The Network Structure of Collective Intelligence

Public registration

Metadata

Study Information

Title

The Network Dynamics of Collective IntelligenceT

Authors

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Description

Prior research on social influence has provided contradictory recommendations on whether social influence can improve belief accuracy as compared with independent estimates. While some evidence suggests that the "Delphi" method, i.e. numeric exchange, produces the best estimates, other evidence suggests that open discussion produces the best estimates, while still other evidence suggests that aggregation of independent responses produces the most accurate estimates.

We predict that latent variation in network structure, even in fully connected committee-style networks (i.e., where everyone talks to everyone) can explain these divergent results. Our theory is based on the empirical finding that the effect of social influence is moderated by initial belief distribution. The critical metric is the proportion of people on the truth side of the mean, defined in our attached code. When this value is greater than 0.5, a randomly selected individual is likely to hold a belief on the truth side of the mean, and centralized individuals are therefore likely to become more accurate as a result of communication.

The key theoretical insight is that even in apparently unstructured networks, latent centralization occurs from two mechanisms. First, some people are more intransigent, and are thus more influential. Therefore, there is some minor variation in influence even in "Delphi" communication. Second, in unstructured discussion, there are even greater opportunities to become more influential. Therefore, unstructured discussion can produce greater latent centralization and will therefore be more impacted by initial belief distribution than Delphi communication.

As a result, for distributions where most people are on the truth side of the mean, both Delphi communication and unstructured discussion are likely to improve beliefs. However, when most people are on the opposite side of the mean, only Delphi communication is expected to improve beliefs, while unstructured communication is likely to reduce accuracy.

Our primary metric is the error of the mean. As such, our outcome variable is simply whether the post-discussion mean belief is closer to the truth than the pre-discussion mean.

Hypotheses

Our outcome variable is bernoulli: whether or not the mean belief becomes closer to the truth after communication.

For any given belief distribution, we define φ as the proportion of beliefs on the same side of mean as the true value.

For unstructured discussion, we measure centralization as the Gini coefficient on the number of messages contributed by each subject.
H1. The probability that a group improves will increase with φ for both communication formats.
H2. The effect in H1 will be stronger for unstructured discussion than for Delphi communication.
H3: In unstructured discussion, high-centralization groups will perform better than low-centralization groups when $\varphi > 0.5$ and low-centralization groups will perform better than high-centralization groups when $\varphi < 0.5$.

Design Plan

Study type

Experiment - A researcher randomly assigns treatments to study subjects, this includes field or lab experiments. This is also known as an intervention experiment and includes randomized controlled trials.

Blinding

No blinding is involved in this study.

Is there any additional blinding in this study?

No response

Study design

We will employ a 2x1 study design.

Subjects will be assigned to either a Delphi communication group or an unstructured communication group.

No files selected

Randomization

Subjects will be recruited from a panel of 20,000 MTurk users who have previously agreed to participate in research with our group. Prior to the beginning of data collection, each subject will be randomized to

one of the two conditions. This will allow us to run the two conditions asynchronously while maintaining randomization.

Sampling Plan

Existing Data

Registration prior to creation of data

Explanation of existing data

No response

Data collection procedures

We will employ a web-based experiment using human subjects recruited from an Amazon Mechanical Turk panel maintained by our university. There are no eligibility requirements except that they have previously agreed to be part of our panel.

No files selected

Sample size

Each trial will contain 20 subjects.

We will test 10 different numeric estimation tasks.

We will collect 10 trials for each estimation task for each condition.

In total, we will collect 100 trials of Delphi communication and 100 trials of unstructured discussion.

Sample size rationale

This sample size is based on power analyses conducted previously published datasets.

Stopping rule

No response

Variables

Manipulated variables

We will manipulate (a) communication format and (b) estimation task.

No files selected

Measured variables

We will measure:
1. the error pre- and post-communication mean as defined in our attached code
2. the proportion of people on the truth-side of the mean in the initial distribution, as defined in our attached code
3. the Gini coefficient on chat message distribution, as defined in our attached code

No files selected

No files selected

Indices

No response

No files selected

Analysis Plan

Statistical models

The attached files show our analysis plan, conducted using a re-analysis of previously published experimental data.

- PreRegistrationCode_Effect_of_Distribution_2019_Jun_23.R (https://osf.io/project/9xq2j/files/osfstorage/5d101d0c693ba8001a8df347?view_only=2c63a8b7e6154139a0641f4e57f8f9f2)
- PreRegistrationCode_Evidence_Of_Centralization_2019_Jun_23.R (https://osf.io/project/9xq2j/files/osfstorage/5d101d0c693ba8001a8df345?view_only=2c63a8b7e6154139a0641f4e57f8f9f2)
- question_lookup.csv (https://osf.io/project/9xq2j/files/osfstorage/5d101d0c693ba8001a8df343?view_only=2c63a8b7e6154139a0641f4e57f8f9f2)
- chatlog.csv (https://osf.io/project/9xq2j/files/osfstorage/5d101d0c693ba8001a8df341?view_only=2c63a8b7e6154139a0641f4e57f8f9f2)
- GURCAY_et_al_newDataApr30.csv (https://osf.io/project/9xq2j/files/osfstorage/5d101d0b693ba8001a8df33f?view_only=2c63a8b7e6154139a0641f4e57f8f9f2)

Transformations

No response

Inference criteria

No response

Data exclusion

We will only analyze responses by subjects who provide both an initial and a final response.

Missing data

No response

Exploratory analysis

No response

Other

Other

No response