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Edison and Einstein: the Influence of Problem-solving Styles on Knowledge Sharing in Life-science and ICT Teams

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Edison and Einstein: The influence of problem-solving styles on knowledge sharing in life-science and ICT teams

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Abstract

There is a widely held generalisation that knowledge creation is a consequence of social interaction. However, sociology has taught us that interaction is not as simple as it seems, and that we exhibit preferences for those with whom we interact, thus placing boundaries on the knowledge we create. One robust explanation for increased or reduced interaction is the perception of similarity or dissimilarity. One such similarity/dissimilarity is our individual preferences for problem-solving approaches. In order to describe the influence of individual problem-solving preferences on communication and knowledge sharing, the results of a study in life-science and ICT technical teams are presented in this article. At a team level of analysis it was shown that the greater the diversity of problem-solving styles in a group the less interaction and therefore the less knowledge sharing. Similarly, at an individual level of analysis the greater the cognitive gap between individuals the less the interaction. It was also observed that influential clusters based on problem-solving style preferences form within teams, thus dominating the information and advice. The management implications of these findings are discussed.

Keywords*: knowledge sharing; cognitive style; diversity*

1. Introduction and theory

My research and management practice area of interest is how social interaction influences the innovation process, that is, how social interaction affects ideation, problem-solving and implementation. In their seminal work on knowledge creation Nonaka and Takeuchi (1995) claim that knowledge is a social construct that emerges through interaction, indicating that social interaction is a fundamental element of the innovation process. Having observed how Japanese manufacturing firms operate, Nonaka and Takeuchi developed their now famous SECI knowledge creation model which describes how, through social interaction, tacit knowledge is shared and then made real and explicit by sense-making. It is then combined with existing knowledge and internalised into greater tacit knowledge. While Nonaka and Takeuchi come from an organisational science discipline, sociology has arrived at similar conclusions. Sociologists studying social capital - the potential from social ties - have found that the strength of interpersonal ties and networks to be positively related to knowledge

creation (McFadyen and Cannella, 2004; Bjoerk et al., 2011), ideation (Bjork and Magnusson, 2009; Kijkuit and van den Ende; 2010, Rhee and Ji, 2011), and innovation (Casanueva and Gallego, 2010; Chen and Wang, 2008; Kratzer et al., 2005; Lau, 2011; Maurer et al., 2011, Obstfeld, 2005).

However, notwithstanding the robustness of this research, individuals do not always choose to socially interact, and given that choice, there are times when we all, consciously or subconsciously, stay away from other specific individuals, ignoring the social capital potential and thus reducing the potential for ideation, innovation and knowledge creation. This lack of enthusiasm to interact has a knock-on effect on organisational performance and therefore poses a management challenge regarding understanding and counteracting the mechanism that causes this phenomenon. Sociology offers one highly robust answer to why individuals are inclined, or disinclined, to interact. Byrne's (1971) similarity-attraction-similarity theory states that information about another person's opinions, interests, or traits is reinforcing to the extent that these characteristics are similar to those of the perceiver (Banikiotes and Neimeyer, 1981; Bleda, 1974; Klein et al., 2004; Tan and Singh, 1995). Being associated with these reinforcing events, the other person becomes attractive as a direct function of the proportion of similar characteristics. Attitudes toward another person is determined by his or her beliefs that the person has certain attributes, multiplied by his or her evaluation of these attributes (Ajzen, 1974). This phenomenon is considered one of the most robust phenomena in social psychology (Barsade et al., 2000; Darr and Kurtzberg, 2000; Montoya and Horton, 2004; Van Oudenhoven and Deboer, 1995). In the 1990s Tsui, Egan and O'Reilly (1992) claimed that the conceptual foundation for almost all of the research on organisational demography has been the similarity-attraction paradigm.

As my specific area of research interest is how social interaction affects ideation, problem-solving and implementation I choose to look at the effect of the personality trait most associated with these human endeavours: cognitive style. Cognitive style is our innate preferences in problem-solving and ideas generation. The term *style* refers to a habitual pattern or preferred way of doing something (Grigorenko and Sternberg, 1995), while cognitive psychologists describe cognitive style as consistent, individual differences in the way people experience, organize, and process information (Cools and Van den Broeck, 2007;

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Guilford, 1980; Hunt et al., 1989; Puccio et al., 1995). A common operationalisation of cognitive style is the Kirton Adaption-Innovation Survey (KAI) with proven reliability and validity and which has been used in several authoritative studies. Kirton's theory (2003) places us all on a continuum between highly adaptive to highly innovative. The main characteristics of differences are sufficiency-of-originality, efficiency and rule/group-conformity in our idea generation, and problem- solving. In terms of preference, the more adaptive an individual is the more s/he will prefer more structure, be more likely to have fewer but more manageable ideas, be more precise and methodical, to maintain group cohesion, and depend on the current system as enabling. Conversely more innovative individuals recognize that the current system is limiting, preferring less structure, proliferating ideas, thinking tangentially, and acting as a catalyst in settled groups. As it is a continuum, most of us interact daily with others who are either more adaptive of more innovative.

To illustrate these characteristics more clearly we relate the work of Thomas Edison and Albert Einstein who are considered an extreme adaptor and an extreme innovator respectively. Edison was the one of the world's most prolific inventors with over two thousand patents to his name. As a man who believed in structure and work ethic, he is famous for quotes such as "*genius is one percent inspiration and ninety-nine percent perspiration"*; and "*we often miss opportunity because it's dressed in overalls and looks like work*." As he was born in 1847 he preceded the scientific management practices that really developed in the early 20th century, but this is hard to believe when one visits his workshops, some of which are maintained as museums today. They were a model of efficiency where employees worked to very modern work practices and to his philosophy of experimentation leading to gradual improvement. Another of his famous quotes is, "*if there's a better way to do it, find it,"* exemplifies that he, in KAI language, is an extreme adaptor. His intent was to improve the world, and he did this in a highly structured, methodical and precise way. For example, his inventions in the areas of the phonograph and ticker-tapes are practical evolutions of his earlier work on the telegraph – practical implementations enabled by what was considered the current system. These practical improvements were expected to work, and they did. Edison would have had a high expectation of success and a low tolerance of failure. Contrast this to Einstein who, rather

than improving the world, changed the world. His ideas broke all existing paradigms and for many years only a few people could understand many of his concepts. As an example of how conceptual Einstein was, his theory on special relativity, which explained the relationship between space and time, was presented in only three pages where he then suggested to his audience that they should take it away and test it: he was moving on to the next big idea. This tangential thinking would place Einstein, in KAI language, an extreme innovator.

Kirton's theory (2003) in that there is a continuum between the extremes of Edison and Einstein, stressing that when considering the effect of difference, it can happen anywhere in the continuum. We are not either an adaptor or an innovator but can lie anywhere in the continuum with perceptions of those who are more adaptive or innovative than we are. However, it is the difference in cognitive style, called *cognitive gap*, that stimulates and amplifies these perceptions, and it is our assertion that these perceptions cause collaboration difficulties leading to a lack of performance due to the lack of knowledge sharing. These perceptions manifest themselves when observing individuals who are more innovative as unsound, impractical, abrasive, cavalier towards others' ideas, generators of turbulence, creating confusion and dissonance, risky and challenging of rules and customs. Conversely we view those more adaptive as timid in ideation, compliant with authority, stuck within their system, picky, narrow, pedestrian, overly cautious, conforming, taking an 'in-group' view and intolerant of ambiguity (Kirton, 2006).

2. Methodology and Results

The study described in this article involved a sample population of 16 engineering and scientific teams in l i f e - science and ICT companies. Each member of each team completed a KAI survey and a social network analysis (SNA) questionnaire. The KAI survey allowed the profiling of the team's cognitive styles while the SNA data provided the data to profile the communication pattern within the team.

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To test at a group level whether difference of cognitive style affects communication in these teams a Pearson product-movement correlation was computed between the density of each team and cognitive style diversity for both instrumental (work related) and advice relations, controlling for team size. This is depicted in Figure 1 where a strong negative relationship was observed between diversity of cognitive style and instrumental interaction.

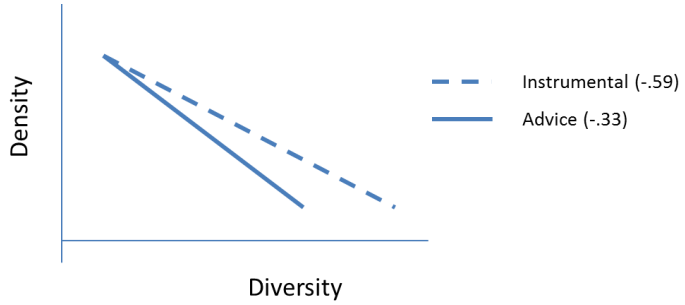
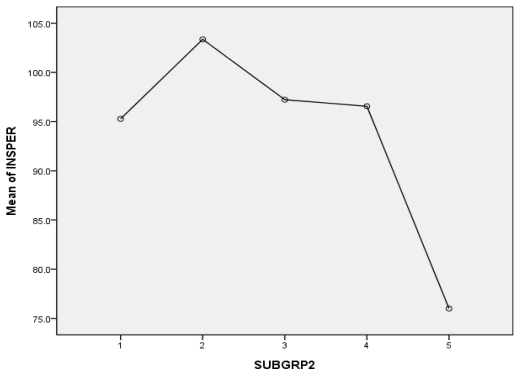


Figure 1 – Relationship between diversity of cognitive style and network density

To prepare to test the similarity-attraction-similarity phenomena at an individual level, each team was divided into five subgroups of equal KAI range to simplify the measurement of interaction between members in the subgroups. To test the phenomena the average communication between subgroups of similar cognitive style was achieved using an analysis-of-variance. Figures 2 and 3 show the relationship between instrumental and advice interaction with an average KAI of each subgroup as a % of total interaction. Position 1 on the horizontal axis is the average intra-sub group; position 2 relates to interaction between two adjoining subgroups, while position 5 relates to interaction between subgroups furthest from each other.



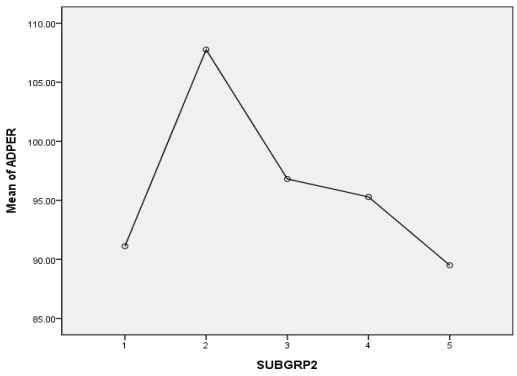


Fig 2: Instrumental KAI subgroup interaction (as a % of total interaction) mean plots

Fig 3: Advice KAI subgroup-group interaction (as a % of total interaction) mean plots

1 = Intra-KAI subgroup average interaction;
2 = 1 KAI subgroup difference; 3 = 2 KAI subgroup difference;
4 = 3 KAI subgroup difference; 5 = 4 KAI subgroup difference

To understand what else emerges in each team's communication patterns a cluster analysis (a statistical test which identifies similarities) was completed on the SNA data. The exercise identified two phenomena. First, of the five teams, each consisting of six or fewer team members, there was extremely high levels of communication with no breakdown in the team structure and therefore no clustering affect. These groups exhibited a much higher degree of interaction (66% higher), with no one individual on the periphery isolated. Secondly, in nine of the remaining eleven teams an identifiable cluster, based on cognitive style, was observable. Figure 4 is an example of this pattern. The colour of the network node signifies team members of similar cognitive style. Here we can see that nodes 10, 11 and 12 all have a similar style and are most central in the network

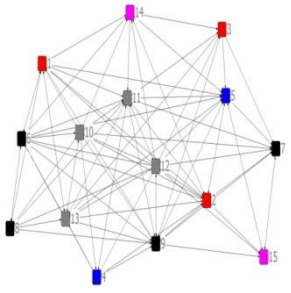


Figure 1 – SNA diagram of Team 1 instrumental communication

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3. Discussion

The results show that individuals tend to interact more with individuals of similar cognitive style compared to individuals of dissimilar cognitive styles since interaction decreases with an increase in cognitive gap; and when viewed from a group perspective, the greater the difference or diversity of cognitive styles the less the total interaction within the group. Figure 1 shows the strength of the inverse relationship between density and both instrumental and advice interactions, while the result of the ANOVA, depicted in Figures 2 and 3, show clearly the reduction in communication as cognitive gap increases, i.e. the clear path of decreasing communication between position 2 (adjacent cognitive style subgroup interaction) to position 5 (furthest cognitive style subgroup interaction) on the horizontal axis.

The primary implication of these results is that differences in cognitive style will lead to collaboration difficulties, resulting in less knowledge sharing, which will have a negative impact on performance (Argote et al., 1989; Gully et al., 2002; Lazer and Friedman, 2007). Two other simple but profound implications are implicit with respect to increased interaction between those of similar cognitive styles and reduced interaction between those of dissimilar cognitive style. The first implication is that working only with those of a similar cognitive style leads to a single problem-solving approach; similar in all situations irrespective of the needs of the problem. For example should a problem ideally require a modest improvement, the natural inclination of a group of adaptors will be to offer an apt solution, while the inclination of a group of innovators will be to add significant novelty and offer a solution that will change the situation. The converse is also true – a group of adaptors will be inclined to improve situations where more significant change is the apt solution. The second implication is that, should a subgroup of members with a similar cognitive style influence the communication within a group, the implication is that those of dissimilar cognitive styles can become isolated and not be in a position the opportunity to contribute. Kirton's (2003) work suggested that individuals outside the subgroup have a harder time integrating, feel isolated or perhaps disenfranchised, and downgrade their own contribution due to a lack of motivation. Due to a cognitive gap, those outside the group

have little inclination to communicate with others and therefore most communication happens within the dominant subgroup and to and from those in reasonable proximity.

While the subgroups above are described in conceptual terms the results show that clusters based on cognitive style do form in groups of six or more. In such group a specific cognitive climate prevails (Kirton, 2003), i.e. 'a structure which both enables team members to problem-solve while limiting the options available.' In such a climate, individuals outside the 'consensus subgroup' have a harder time integrating, so downgrading their own contribution, which can in turn lead to a lack of motivation. It means that those who aren't in, or cognitively close to, the influential cluster may feel isolated or perhaps disenfranchised. In the eyes of the influential cluster, all problems should be addressed in the same way as has proven successful in the past.

As a management issue the most appropriate answer is for team members to be self-aware of their own style. When a given member is not aware of their own problem-solving preferences they cannot appreciate the preferences of others. If this awareness and appreciation is understood then there is the potential of reducing conflict and harnessing the potential that comes with differences.

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