Necesse 2020, Vol 5, Issue 1, 166-180

Peer reviewed article

Two teams - the power of group dynamics

Stein Hatlem Forsdahl
Endre Sjøvold

The annual exercises on board the sailing ship Statsraad Lehmkuhl is an important part of the leadership training. The cadets work in teams in parallel and in different constellations. Foto: Norwegian Armed Forces.

Abstract: This paper reports findings from a pilot study regarding the marked differences in academic and extracurricular performance in two teams at the Royal Norwegian Naval Academy. The findings suggest that intelligence (IQ) or General Mental Abilities (GA) do have a say, but the significant differences between the two teams are related to teamwork and cooperation. The data suggest that main drivers for performance are task orientation, caring, engagement and empathy, which was evident in the team with the highest performance. These behavioral markers support other research (Google, 2014; A. Pentland, 2015; Torgersen, 2018) regarding team behavior that boosts team performance. On the other hand, behavior as passivity, self-sufficiency, opposing and spontaneous behaviors was found in the low performance group. The key takeaway is that teams may perform very well if members use fruitful behavior as stated above. This is possible to achieve for most people regardless of their GA. The behavior markers described in this article are perhaps more precise and helpful as trainable skills, skills that require effort on the team's part to hone and get better at. The data also suggest that proper teamwork can equalize GA differences in teams when it comes to performance.

1. Preface and research question.

This article looks at a particularly striking example of two quite similar teams at the Royal Norwegian Naval Academy that varied significantly in performance during one semester. Their background at the academy was very similar, and the subjects they studied were too similar to claim that one team had a more difficult academic program than the other did. The article describes an important example of how effective teamwork can boost performance and provides a detailed description of basic processes of group interaction linked to major research (Google, 2014; A. Pentland, 2015; Torgersen, 2018).

The article is considered as a pilot study on teams and performance. A follow-up study on 24 similar teams is planned to take place during 2020/2021.

The main research question is as follows:

> *What can account for significant differences in team performance (mainly academic, but also social responsibility) of two teams under quite similar conditions?*

The two hypotheses formulated from the research question are tested using data from various sources as described in the method chapter.

1. There were significant differences in General Mental ability (GA) – intelligence (IQ) between groups.
2. There were significant differences in teamwork.

The hypotheses are not mutually exclusive, so both can be valid to a smaller or larger extent. There is of course the possibility that differences in GA also account for differences in teamwork, but that hypothesis is hard to test with the data provided and will only be discussed briefly.

The article will discuss GA measures, performance measures in the form of academic grades, and team interaction measures in the form of results from the Systematizing the Person – Group - Relations (SPGR) tool. The SPGR tool provides concrete behavioral markers on interaction in teams – i.e. teamwork. These data will be discussed systematically to provide insight into the hypotheses stated above.

2. Theoretical background

Recent, extensive research on differences in team performance has been carried out by Alex Pentland (Massachusetts Institute of Technology) and Google Inc.

Pentland's book *Social Physics* (2015) presents some very interesting results (Dong, Kim, & Pentland, 2009; Dong et al., 2007; A. Pentland, 2009; A. S. Pentland, 2012; Woolley, Chabris, Pentland, Hashmi, & Malone, 2010) on this topic. The main conclusions were that individual intelligence, personality and skill together mattered less than the pattern of idea flow. The most significant factor predicting group performance was thus the balance of conversational turn-taking, meaning more or less equal dominance in the group, as opposed to a few people dominating the group work. The second most important factor was the members' ability to read each other's social signals. The group's problem-solving abilities thus emerge from the pattern of interactions in the groups, particularly interactions that support sharing of diverse ideas by fairly even participation and engagement of group members.

The Google Aristotle Project (Google, 2014)studied 180 teams from all over the company. The findings suggest that what really mattered was how the team worked together, the team dynamics. Google identified five major dynamics that could account for team performance:

1. *Psychological safety*: It is safe to take risks, make mistakes and be vulnerable in front of each other. In short, they trust each other.
2. *Dependability*: team members get things done on time and with good quality.
3. Structure and clarity: team members understand job expectations and have clear roles, plans and goals.
4. *Meaning*: the work is important to team members and there is a sense of purpose.
5. *Impact*: team members create change, think their work matters and contribute to work and discussions.

There are interesting overlaps between (A. Pentland, 2015) and (Google, 2014) here. It may be that some of Google's five dynamics provide the foundations for Pentland's two main findings of equal dominance and ability to read team members' social signals. For example, psychological safety and impact may provide the basis for equal contributions and reading social signals. They may also be different terms describing the same phenomena. In this article, we will propose that data from SPGR theory and apparatus on the two teams further support Pentland and Google and provide a supporting taxonomy or perhaps underlying behavior for Google's five dynamics and Pentland's two main findings.

For the armed forces and for other civil services like hospitals, police etc., teamwork is extremely important. This is emphasized in the book *Interaction: "samhandling" Under Risk* (Torgersen, 2018) which focusses on coping with unforeseen events.

The term "samhandling" is a Norwegian term and indicates the broad meaning of interaction, collaboration, cooperation and coordination. The following fifteen underlying processes that are important for effective interaction or "samhandling" are described.

1) Coordination
2) Complementary Expertise
3) The Ethical Aspect
4) Learning
5) Interaction training
6) Involvement and Awareness
7) Mastering Tools
8) Organizational and Cultural knowledge
9) Power Balance
10) Precision in Communication
11) Role Awareness
12) Professional Jargon
13) Sense
14) Shared Situational Awareness
15) Trust, Transparency and Confidence

These processes are multi-leveled in the sense that they can apply on the individual, team and organizational level. Some are more appropriate for the team level and more easily translated to visible behavior. These will be discussed against the performing team's team interaction measurements (SPGR).

3. Method

Sample size

The sample consists of two different teams, team A and team B with nine participants in each team. The sample size is recognized to be quite small, but as this is defined as an example and pilot study, it can still provide valuable insight in efficient teamwork, especially when combined with other relevant research and theory. According to (DeVellis, 2017) more reliable scales can allow for smaller sample sizes to provide sufficient statistical power. Several of the measurements in this article can be considered to have a high degree of reliability. GA measurements (alpha coefficients .081-.90) and grades from technological academic subjects have a higher degree of right and wrong answers and are thereby perhaps more reliable than other social studies that are subject to interpretation (and thereby require larger sample size). The SPGR measurements (alpha coefficients .065-.73) are constructed in such a way that all participants answer questions about all participants, providing a gearing of sample size that can increase statistical power. Thus, even if the sample size is small the results are worthwhile reporting and discussing.

Performance measurements

The performance was measured from the grades obtained in four different academic subjects in the third semester at the Naval Academy. Physical fitness was included in academic average because it is an important part of overall performance at the Naval Academy.

Mean and SD was directly calculated for each team from the Naval Academy's standard grade scale (A to F). In this article, A=5 and F=0.

GA Measurements

The General Mental Ability (GA), a general measure for IQ as used in the Norwegian armed forces, was measured by a draft board when the subjects were in the 17-18 yrs. range. See (Sundet, Barlaug, & Torjussen, 2004). The scores are from the Norwegian armed forces database and presented according to the stanine (1-9) scale.

Team measurements

The SPGR (Systematizing the Person-Group Relation) method was used to analyze team behavior. SPGR is the operationalization of the spin theory of small groups (Sjøvold, 2002, 2006, 2007, 2014) . Spin theory claims the existence of four *basic group functions*: CONTROL, NURTURE, OPPOSITION, and DEPENDENCE. Any group engaged in a specific task needs to share goals and plans and ensure execution and productivity. When behavior supporting structure, rules, authority, procedures and "how things are done" is predominant, it shows that the CONTROL function is active. Over time, any group needs to maintain the social relations among all the work and deadlines. When people-oriented behaviors, as caretaking, relation building, acceptance, listening and contentment are predominant the NURTURE function is active. However, sometimes things change and situations are no longer stable. Unforeseen events often call for someone to question the way things are done and whether the current solutions are viable. When we experience criticism, conflict, influence, resistance and power struggles the OPPOSITION function is prevailing. This can be very annoying and energy-draining, but also important when the group needs to reorient and find new solutions. One way or the other, the group has to agree and somebody has to do some work to get things done. Adaptation, loyalty, acceptance, obedience and acting according to decisions are typical behaviors showing that the DEPENDENCE function is active.

In both the spin theory and the SPGR method, the *basic group functions* are poles in two of the *basic dimensions*: CONTROL - NURTURE and OPPOSITION – DEPENDENCE. The third *dimension* in the models is SYNERGY - WITHDRAWAL that in general is an indicator of the robustness and flexibility of a group. Most people, when facing new situations or becoming members of a new group, tend to stick to the behavior they know has worked before. It is natural to stay in the comfort zone when it comes to function. A structured and analytical person will stick to that role, another would probably stick to nurture by use of humor and jokes. In this way, the individuals have a "what's in it for me" attitude and the role pattern is fixed from predisposed abilities and interests. Each man or woman contributes according to their own specialty or knowledge. These patterns represent the WITHDRAWAL pole, where achievement is never greater than the sum of the parts. The opposite pole is SYNERGY. Here the fixed roles and patterns are largely neutralized since all members master all the *Basic Group Functions*. Bold exchange of opinion and ideas take place in a climate where anybody can be nurturing, controlling, dependent or oppositional at any time. The group will experience a high degree of learning and reorientation through exchange of energy and knowledge with the outside world.

The three SPGR *dimensions* are described in more detail with their respective *vectors*. These vectors are the definitions and descriptions of the clusters of behavior that underlie the three *dimensions*. This refinement of the SPGR space with its dimensions is then a catalogue of observable behavior that can be used to label

and structure team behavior. When SPGR data are gathered and mathematically analyzed, numbers for each vector are retrieved for each team. Each of the vectors are explained below in table 2, since they are the entities that are subjected to t-tests between the two teams. Each vector is represented by a number between 0 and 4 indicating amount of behavior as reported by each group.
In addition measures for the *parameters* INNOVATION, POLARISATION, MENTAL MODELS and INFLUENCE were calculated. INNOVATION is a measure of the group's scores along the WITHDRAWAL-SYNERGY *dimension*. POLARIZATION is a measure of a group's sub-grouping, MENTAL MODELS is a measure of how different group-members perceive the group-dynamics and INFLUENCE is a measure of the variance of influence in the group. While higher values on Innovation are positive, lower values are positive for the three other parameters which measure variance.
The SPGR 24 item questionnaire version 200909 was used. (Sjøvold, n.d.). Each team reported perceived team-behavior during the third semester. Each team member used the 24-item SPGR questionnaire for both self- and peer-rating.
All means and SD calculated with "R", Version 1.0.143.

Case description

The Royal Norwegian Naval Academy houses around 200 cadets each year, and they all study leadership and the art of maritime warfare. The cadets are divided into different teams and classes during their three- to four-year degree, according to branches, subjects and levels. Overall, at any one time there are up to 30 different teams working together during a normal school year. Most teams stay together for a year or two. Thus, in the course of the last decade the Naval Academy has had almost 300 teams working together to become naval officers, studying many different academic subjects including leadership and teamwork. It should come as no surprise that the faculty at the academy regularly experience differences in team performance. Some teams or classes perform low, some mediocre and some again top notch. This is quite in line with most research on teams over time (Espevik, Johnsen, & Eid, 2011; Google, 2014; A. Pentland, 2015; Salas, Sims, & Shawn Burke, 2005; Sjøvold, 2006).

In this particular instance, two different teams, team A and team B, were observed by a senior officer to have differences in how they interacted and performed. The two teams were formally engineering classes randomly assigned in the sense that they had applied and were admitted to specific similar branches and subjects at the Naval Academy. After the third semester, team A not only performed better at all exams, but were also more involved in extracurricular activities at the academy. They had the leader of the student union, the leader of the sports team and won a prize for best class cohesion. Team B performed significantly poorer at the exams, including several fails where they had to re-sit exams, and only took on some minor extracurricular responsibilities. The senior officer's subjective perception was that the energy and commitment level was higher in the classroom of team A compared to team B. Nevertheless, both teams were perceived as pleasant and team B was not in any sense negative or hard to get along with. There was just a different feel of the energy in the room.
Both teams had exactly the same background at the academy. Before starting the education, they all completed basic courses in engineering (mathematics and

physics etc.), in teams according to their branch. Then they split up in new teams for a first and second semester where they were rigorously trained in leadership, teambuilding and military skills. Then, before they started the third semester, they had a week of teambuilding in order to set the branch teams again so they could perform at their best as a team in their academic subjects. Both teams were engineering classes with somewhat different subjects, but similar in the sense that they were in the range of mathematics, physics and engineering. Two of the subjects were the same, namely mathematics and physical fitness.

4. Results

Table 1 to 3 is a summary of academic performance measurements, GA measurements and SPGR measurements.

Table 1: Academic performance and General mental ability Team A and team B.

Measure	Code	Description	Team A	Team B	
Grade	G	Mean of four engineering grades, A=5,F=1	4.1(0.8)	2.8 (1.2)	***
IQ	GA	Mean General Mental ability (stanine scale)	6.9(1.5)	5.7 (1.0)	***

GA Mean cohort 6.15(1.24) n=212

Table 2: 12 vector SPGR comparison Team A and team B.

Vector	Code	Typical behavior	Team A	Team B	
Ruling	C1	Controlling, autocratic, attentive to rules and procedures	1.32	1.54	
Task-orientation	C2	Analytical, task-oriented, conforming	3.12	2.31	***
Caring	N1	Taking care of others, attentive to relations	3.32	2.89	**
Creativity	N2	Creative, spontaneous	0.62	1.11	**
Criticism	O1	Critical, opposing	0.83	1.20	*
Assertiveness	O2	Assertive, self-sufficient	1.15	1.53	**
Loyalty	D1	Obedient, conforming	3.16	2.86	*
Acceptance	D2	Passive, accepting	3.48	3.15	*
Resignation	W1	Sad appearance, showing lack of self-confidence	0.70	0.99	*
Self-sacrifice	W2	Passive, reluctant to contribute	0.32	0.91	***
Engagement	S1	Engaged, inviting others to contribute	3.39	2.73	***
Empathy	S2	Showing empathy and interest in others	3.00	2.63	**

** $p<0.05$ **$p<0.01$ ***$p<0.001$ (2-tailed, Team A n=9, Team B n=9*

Table 3: 12 SPGR Parameters Comparison Team A and team B.

Parameter	Code	Description	Team A	Team B
Innovation		Ability to learn (1to 18 scale)	14.43	9.28
Polarization		Degree of opposing behaviors in team	1.90	2.28
Mental models		Differences in view of own team	2.66	3.17
Influence		Differences in influence in team	1.60	1.84

Academic performance and General mental ability (GA)

The academic performance is significantly better for team A than for team B, $p<0.001$. Noteworthy is also that SD on grades for Team A, M=4.1 (SD 0.8) was lower than team B, M=2.8 (SD 1, 2).

GA measurements show a non-significant difference where Team B, M=5.7 (SD 0.8) nevertheless scored visibly lower than team A, M=6.9 (SD 1, 5). Observe that SD was lower for team B than team A. The GA score for the whole cohort at the Royal Norwegian Naval Academy, the Royal Norwegian Military Academy and the Royal Norwegian Air Force Academy was 6.15 (SD 1.24, n=212).

SPGR team measurements

First, we see that the SPGR measurements in table 3 for the INNOVATION *parameter* show that team A scores higher than team B, indicating a higher ability to learn collectively from experience. POLARIZING and MENTAL MODELS are lower for team A, indicating less polarization, and more common mental models of own team behavior. The INFLUENCE *parameter* is more or less the same, indicating that members in both teams have an equally distributed share of active behavior. These measurements are single numbers for the team as a whole as explained above and therefore not subject to means, SD and t-test measurements.

When we look into the detailed group behaviors as described by SPGR 12 vector measurements in table 2 (C1 to S2), we note the following interesting results: All vectors except Ruling (C1) show significant differences between team A and team B (table 3). Task orientation (C2) and Engagement (S1) are significantly higher in Team A than team B ($p<0.001$). Team A seems to have put more focus on the task at hand and also played on each other's strengths through the engagement vector. The same applies for Caring (N1) ($p<0.01$), Loyalty (D1) ($p<0.05$), Acceptance ($p<0.05$) and Empathy (S2) ($p<0.01$). Team A apparently socialized more by being attentive to relations and accepting the premise that they are a team and should work together as a team. In total, team A put more effort into solving the mission collectively by being focused both on the tasks and on the team simultaneously.

Self- sacrifice (W2) is on the other hand higher in team B ($p<0.001$). As well as Creativity (N2) ($p<0.01$), Criticism (O1) ($p<0.05$), Assertiveness (O2) ($p<0.01$), and Resignation (W1) ($p<0.05$). This could mean that team B was significantly more prone to working as individuals and withdrawing from collective efforts. They also showed more opposing and critical behavior, and spontaneous refocusing or distraction from the task, which could hamper productive work. In total, this could make it difficult for team B to play on each other's strengths and thereby

utilize the team in a way that creates synergy in the sense that the whole is greater than just the sum of the parts.

The data thus tell us that team A in sum showed more fruitful behavior regarding focus on the task, not only as individuals but also as a team, by helping each other, being engaged in the work, accepting that they were part of a team, committing, and taking care of each other. Team B on the other hand worked more as individuals and did not show same level of commitment either to the task or to the relations and the team.

5. Discussion

Since grades are considered as the effect and the other measurements as causes, the discussion is structured in line with the hypothesis as follows: First GA differences are discussed (H1), then the SPGR vectors and parameters (H2). Further on, team A's own view of themselves is discussed in light of the SPGR vectors and finally the theoretical constructs from other research are discussed in light of the SPGR vectors (H2).

Differences in GA

It is tempting, and not unreasonable, to point out that the differences in grade average tally with the differences in average GA. That is however not the whole story. First, even if the GA average is different in the two teams it is not statistically significant. Not to say that GA has no impact on the results, it probably has. The point is that there are other measurements in this data set that are statistically significant and far more interesting to discuss. GA is on the one hand considered a relatively fixed measure, but also subject to ambiguity and dependent on many factors in the environment (Neisser et al., 1996). So, GA tests are used, and useful, for selection, but do not help very much if you want to make teams or organizations perform better with the people you have at your disposal. It is therefore much more interesting to study the behavioral data that can give some clues to behavior that enhances team performance.

Even if GA measurements do not show a statistically significant difference, it would be quite naïve not to acknowledge that team A scores 1.2 points above team B on the stanine scale. GA matters and these results are much in line with other research on IQ and academic performance (Mchenry, Hough, Tooqyam, Hanson, & Ashworth, 1990). On the other hand, when we consider the overall GA results for the cohort, both teams are well inside the SD and in that sense within the normal range of variation, supporting the statement that team A is not significantly higher in GA. Nevertheless, considering the SD on GA and academic performance, the results show opposite measures than expected: One should expect that team A had larger SD on grades (0.8) in line with the SD on GA (1.5). This is not the case. The grades in team A has a lower SD indicating that some other effect has made the academic performance more even in the team. This could very well be a result of constructive teamwork. The SD on GA (1.0) and grades (1.2) for team B is more similar and according to expectations, meaning differences in GA in the group reflect differences in grades. So, these data indicate that team A not only performs better due to higher GA scores, but also better and more evenly due to

some other effect that probably has something to do with the way team A members work together. Even if the exams themselves were individual, the learning process leading to the exams is very much in a group and classroom setting with extensive teamwork in lectures, filings, lab - and homework. The SPGR data support this and will be discussed in the following.

Differences in SPGR vectors

The C1 vector shows no significant difference between the teams, indicating that both teams are equally attentive to rules and procedures, like attendance, correct uniform, doing homework and in general following the Naval Academy's standards, rules, and procedures. This appears quite normal considering that the Naval Academy is a military school, and the military setting is therefore part of the context, with an extra layer of norms on top of the average student setting at any university.

The C2 and N1 are interesting to discuss as a pair. They reflect very well the Norwegian Armed Forces' leadership motto; *solve the mission and take care of your men* (and women). These vectors are related to two types of behaviors (initiating structure and consideration) from the OHIO studies, (Shaw & Stogdill, 1974). Team A scores significantly higher on both vectors, indicating that they had a more active focus on the tasks, but also were more attentive to each other and helped out when needed. This could very well account for better academic performance.

As for Creativity (N2) the score is lower for team A. One should perhaps think that creativity would be more important for learning and therefore an opposite result should be expected. In the SPGR context however, creativity is more like spontaneity, meaning interruption from task-oriented behavior. For team B this would mean that they had more spontaneous interruptions from productive academic work than team A.

The O1 indicates that team B showed more opposing behavior within the team. This behavior is sometimes important in order to learn and can indicate critical thinking. In this case, the difference may imply that the level of opposing behavior in team B is so high that it hampers fruitful teamwork.

The O2 indicates that members of team B showed more individualistic behavior than team A.

Together the O1 and O2 vectors are also in line with the W1 and W2 vectors, which indicate withdrawal along the SYNERGY-WITHDRAWAL *dimension*, as team members are more preoccupied with their own tasks and opinions than the common good and result of the team. This is especially significant in the W2 vector indicating passivity and reluctance to contribute.

Interestingly, both D1 and D2 vectors are lower for team A. This is, however, probably quite natural since D behavior is opposite of O behavior (O1 and O2). A valid interpretation is that members of team A are more willing to submit to the team norms and rules, (being present during homework, working together etc.) and accepting that their personal needs sometimes are less important than the needs and demands of the group. The willingness to submit to the group or have a degree of team orientation is important for team performance according to (Salas et al., 2005). These data support that view.

The engagement (S1) and empathy (S2) are perhaps the most important vectors to explain the differences in academic performance between team A and team B

due to better teamwork. When team members engage in work, invite others to contribute, in general are empathetic and take an interest in each other, the exchange of information is probably higher than in a team where this is not the case. If exchange of information and ideas increases, then the team can update the status on their tasks and mission and create effective and useful common mental models. This will probably increase learning and thereby academic performance for all the members in the team. This effect is visible in the somewhat lower SD in grades for Team A.

Differences in SPGR Parameters.

The INNOVATION or learning parameter is higher for team A. As previously stated, this is a parameter along the synergy-withdrawal axis and is unsurprisingly in line with the S (1,2) and W (1,2) data. Team A has a higher rate of innovation or learning due to more engagement and empathy and less withdrawal behavior. This probably also leads to less POLARIZING (lower spread in behaviors in SPGR space) and more common mental model of how the team members view each other's behavior, indicated by a lower score on MENTAL MODELS 1.6 vs 1.84. This will probably mean less uncertainty of own status and position in the team and thus more energy available for productive work. In other words, the *psychological safety* (Google, 2014) is probably larger in Team A.

The INFLUENCE parameter is more or less the same, but may be a little better for team A, meaning they have more even influence in the team. This is also supported by the Google Aristotle project (Google, 2014) where more effective teams had more even influence and "air time" among the members (referred to as *Impact* in the model).

Team A's own view and SPGR vectors

To better understand the differences, team A was tasked to write down some short points (one page) on their own opinion of what was the secret to their success. The following are the main points somewhat rephrased and translated from the original Norwegian document:

1. Emphasis on the importance of everybody performing, no free-riding or half-way solutions.
2. Everybody is responsible for their own success, but help each other.
3. Cohesion through being together a lot during work and spare time.
4. Address all problems or conflicts early.
5. Zero tolerance for selfishness or keeping work-related things to themselves.
6. Prioritizing work and the team.
7. Commitment according to being a cadet at the Naval Academy. ("sense of honor")

The list obviously holds important points for productive teamwork, but this is not rocket science. There is nothing here that any leadership or teamwork book in the airport bookstore would not tell you. So, what is the secret? The data indicate that team A used fruitful behavior according to SPGR theory and accordingly performed better than team B. As for the list above, it was more than empty promises made in a fun teambuilding weekend. The points on the list were actually carried out in

real life and practical behavior visible for the whole team – and they experienced firsthand the results on a day-to-day basis, which again stimulated the team to continue the good behavior.
Number one and six on the list are perhaps expressed through the Task-orientation (C2) vector, and number two through Assertiveness (O2) balanced with Caring (N1) and Engagement (S1). Loyalty (D1) and Acceptance (D2) vectors support point three (cohesion), point five (no selfishness) and point seven (commitment). A balanced Criticism (O1) will take care of point four. Points one to six expressed through the relevant SPGR vectors could also account for the extracurricular work that team A was involved in. By being together as a cohesive team with focus both on tasks and people, it is no stretch to assume that team A would muster more energy to assume responsibility for other things than purely academic work.

The points above also agree with the main findings in the Aristotle project (Google, 2014), which highlights five dynamics of effective teams: *psychological safety, dependability, structure and clarity, meaning and impact. Psychological safety* was perhaps provided through points four and six. *Dependability and structure and clarity* through one, two and six. *Meaning* was perhaps strongest taken care of by point seven, and *impact* through three, four and five.

Other research and SPGR vectors

There are some good links between the Aristotle project dynamics of effective teams and the SPGR vectors. One could from the above postulate that Caring (N1) is visible behavior for *psychological safety*. Loyalty (D1), Acceptance (D2) account for *dependability* and perhaps *meaning*. By employing Task-orientation (C2) one ensures *structure and clarity.* By allowing for balanced Criticism (O1) and using Engagement (S1) the team ensures that members have *impact*. The *impact* dynamic also relates to Pentland's (2012) two main findings of equal dominance and ability to read team members' social signals. Consequently, by utilizing Engagement (S1) behavior team A, by perhaps reading social signals well, provided the basis for equal dominance and thereby *impact* for all which in turn created change and learning.

If we map the statistically different SPGR vectors on the "samhandling" processess (Torgersen, 2018) the following similarities are noteworthy:
Task-orientation (C2) can possibly be an expression of *2) Complementary Expertise* and *11) Role Awareness* and to some extent *1) Coordination.*
The significantly higher score on C2 for team A may indicate that they more consistently utilized their complementary expertise, clarified their roles and distributed their work responsibilities through coordination.
Caring (N1) is quite clearly a visible behavior that supports *15) Trust, transparency and confidence.* By being more attentive to relations, team A was possibly more transparent, had confidence in each other and thereby instilled more trust.
The Self-sacrifice (W2) and the Engagement (S1)/Empathy(S2) vectors are opposites and can be interpreted as behavior that supports (S1/S2) or hinders (W2) the *4) Learning* and *6) Involvement and Awareness* processes. In order to learn mutually from each other, activation of behavior that invites others to contribute, engagement and empathy is vital. Likewise, passivity and reluctance to contribute will hamper fruitful interaction that supports common learning.
We can also map the SPGR *parameters* on the "samhandling" processes.

Here the INNOVATION parameter (ability to learn) will be an expression of *4) Learning*.
The MENTAL MODELS can be interpreted as *14) Shared Situational Awareness* and *11) Role Awareness*, especially regarding the social mental models of the team. Team A possibly had a better overview of the many tasks at hand through more consistent engagement, but also fewer differences in the views of own team social structure.
Finally the INFLUENCE parameter will fit very well with *9) Power Balance*. Team A had more absence of dominance or unequal power balance, which probably supported more efficient exchange of relevant information and ideas.
In total, it is quite clear that team A showed evidence of several of the important processes underlying "samhandling" according to (Torgersen, 2018), by using fruitful behavior as described in SPGR terminology.

6. Further research

Still one open point remains. Could it be that intelligence was the cause of the productive teamwork? It is not an unfair hypothesis, but the data do not support it directly and this would require further research. There is a possibility that people with higher GA scores are more likely to engage in fruitful interplay with others since they may have spare mental capacity to do so. However, the question remains if there is a "cut-off level" or linear relation. As for these two teams, it may be that the differences are too small in GA to have any practical implication. The opposite could also very well be the case; that highly intelligent people will have problems with cooperation since they will promote their own views more forcefully. Some research supports this view (Google, 2014). Nevertheless, this report can only point out the fact that there were differences in GA, but teamwork differences were more statistically significant and therefore could account for more of, but not all, the differences in performance. Another interesting theme is whether team A`s list of six points with associated SPGR vectors is common for other high performing teams. Further research scaling up the sample size with more teams could provide more conclusive insights in these matters.

7. Conclusions

This article shows the importance of fruitful teamwork for academic (and for that matter other) performance. The data indicate that even if intelligence levels between the two teams are somewhat different, the statistical differences between two teams are mainly in the group behavior. The data also suggest that proper teamwork can equalize GA differences in teams when it comes to performance. Analysis indicates that according to SPGR theory and apparatus, team A showed more behavior like Task-orientation, Engagement, Empathy, Caring, and Loyalty, which supports academic performance. A key takeaway point could be that even if teams are not top equipped with expertise or intelligence it is still possible to increase performance through good teamwork, perhaps due to efficient idea flow patterns.

What this good teamwork actually consists of, is indicated in the results in this article. Using SPGR vectors or theory as guidelines, teams could get systematic and

specific training, advice or coaching on behavior that could boost performance for the team as a whole without extra training of expertise or task-related skills. By strengthening fruitful behavioral vectors like Engagement (S1), task-orientation (C2), Loyalty (D1), Empathy (S2) and Caring (N1) and thus mitigating Resignation (W1), Self-sacrifice (W2) and Criticism (O2,) one can improve performance. The SPGR tool itself could provide useful help by providing pre and post training measurements on relevant SPGR vectors.

These fruitful behavioral vectors that team A utilized are also very much in line with Google's Aristotle project on effective team dynamics. However, the behavior vectors described in this article are perhaps more precise and helpful as trainable skills, skills that require effort on the team's part to hone and improve. Only through commitment and active experimentation with team behaviors will the team get better at these fruitful behaviors. It is worth remembering that in the world at large, most people have medium range IQ[1], and that well-developed teams may optimize performance.

References

- DeVellis, R. F. (2017). *Scale Development Theory and Applications* (4th ed.). Los Angeles: SAGE.
- Dong, W., Kim, T., & Pentland, A. (2009). A quantitative analysis of the collective creativity in playing 20-questions games. *C and C 2009 - Proceedings of the 2009 ACM SIGCHI Conference on Creativity and Cognition*. https://doi.org/10.1145/1640233.1640303
- Dong, W., Pentland, A., Lepri, B., Pianesi, F., Cappelletti, A., & Zancanaro, M. (2007). Using the influence model to recognize functional roles in meetings. *Proceedings of the 9th International Conference on Multimodal Interfaces*, ICMI'07. https://doi.org/10.1145/1322192.1322239
- Espevik, R., Johnsen, B. H., & Eid, J. (2011). Outcomes of Shared Mental Models of Team Members in Cross Training and High-Intensity Simulations. *Journal of Cognitive Engineering and Decision Making*. https://doi.org/10.1177/1555343411424695
- Google. (2014). The Aristotle project. Retrieved from https://rework.withgoogle.com/print/guides/5721312655835136/
- Mchenry, J. J., Hough, L. M., Tooqyam, J. L., Hanson, M. A., & Ashworth, S. (1990). Project A validity results: The relationship between predictor and criterion domains. *Personnel Psychology*. https://doi.org/10.1111/j.1744-6570.1990.tb01562.x
- Neisser, U., Boodoo, G., Bouchard, T. J., Boykin, A. W., Brody, N., Ceci, S. J., … Urbina, S. (1996). Intelligence: Knowns and Unknowns. *American Psychologist*. https://doi.org/10.1037/0003-066X.51.2.77
- Pentland, A. (2009). Honest Signals: How They Shape Our World. In *Journal of Artificial Societies and Social Simulation*. https://doi.org/10.1145/2072298.2072374

[1] *Intelligence test scores (IQ) according to a scale where M is 100 and SD is 15. (Neisser et al. 1996)*

- Pentland, A. (2015). *Social physics : how social networks can make us smarter.* New York, NY: Penguin Books.
- Pentland, A. S. (2012). The new science of building great teams. *Harvard Business Review*, (April).
- Salas, E., Sims, D. E., & Shawn Burke, C. (2005). Is there A "big five" in teamwork? *Small Group Research*. https://doi.org/10.1177/1046496405277134
- Shaw, M. E., & Stogdill, R. M. (1974). Handbook of Leadership: A Survey of Theory and Research. *Administrative Science Quarterly.* https://doi.org/10.2307/2391816
- Sjøvold, E. (n.d.). SPGR Institute AS. Retrieved September 17, 2019, from http://www.spgr.no/institute/
- Sjøvold, E. (2002). *SPGR manual.*
- Sjøvold, E. (2006). *Teamet*. Oslo: Universitetsforlaget.
- Sjøvold, E. (2007). Systematizing person-group relations (SPGR): A field theory of social interaction. *Small Group Research.* https://doi.org/10.1177/1046496407304334
- Sjøvold, E. (2014). *Resultater gjennom team.* Oslo: Universitetsforlaget.
- Sundet, J. M., Barlaug, D. G., & Torjussen, T. M. (2004). The end of the Flynn effect? A study of secular trends in mean intelligence test scores of Norwegian conscripts during half a century. *Intelligence*. https://doi.org/10.1016/j.intell.2004.06.004
- Torgersen, G. E. (ed. . (2018). *Interaction: "Samhandling" Under Risk: A Step Ahead of the Unforeseen.* https://doi.org/https://doi.org/10.23865/noasp.36
- Woolley, A. W., Chabris, C. F., Pentland, A., Hashmi, N., & Malone, T. W. (2010). Evidence for a collective intelligence factor in the performance of human groups. *Science*. https://doi.org/10.1126/science.1193147