COMMENTARY

From equality to hierarchy

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As an old Scottish proverb says, "give a Dog an ill Name, and he'll soon be hanged." Even when the signal has little to do with underlying reality, endorsement—or contempt—can produce lasting consequences for a person's social position. The ease with which such pieces of folk wisdom translate across both time and species suggests that there is a general, and even perhaps universal, logic to hierarchies and how they form. Kawakatsu et al. (1) make an important advance in the quest for this kind of understanding, providing a general model for how subtle differences in individual-level decision-making can lead to hard-to-miss consequences for society as a whole.

Their work (1) reveals two distinct regimes—one egalitarian, one hierarchical—that emerge from shifts in individual-level judgment. These lead to statistical methods that researchers can use to reverse engineer observed hierarchies, and understand how signaling systems work when prestige and power are in play. The results make a singular contribution at the intersection of two distinct traditions of research into social power: the mechanistic (how hierarchies get made) and the functional (the adaptive roles they can play in society).

How Rank Works

Hierarchies were first understood mechanistically, as pecking orders that were the cumulative consequence of individual aggressive acts (2). Researchers focused on how to translate aggression (e.g., physical harm) or endorsement (e.g., signals of submission) into rank. Ideally, aggression and rank should be consistent. If A ranked above B, one wanted no aggressive acts from B to A, or submissive acts from A to B. Cycles frustrated this goal (A might aggress against B, B against C, and C against A), and so a next step adjusted the final ranks to minimize both the number and the strength of the inconsistencies (3).

These methods produced holistic assessments: The relative rank of A and B depended, in part, on how B interacted with C and how C interacted with others. Holism greatly complicates how individuals navigate a hierarchy. Social status is no longer a horse race where individuals accumulate independent points, as in the early "music laboratory" prestige experiments (4), but a complex, Machiavellian world where, for example, one way for A to rise relative to B is to endorse B's opponents.

The holistic nature of rank received unexpected attention when the "PageRank" algorithm (5) helped Google dominate Internet search in the early 2000s. PageRank used eigenvector centrality to determine community consensus about the relative prestige rank of pages on the Internet. A link from one page to another counted as an endorsement, but the effect of that endorsement depended on the prestige of the endorsing page itself, which depended upon the prestige of the pages that endorsed it, and so on, recursively.

PageRank's holistic measure provided better results than competing engines that used only "local" information to judge a page, such as the number of inbound links, or human-curated judgments of intrinsic worth. Furthermore, while earlier ranking methods saw cycles as aberrations to be minimized, PageRank and similar models of "transitive prestige" placed them on an equal level with more-linear relationships. PageRank uses cycles to adjust rank in ways that fit the intuitive sense of the mutuality of many (although not all) power relationships: Mutual respect—or antagonism—is often a sign of near equality.

What Rank Does

Methods like these showed how individual decisions made hierarchies, but we also want to understand the potentially adaptive functional roles rank can play. Caution is required. While hierarchies might benefit the group as a whole, the benefits are distributed unequally, with those at the bottom suffering the most (6, 7). Providing an evolutionary account of hierarchy is a challenge, involving, potentially, both kin selection and intergroup competition (8, 9). In the meantime,

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we can ask, What things does a hierarchy help a group get done?

First, rank can be an efficient way to summarize the accurate, but noisy, perceptions of individuals. This is at the heart of Google's use of PageRank, which amalgamated the judgments of authors when they choose where to link. In these cases, rank is like an economist's price mechanism, summarizing an enormous number of perceptions in a single signal.

Second, rank can increase predictability. Without rank, for example, an individual jockeying for resources within the group may have to test himself against many opponents; with rank, these conflicts can be greatly reduced if there is general agreement about who ranks above whom and how to act toward those above and below. In this case, rank is not an assessment of who has the best intrinsic properties, but rather a useful consensus view that provides rules for how to behave toward others.

Predictability enables systems of rules that can coordinate a variety of new goals. Consensus about rank, for example, enables successful third-party conflict management, such as policing by high-ranking members (10). Groups can benefit when rank conditions and channels behavior (11).

This is true even when ranks detach from reality. Kawakatsu et al. (1) provide the particularly nice example of a politician choosing a rival candidate to endorse. In a US presidential primary, endorsement provides inputs to the political process, clarifying the relative ranks of those who remain and, by avoiding contested primaries farther down the line, helping to avoid politically damaging conflicts (12). This works even when the endorser has no useful opinions about her rivals.

Where Rank Comes From

Now, however, a paradox emerges. For ranks to get this second job done, they must be visible enough to provide common expectations. But how can this happen if rank is not tied to stable intrinsic properties? If some candidates truly are better than others, endorsement might heighten the contrast, but how can the magnifying process of consensus work if the underlying endorsements are arbitrary? Kawakatsu et al. (1) show how the systematic ways in which individuals respond to rank make it visible through a self-fulfilling prophecy.

The process is governed by two "psychological" parameters: an individual's tendency to endorse those high in the hierarchy (the "preference for prestige"), and to focus on those nearby (the "preference for proximity"). These preferences are cashed out, satisfyingly, in utility theory, where your utility for endorsing another is a function of their rank (the preference of prestige), and the squared difference of rank between you and them (the preference for proximity). Under a broad range of conditions, what matters is the preference for prestige. At a critical point in this preference, the system undergoes a discontinuous (second-order) transition between an egalitarian system, with few real differences in social power, and a hierarchical one, where a few oligarchs receive the lion's share of prestige.

Kawakatsu et al.'s (1) simulations also provide a method of inference. Given pairwise interactions between individuals, one can both measure their preferences and make a best guess at the underlying rank function that defines them. Both are informative. In the case of academic hiring networks, for example, Kawakatsu et al. find that a breadth-based rank (13), rather than holistic ones like PageRank, best accounts for how hiring takes place. This, in turn, gives clues to how academic prestige works: A good department is one that gets its PhDs jobs, regardless of where. Conversely, in the Newcomb Fraternity data, prestige is governed by the holistic "SpringRank" function: To be cool, it is not enough for people to think you are cool—you must be thought to be cool by the right people. In both the Newcomb Fraternity and the Parakeets, Kawakatsu et al. also found strong proximity preferences; the latter matches the results of independent studies by ourselves and collaborators (14).

Kawakatsu et al.'s (1) estimators are Bayesian, and so both unbiased and with robust errors, an important concern for comparative studies where the data available can vary by many orders of magnitude. Applied to cross-species datasets of animal conflict (14, 15), these methods can reveal the evolutionary history of how species construct, infer, and maintain hierarchies. Applied to human systems, these methods may be able to reveal common patterns both within and between societies, and give important clues to basic questions in anthropology about the emergence of hierarchy as a function of group complexity (16, 17).

Kawakatsu et al. (1) also raise the question of how rank itself is known. To endorse the powerful, we must first determine who they are. Sometimes, the rank function makes this easy: It is plausible, for example, that academic hiring committees track the placement records of their competitors. In other cases, it is hard: It is much less likely that fraternity members, or parakeets, diagonalize a matrix to compute the PageRank or SpringRank of others in their group. What signals are available to participants, and how are they compiled into estimates of rank? Their model assumes that knowledge of rank is noisy, but not (statistically) biased. While we can build more-sophisticated models of the biases in our judgments, however, Kawakatsu et al.'s (1) success highlights the virtues of simplicity. It is possible, for example, that, even if the signals are not accurate at first, we might act to make them so.

For those who focus on the social benefits of hierarchy, Kawakatsu et al.'s results urge humility. Hierarchies may help organize society for the benefit of all, but even the most extreme differences in rank may be the product of accident, not worth.

Hierarchies may be pervasive features of social life, but, as noted above, they are often a source of suffering. Even seemingly innocuous rankings can undermine the goals of the participants, as appears to happen in the circulation of scientific ideas (18). This raises challenging questions not only for evolutionary theory but also for how we organize society.

For those who focus on the social benefits of hierarchy, Kawakatsu et al.'s (1) results urge humility. Hierarchies may help organize society for the benefit of all, but even the most extreme differences in rank may be the product of accident, not worth. For those who wish to level hierarchies, their results provide hope. The transition to oligarchy at a critical level of prestige obsession may be a sudden one, but it goes both ways. Humankind need not completely abandon its fascination with the high and low for a more egalitarian world to emerge. A little less might do a lot.

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