole.

2. Analysis of Communication Network

1) Measuring Networks

Network analysis is based on various analytical or empirical measures that capture certain characteristics of a network. Analytical approaches of a network have used such measures as connectivity, indirect connectivity, centrality and density (Freeman, 1978; Rogers and Kincade, 1981; Shrum and Check, 1987). Basically, the measures try to capture the characteristics of the linkage structure of a network and the role of members within the web of relationship.

Ultimately, by analyzing the architecture of a network, we can better understand the nature of the relationship among members and the effects of social behavior.

In general, nodes of a network signify the members and the ties of a network reflect the relationship between any two nodes. Actually, depending on the unit of analysis of a research the nodes may imply individuals, groups, sub-communities, or organizations. The relationship symbolized by tie could be a friendship, information exchange, or governance.

2) Whom-to-Whom Matrix and Measures

We employed three variables - connectivity, indirect connectivity, and centrality - to measure and analyze the nature of a network. These measures are computational outcomes base on the “whom-to-whom” matrix. A whom-to-whom matrix is a simple table that visualizes the existence of the relationships among members.

If there are N members, the whom-to-whom matrix becomes an N x N rectangular matrix. Each cell of the matrix $C_{ij}(i=1 \text{ to } N, j=1 \text{ to } N)$ can have a value based on a simple rule:

(1) when $i=j$, $C_{ij} = 0$,

(2) when $i \neq j$,

▷ $C_{ij} = 1$ if there is no communicative relationship between i-th and j-th

members

▷ $C_{ij} = 1$ if there is a communicative relationship between i-th and j-th members.

This way, the matrix visualizes if the individuals in row have a contact with the individuals in column. The matrix shows how densely the members share the web of relationship in a given community. The total amount of linkage can be computed by counting the number of all 1's in each column. That is, the total linkage of connection of member j should be:

$$\text{Linkage of member } j: L_j = \sum C_{ij} \dots (1)$$

Index for member j can be computed by producing relative proportion of j's linkage out of total possible linkage in the community. Connectivity of member j reflects j's linkage out of total possible dyadic relationship. Indirect connectivity includes relationships with no direct contact but linkages that can be established by two steps passing through a direct contact. It could be described as 2 degrees of separation (Barabasi, 2002). Centrality of member j means the proportion of the members that have been contacted directly from member j out of total members. It signifies how central the j-th member is in the web of contact

among members.

- Connectivity of member j: $CN_j = \frac{L_j}{N(N-1)/2}$
- Indirect connectivity of j: $ICN_j = \frac{L_j}{(N-1)(N-2)}$
- Centrality of member j: $CNT_j = \frac{L_j}{N-1}$

By extending the logic to the whole network, we can easily establish measures of similar nature of the whole network. The measures and their meanings are summarized in Table 1.

to measure the psychological traits (Myers, 1962, Barkhi, 2001).

The Jungian typology is characterized by four dimensions; extrovert/introvert, sensing/intuition, feeling/thinking, and judging/perception (Mason and Mitroff, 1973). The way people make a decision, solve a problem, and establish a relationship depends on these cognitive traits (Leonard and Straus, 1997).

Table 1. Network measures

Measures	Formula	Meaning
Connectivity (CN)	$L/N(N-1)/2^*$	Degree of connectivity with others in same community via online communication media
Indirect connectivity (ICN)	$L/(N-1)(N-2)^*$	Degree of indirect connectivity with others in same community
Centrality (CNT)	$L/(N-1)$	Degree of centrality in same community

Remarks) *L: Connections, N: Total members, $N(N-1)/2$:Maximal and possible connections

3. Psychological Styles

Carl Jung (1923) developed a theoretical framework to classify individuals by their psychological traits. Briggs and Myers materialized Jung's model by developing a specific measure. Since its inception in 1943 Myers-Briggs Type Indicator or MBTI has evolved into a stable and reliable instrument

Extrovert/introvert dimension is related to an individual's attitude toward outer or inner worlds. Sensing/intuition dimension describes how one acquires information for perception, and thinking/feeling dimension is related to the ways how, after aggregating information, people make a judgment. Judging/perception is a dimension related to the cognitive strategy we use in processing

information. The combination of the four preferences produces 16 personality types that form the basis of MBTI inventory.

1) Psychological style in IS Research

In the field of MIS, there exists a stream of research that present results showing that cognitive styles affect the pattern of IS use. These researches brought a series of discussion on the implication of cognitive style for the design of management information systems (MIS) and decision support systems (DSS) (Bariff and Lusk, 1977; Doktor and Hamilton, 1973; Mason and Mitroff, 1973; Zmud, 1980). Since people with different psychological traits have different perspective on the form and contents of information, it is expected that managers and users provided with information geared to their psychological type would use information better. However, the discussion on the relationship between the style of cognition and the design of information could not draw solutions practical enough to improve IS development effectiveness and efficiency (Huber, 1983)

Cognitive style could be a more important consideration when technology is used as a medium of communication. Conway and Rubin (1991) explored the psychological origins of media gratifications by examining

how pertinent psychological variables help explain the level of motivation to view media. Recently, some empirical evidences have been provided that extravert trait and neuroticism are related to different uses of Internet (Hamburger and Ben-Artzi, 2000).

4. Synchronicity of on-line media

An online medium can be either synchronous or asynchronous depending on the existence of temporal break between the exchanges of messages (Cristian, 1996).

As summarized in Table 2, synchronous media such as on-line chatting and instant messenger support real-time transmission of communication contents between the message sender and the receiver. By the nature of synchronous communication session, the number of participants for a given communication instance is generally limited. Services that support synchronous communication tends to require the registration of membership. Electronic mail is probably the most popular asynchronous medium of the day for both personal and official purposes. It is not necessary for senders and receivers to stand by at the same time.

Table 2. Synchronicity of on-line media

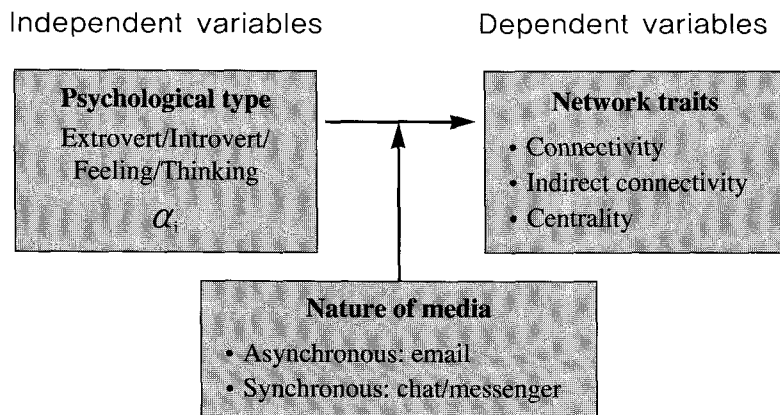
	Media	Initiator	Mode
Asynchronous	Email Mailing list BBS, Usenet	Sender Receiver Receiver	One-to-one, One-to-many Many-to-many Many-to-many
Synchronous	Chatting room Messenger	Interactive Interactive	Many-to-many, One-to-one One-to-one, Many-to-many

III. Research Methodology

We modeled that the psychological type, or the independent variable, would affect the traits of social network among members in cyber community as measured by the levels of connectivity, indirect connectivity, and

centrality variables. As depicted in Figure 1, we further modeled that the nature of media in terms of asynchronicity would moderate the relationship.

We think extrovert-introvert dimension and thinking-feeling dimension have special relevance to our research purpose, which



$$\text{Network Traits} = \mu + \alpha_i + \varepsilon_i, i=1, \dots, n$$

Figure 1. Research model

focuses on communicative behavior. The resultant four types are as follows:

- *Extrovert/thinking*: People of this type would be more involved with the outer world of people and things, but bases his judgment on a logical and impersonal process.
- *Introvert/thinking*: People of this type would focus on their inner worlds of concepts and ideas, and would pay more attention to the logic of the task and find it difficult to confront others to express their own feeling.
- *Extrovert/feeling*: People of this type emphasize subjective values as well as personal values of people and tend to be talkative, impulsive, and gregarious.
- *Introvert/feeling*: People of this type tend to work alone, dislike distractions, and think before action.

The four types of psychology are measured by six items each in Liker-type seven-point scale. We used the 'Psychological Trait Rating Scales' previously developed in educational psychology. One unique aspect of the Psychological Trait Rating Scales is that extrovert and introvert aspects are measured by different items. Similarly, feeling and thinking aspects are measured by different items. The psychometric scale is composed of bipolar adjective descriptions of opposite

meaning. For instance, one of the scales has 'Serious and determined' at one end and 'Easy-going' at the other. 48 adjectives were chosen and used in the research.

For assessing the traits of network, we asked the respondents (college students who are members of a cyber community) to report the names and frequency of contact they made with certain on-line media for the last one month. We applied the formula presented in Table 1 to the collected data and computed different measures of the degrees of social network.

IV. Research results

1. Sample

146 undergraduate students from the school of management in two universities were used as research subjects. The subjects in each university were members of the corresponding college cyber community. The participants were selected randomly without a priori knowledge of the subjects' psychological types. The students were generally familiar with and frequently using instant messengers and electronic mail. After excluding 5 uncompleted responses, total 141 responses were analyzed in the research. As

shown in Table 4, most of the subjects were in their ages of late teens and early twenties. Out of the total 141 subjects, 77 were female and 64 were male.

Among the subjects 80 percent was 'thinking' type and 20 was 'feeling' type. 55 percent was extrovert and 45 percent was introvert. Introvert/thinking type was the most popular type followed by extrovert/thinking type. Extrovert/feeling type was the least popular type.

2. Characteristics of the Variables and Values

1) Psychological Measures

Table 4 summarizes the results from factor analysis. The factor loadings and structure were considered reasonable and usable for

further analysis. Reliability as measured by Cronbach's Alpha showed that the reliabilities of extrovert and introvert were high and the reliabilities of feeling and thinking were lower than the others but still acceptable (Table 5) (Nunnally, 1978).

2) Measures of linkage

On the average each individual had contacts of 3.9 other individuals with instant messenger and 0.7 others with electronic mail. The average connectivity of instant messenger was 0.0019, and that of email was 0.0002, showing that the connectivity with messenger is 9.5 times that with e-mail. The levels of indirect connectivity and centrality were also higher in messenger than e-mail for the subjects in our research.

Table 3. Psychological types

	Feeling (F)		Thinking (T)	
	Frequency	Ratio(%)	Frequency	Ratio(%)
Extrovert (E)	8	6	55	39
Introvert (I)	20	14	58	41
Total (N)	28	20	113	80

Table 4. Factor analysis results

Questionnaire number	Factor loadings			
	Extrovert	Thinking	Feeling	Introvert
33	.836			
17	.799			
1	.775			
10		.783		
46		.724		
26		.643		
28			.717	
48			.674	
12			.606	
4				.654
20				.695
35				.726

Table 5. Reliability of the variables

variable	Item # of questionnaire	Cronbach's α
Extrovert	1, 17, 33	.8631
Introvert	4, 20, 35	.7514
Feeling	12, 28, 48	.6317
Thinking	10, 26, 46	.6878

3. Verification of the research model

To test the research model, analyses of variance was performed first to examine mean differences among the four groups with different psychological types.

1) Difference among four groups

The four groups showed significant overall difference in all network measures ($p < .000$)

as appeared in Table 6. The highest group in the use of messenger was introvert/thinking type group. This result is consistent with our previous survey outcome showing that introvert/thinking people were highest in 'perceived usefulness' and 'usage of cyber community' among all types (Cho and Park, 2001).

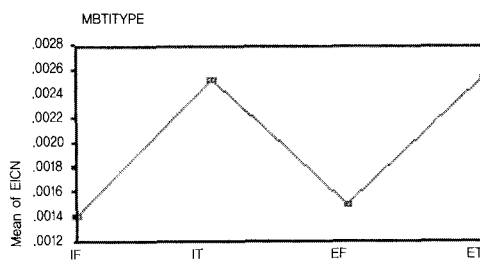
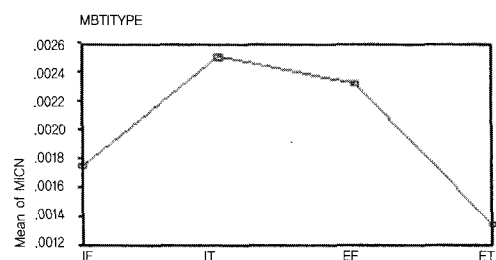
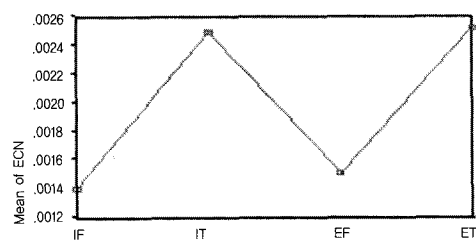
In the case of e-mail, extrovert/feeling type was highest in indirect connectivity and extrovert/thinking type was highest in connectivity and centrality. Overall we can

Table 6. Measurement results and ANOVA statistics in four groups

Type	Messenger			Email		
	Connectivity	Indirect connectivity	Centrality	Connectivity	Indirect connectivity	Centrality
Introvert/Feeling Mean(SD)	.00170 (.00199)	.00206 (.00213)	.0494 (.0435)	.00014 (.000368)	.00070 (.000577)	.00345 (.00780)
Introvert/Thinking Mean(SD)	.00241 (.00383)	.00324 (.00431)	.0624 (.0792)	.000248 (.000553)	.000973 (.000744)	.00585 (.01174)
Extrovert/Feeling Mean(SD)	.00225 (.00265)	.00266 (.00283)	.0618 (.0539)	.000150 (.000424)	.00120 (.00000)	.00305 (.00863)
Extrovert/Thinking Mean(SD)	.00130 (.00209)	.00181 (.00238)	.0415 (.0474)	.000251 (.000550)	.000875 (.000751)	.00627 (.01186)
R^2	.306	.384	.428	.168	.634	.206
F	15.123**	16.545**	25.585**	6.934**	13.873**	8.909**
p-value	.000	.000	.000	.000	.000	.000

<Messenger>

<Email>



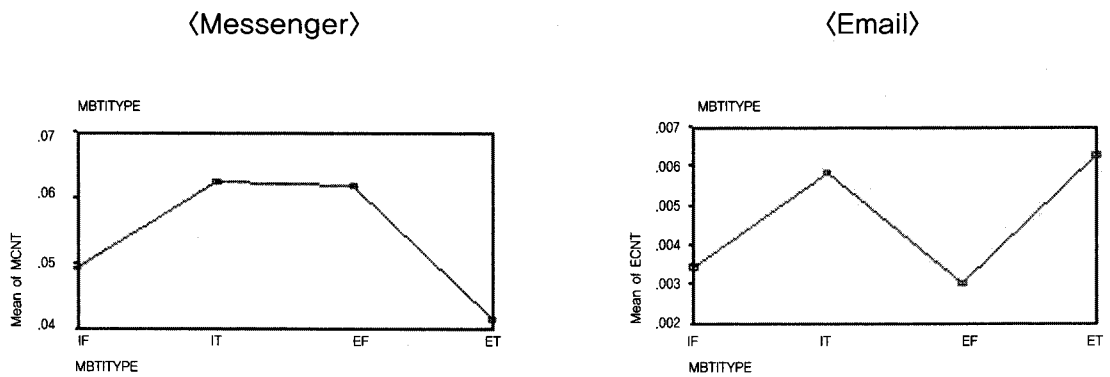


Figure 2. Mean difference in network measures among four psychological types

conclude that mean differences in network measures among the four psychological groups are statically significant. Mean values of the network measures of the four psychological type groups are graphically presented in Figure 2.

In messenger usage, introvert/thinking and extrovert/feeling groups were consistently high in all measures than introvert/feeling and extrovert/thinking groups. In the case of electronic mail use, extrovert/thinking and introvert/thinking groups showed consistently high score in all measures than extrovert/feeling and introvert/feeling groups. The result implies that attitude dimension is the more important determinant than judgment dimension in e-mail use.

2) Comparison between extrovert and introvert groups

The results of statistical analyses show that there are statistically significant differences between extrovert and introvert groups. Extrovert group is significantly lower in all measures of messenger usage than introvert group. Specifically, centrality represents the popularity of the member in a community. The result indicates that introverts using messenger are more popular than extroverts. This result is also in the same line with our previous research that introverts are more active than extroverts in cyber community. In the case of email use, extroverts are higher in connectivity and centrality than introverts, but introverts are higher in indirect connectivity. Therefore, the results show that introverts prefer messengers to e-mail when compared to extroverts (Table 7).

Table 7. Extrovert and Introvert comparison

Network measures	Extrovert/Introvert	t	Sig.
Messenger			
Connectivity	0.00140/0.00220	-3.461**	.000
Indirect connectivity	0.00190/0.00290	-2.786**	.000
Centrality	0.04410/0.05910	-3.012**	.000
Email			
Connectivity	0.00024/0.00022	2.895**	.000
Indirect connectivity	0.00089/0.00092	-3.217**	.000
Centrality	0.00586/0.00523	2.347**	.000

3) Comparison between feeling and thinking groups

According to Table 8, there are significant differences in all network measures between feeling and thinking groups. Overall, feeling

type group is consistently lower in all scores except for messenger centrality. The latent tendency that messenger users use richer emoticons and text messages that represent facial and emotional expressions than e-mail users help feeling-type people communicate actively.

Table 8. Feeling and Thinking comparison

Network measures	Feeling/Thinking	t	p
Messenger			
Connectivity	0.00185/0.00187	-2.591**	.000
Indirect connectivity	0.00224/0.00256	-3.112**	.000
Centrality	0.05290/0.05230	3.339**	.000
Email			
Connectivity	0.00014/0.00025	-4.068**	.000
Indirect connectivity	0.00080/0.00092	-3.750**	.000
Centrality	0.00334/0.00605	-4.047**	.000

V. Conclusion and discussion

In this research we analyzed the relationship between psychological style and selected aspects of social communication network among members in cyber community. We found various statistically significant differences among four groups with different psychological style. Specifically, the introvert/thinking group showed highest score in all three selected social network measures for instant messenger use. In the case of e-mail, however, the extrovert/thinking group was highest in connectivity and centrality scores.

The result implies that the introvert/thinking type people prefer to use messenger services, while extrovert/thinking people prefer e-mail. While e-mail is used widely and is the most

popular office support medium these days, the use of messenger services can provide additional advantages and produce different aspects of utility for e-business.

In addition, careful accounts on individual difference may provide us with better personalized services. Such arrangements can contribute to the creation of differentiated services and to the improvement of productivity and competitiveness. The result also implies that the management of media by synchronicity type might be required for improved communication of business activities. New messenger-type synchronous media can provide us with additional opportunities for administrative and marketing purposes. The opportunities will best be utilized by companies prepared to manage the media appropriately.

References

1. Agarwal, R. and Karahanna, E., "Time Files When You're Having Fun: Cognitive Absorption and Beliefs about Information Technology Use," *MIS Quarterly*, 24(4), 2000, pp.665-694.
2. Barabasi, Albert-Laszio, *Linked: The New Science of Networks*, Perseus Publishing, 2002
3. Bariff, M.L. and Lusk, E.J., "Cognitive and Personality Tests for the Design of Management Information Systems," *Management Sciences*, 23(8), April 1977, pp.820-829.
4. Barkhi, R., "Cognitive style may mitigate the impact of communication mode," *Information and Management*, 39(2002), 2001, pp.677-688
5. Cho, N.J. and Park, S.H., "The Analysis on the Psychological Traits of the Usage Pattern on the Online Communication Media," *Journal of IT Application*, Vol.3, No.4, 2001, pp.93-117.
6. Cho, N.J, Baek, S.I and Ryu, K.M., "An Exploratory Investigation of Player Loyalty To Online Games," *Korean Journal of Management Science*, Vol.26, No.2, 2001, pp. 85-97.
7. Conway, J.C. & Rubin, A.M., "Psychological Predictors of TV Viewing Motivation," *Communication Research*, 18(4), 1991, pp. 443-463.
8. Cowan, D.A., "An Alternative to the Dichotomous Interpretation of Jung's Psychological Functions: Developing More Sensitive Measurement Technology," *Journal of Personality Assessment*, 53, pp. 459-471
9. Cristian, F., "Synchronous and Asynchronous Group Communication," *Communication of the ACM*, 39(4), 1996, pp. 88-97.
10. December, J., "Units of Analysis for Internet Communication," *Journal of Communication*, 46(1), 1996, pp. 14-38.
11. Doktor, R.H. and Hamilton, W.F., "Cognitive Style and the Acceptance of Management Science Recommendations," *Management Science*, 19(8), April 1973, pp. 884-894.
12. Freeman, L.C., "Centrality in Social Network," *Social Networks* 1(1978-79), pp.215-239
13. Hamburger, Y.A. and Ben-Artzi, E., "The Relationship between Extraversion and Neuroticism and the Different Use of Internet," *Computer in Human Behavior*, 16, 2000, pp.441-449.
14. Huber, G.P. and Robey, D., "Cognitive Style as a Basis for MIS and DSS Designs: Much A Do About Nothing?", *Management Science*, 29(5), 1983, pp.

- 567-581.
15. Jung, C.G., Psychological types, Routledge & Kegan Paul, London, 1923.
 16. Leonard, D. and Straus, S., Putting Your Company's Whole Brain to Work, *Harvard Business Review*, July-August, 1997, pp. 111-121.
 17. Mason, R.D. and Mitroff, I.I., A Program for Research on Management Information Systems, *Management Science*, 19(5), 1973, pp. 475-487.
 18. Myer, I.B., The Myers-Briggs Type Indicator, Palo-Alto, CA: Consulting Psychologists Press, 1962
 19. Nunnally, J., *Psychometric Theory*, McGraw-Hill, 1978.
 20. Rogers, E.M. & Kincade, D.L., Communication Networks-Toward a New Paradigm for Research, 1981, The Free Press
 21. Scott, J., Trend Report Social Network Analysis, *Sociology*, 22(1), 1991, pp. 109-127
 22. Shrum, W. & Check, N.H., Social Structure during the School Years: Onset of the Degrouping Process, *Amerald Sociological Review*, 52, pp. 218-223.
 23. Wellman, B. & Berkowitz, S.D., Structural Analysis: From Method and Metaphor to Theory and Substance in Social Structures: A Network Approach, Cambridge University Press, pp19-61
 24. Williams, R.L., Cothnel J., Four Smart Ways to run online communities, *Sloan Management Review*, 41(4), 2000, pp.81-91
 25. Zmud, R.W., Individual Differences and MIS Success: A Review of the Empirical Literature, *Management Science*, 26, 1980, pp. 969-979

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