Social and economic consequences of prestige and dominance in rural Colombian social networks

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Social status regulates influence and well-being in most social-animals. In humans, social status can be attained via two distinct routes: prestige (freely-conferred deference, typically tracking the ability of individuals to confer benefits) and dominance (fear-based deference, typically tracking the ability of individuals to inflict costs). While prestige and dominance are well-studied from a psychological perspective, their influence on dyadic behavior, including social leveling, remains underexplored—especially in small-scale communities. Here, we present data from four Colombian communities ($N_{\text{ind}} = 496$), where we collected peer nominations of prestige, dominance, trust, affinity, fear, and friendship, and ran network-structured economic games measuring altruistic giving, exploitation, and costly punishment. Applying a multiplex network model to these data ($N_{\text{obs}} = 865,944$; $N_{\text{ties}} = 76,427$), we analyze how perceptions of status relate to dyadic game behavior. More-prestigious individuals were more trusted, had more friends, received more cooperative transfers, and were less frequently punished or exploited. More-dominant individuals experienced discrepant outcomes: they too had more friends and received more cooperative transfers, but they were also more feared and distrusted, and were preferential targets of exploitation and costly punishment. In short, prestige conferred clear social and economic advantages, while dominance carried net costs. Our work provides the first large-scale test of dyad-level dominance leveling in real-world networks, and yields support for the idea that dominance in human communities is a precarious strategy. Although dominant individuals may be targets of friendship and cooperation, perhaps due to a linkage between dominance and local authority, they are more heavily leveled and face difficulty in obtaining positive, community-wide standing.

Cooperation | Inequality | Social Capital | Social Hierarchy | Social Networks

Social hierarchies are observed in all socially-living species (1). Within groups of social animals—non-human and human alike—individuals often differ in their social influence and decision-making authority (i.e., in their *social status*) and these differences in status may reliably influence individuals' access to the material, social, and informational resources of others in their groups (2–4). Ultimately, individuals in more privileged positions within a hierarchy tend to garner direct and indirect benefits to their health and well-being (5–7), and gain other important fitness advantages (reviewed in: 8, 9). Social hierarchies are by no means universally beneficial to the individuals subject to them (10, 11), or even to groups as a whole (12). However, hierarchies often have functional explanations and provide group-level benefits by facilitating coordination and collective action, reducing costly intra-group conflict, and improving outcomes in inter-group competition (13–16). Given the broad-reaching implications of social hierarchy, understanding how and why certain individuals achieve and maintain elevated social status has been a major focus in the social and evolutionary sciences. Nevertheless, despite decades of research on social status in humans, we lack a detailed understanding of how perceptions of status affect dyad-level social and economic behaviors in real-world social networks—especially outside of western, educated, industrial, rich, and democratic settings (17–19).

Early examinations of social status in humans from an evolutionary perspective—with an intellectual history tracing back to studies of animal behavior—emphasized the role of *coercive dominance*, a mechanism by which individuals who are both *able and willing to inflict costs upon others* would maneuver their way up a status hierarchy (20–22). Such dominance rankings are clearly observed in many socially-living species, with key individuals displaying public badges or signals of their formidability (e.g., scaring, weaponry,

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physical size, or ornamentation) and thus their ability to win agonistic contests; this in turn leads to avoidance or deference behaviors from less formidable conspecifics in order to prevent or minimize such agonistic contests, leaving unambiguous social signals of status hierarchy (23–27). Dominance-based social status has also been observed in human groups, but—outside of exceptional settings such as areas of heated intergroup conflict and criminal organizations—it is often more subtle than in non-human mammals. These more subtle forms of dominance are based more heavily on forms of cost imposition that are not overtly physical, with individuals achieving positions of high status through non-verbal badges and signals (28–30), aggressive, assertive, or forceful verbal communication (31, 32), and perceived threats or manipulation based on institutionally-sanctioned differentials in power or resource control (33).

More recent theory has emphasized that, especially in human groups, social hierarchies are multidimensional systems (34, 35). Contemporary empirical evidence has, for example, highlighted the role of *prestige* as a form of social status based closely on an individual's *perceived ability and willingness to confer benefits to others* (36). Experimental and self-report survey data have shown that prestige is associated with a distinct psychological profile in comparison to dominance (37)—with prestigious individuals being viewed as more likeable, generous, and higher in genuine self-esteem and authentic pride (38–40). Moreover, prestige-based status has been shown to rest upon the freely-conferred respect and admiration that group members have for an individual (as opposed to dominance, where such deference is based upon fear; 41, 42). In real-world settings, prestige has been linked to perceived skill, knowledge, and expertise in locally-relevant practices (e.g., hunting ability or knowledge of medicinal plants; 9, 36), and is associated with self/peer-perceived prosocial disposition or cooperative proclivities (e.g., food sharing behavior; 3, 43). This quantitative research in real-world settings, and similar qualitative ethnographic work (e.g., 44), have both focused almost exclusively on the factors associated with *men's* social status (45). An emerging literature, however, has highlighted that—although men are generally more privileged in status-related factors (e.g., they have more cooperation partners and greater access to education: 46)—women's status is also largely based upon respect and generosity, and entails similar fitness-related outcomes to men's status (47). While a recent body of evidence has advanced our understanding of the personality traits and peer-perceptions that are linked to prestige and dominance, we lack fine-scale behavioral data on how such perceptions structure cooperation, exploitation, and costly punishment at a dyadic level. Such nuanced behavioral economic data, however, are increasingly becoming the nexus of empirical and theoretical models of human social behavior (see: 48–53).

Disentangling the social and economic consequences of prestige and dominance. The now-mounting evidence for the importance of benefit generation in attainment of social status has revived longstanding debate about whether dominance is a viable pathway to attaining social status in humans. Ethnographic accounts of social status across a diverse array of small-scale subsistence populations have led many to argue that there is a human aversion towards dominance, where members of a group form coalitions and band together to sanction dominant individuals (54). Such qualitative evidence has inspired several formal (i.e., computational or mathematical) models which have shown that leveling of dominant individuals may emerge in conditions where: (1) individual-level benefits to leveling outweigh the costs (55, 56), (2) group members benefit from preventing dominants from usurping the resources held by lower-ranked individuals (57), and (3) a group's existing social networks are structured in a way that facilitates the mobilization of coalitions against potential dominants (58, 59). Complimentary findings from experimental studies (e.g., 60–63) have shown that individuals have preferences for conferring social status to more prosocial and generous (i.e., prestigious) individuals, and punishing or sanctioning those perceived to be narcissistic and aggressive. This has led many to argue that dominance-based status attainment in human communities must also function through benefit generation, rather than solely through the cost-imposition dynamics often observed in non-human animals (64, 65). Taken together, the theoretical and empirical literatures have begun to converge on the ideas that: (1) in the absence of institutions that canalize and legitimate unequal social positions, groups tend to level the social status that is afforded to those perceived to be high in dominance, and (2) dominant individuals with structural power might use selective bequeathal of benefits, rather than solely imposition of costs, to maintain their social positions in the face of such leveling.

Although it seems plausible that individuals may level the status of those perceived as dominant, *when group members either benefit from such leveling* and/or *when the group is capable of performing such a task*, in real-world settings these conditions are not always met. First, and most obviously, when an individual high in dominance has institutional power, leveling may be costly, slow, or impossible. Moreover, in the absence of formal institutions that apportion power, some group members may in fact benefit from a given dominant individual having high status, and would therefore not be motivated to lower that individual's standing. Rather, these individuals may invest their time and resources into forming coalitional or cooperative bonds with a dominant to maintain their own positions (43, 66). This is because individuals do not typically live in isolation, they are embedded in many different networks of social relationships within (and outside of) any given group. The social relationships in which individuals are involved impact their ability to effectively access and mobilize the social capital of others within their group (67). Having ties with high status others—and being able to access their social and material resources—may therefore provide benefits that outweigh the costs of having to associate with someone that many group members perceive to be dominant. This dynamic is especially well-described in ethnographic accounts of gangs or mafias (44, 68)—where ties to powerful individuals are often seen as beneficial by insiders in the status hierarchy, even when those powerful individuals openly show willingness to inflict extreme costs on (suspected) challengers or threats. A similar dynamic is likely much more general in typical human social networks, even if it is more moderate in intensity.

In light of past work, either of two major empirical patterns for dominance may be expected in real world settings. First,

it may be the case that dyadic interpersonal sentiments track the dominance levels of community members and overwhelmingly drive social and economic leveling, leading dominant individuals to be passed over in cooperative interactions, and be the subject of exploitation, and punishment (50, 52). Alternatively, even if dominant individuals are often the target of leveling by many in the community, there may be potentially substantial sub-sets of the community that abstain from any acts of leveling—or even 'altruistically' support dominant individuals—as the potential benefits of that support might offset the costs of maintaining those ties.

To the best of our knowledge, there has not been a direct quantitative test of dominance-leveling in real-world networks that addresses this question. Ethnographic accounts in small-scale subsistence societies have provided qualitative anecdotes that suggest such a mechanism (54), but do not quantify its scope. Experimental research has shown that such a leveling mechanism may indeed guide status differentiation in humans, but these results can only speak to individuals' *preferences* in abstract, hypothetical scenarios that likely do not reflect real-wold decision-making (i.e., there are some ecological validity concerns; 34). Our work here aims to fill this gap, by linking dyad-level perceptions of prestige and dominance, to behavior in three network-structured experimental economic games.

The Current Study

Here, we investigate the social and economic consequences of dominance and prestige in four rural Colombian communities. To do this, we collected near-complete sociocentric network data, dyadic peer-reports of personal qualities and sentiments (including prestige, dominance, trust, distrust, affinity, and fear), and incorporated network-structured behavioral economic games where deciders know the identities of the targets of their behaviors during game-play. These economic games are known as RICH (recipient identity-conditioned heuristics) games and have been detailed and validated in prior work (see: 51, 69, 70). These three RICH games measure individuals' preferences for cooperating with, exploiting, and punishing known individuals in their communities. Our data thus permit a direct test of whether an individual's social relationships facilitate access to the economic resources of others—a foundational assumption in many theories of social capital (e.g., 67, 71)—and a further test of whether perceptions of dominance and prestige influence the structure of cooperative, exploitative, and punitive ties. More specifically, the current study will examine the predictions outlined below.

Social relationships and positive interpersonal sentiments mediate access to the economic assets of others. The notion that social relationships and positive inter-personal sentiments mediate individuals' opportunities to access and mobilize the social, economic, and informational resources of others is central to social capital theory*. Given this, we would expect that—when provided the opportunity to allocate resources to others in the RICH games—individuals would have a preference for allocating resources towards, and not exploiting or reducing, their friends, and others whom they like and trust.

*Note that there are many strands of theory and research on social capital (72, 73), and that here we follow the individual-level perspective that defines social capital as *resources embedded in a social structure that are accessed and/or mobilized in purposeful actions* (67).

Prestige and dominance will be associated with distinct types of peer-perceptions and economic behaviors. Previous research has shown that prestige and dominance are associated with distinct personality traits and interpersonal sentiments. For example, evidence shows that prestige is positively associated with perceived cooperativeness, morality, and self-reported conscientiousness—while dominance has a negative association with the same variables—at least among North American university students (37). Complimentary findings from Chabu hunter-gatherers in Ethiopia further suggest that prestige was linked to peer-perceived expertise, likeability, and respect, while dominance was linked to being feared, perceived fighting ability, and coercive control (74). These peer perceptions most likely form through focal individuals repeatedly observing the behavior of others (75, 76) in order to appropriately respond to those others when circumstances arise. Accordingly, we would predict that prestige acts to track potentially beneficial ties (e.g., one might generally cooperate with a prestigious person), while dominance tracks ties which may or may not be beneficial (e.g., one might abstain from cooperating with a dominant person, unless the details of the circumstance require concession).

As we will see shortly, our multiplex network analysis framework permits our predictions to be formulated at two levels: the node level and the dyad level. At the node (i.e., individual) level, we predict that individuals with prestigious reputations (i.e., those nominated as prestigious by many in the community) will be more trusted, liked, and socially connected, and will be preferential targets of allocations in the giving game, but will not be targets of exploitation or costly reduction. At the dyadic level, we predict that if individual i perceives individual j to be prestigious, then i will be more likely to trust and like j, more likely to give to j, and less likely to exploit or reduce j. Under the pure dominance leveling argument, the predictions for dominance will be exactly inverted relative to those of prestige (i.e., cooperation with dominant individuals will be withheld in these decider-anonymous, but recipient-identity-conditioned games, and exploitation and costly reduction will be deployed), but we detail a slightly more nuanced expectation below.

Those high in dominance will be anonymously leveled (i.e., exploited and punished) by many members of their community, but they may also glean social and economic benefits from a sub-set of the community network. In contrast to the pure dominance-leveling model, there may be a more nuanced relationship between dominance and ostracism, such that dominant individuals are able to maintain somewhat privileged social standing by recruiting support from a sub-set of the population. Dominant individuals, even if disliked, routinely have structural power and authority (45), but rely on some degree of social leverage to maintain those positions. As such, even if dominance-leveling is deployed by many, we might expect dominant individuals to be sought out more often than less authoritative individuals for positive social connection by a sub-set of the community, due to the potential benefits that these group members receive from maintaining relationships with those dominant individuals.

Table 1. Descriptive statistics of the multiplex data included in this study. In total, the database consists of 865,944 binary data-points representing the presence/absence of directed dyadic social connections, peer ratings, or economic transfers (with 76,427 positives ties), taken across 12 network layers, from 496 respondents, in 4 rural Colombian communities.

Site	Layer	Nodes	Edges	Density	Reciprocity	Transitivity	Mean Degree	Out-Degree Range	In-Degree Range
Coastal	Friendship	186	2484	0.072	0.349	0.265	26.7	2–49	1–46
Lowland	Friendship	154	2117	0.09	0.38	0.278	27.5	0–39	2–45
Highland	Friendship	45	354	0.179	0.486	0.431	15.7	2–21	0–25
Altiplano	Friendship	111	657	0.054	0.545	0.377	11.8	0–17	0–16
Coastal	Give	186	1596	0.046	0.213	0.181	17.2	0–23	1–25
Lowland	Give	154	1128	0.048	0.195	0.194	14.6	0–18	0–31
Highland	Give	45	401	0.203	0.364	0.47	17.8	0–25	1–22
Altiplano	Give	111	910	0.075	0.314	0.302	16.4	0–25	0–30
Coastal	Take	186	20362	0.592	0.626	0.838	218.9	0–184	59–143
Lowland	Take	154	13607	0.577	0.589	0.846	176.7	0–153	62–107
Highland	Take	45	810	0.409	0.427	0.682	36	0–44	9–29
Altiplano	Take	111	6690	0.548	0.549	0.823	120.5	0–108	36–77
Coastal	Reduce	186	204	0.006	0.039	0.025	2.2	0–13	0–12
Lowland	Reduce	154	331	0.014	0.048	0.083	4.3	0–15	0–10
Highland	Reduce	45	17	0.009	0	0	0.8	0–7	0–2
Altiplano	Reduce	111	67	0.005	0.119	0.019	1.2	0–7	0–7
Coastal	Prestigious	186	2076	0.06	0.15	0.218	22.3	0–31	0–65
Lowland	Prestigious	154	1488	0.063	0.175	0.227	19.3	0–29	0–62
Highland	Prestigious	45	288	0.145	0.319	0.348	12.8	0–18	0–19
Altiplano	Prestigious	111	604	0.049	0.354	0.294	10.9	0–14	0–22
Coastal	Contemptible	186	775	0.023	0.08	0.084	8.3	0–46	0–30
Lowland	Contemptible	154	875	0.037	0.137	0.123	11.4	0–30	0–37
Highland	Contemptible	45	33	0.017	0	0.085	1.5	0–9	0–4
Altiplano	Contemptible	111	101	0.008	0.059	0.038	1.8	0–9	0–6
Coastal	Passive	186	1630	0.047	0.102	0.165	17.5	0–30	1–58
Lowland	Passive	154	1024	0.043	0.119	0.155	13.3	0–23	0–37
Highland	Passive	45	206	0.104	0.291	0.357	9.2	0–17	0–13
Altiplano	Passive	111	408	0.033	0.162	0.204	7.4	0–16	0–17
Coastal	Dominant	186	1095	0.032	0.051	0.122	11.8	0–20	0–39
Lowland	Dominant	154	821	0.035	0.076	0.152	10.7	0–56	0–44
Highland	Dominant	45	101	0.051	0.099	0.217	4.5	0–9	0–11
Altiplano	Dominant	111	293	0.024	0.143	0.142	5.3	0–12	0–22
Coastal	Trust	186	1637	0.048	0.264	0.205	17.6	0–32	0–45
Lowland	Trust	154	1179	0.05	0.27	0.212	15.3	0–18	0–39
Highland	Trust	45	273	0.138	0.462	0.351	12.1	0–19	0–17
Altiplano	Trust	111	580	0.048	0.462	0.33	10.5	0–23	0–13
Coastal	Distrust	186	1080	0.031	0.076	0.102	11.6	0–25	0–59
Lowland	Distrust	154	1146	0.049	0.117	0.172	14.9	0–149	0–45
Highland	Distrust	45	97	0.049	0.144	0.133	4.3	0–9	0–12
Altiplano	Distrust	111	182	0.015	0.099	0.076	3.3	0–9	0–13
Coastal	Like	186	2321	0.067	0.282	0.24	25	1–31	1–58
Lowland	Like	154	1394	0.059	0.217	0.195	18.1	0–24	0–38
Highland	Like	45	295	0.149	0.373	0.407	13.1	0–21	0–21
Altiplano	Like	111	756	0.062	0.45	0.334	13.6	0–24	0–17
Coastal	Fear	186	919	0.027	0.078	0.096	9.9	0–26	0–52
Lowland	Fear	154	766	0.033	0.086	0.112	9.9	0–53	0–43
Highland	Fear	45	77	0.039	0.078	0.156	3.4	0–8	0–12
Altiplano	Fear	111	172	0.014	0.221	0.071	3.1	0–8	0–10

Results

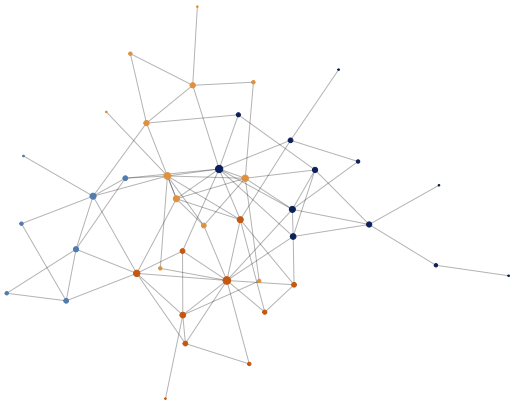
We begin the presentation of our results by outlining the descriptive statistics of our multiplex networks in Table 1. The data consist of $N_{obs} = 865,944$ binary data-points representing the presence/absence of directed dyadic social connections, peer ratings, and economic transfers, taken across $K = 12$ network layers, from $N_{ind} = 496$ respondents, in 4 communities. Of these binary data, there are $N_{ties} = 76,427$ positive values indicating the presence of the binary tie in question. Of particular importance to our study design, our elicitation methods yielded networks with substantial variation in out- and in-degree, which gives us ample power to detect how peer-perception/reputation in one layer is related to economic outcomes in another. We visualize the structure of the friendship networks—collected using a community-wide, photo-roster-based elicitation method (77, 78)—in Figure 1, in order to provide readers with an understanding of the social structure and sample size in each of the four study communities. In Figure 2, we visualize the multiplex structure of our data using the Altiplano community as an exemplar. Here, we show the friendship network as a bolded backbone and show dyadic peer-ratings for prestige and dominance as

Fig. 1. The largest connected components of the social networks included in our study. Frames 1a and 1b show friendship ties that were nominated mutually by both members of a dyad in the coastal and lowland communities—-these communities are comprised mostly of Afrocolombians, with a small cluster of indigenous Emberá in the rightmost side of the network at each site. Frames 1c and 1d show friendship ties that were nominated mutually by both members of a dyad in the highland and altiplano communities—these communities are comprised mostly of Mestizos. Nodes are colored using a sub-community detection algorithm and scaled by degree. The Afrocolombian communities are larger, and have substantially denser social networks than the Mestizo communities. Nevertheless, the Bayesian multiplex network models we deploy to study correlations in node-level features (i.e., correlations in receiver effects across layers) and edge-level features (i.e., correlations in how individual i acts on j as a function of i's perceptions of j and i's sentiments towards j) are robust to density, degree variation, and between-layer heterogeneity in network structure. Figure 2 provides an exemplar of the multiplex nature of the data collected at each of the included field-sites.

(a) Friendship network at the coastal site.

(b) Friendship network at the lowland site.

(c) Friendship network at the highland site.



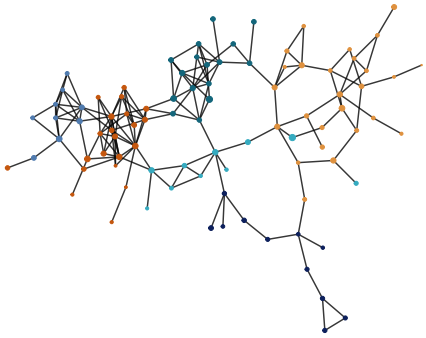
(d) Friendship network at the altiplano site.

gray edges. This figure illustrates that reputational booking extends well-beyond immediate social connections, as we see that peer-ratings of prestige and dominance bridge local sub-group clusters.

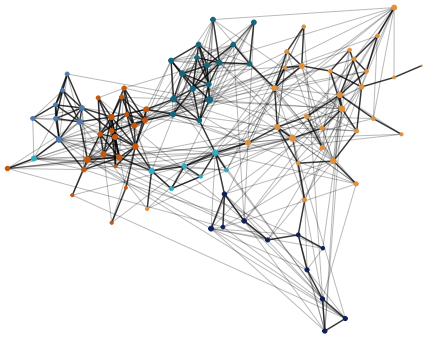
Across sites, individuals track status/reputational considerations widely, and act on those considerations when deciding who to give to, take from, and pay to reduce in the RICH economic games. When considering how reputational considerations are associated with network-structured economic game-play and social network structure, there are two distinct types of correlations that we must account for in our multiplex network models: *dyadic correlations* and *nodal correlations* (70, 79). Dyadic correlations in a multiplex model measure, for example, how the propensity of individual, i, to rate another individual, j, as prestigious is associated with the propensity of i to take coins from j in the RICH taking game—i.e., they measure the strength of associations in *directed edges* within and across network layers. In contrast, nodal correlations in a multiplex model measure, for example, how the propensity of individual i to be nominated as prestigious *by anyone* is associated with the propensity of individual i to have coins taken from them *by anyone* in the RICH taking game—i.e., it measures the strength of association in *nodal degree* within and across network layers. For our purposes, we treat the dyadic correlations as representing propensities *within the minds of the individuals* making economic decisions regarding who to give to, take from, and punish, as a function of direct dyadic perceptions of the characteristics of those others. We treat the nodal correlations as representing patterns in *community-wide aggregate assessments* of reputation, which persist even when controlling for the direct dyadic structure in nominations within and across network layers. In Supplemental Figures 1–4, we show that, as is expected from the literature on the role of social capital on experimental economic decision making, individuals express strong preferences for allocating resources to, and not exploiting or reducing, their friends, and others whom they like and trust.

Fig. 2. An exemplar of the multiplex nature of the social, economic game, and peer-perception networks. Frame 2a shows friendship ties that were nominated mutually by both members of a dyad in the altiplano field-site. Nodes are colored using a sub-community detection algorithm and scaled by degree. This social network serves as the backbone for the subsequent plots. Frames 2b and 2c illustrate peer-perceptions of prestige and dominance. These peer-perception networks are denser than the social network, as people know many others in the community well enough to rate for social attributes—like prestige and dominance—and interpersonal sentiments—like trust, distrust, fear, and liking. Perceptual ties thus bridge social network sub-clusters. Similar plots can be constructed for the other peer-ratings and field-sites. Note that we omit arrows representing tie directionality to keep the plots uncluttered, but we account for such directionality in our statistical models.

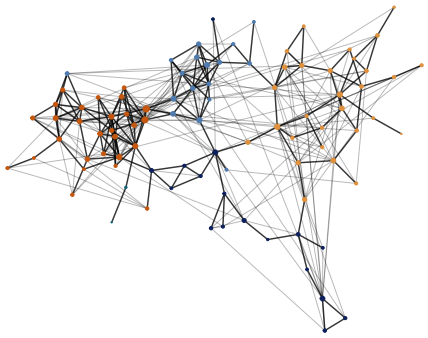
(a) Mutually nominated friendship network in the altiplano site.



(b) Multiplex structure. Peer-perceptions of prestige are plotted as gray lines.



(c) Multiplex structure. Peer-perceptions of dominance are plotted as gray lines.



Focusing on the two major status indicators in our study, Figure 3a contrasts how individual i's perception of individual j as prestigious or dominant is associated with various interpersonal ratings and dyadic economic game outcomes.

Table 2. Cross-layer, cross-individual dyadic reciprocity estimates for giving game and dominance/prestige networks.

Site	Perception direction	Resource flow	Estimate
Coast	Dominant (i to j)	Give (j to i)	0.12 (0.07, 0.17)
Lowland	Dominant (i to j)	Give (j to i)	0.13 (0.09, 0.18)
Highland	Dominant (i to j)	Give (j to i)	-0.04 (-0.16, 0.07)
Altiplano	Dominant (i to j)	Give (j to i)	0.16 (0.1, 0.24)
Coast	Prestigous (i to j)	Give (j to i)	0.43 (0.4, 0.46)
Lowland	Prestigous (i to j)	Give (j to i)	0.4 (0.36, 0.45)
Highland	Prestigous (i to j)	Give (j to i)	0.4 (0.32, 0.48)
Altiplano	Prestigous (i to j)	Give (j to i)	0.65 (0.62, 0.69)

In line with theory, if i perceives j to be prestigious, then i is much more likely to give to j, nominate j as a friend, report trusting j, and report liking j. These effects replicate across all four communities. We note similar positive effects of i perceiving j to be dominant on ties in the giving game, friendship nominations, trust nominations, and liking nominations. The effect sizes, however, are much smaller than those for prestige. Though dominant individuals might achieve some benefits from their status *relative to those not seen as dominant*, those rated as prestigious garner even greater benefits. Most effects here generalize well across communities, but in the highland community all effects of dominance on positive-valance ties are negative. The highland community is the smallest of the four, and it is possible that stochasticity played a role here—by chance, the most dominant individuals might have also had particularly negative reputations, muting the moderate positive effects of dominance seen in the other communities.

Turning now to negative-valance ties in Figure 3a, if i perceives j to be prestigious, then i is much less likely to punish j in the costly reduction game, take from j in the exploitation game, report distrusting j, and report fearing j. These effects again replicate across all communities, with the exception of the fear effect at the coastal community, where prestigious people are not less likely to be feared. On the other hand, if i perceives j to be dominant, then i is much more likely to punish j in the costly reduction game, take from j in the exploitation game, report distrusting j, and report fearing j. These effects, again, replicate across all communities, with the exception of the taking game effect at the coastal community, where individuals perceived to be dominant are less likely to be taken from in the exploitation game.

Looking briefly at cross-layer, cross-individual dyadic reciprocity estimates in Table 2, we see that if individual i reports individual j to be dominant, then individual j is more likely to gives coins to i anonymously in the giving game (in 3 of 4 communities). This suggests that more dominant individuals strategically utilize some degree of generosity *towards those that view them as dominant* in order to garner a degree of positive sentiment and social support, at least from a sub-set of the community network. The effect sizes for prestige here, however, are much larger in magnitude, consistent with the existing literature that prestigious reputations are heavily dependent on conferring benefits to others.

The general pattern uncovered in our dyadic multiplex analysis in Figure 3a suggests that acquisition of prestigious status in the eyes of those in one's community yields strong positive socio-relational and economic benefits, and minimizes

socio-relational and economic costs—such as those owing to receipt of spiteful punishment, exploitation, or ostracism (49, 52, 53). Acquisition of status through dominance in the eyes of those in one's community yields some moderate positive socio-relational and economic benefits, perhaps due to dominant individuals securing higher social standing than more passive or yielding individuals (who may be viewed as having lower power, decision making authority, or socio-relational 'value'). However, there appear to be substantial socio-relational and economic costs to being viewed as dominant. Averaging across all dyads, dominance-based status elevates distrust and fear more strongly than trust or liking, and it motivates negative economic behaviors, such as exploitation and spiteful punishment, more strongly than positive behavior like altruistic giving. Our data and methods here permit us to study these dyadic effects in full-community networks, rather than focusing only on males. However, we can also break-down the analysis to study male–male or female–females dyads specifically. In Supplemental Figure 5, we show that the direction of most effects in the merged data replicates (for both sexes) in the sex-specific reanalysis.

Figure 3b illustrates largely the same story as Figure 3a, but via node-level associations. Even after accounting for the dyad level effects outlined above, our multiplex analysis reveals that individuals who are nominated as prestigious by many others are given to by many others, nominated as friends by many others, trusted by many others, and liked by many others—even by those that did not explicitly make a dyadic prestigious rating towards them. As before, we note positive effects of both prestige and dominance on the positive-valance outcomes, with prestige having a larger effect size. For the negative-valance outcomes, we see that prestigious individuals were less likely to be taken from in the RICH exploitation game, but all other effects are close to zero, indicating that there is little node-level effect of prestige on negative-valance responses after accounting for dyadic perceptions. Dominant individuals, however, were generally more likely to be reduced, distrusted, and feared, even after accounting for dyadic perceptions explicitly.

Figure 4 illustrates the total payout earned by each individual in the set of three RICH economic games. Figure 4a shows the payout gained from the behavior of others (i.e., the sum total of how much respondents were given by others in the allocation game and left by others in the exploitation game, minus how much they were reduced by others in the costly reduction game). Figure 4b shows the payout gained from the behavior of the self (i.e., the sum total of how much respondents kept for themselves in the allocation game, took from others in the exploitation game, and kept for themselves in the costly reduction game). For comparability, we normalize pay-offs by community on the y-axis. The x-axis rating is a node-level aggregate, defined for dominance as number of times an individual was nominated as especially dominant minus the number of times they were nominated as especially passive/yielding, and defined for prestige as number of times an individual was nominated as especially respectable/prestigious minus the number of times they were nominated as especially contemptible. As with the y-axis data, we normalized these x-axis scores by site for comparability. In sum, we note a substantial negative relationship between reputation as dominant on *socially-acquired* pay-offs, and a substantial positive relationship of reputation as prestigious on *socially-acquired* pay-offs. There were no strong associations between individuals' reputations as dominant or prestigious, and how much they earned from *ego-acquired* payoffs in the economic games.

Discussion

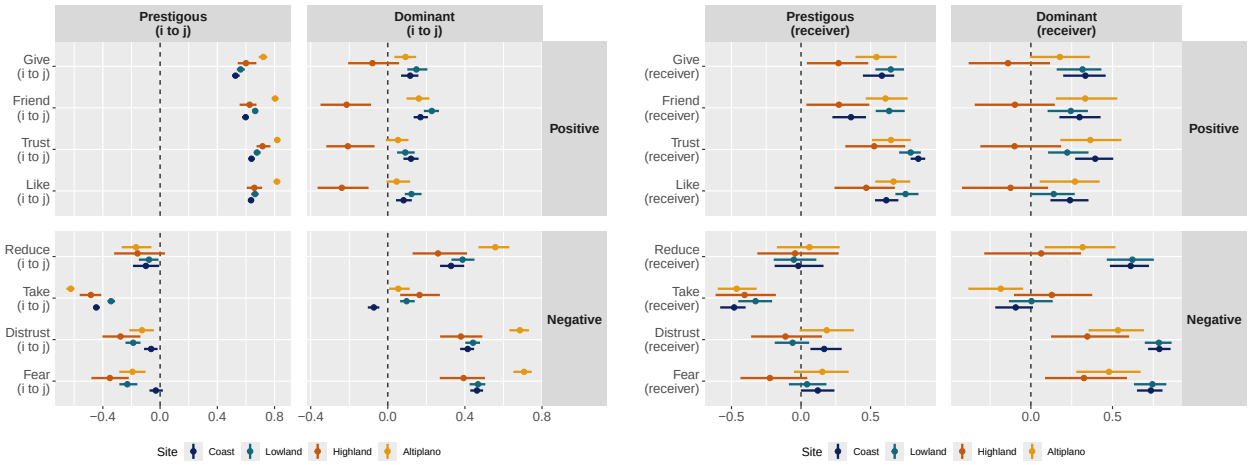
The present study offers one of the most detailed empirical examinations to-date of how prestige and dominance manifest as distinct forms of social status—with divergent social and economic consequences—in rural, subsistence economies. By applying state-of-the-art multiplex network models to fine-grained perceptual, social network, and behavioral economic data from four rural Colombian communities, we unpack node-level and dyad-level structure in how prestige and dominance shape interpersonal ties and economic decisions. Our findings show that prestige confers generalized social and economic advantages. Dominance is associated with some accrual of benefits (for a sub-set of dyads in each network), but a much more substantial accrual of costs. As such, our study provides strong evidence in support of the debated distinction made between prestige and dominance as distinct forms of social status (62, 80). As shown in Figure 4c, dominance and prestige have either no clear relationship, or a negative relationship, within each of the four communities. Taken together, our results provide a nuanced picture of how prestige and dominance operate in real-world settings, highlighting the fundamental role that reputational cognition plays in shaping dyadic interpersonal sentiments and behavior.

Positive social relationships and sentiments facilitate access to the economic resources of peers. Seminal theory in the social and economic sciences posits that positive social relationships, such as friendships (81), allow individuals to access and mobilize the social and economic resources of those they have ties with (i.e., they provide *social capital;* 67). In line with theory, we found that dyadic peer ratings as elicited via our photo-roster method and behavior in the RICH games are perfectly consistent with this body of theory: respondents gave to—and avoided exploiting or punishing—individuals they viewed as friends, and individuals they liked or trusted. This shows that there are clear benefits to attainment of social connections and positive reputation or social standing in the communities studied here.

While a large body of attribute-based research has advanced our knowledge of how certain personal characteristics—such as personality traits (82, 83) or physiological cues (65)—predict an individual's position within a hierarchy, social status is fundamentally relational (34). That is, an individual can only be high-rank in status or social standing if they have lower-rank counterparts. This can lead to competition for positive-valence social status, especially prestige, through mechanisms like competitive altruism (38). Such dynamics are also fundamentally linked to supply–demand dynamics in the local market for friendships (84) and marriages (85), as individuals with high social rank often have short-side power, more freedom in partner choice, and more potential to secure fitness-improving social bonds. This implies that there are potentially interesting questions about the linkages between social relationships, access to social capital, and

Fig. 3. Results of multiplex network analysis using STRAND. Frame 3a shows the correlation between how individual i views or behaves towards individual j and i's perception of j as prestigious or dominant. Across sites, if i views j as prestigious, then i is much more likely to give to j in the allocation game, nominate j as a friend, report trusting j, and reporting liking j. We note similar positive associations between i's perception of j as dominant and the same outcomes in most sites, though the size of the correlation is appreciably smaller; prestige generates more positive connections than dominance. Across sites, if i views j as prestigious, then i is much less likely to reduce j in the costly punishment game, take from j in the exploitation game, report distrusting j, or reporting fearing j. Here, the results for dominance diverge strongly. If i views j as dominant, then i is more likely to reduce j in the costly punishment game, take from j in the exploitation game, report distrusting j, and reporting fearing j. Frame 3b shows the correlation between node-level receiver effects—e.g., the association between individual i's propensity to be nominated as prestigious by anyone and individual i's propensity to be given to in the allocation game by anyone. Individuals who are widely viewed as prestigious are preferential targets for giving and friendship nominations, and also enjoy reputations for being trusted and liked. Dominant individuals are afforded many of the same advantages, though the effect size is smaller. Prestigious individuals are less exploited in the taking game overall, while dominant individuals are more likely to be reduced in the costly punishment game. Dominant individuals are also more distrusted and feared overall.

(a) Dyad-level: Cross-layer correlations in i's directed ratings/behavior towards j. **(b)** Node-level: Cross-layer correlations in in-degree (i.e., receiver effects).



social status that go beyond the comparative statics approach advanced here. Future longitudinal research drawing on RICH games data and dyadic peer ratings, could investigate, for example, how changes in individual characteristics (e.g., material wealth) affect changes in dyadic sentiments (e.g., respect) and concomitant social bonds (e.g., friendship), and finally reputational features (e.g., prestige) that depend on the distribution of social capital in a community.

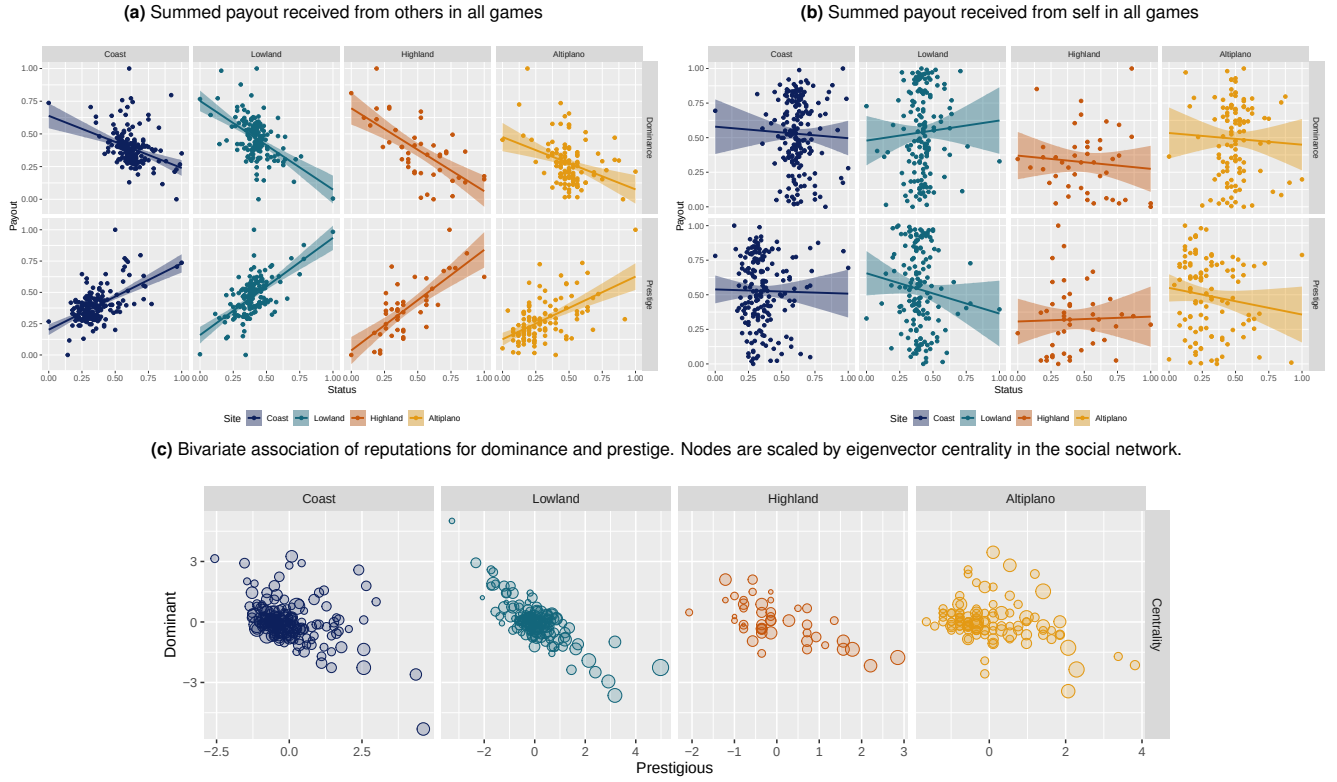
Prestige yields broad social and economic rewards. The clearest finding of our study is that individuals high in prestige consistently accrue the most social capital. That is, they are among the most liked, trusted, and popular people in their communities, which ultimately facilitates their access to the social, emotional, informational, and economic resources of communities members in moments of need or turmoil (86–89). Prestigious individuals are also much less likely to receive negative-valance sentiment ratings (e.g., distrust or fear) or economic behaviors (e.g., exploitation or punishment) from others. Taken together, these findings highlight that prestige-based status—though potentially costly to acquire, owing to the need to invest resources in the well-being of others—can be stabilized by the social capital that it affords. Indeed, there may even be feedback loops where some forms of social capital (e.g., network centrality, and widespread positive interpersonal sentiments) provide a foundation for individuals to further gain prestige through increased visibility of their kindness and generosity (3)—including through mechanisms like competitive altruism (38).

Dominance as a double-edged strategy. In contrast to prestige, dominance carries both privileges and costs. Individuals viewed as dominant received more friendship nominations and giving-game allocations, and were more liked and trusted, than individuals not perceived of as dominant, likely due to an association between dominance and decision-making authority in local matters. These benefits, however, were markedly smaller in magnitude than those enjoyed by prestigious individuals, and were coupled with sharply higher rates of distrust, fear, exploitation, and punitive reduction. In short, more dominant individuals had lower net social capital as operationalized here.

Negative interpersonal sentiments (distrust and fear) and economic game decisions (exploitation and punishment) were strongly positively associated with dominance (but not prestige) both at the dyadic level (i.e., individuals were more likely to reporting fearing and distrusting those they rated as dominant) and at the individual-level (i.e., those nominated by many community members as being dominant were also feared by many community members, above and beyond what was explained by dyadic effects). Our study thus provides clear evidence of dominance leveling across all four communities, even though they differ substantially in terms of ethnic composition and subsistence mode. These empirical patterns align with ethnographic observations of "leveling" behavior (54), and evolutionary models that predict coercive strategies to provoke counter-coalitions (56, 57) and retaliatory behavioral responses—like exploitation, punishment, and ostracism (52, 53)—unless they are coupled with benefit provisioning.

Dominance might persist in human groups despite its social costs for two major reason. First, there may be substantial direct gains to the assertive, ego-focused behavior that characterizes dominance. Second, more subtly, selective generosity expressed by individuals generally viewed as

Fig. 4. Real earnings in the RICH games—from others (4a) and from the self (4b)—as correlated with aggregate-level reputational measures for dominance and prestige. Payouts and reputational scores have been standardized to the unit interval by site for comparability. Reputations for dominance are associated with lower *socially-acquired* payoffs in the RICH games, while reputation for prestige are associated with higher *socially-acquired* payoffs. There is little association between either reputation score and *ego-acquired* payoffs. In frame 4c, we see that, across sites, there is a general negative association between dominance and prestige.



dominant can offset reputational risks by fostering the formation of small, but non-trivial, sub-networks of close friends and allies. The results of our economic games directly speak to the latter point, and indicate that dominance may indeed rest upon benefit generation—at least within small sub-sets of individuals in each community. This finding is consistent with recent theoretical work in the evolutionary social sciences making precisely this point (62), and wider arguments that dominance among humans is founded upon general imposition of one's will upon others, tempered by—perhaps strategic—conditional cooperation/generosity (90, 91). While our findings were directionally consistent across the four communities in most cases, there is variation in effect sizes. Investigating the site-level drivers of such difference in RICH-game behavior may prove to be a fruitful avenue of comparative research that can shed light on how specific social and ecological settings influence social dynamics related to prestige and dominance (4). In particular, we expect dominance to potentially be more beneficial and less costly in communities without access to formal legal systems and other state-based institutions that adjudicate power, as such institutions typically penalize the behaviors that dominant individuals use to reinforce their power.

By leveraging a network framework, we show that dominance is broadly costly at the community level, but potentially advantageous within sub-network clusters. The current study preserves the complexity of status perception in real-world settings (where status is acquired and maintained over lifetimes of real-world behavior in stable communities) and reconciles why dominance often appears maladaptive in experimental settings (e.g. 62, 65), yet clearly persists ethnographically (e.g., 9, 29, 41, 43): its efficacy is contingent on the broader social setting, being shaped by the structure of a group's social network. Dominant behaviors can lead an individual to be ostracized or leveled by many, but selective generosity can be deployed to maintain a sufficient set of social ties. These nuanced effects were detectable in this study precisely because we did not start by constructing node-level "reputation" indices (which collapse potentially divergent opinions among peers into target-specific averages). Instead, our multiplex model allows—for example—individuals i and j to view individual k as dominant, and individuals l and m to view individual k as non-dominant, when testing for a dyadic effect of dominance on giving, exploitation, and punishment. Simple node-based regressions require socially consonant reputational ratings to be carefully justified, whereas the multiplex Social Relations Model used here implements node-based regressions that simultaneously estimate and control for dissonant opinions about nodes at the dyadic level. As social cleavages, e.g., family lineages, ethnic sub-groups, rival clans, and religious sects—are often observed in human communities and structure perceptions of social standing, our work highlights the importance of deploying methods that link dyad-level perceptions to dyad-level behavior. Our study here also underscores the need for theories of status and reputation to better incorporate network theory and methodology (34, 92).

Conclusions. In closing, our results provide much-needed evidence on the distinct social and economic consequences of prestige and dominance in four rural, subsistence communities. By integrating peer-perception, social-network, and economic-game data, the current study clarifies the debated distinction between prestige and dominance. We find that there are consistent benefits to prestige across all study communities, suggesting that prestige is fundamentally associated with increased social capital, while dominance has a mixed relationship with social capital. Our results further highlight that while those high in dominance are often targets of status 'leveling', these individuals can maintain a degree of preeminence by providing conditional social and economic benefits to a small group of friends and allies. Future research extending our network-based approach should aim to identify how broader, site-level, social, economic, and ecological factors modulate the intensity of the covariance between prestige, dominance, and the social and economic outcomes explored in this study. Such work would require cross-site deployment of the RICH economic games across a much wider set of study communities, following in the footsteps of ground-breaking work in comparative behavioral economics (48).

Materials and Methods

Data Collection. The data presented here come from a long-running, multi-year study of inequality, poverty, and social support networks, with relevance for both academic and applied research that been assessed by the Max Planck Society's Ethics Council: "Application No. 2022_04/2024_07: A study of social networks, wealth, inequality, and community resilience". All field protocols were also approved by the Department of Human Behavior, Ecology, and Culture at the Max Planck Institute for Evolutionary Anthropology in Leipzig, Germany. Following local norms, permission to conduct research was also sought and obtained from the community leader (in Emberá communities) or local community council (in the lowland community). Research has been ongoing for nearly 10 years, and individual-level informed consent is re-obtained at each wave of data collection. Because literacy is limited in the study populations, informed consent is obtained verbally after providing participants with a verbal description (in Spanish) of the research process and explaining how data will be used (anonymously, for research purposes); in addition, participants are provided with a written consent document. This research project was conducted as part of a long-term collaboration with Afrocolombian researchers A.H.M. and D.H.M. who, along with C.T.R., collected the data and managed field research.

We collected data in four rural Colombian communities: a coastal Afrocolombian/Emberá community ($n = 186$), a lowland Afrocolombian/Emberá community ($n = 154$), a highland Mestizo community that borders the lowland community ($n = 45$), and a second Mestizo community in the altiplano ($n = 111$). Each community was sampled as completely as possible within a pre-demarcated geographic area; in the coastal, lowland, and highland sites, nearly all households in the census area opted into the study, and in the altiplano community about three-quarters of households opted in. We invited all adult residents within the census area to participate in the study, and no further selection criteria were applied.

Ethnographic Setting. Due to increasing concerns about replicability and generalizability in the social and psychological sciences (93–95), and an inordinate focus on western, educated, industrial, rich, and democratic samples (17–19), we chose to repeat our study in four ecologically and ethnically diverse, rural Colombian communities.

In terms of subsistence, the coastal community relies primarily on a mixture of artisanal fishing and local wage labor, along with limited levels of hunting, horticulture, and animal husbandry. There is no ground transportation linking the coastal community to Colombia-at-large, and so the population is fairly isolated; even so, the nearest town is well-integrated into the market economy. The lowland community is located in the rain-forests of western Colombia, and relies primarily on a mixture of horticulture and local wage labor, but hunting, fishing, and animal husbandry are also practiced, as is small-scale gold panning. The highland community is located close to the lowland community and relies on small-scale agricultural production of coffee and sugarcane. The altiplano community is located close to the national capital, and residents primarily rely on wage labor, especially in companies focused on large-sale flower cultivation.

RICH network-structured economic games. To measure interpersonal cooperation, exploitation, and punishment/animus, we used three network-structured economic games—the RICH economic games developed by Gervais (51), and validated by Gervais (51), Pisor et al. (69), and Ross and Pisor (96). The RICH games include a dyadic giving game, a dyadic taking/exploitation game, and a dyadic costly reduction/punishment game. For each of these games, we presented respondents with a photo array containing 7x10 cm photographs of all male and female adults residing their respective communities, and invited each participant to make economic decisions with the respect to the individuals on the photo array. In total there were 220, 178, 53, and 160 targets/alters (in the coastal, lowland, highland, and altiplano communities, respectively) to whom focal players could allocate coins or tokens. Of these, 186, 154, 45, and 111 individuals in each community, respectively, were present at the time of data collection to act as deciders in the games. Photographs were organized onto four boards. The order of the boards was randomized between respondents. All three games were played in sequence—in the same order—during the same interview. Data collection and digitization was handled using the `DieTryin` Android app and R package (77, 78).

In the giving game, the stakes were set at 25,000, 20,000, 30,000, and 30,000 Colombian pesos in the coastal, lowland, highland, and altiplano communities, respectively. Individuals could allocate, in private, any number of 1,000 peso coins to any cell in the photo array, including their own. In the taking game, the stakes were set at 110,000, 88,500, 53,000, 80,000 Colombian pesos in the coastal, lowland, highland, and altiplano communities, respectively. Individuals, in private, could take or leave the single 500 peso coin that was pre-allocated to each photo in the photo array (in the smaller highland community, we used 1,000 peso coins instead of 500 peso coins). In the costly reduction game, the stakes were set at 15,000 Colombian pesos in every community. Individuals, in private, could keep the coins or use them purchase red tokens to punish/reduce other community members. Each token cost 1,000 pesos, and led to a reduction of the target's income by 4,000 pesos—the same multiplier used elsewhere (51).

Total stakes per person amounted to 150,000 (coastal), 123,500 (lowland), 98,000 (highland), and 125,000 Colombian pesos (average of ∼45 USD, or about 2 day's wages at the national minimum wage rate) at the time of data collection. At the community level, payouts are heavily affected by the size of the roster, since a coin must be pre-allocated to each person in the photo array in the taking game. Equal average community-level payouts were achieved by adding a flat-rate 'show-up' fee to each participant's earnings in the smaller communities. After all interviews in a community were complete, all game participants were given the currency allocated to them by themselves and other community members during the games. Each and every game decision was paid in full to participants. Though the number of coins per game varied by community, we use statistical models that account for these differences and yield comparable estimates.

Social networks and peer-report data. To collect social networks and dyadic peer-report data, we used the same photograph roster as in the RICH games. To collect the social network data, we asked participants to place blue tokens on the photographs of community members "with whom they spent time socializing" in the last thirty days: we framed the question as being about friendship, but opted for the slightly broader definition so as not to inadvertently exclude affinal or consanguineal kin from inclusion as 'friends'. There was

no minimum or maximum limit on the number of tokens that could be placed by each respondent, and sufficient tokens were available to cover the entire photo array if needed. Once all tokens were placed, the `DieTryin` Android app (78) was used to take a photo of the tokens as distributed on the roster using a cell-phone. These cell-phone photos were then automatically processed to yield a network edge-list using the `DieTryin` R package (78).

This same workflow was used to elicit the peer-reports. For the peer-report questions, we asked respondents—in private—to place purple tokens on community members who they viewed as especially contemptible and green tokens on community members who they viewed as especially prestigious or worthy of respect. These data were recorded via cell-phone photographs, and we then moved on to questions about passivity and dominance, trust and distrust, and fear and liking. As before, there was no minimum limit on the number of tokens that could be placed by each respondent, but there was an upper limit of about 60 due to the number of green and purple tokens we had available; in practice, however, very few respondents used anywhere near the full set of tokens, with most respondents making about 7–10 nominations per question. See Table 1 for a breakdown of the out-degree and in-degree ranges by question.

Statistical analysis. In each community, we have K layers of network data from N respondents. Our outcome variable of interest, G, is thus an $N \times N \times K$ multiplex adjacency array, with each element, $G_{[i,j,k]}$, indicating the presence/absence of a tie from focal individual i, to alter j, in network layer k. For each community, we model the social network, the peer-report networks, and the economic game networks jointly. We estimate the dyadic and nodal covariance structure using a multiplex generalization (see: 70, for details) of the classic Social Relations Model (SRM: 97) in the `STRAND` R package (79, 98, 99). The model has the following form:

$$G_{[i,j,k]} \sim \text{Bernoulli}\left(\text{logistic}(\theta_{[i,j,k]})\right) \quad [1]$$

where:

$$\theta_{[i,j,k]} = \eta_{[k]} + \alpha_{[i,k]} + \beta_{[j,k]} + \delta_{[i,j,k]} \quad [2]$$

The intercept term in layer k is $\eta_{[k]}$, and it accounts for differential network density across layers. The next term, $\alpha_{[i,k]}$, is the 'sender' or 'focal' effect of individual i in layer k; these parameters measure the likeliness of individual i directing ties outwards towards others in layer k, and they account for differential network out-degree across layers. The next term, $\beta_{[j,k]}$, is the 'recipient' or 'target' effect of individual j in layer k; these parameters measure the likeliness of individual j receiving ties from others in layer k, and they account for differential network in-degree across layers. The final term, $\delta_{[i,j,k]}$, is a dyad-level random effect in layer k; these parameters measure the likeliness of individual i directing a tie to individual j in layer k. The structured covariation in the δ tensor is often the primary focus of inference in the multiplex Social Relations Model. To estimate this structured covariation, we use a multi-level model structure for both the nodal effects and the dyadic ones.

The basic SRM sub-model for generalized reciprocity can be extended to a multiplex model by concatenating the sender and receiver effects for each layer into a single vector, and then using a standard multivariate normal model:

$$\begin{pmatrix} \alpha[i,1] \\ \cdots \\ \alpha[i,K] \\ \beta[i,1] \\ \cdots \\ \beta[i,K] \end{pmatrix} \sim \text{Multivariate Normal}\left(Z, \sigma\rho\sigma\right) \quad [3]$$

where Z is a vector of zeroes, and σ is a $2K \times 2K$ diagonal matrix of standard deviations, and ρ is a $2K \times 2K$ correlation matrix.

The dyadic reciprocity sub-model follows a similar form to the generalized reciprocity sub-model, where dyadic random effects are concatenated across network layers and modeled using a standard multivariate normal model:

$$\begin{pmatrix} \delta_{[i,j,1]} \\ \cdots \\ \delta_{[i,j,K]} \\ \delta_{[j,i,1]} \\ \cdots \\ \delta_{[j,i,K]} \end{pmatrix} \sim \text{Multivariate Normal}\left(Z, \varsigma\varrho\varsigma\right) \quad [4]$$

where ς is a $2K \times 2K$ diagonal matrix of standard deviations with the constraint that $\varsigma_{[k,k]} = \varsigma_{[k+K,k+K]}$, and ϱ is a $2K \times 2K$ correlation matrix with the constraint that it has block structure of the form: $\varrho = \begin{pmatrix} A & B \\ B^\intercal & A \end{pmatrix}$, with $B = B^\intercal$. The key quantities of interest, that we plot in Fig. 3 are ϱ (in Fig. 3a) and ρ (in Fig. 3b).

Data and code accessibility statement. The code and data needed to fully reproduce all results and figures in this study are available at: https://github.com/ctross/prestige_and_dominance

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