This registration is a frozen, non-editable version of this project

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Register

A. Hypotheses - Essential elements
Description of essential elements
Recommended elements
Recommended elements
B. Methods - Essential elements
Description of essential elements
Recommended elements
Recommended elements
C. Analysis plan - Essential elements
Confirmatory Analyses
Second Prediction
Third Prediction
Fourth Prediction
Further Predictions
Recommended elements
Recommended Elements
Final questions
Data Completion
Looked at Data
Data collection period
Additional comments

A. Hypotheses - Essential elements

Description of essential elements

Describe the (numbered) hypotheses in terms of directional relationships between your (manipulated or measured) variables.

In collaborating teams, individual team members that are central for communication and reliance may benefit from this in their performance. On the other hand, it may be beneficial for the team as a whole that all members communicate with and rely on each other in an equal manner. The current research project will test whether patterns of centrality concerning communication and reliance in emergency response teams (ERTs) are related to the teams' shared beliefs about ongoing training scenarios. The data have already been collected, and the current project is an extension of previous research published on the same data (See Sætrevik and Eid, 2014, Journal of Cognitive Engineering and Decision Making; Sætrevik, 2015, Safety Science).

“Communication” is measured by each respondent’s ranking of which of the other team members they had “communicated most with” during a training scenario. “Reliance” is measured by each respondent’s ranking of which of the other team members they “relied most on” during a training scenario. Each team will be graphed as a "communication" network, and as a "reliance" network, using social network analysis (SNA). Individual centrality scores from the SNA will be used to calculate centralization scores for the team as a whole. Both the centrality and the centralization scores will be used as predictors for variation in shared mental models (SMM) and situation awareness (SA). The SMM indices quantifies the similarity between individual team members' beliefs about the scenario and the beliefs of the other team members. The SA indices quantifies the similarity between individual team members' beliefs about the scenario and the beliefs of the team leader. The indices are calculated following an approach developed by Sætrevik and Eid (2014).

Predictions for the individual team member's centrality in the network:
H1a: Individual team members' centrality in the communication networks will be positively associated with individual SMM.

H1b: Individual team members' centrality in the reliance networks will be positively associated with individual SMM.

H1c: Individual team members' centrality in the communication networks will be positively associated with individual SA.

H1d: Individual team members' centrality in the reliance networks will be positively associated with individual SA.

Predictions for the teams' overall network centralization:
H2a: Lower degrees of centralization in ERTs' communication networks will be positively associated with team SMM.

H2b: Lower degrees of centralization in ERTs' reliance networks will be positively associated with team SMM.

H2c: Lower degrees of centralization in ERTs' communication networks will be positively associated with team SA.

H2d: Lower degrees of centralization in ERTs' reliance networks will be positively associated with team SA.

For interaction effects, describe the expected shape of the interactions.

N/A

If you are manipulating a variable, make predictions for successful check variables or explain why no manipulation check is included.

N/A

Recommended elements

Recommended elements

A figure or table may be helpful to describe complex interactions; this facilitates correct specification of the ordering of all group means.

Sætrevik and Eid 2014.pdf
Translated questionnaire.pdf

For original research, add rationales or theoretical frameworks for why a certain hypothesis is tested.

A team member's mental model of the task at hand is developed through communication and collaboration with the other team members. It is reasonable to assume that team members that are more central in the communication and reliance networks have access to more information at any given time than less central members. Assuming that such central positions lead to greater knowledge about the situation, these team members are expected to have higher degrees of individual SA. Frequent contact with other members, implied by centrality, should also lead to greater overlap in mental models between closely knit units, leading us to expect central members to have higher degrees of individual SMM.

On the other hand, teams with evenly distributed communication and collaboration are expected to have more accurate mental models and that these are shared between team members. Based on this assumption, the degree of centralization may be a relevant predictor for variance in shared beliefs. High degrees of centralization (i. e. one or a few members are more central than all other members) in a network may inhibit distribution of information on a team level, as it is concentrated around the most central team member(s). The same assumptions can be made concerning reliance centralization, as the teams' overall shared beliefs may diminish when the focus of reliance is on one or a few individuals, compared to when reliance is equal between all team members. Previous research on the data this thesis is based on, indicated between-team differences in shared beliefs (Sætrevik, 2015). The goal of the current project is to establish whether team specific qualities regarding distribution of within-team communication and reliance can predict variance in shared beliefs (SA and SMM).

If multiple predictions can be made for the same IV-DV combination, describe what outcome would be predicted by which theory.

N/A

B. Methods - Essential elements

Description of essential elements

Design

List, based on your hypotheses from section A:

Independent variables with all their levels
a. whether they are within- or between-participant
b. the relationship between them (e.g., orthogonal, nested).

"Individual communication centrality" - a calculation of the extent to which other team members state that they communicated with the team member

"Individual reliance centrality" - a calculation of the extent to which other team members state that they relied on the team member.

"Team communication centralization" - a calculation of the extent to which team communication is concentrated around certain team members (high communication centralization), or distributed more evenly between all members (low communication centralization).

"Team reliance centralization" - a calculation of the extent to which team reliance is concentrated around certain team members (high reliance centralization), or distributed more evenly between all members (low reliance centralization).

All variables listed above are "between participants" measures.

The communication and reliance measures are expected to be positively correlated (non-orthogonal), as the two constructs overlap to some extent.

List dependent variables, or variables in a correlational design

At given intervals during the scenario training, the scenario play was "frozen", and all team members were asked to answer what they believe the status of the scenario to be, in 6 different domains. The stated beliefs are used to calculate the following dependent variables:

"Individual SMM" - A calculation of the extent to which the team member shares the beliefs of the other team members.

"Individual SA" - A calculation of the extent to which the team member shares the beliefs of the team leader.

"Team SMM" - The arithmetic average of the value of the "Individual SMM" for all members of the team.

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"Team SA" - The arithmetic average of the value of the "Individual SA" for all members of the team.

For details on the calculations of the above measures, please see section C.

Third variables acting as covariates or moderators.

N/A

Planned Sample

If applicable, describe pre-selection rules.

The sample will be the full number of participants included as Experiment 1 (six teams) and Experiment 2 (5 teams), corresponding to the sample in our previous study (Sætrevik and Eid, 2014).

Indicate where, from whom and how the data will be collected.

A previously collected data set from a Norwegian hydrocarbon industry emergency response team (see Sætrevik and Eid, 2014, for details) will be used in the current project.

Justify planned sample size

All possible respondents were invited to partake in the scenario training sessions, in the original data collection process, conducted by Sætrevik and Eid (2014). This sample included all the members of the emergency organization at our industry partner (subject to availability and compliance for participating in the study). Some teams and team members will have been measured twice in our sample.

*If applicable, you can upload a file related to your power analysis here (e.g., a protocol of power analyses from G*Power, a script, a screenshot, etc.).*

no file selected

Describe data collection termination rule.

N/A

Exclusion Criteria

Describe anticipated specific data exclusion criteria. For example:

a) missing, erroneous, or overly consistent responses;
b) failing check-tests or suspicion probes;
c) demographic exclusions;
d) data-based outlier criteria;
e) method-based outlier criteria (e.g. too short or long response times).

For the individual and team SMM and SA calculations, the same approach will be used as in the previous study (Sætrevik and Eid, 2014). If a team member has no answers on a given freeze point, this freeze point will be excluded from this member's average (as he/she may have been unavailable to answer the probes at the time). If a team member has answered some but not all belief domains at a freeze point, the unanswered domains will be scored as "Don't know". If the team leader has not answered some or all belief domains at one or more freeze points, the team's SA will not be calculated for those freeze points.

Procedure

Describe all manipulations, measures, materials and procedures including the order of presentation and the method of randomization and blinding (e.g., single or double blind), as in a published Methods section.

Manipulations: Experiment 1 was conducted as a regular scenario training exercise, involving communication with onshore and offshore staff that would be engaged in a real incident. In Experiment 2, however, subject matter experts acted the parts in a scripted scenario and to interact with the emergency response team members. The scripted scenario was intended to enhance experimental control and make the scenario comparable between the different teams.

Measures/materials:
A questionnaire specifically designed to measure individual SA and individual SMM during ERT scenario training exercises were distributed to all team members at every freeze point during the sessions. The questionnaires consisted of probes regarding five different belief domains thought to be highly relevant for measuring for SA and SMM. See attachment for a translation of the relevant questions.

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At the end of each scenario, participants were also asked to list with whom they communicated the most (response options listed the different positions held in the team), who they communicated the second most with, and who they communicated the third most with. Following this is a similar question where they were to indicate whom they were most reliant on to complete their tasks, who they were the second most reliant on, and who they were the third most reliant on. For how the responses from the questionnaires were calculated into the variables used in the analysis, see section C

Order of presentation in the experiment series:
Data collection was conducted within a second-line emergency preparedness center in a large hydrocarbon energy company, with the ERT assuming a center level position between first-line responders and the strategic emergency management at corporate level.

Recommended elements

Recommended elements

Procedure

Set fail-safe levels of exclusion at which the whole study needs to be stopped, altered, and restarted. You may pre-determine what proportion of excluded participants will cause the study to be stopped and restarted.

N/A

If applicable, you can upload any files related to your methods and procedure here (e.g., a paper describing a scale you are using, experimenter instructions, etc.)

Sætrevik and Eid 2014.pdf
Translated questionnaire.pdf

C. Analysis plan - Essential elements

Confirmatory Analyses

Describe the analyses that will test the first main prediction from the hypotheses section. Include:

the relevant variables and how they are calculated;

The following variables will be used in testing hypotheses H1a, H1b, H1c, and H1d:

"Individual communication centrality"
Each team member's communication centrality score will be generated by mapping out the respondents' ranking of which of the other team members they communicated with the most, second most and third most during the scenario training (each assigned weights of 3, 2, and 1, respectively). From these responses a social network analysis will be graphed and we will extract the centrality value of each team member. Each member's centrality measure is determined by the strength and number of links directed towards it (weighted in-degree centrality) . See attachment for calculation term.

"Individual reliance centrality":
Each team member's reliance centrality score will be generated by mapping out the respondents' ranking of which of the other team members they relied most on, second most and third most during the scenario training (each assigned weights of 3, 2, and 1, respectively) during the scenario training sessions. Individual reliance centrality is measured in the same way as individual communication centrality, see attachement for calculation term.

"Individual SMM":
Individual SMM will be measured using Sætrevik and Eid's (2014) Similarity index. The index generates a numerical expression that ranges between 0-1 for individual SMM. At each freeze point, the team members' stated beliefs about each domain are compared to the answers of the rest of the team members (including the team leader). For each domain of knowledge, a value is calculated using the term

1 - l (team member's answer - average of team's answer) / highest answer l

Values from 0 (indicating no overlap in beliefs) to 1 (indicating a perfect overlap in beliefs among all team members). For each team member, the degree of SMM compared with the rest of the team will be averaged across belief domains, and across the different freeze points, yielding the "Individual SMM".

"Individual SA":

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Individual SA will be measured using Sætrevik and Eid's (2014) Similarity index. The index generates a numerical expression that ranges between 0-1 for individual SA, by comparing each respondent's score with the respective team leader's score. The team leaders are expected to have the most extensive SA, given the nature of their function in the team. The rationale for this is that team leaders are expected to communicate most with all team members. Each team function reports to the team leader on a regular basis so that the leader can distribute information about the ongoing situation to the whole team as seen fit. Team leaders may thus be viewed as an informational focal point in the team, implying that they are on average better informed than other team members. Therefore, Sætrevik and Eid (2014) argued that individual SA should be measured by comparing each team member's scores with the respective team leader's scores. Team leaders' own responses are to be excluded from these analyses on account of them being the point of reference. For each probe, the index calculates the difference between a team member's response and the team leader's response. The term for this calculation is

1- l (team member's answer - team leader's answer) / highest answer l

An average of the disparity between these scores across all belief domains at one freeze point is thus taken as an index for similarity between the team leader and the respective team member for that freeze point. By aggregating the disparities in responses between that team member and the team leader across all freeze points a similarity index for the whole scenario is established. Measures range from 0 (no overlap) to 1 (perfect alignment between team member response and team leader's response on each probe, across all time points).

the statistical technique;

Simple linear regression analysis between one dependent and one independent variable, tested individually for each of the four hypotheses.

each variable's role in the technique (e.g., IV, DV, moderator, mediator, covariate);

Test of H1a:
IV = "Individual communication centrality"
DV = "Individual SMM"
(Positive association)

Test of H1b:
IV = "Individual reliance centrality"
DV = "Individual SMM"
(Positive association)

Test of H1c:
IV = "Individual communication centrality"
DV = "Individual SA"
(Positive association)

Test of H1d:
IV: "Individual reliance centrality"
DV: "Individual SMM"
(Positive association)

rationale for each covariate used, if any;

N/A

if using techniques other than null hypothesis testing (for example, Bayesian statistics), describe your criteria and inputs toward making an evidential conclusion, including prior values or distributions.

N/A

Second Prediction

Describe the analyses that will test the second main prediction from the hypotheses section. Include:

the relevant variables and how they are calculated;

The following variables will be used in testing hypotheses H2a and H2b:

"Team communication centralization"
This variable will be generated from the communication network resulting from each respondent's ranking of which of the other team members they had "communicated most with" (top three, ranked 1=most important, in descending order to 3) during the scenario training session. To reflect the ranking order rank 1 will be assigned an edge value of 3, rank 2 a value of 2 and rank 3 a value of 1, with the resulting weighted relationship pointing from the subject who is scoring to the respective ranked team member. Other possible relations will be assigned 0, though this does not necessarily imply no communication happened in that dyad. See attachment for calculation term.

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"Team reliance centralization"
This variable will be generated from of the reliance network resulting from each respondent's ranking of which of the other team members they were "most reliant on" (top three, ranked from 1=most important in descending order to 3) during the scenario training session. To reflect the ranking order rank 1 will be assigned an edge value of 3, rank 2 a value of 2 and rank 3 a value of 1, with the resulting weighted relationship pointing from the subject who is scoring to the respective ranked team member. Other possible relations will be assigned 0, though this does not necessarily imply no reliance was present in that dyad. See attachment for calculation term.

"Team SMM"
Each team member's belief domain scores for every freeze point compared against the team average on the belief domains for every freeze point (including team leaders scores); calculating a similarity index that ranges between 0 and 1, with 1 indicating all belief domain scores for the team being identical and 0 indicating no belief domain scores being identical; calculated by the term:

1- l (team member's answer - average of team's answer)/highest answer l

These indices generate a sum score which, by comparing it against the team's (including the team leader's) averaged belief domain scores for all freeze points, represents each team's SMM for each scenario.

The following variables will be used in testing hypotheses H2c and H2d:

"Team communication centralization":
See description above.

"Team reliance centralization":
See description above.

"Team SA":
This variable will be calculated by using the repeated measures of SA from each respondent for every freeze point during the scenario training session. These measures are to be compared to the team leader's responses, in accordance with Sætrevik and Eid (2013), as the team leaders are expected to have the most extensive SA. The similarity index will generate a numerical expression of the degree to which SA is cohesive in the respective teams, calculated by the term

1- l (team member's answer - teamleader's answer)/highest answer l

These indices generate a sum score which, by comparing it against the team leader's averaged belief domain scores for all freeze points, yields the measure of team SA for each scenario.

the statistical technique;

Simple linear regression analysis between one dependent and one independent variable, tested individually for each hypothesis.

each variable's role in the technique (e.g., IV, DV, moderator, mediator, covariate);

Test of H2a:
IV = "Team communication centralization"
DV = "Team SMM"
(Negative association)

Test for H2b:
IV = "Team reliance centralization"
DV = "Team SMM"
(Negative association)

Test for H2c:
IV = "Team communication centralization"
DV = "Team SA"
(Negative association)

Test for H2d:
IV = "Team reliance centralization"
DV = "Team SA"
(Negative association)

rationale for each covariate used, if any;

N/A

if using techniques other than null hypothesis testing (for example, Bayesian statistics), describe your criteria and inputs toward making an evidential conclusion, including prior values or distributions.

N/A

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read-only

Third Prediction

Describe the analyses that will test the third main prediction from the hypotheses section. Include:

the relevant variables and how they are calculated;

the statistical technique;

each variable's role in the technique (e.g., IV, DV, moderator, mediator, covariate);

rationale for each covariate used, if any;

if using techniques other than null hypothesis testing (for example, Bayesian statistics), describe your criteria and inputs toward making an evidential conclusion, including prior values or distributions.

Fourth Prediction

Describe the analyses that will test the fourth main prediction from the hypotheses section. Include:

the relevant variables and how they are calculated;

the statistical technique;

each variable's role in the technique (e.g., IV, DV, moderator, mediator, covariate);

rationale for each covariate used, if any;

if using techniques other than null hypothesis testing (for example, Bayesian statistics), describe your criteria and inputs toward making an evidential conclusion, including prior values or distributions.

Further Predictions

Describe the analyses that will test any further (main) predictions from the hypotheses section. Include:

the relevant variables and how they are calculated;

the statistical technique;

each variable's role in the technique (e.g., IV, DV, moderator, mediator, covariate);

rationale for each covariate used, if any;

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If using techniques other than null hypothesis testing (for example, Bayesian statistics), describe your criteria and inputs toward making an evidential conclusion, including prior values or distributions.

Recommended elements

Recommended Elements

Specify contingencies and assumptions, such as:

Method of correction for multiple tests.

Given the limited sample size and this being our first exploration of associations between shared beliefs and social network, we will set our initial alpha level at $p = 0.1$ to safeguard against a Type II error.

Using Bonferroni correction for eight statistical analyses, alpha level is adjusted to p equal to or smaller than 0.013.

As all our hypotheses are directed, we will use one-tailed tests for significance.

We will report exact p-values from the analyses.

The method of missing data handling (e.g., pairwise or listwise deletion, imputation, interpolation).

Imputation: In case of erroneous responses regarding ranking of communication/dependency, where higher ranks are missing, the lower ranks will be moved up in ranking order (e.g. rank 1 missing, rank 2 and 3 will become rank 1 and 2, respectively).

Reliability criteria for item inclusion in scale.

N/A

Anticipated data transformations.

To reflect the ranking order in the communication and reliance networks, rank 1 will be assigned an edge value of 3, rank 2 a value of 2 and rank 3 a value of 1, with the resulting weighted relationship pointing from the subject who is scoring to the respective ranked team member. Other possible relations will be assigned 0, though this does not necessarily imply no communication or dependency was present in that dyad.

Assumptions of analyses, and plans for alternative/corrected analyses if each assumption is violated.

Optionally, upload any files here that are related to your analyses (e.g., syntaxes, scripts, etc.).

Calculations for centrality and centralization.pdf

Final questions

Has data collection begun for this project?

Please choose

Yes, data collection is underway or complete

If data collection has begun, have you looked at the data?

Please choose

Yes

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The (estimated) start and end dates for this project are

The data was collected in 2011. The estimated end date for the current project is January 5, 2018.

Any additional comments before I pre-register this project

Explanation of the "Have you looked at the data" question above:
Individual and team SMM and SA scores have been calculated, and have been analyzed for patterns showing variation during the scenario, associations with psychophysiological measures and with team membership. However, the associations have not been tested between the SMM and SA scores and the data on "communication" or "reliance", which is the focus of the current analysis.

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