UC SANTA BARBARA

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# Balance Under Pressure

In the 1940s eminent sociologist Fritz Heider devised Structural Balance Theory (SBT) to describe interpersonal relationships in a group. Since then, the theory has been applied across disciplines and continues to gain prominence in fields that study social networks, conflict and change. However, scientists had yet to evaluate the model over time.

Now a team of scholars from UC Santa Barbara, Harvard University and Northwestern University has applied the theory to a long-term dataset. They found that the SBT was largely accurate, and that groups that were balanced in the model showed better real-world performance. Their results appear in Nature Communications.

Structural Balance Theory models relationships between members of a group and describes how they evolve over time. The theory's axioms give rise to balanced and unbalanced configurations, which researchers have used to gain insight on many real-world systems.

"This is the first time ever we're looking at a longitudinal, empirical study for a very famous sociology model and specifically tying it to performance," said lead author Omid Askarisichani, a doctoral candidate in UC Santa Barbara's computer science department.

So why has it taken so long for researchers to test the theory this thoroughly? One reason is the challenge in getting access to a large set of interpersonal data. Then

comes the task of distinguishing positive and negative relationships and tracking how they develop.

One of Askarisichani's coauthors, Brian Uzzi of Northwestern University, obtained two years' worth of deidentified instant messages between 66 stock traders at a hedge fund. The team used the messages to determine the relationships between co-workers.

First, they split the messages into work-related and social content using a natural language processing algorithm to look for company stock symbols and terms of the trade. Everything else was sorted into "social." The team checked 1000 messages manually to verify that the algorithm was sorting them properly.

The researchers then classified relationships between coworkers as either positive or negative based on the total number of non-work-related messages sent between two traders. The thought was that coworkers with good relationships were likely to send more messages to each other. The team next looked at groups of three coworkers and compared how their relationships developed with theoretical predictions.

**It Works in Theory …**

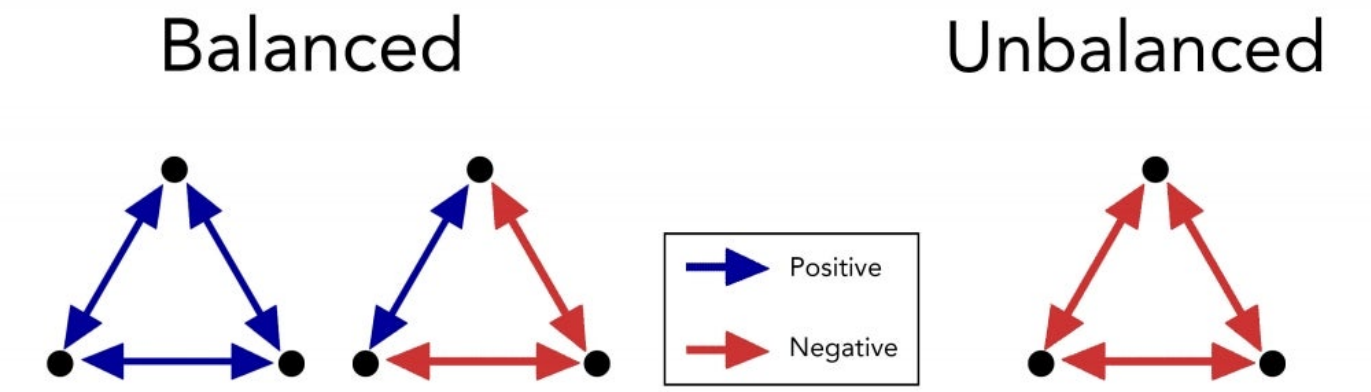
Structural Balance Theory is a simple model of relationships. One individual has either a positive or negative relationship with another, and vice-versa. This gives rise to 16 different sets of relationships between three people, the conventional unit in the theory.

SBT also has four rules:

- - A friend of a friend is a friend,
- - A friend of an enemy is an enemy,
- - An enemy of a friend is an enemy,
- - An enemy of an enemy is a friend.

According to these rules, only two triads should be stable, or balanced: a group with three mutual friends or a group where two members join together against the third. Accordingly, the researchers expected to see the network converge to a state where most of its subsets were one of these two triads. They also suspected that traders in these balanced triads would meet with more success than their unbalanced

colleagues.




The researchers found that these three triads persisted in the system, even though only two are balanced under classical Structural Balance Theory.

**Photo Credit:** DANIEL SMITH

Studying day traders simplified the latter aspect. These traders start with some amount of money in the morning, buy and sell stocks all day, and then sell out everything they hold at the day's close. That meant that the researchers could track traders' performances simply based on their net earnings for the day.

"And we found that when the system is more balanced, the traders end up being more profitable," Askarisichani said. "In fact, when the traders are structurally balanced, they become 30% more profitable." This a remarkable improvement in a sector that often operates on margins.

The concept of balance in the model actually translates into real life. "When there is an issue between people, their relationship is not balanced," Askarisichani explained. So, when a person is balanced, it means that they've solved the interpersonal tensions in the groups they belong to. And these tensions can take a real toll on a person.

Consider the mutual friend of a couple that just experienced a rough breakup. The system is in tension. The individuals aren't sure what to do, which consumes their time and energy. This situation isn't stable, and eventually, the group will move toward a more secure state.

Day traders are under immense pressure. They need to gather as much information as efficiently as possible, so even minor interpersonal tension can directly impact their performance. In fact, out of six factors they considered, interpersonal balance was the only metric that showed a statistically significant association with increased performance.

“The theory is robust, it’s strong, it’s correct,” Askarisichani said, “but it’s not perfect in the empirical study.” For instance, although triads developed toward the two stable configurations the theory predicted, groups of three mutual enemies tended to persist over time as well. According to classical SBT, two members should eventually band together against the third.

However, the persistence of groups of mutual enemies actually corresponds with a model of SBT called “clustering balance,” developed in 1967. “Finally, this overlooked prediction in balance theory turns out to have empirical support,” Askarisichani said.

The team has begun work on a three-value model similar to SBT, which has neutral values alongside the positive and negative values of the classical theory. The complexity of the three-value system makes it more challenging to apply but also allows it to capture more nuance.

Askarisichani will evaluate this theory against an even more ambitious dataset. He plans to model the relationships between 250 countries based on over 8 million news articles from 1995 through 2018. His results so far lend support to the theory’s accuracy and utility.

“We believe this paper will be of great interest across the sciences and will reduce error in the application of SBT,” Askarisichani said. “And the pragmatic implications will be of great use to any individual or organizations that manage teams or networks of collaborators.”

Askarisichani’s collaborators in the research were UC Santa Barbara’s Francesco Bullo, Noah E. Friedkin and Ambuj Singh; Jacqueline Ng Lane, of Harvard; and Uzzi, of Northwestern.

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## About UC Santa Barbara

The University of California, Santa Barbara is a leading research institution that also provides a comprehensive liberal arts learning experience. Our academic community of faculty, students, and staff is characterized by a culture of interdisciplinary collaboration that is responsive to the needs of our multicultural and global society. All of this takes place within a living and learning environment like no other, as we draw inspiration from the beauty and resources of our extraordinary location at the edge of the Pacific Ocean.