

Research



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Competitive gossip: the impact of domain, resource value, resource scarcity and coalitions

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Those with better reputations often obtain more resources than those with poorer reputations. Consequently, gossip might be an evolved strategy to compete for valuable and scarce material and social resources. Influenced by models of non-human primate competition, we test the hypotheses that gossip: (i) targets aspects of reputation relevant to the domain in which the competition is occurring, (ii) increases when contested resources are more valuable, and (iii) increases when resources are scarcer. We then test hypotheses derived from informational warfare theory, which proposes that coalitions strategically collect, analyse and disseminate gossip. Specifically, we test whether: (iv) coalitions deter negative gossip, and (v) whether they increase expectations of reputational harm to competitors. Using experimental methods in a Mechanical Turk sample ($n = 600$), and survey and ego network analysis methods in a sample of California sorority women ($n = 74$), we found that gossip content is specific to the context of the competition; that more valuable and scarcer resources cause gossip, particularly negative gossip, to intensify; and that allies deter negative gossip and increase expectations of reputational harm to an adversary. These results support social competition theories of gossip.

This article is part of the theme issue ‘The language of cooperation: reputation and honest signalling’.

1. Introduction

In many social species, including primates, increased resource competition among group members is a substantial cost of group living [1]. In non-human female primates, for example, agonistic behaviour is more common when food is available versus not, when foods are more contestable and when group sizes are larger (for review and meta-analysis of data from 44 primate species, see [2]). Wheeler *et al.* [2] found that the average rate of agonistic interactions among female primates is 0.61 h^{-1} .

Humans, too, physically contest material and social resources within groups (e.g. [3]). They also obtain contested group resources via their reputations; in other words, they increase and defend access to group resources, including food, mates and care, by increasing and defending their reputations relative to competitors. As in other species, human reputations can involve fighting ability [4–6], but human reputations are often based on demonstrated abilities for providing benefits to group members [4,7–11; see appendix N for proof of acceptance]; success in undertaking risky behaviours, i.e. ‘showing off’ or ‘costly signalling’ [12–14]; and engaging in reciprocal altruism [15,16].

Reputations can be substantially impacted by the transfer of information about the actions and abilities of others. ‘Gossip’ is a construct that encapsulates behaviours related to the transfer of information about peoples’ actions and abilities. Does Cruz *et al.* [17] systematically evaluated definitions of gossip in the scientific literature, finding strong agreement that it involves ‘a sender communicating to a receiver about a target who is absent or unaware of the

content' [17, p. 24]. In addition, many definitions included a valence dimension (that gossip can be positive or negative), and an (in)formality dimension (gossip is informal rather than formal communication). Our operationalization of gossip in this study satisfies these four criteria, but also includes a fifth: that the gossip is true (in the real world, we do not claim that all gossip is true but instead that there are psychological mechanisms to evaluate cues of gossip veracity; [18]). We and many others argue that gossip is not a trivial pastime but rather an important social strategy.

One group of theoretical approaches to gossip, which we term 'social competition' theories, emphasize gossip as a means of manipulating reputations to the benefit of oneself, one's kin and one's allies (e.g. [19,20]). Corroborating this strategic, competitive view of gossip, non-physical forms of aggression, such as gossiping and ostracism, are common in both sexes and all age groups. Evolutionary approaches to this 'indirect' aggression posit that it functions to increase access to resources and mates by harming competitors' reputations or by excluding competitors from the group (e.g. [21–23]; see also [24,25]). Gossip about negative deeds and qualities will decrease a target's reputation, thus decreasing a target's access to group resources—with the effect of increasing one's own access to those resources. For discussions of these and other approaches to gossip in evolutionary perspective, see [11,24,26–35].

Most research on indirect aggression has involved either direct observation (of, e.g. children's playground behaviour), reports by teachers and peers, or self-reports [36]. It has focused on children and adolescents, though more recent research has involved adults (e.g. [37,38]). Observational studies of real-world behaviour are invaluable, but indirect aggression is hard to observe, patterns in children might differ from those in adults, self-reports can be self-serving and the causal roles of factors thought to intensify indirect aggression are difficult to establish. We have hypothesized that the factors which intensify physical competition among non-human animals should also intensify indirect aggression in women and men [11,23,28], specifically, that resource value and scarcity should intensify indirect aggression. Using randomized, experimental methods, we aim to test our hypothesis that competition for valuable and scarce resources causes an increase in indirect aggression in adults.

(a) Coalitional aggression

Among many non-human animals, both males and females form within-group coalitions and alliances to improve defence and acquisition of valuable, scarce resources [39,40]. In particular, coalitions help males and females to increase, and especially maintain, social rank, which is a strong determinant of access to resources [40]. Evolutionary social scientists have similarly argued that coalitions and alliances can substantially enhance coalition members' abilities to physically defend and acquire valuable resources like mates, food and territory [5,41–46]. In humans, coalitional psychology has been linked to an evolutionary history of warfare, an overwhelmingly male activity [5,47–51]. Studies have indeed shown a male bias in coalitional psychology (e.g. [42,52,53]).

Evolutionary accounts of coalitional relationships among human females, however, presume that they do not function for aggressive competition over resources. Smuts [54], for example, emphasizes the role of female relationships in

defending against male aggression. Rodseth *et al.* [55, p. 232] conclude that women's relationships 'seem to be characterized by high degrees of noninterference mutualism, i.e. cooperation that does not impose a cost on any third party'. Taylor *et al.*'s [56] influential 'tend and befriend' model of relationships among women spotlights the mutual nurturing, caring and emotional support that are apparent in female relationships. These accounts suggest that, unlike non-human primates of both sexes and human males, women and girls do not regularly form alliances or coalitions to physically contest resources.

(i) Informational warfare theory

Informational warfare theory proposes that coalitions enhance informational competencies in reputational contests [11,23,28,57,58]. Collecting, analysing and disseminating information about the flaws and misdeeds of others can be difficult because opportunities to observe flaws and misdeeds may be infrequent; because people tend to conceal negative information about themselves, their allies and their kin; because the significance of certain pieces of information might not be immediately clear without additional contextual information and analysis; or because delivering information could require key social network links to a particular recipient. Members of one's coalition supply more eyes and ears for collecting information about the flaws and misdeeds of competitors, more cognitive power for synthesizing, contextualizing and analysing this information, and more routes for disseminating it (see [23,28] for a detailed discussion). If coalitions indeed improve the collection, analysis and dissemination of reputation-relevant information, then the evolved psychology of reputational competition should be sensitive to the quality of one's own coalition and that of one's competitors: those with close, strong, high-quality coalitions are more formidable in reputational contests than those with low-quality coalitions. The studies presented here aim to test our hypothesis that coalitions enhance not just physical formidability, but also reputational formidability, including that among women.

2. Present studies

We conducted two studies in two adult populations using vignette experimental and survey methods. Rather than reporting on the gossip of others or recalling when they gossiped, the participants themselves gossip about a fictional character (study 1) or report their perception that negative gossip will spread (study 2). Our randomized experimental design in study 1 allows us to determine if theoretically relevant factors cause changes in gossip by adults.

According to results on physical competition in non-human animals, the higher value and more limited a resource is, the more competition there should be for that resource ([2], and references therein). According to informational warfare theory, allies should deter negative gossip and increase one's ability to harm competitors with gossip. If gossip is used strategically to increase access to contested resources, participants in study 1 should: (i) transmit gossip that is specific to the domain of the competition (e.g. competition over food might inspire negative gossip about previous food sharing but not necessarily negative gossip about fertility), transmit more negative gossip and less positive gossip about a competitor when the competed-for resource is (ii) valuable and (iii)

Table 1. Categories and female examples of the 40 gossip statements to be rated in phase I. (Each gossip statement had a matched positive and negative version. See the electronic supplementary material, table S1 for the complete list of gossip statements.)

	work domain (10 original statements, 9 after screening)	family domain (10 original, 7 after screening)
positive statements	example: 'Elizabeth is enthusiastic with customers at work'	example: 'Elizabeth loves her siblings'
matched negative versions	example: 'Elizabeth is unenthusiastic with customers at work'	example: 'Elizabeth hates her siblings'

scarce, and (iv) gossip less negatively about a competitor who has a strategically situated ally or allies. Participants in study 2 with high-quality real-world coalitions versus those with low-quality coalitions should anticipate greater reputational harm to a fictional adversary.

Our studies involve participants recruited from Mechanical Turk (MTurk; study 1) and a sorority in southern California (study 2). About 25% of the MTurk sample was from outside the USA, and the sample as a whole had a wide range of ages and occupations. Although the United States (US) is Western, educated, industrialized, rich and democratic (WEIRD; [59]), our MTurk sample was considerably more diverse than most US college samples. There is ongoing research on the quality of data from MTurk versus other samples, with most studies finding that data from MTurk data are equivalent or superior in quality to those collected from other popular sources (briefly reviewed in [60]). Chmielewski & Kucker [60], however, found evidence that MTurk data quality decreased markedly around the summer of 2018. Our MTurk data were collected in 2008; however, shortly after MTurk was launched in 2005.

A California college sorority might seem to be an exceptionally WEIRD institution, and in one sense, it is: participants in our study were definitely Western, educated and generally came from middle- and upper-income families (mean parental income was \$105 K). The sorority setting, though, is not so unusual. The same-sex peer groups are common across cultures, although more so for boys than girls. In their cross-cultural study of adolescence, Schlegel & Barry [61] found that peer groups were often named (i.e. formalized to some degree), although this was more common for male than female groups. For adolescent boys, the peer group was more important than the family in two-thirds of cultures, and in one-third, the family was more important, whereas for adolescent girls, these figures were reversed. Although not universal, separate adolescent dormitories for one sex or the other are (or were) widespread among traditional peoples of Africa, southern Asia and the Pacific. US college fraternities and sororities fall on the more formal end of a spectrum of adolescent peer groups that occur in a wide range of cultures.

3. Study 1: do competitive domain, resource value, resource scarcity and allies affect gossip?

Study 1 was a vignette-based experimental study with two phases. In each phase, participants were recruited from MTurk using identical procedures. The survey was titled '5-minute survey', and the description was 'Read a short scenario and then answer questions about it'. Participants were paid \$1.00 for completions. We did not impose any

qualification or other restrictions on participation other than an age of 18 years or older. We did not employ any attention checks or exclude participants who completed the survey and met the age requirement.

Participants first read a scenario about a target individual in either a work (non-kin) or family (kin) context. Participants then read several negative and positive gossip statements about the target, and indicated how likely they would be to tell each statement to another person. In other words, participants could 'gossip' about the target.

(a) Phase I: stimuli screening

We first needed to establish the validity of the gossip statements that would be used to test our hypotheses in phase II. In order to avoid potential confounds with, e.g. mating psychology, participants read scenarios with same-sexed targets. Female participants read about a female target named Elizabeth, and males read about a male target named Dave. These are the female versions of the stimuli:

- **office scenario:** imagine you work in an office with about 10 co-workers, half men and half women. Your office is one division of a company that has done well in the last year. Elizabeth is one of your co-workers. Your desk is next to Elizabeth's, so you know more about her than most other people in the company know; and
- **family scenario:** imagine you have an elderly aunt and 10 cousins. One of your cousins is named Elizabeth. Although you are not close to her, Elizabeth lives in your neighbourhood, so you know more about her than most other family members know.

We created 10 work-related and 10 family-related gossip statements about the target in the scenario. Each statement had a negative version and a positive version, for a total of 40 statements. See table 1 for examples, and the electronic supplementary material, table S1 for the complete list of gossip statements and their mean ratings.

We then recruited $n = 130$ participants from MTurk. Ages ranged from 18 to 62 years ($M = 33$ years), with 87 women and 43 men. Approximately 77% were US nationals. Participants were randomized into the office scenario ($n = 65$) or family scenario ($n = 65$). Participants were then randomly assigned either the positive or negative version of each gossip statement (20 statements per participant). After reading the scenario, participants rated whether each gossip statement reflected negatively or positively on the target on a Likert scale (1, reflects very negatively on the competitor; 5, neutral; 9, reflects very positively on the competitor).

For all gossip statements, the mean rating for the positive version was greater than or equal to 5 ($M = 7$, $s.d. = 0.73$, range: 5–8.1), and the mean rating for the negative version

Table 2. Experimental conditions in study 1, phase II. (Sample sizes, values of manipulated variables and tested hypotheses for each of the nine conditions. Each participant was randomized into one of these conditions.)

condition	<i>n</i>	scenario	promotions	resource	ally location	allies	hypotheses
1	67	office	1	small	neighbourhood	1	resource size
2	67	office	1	large	neighbourhood	1	resource size, scarcity, allies
3	68	office	1	large	neighbourhood	2	allies
4	67	office	1	large	office	1	allies, ally versus no ally
5	67	office	1	large	office	2	allies
6	68	office	3	large	neighbourhood	1	scarcity
7	66	office	5	large	neighbourhood	1	scarcity
8	64	office	1	large		0	domain specificity, ally versus no ally
9	66	family		large		0	domain specificity

was less than 5 ($M = 3.3$, $s.d. = 0.67$, range: 1.8–4.7), confirming that, on average, positive statements were seen as positive, and negative statements as negative. When examined in the context of the family scenario, however, both positive and negative versions of one statement (Elizabeth goes out to bars one night a month versus Elizabeth goes out to bars every Friday and Saturday night) were seen as negative, so we did not use this statement in phase II.

In addition, we required that positive and negative versions of work-specific gossip statements reflected more positively or negatively on workers than family members, and that positive and negative versions of family-specific gossip statements reflected more positively or negatively on family members than workers. Two statements failed this test, so the positive and negative versions were omitted from analyses in phase II of this study.

One additional pair of statements, regarding good taste in art and literature, was, in both positive and negative forms, slightly more important for co-workers than family members, although we had predicted the opposite. However, the family scenario in phase II involved inheritance of a valuable painting, so instead of deleting this statement, we retained it as a separate variable.

(b) Phase II: methods and predictions

To test our predictions, we recruited a new sample from MTurk ($n = 609$). The final survey was received 5 days after posting. After providing demographic information, nine participants did not answer any questions and were removed from the data, leaving $n = 600$ participants. To test predictions, we randomized participants into nine different conditions in a standard factorial design (but not full factorial), with each condition involving a manipulated version of the vignettes used in phase I (manipulations are described below). We wrote custom software that assigned the participants to different conditions on a rotating basis (so that, e.g. experiment or condition would not be confounded with time of day or day of week). Each participant provided data for only one condition, and tests were between-subjects. The software randomized the presentation order of stimuli. There were about 66–67 participants per condition (see table 2). The sample was female-biased, with 69% female and 31% male. Ages ranged from 18 to 89 years, $M = 34$ years, $s.d. = 11$ years. Roughly 75% of our participants were US nationals and 25% were not.

Participants first read a short vignette about Elizabeth (Dave) that described her (him) as a competitor for a valuable resource, which in the office scenario involved competition over a promotion, and in the family scenario involved competition over a valuable painting (female versions only):

- **office scenario:** imagine you work in an office with about 10 co-workers, half men and half women. Your office is one division of a company that has done well in the last year. The company has authorized your office supervisor to promote one person in the office, and you are a candidate. The promotion comes with a large pay raise. Elizabeth, a co-worker, is also a candidate for promotion. Your desk is next to Elizabeth's, so you know more about her than most other people in the company know; and
- **family scenario:** imagine you have an elderly aunt who owns a very valuable painting. You have loved this painting since you were a child. Your aunt is moving into a retirement community, and she has said that she intends to give the painting to one of her 10 nieces and nephews. Elizabeth, one of your cousins, thinks she deserves the painting. Although you are not close to her, Elizabeth lives in your neighbourhood, so you know more about her than most other family members know.

Participants then read gossip statements from phase I about Elizabeth (Dave) in a random sequence, with random assignment to either the negative or positive version of each statement. These statements were described as known to be true. We then asked participants to 'gossip' about her (him) by rating their likelihood of transmitting each gossip statement to another person in the [office/family] using a nine-point Likert scale (1, very unlikely to tell; 5, might tell; 9, very likely to tell).

We computed the positive and negative gossip scores separately for office-related and family-related gossip, for a total of four scores: *positive office gossip score*, *negative office gossip score*, *positive family gossip score* and *negative family gossip score*. For all scores, higher values indicated a greater likelihood of transmitting the gossip. In both vignette conditions, participants reported significantly more office-related gossip than family-related gossip. We addressed this problem by converting each of our four gossip scores to Z-scores. The outcome variables were thus participants'

mean tendency to relay the four types of gossip statements about Elizabeth (Dave) to another person, in Z-score units.

Some analyses required data in 'long' format, with one row per gossip type per participant (i.e. four rows per participant). In this version of the data, there was a *gossip* Z-score outcome variable, a binary *valence* variable to indicate positive or negative gossip, a binary *domain* variable to indicate if the gossip was in the office or family domain and a binary *scenario* variable to indicate if the participant was randomized into the office or family vignette condition.

To maximize power in experimental designs, it is important to control for extraneous sources of variation [62]. Our prior experience with vignette studies of gossip indicated that the perceived friendliness and aggressiveness of the gossip target were strongly correlated with a tendency to report positive and negative gossip about them, respectively. In addition, these factors were potential confounds in our tests of the effects of allies on negative and positive gossip (because having a friend could change perceived friendliness or aggressiveness). We, therefore, included two items in our survey assessing the perceived *friendliness* and *aggressiveness* of Elizabeth (Dave) to use as controls in our linear models. *Friendliness* and *aggressiveness* had only a small, though significant, degree of correlation ($r = -0.11$, $p = 0.007$), indicating these were largely independent dimensions of the competitor. For testing the protective effect of a friend against gossip, we included a measure of the physical threat posed by the competitor as a control variable in that condition as well. The three control variables were converted to Z-scores prior to inclusion in regression models. As a sensitivity analysis, we also fitted versions of all linear models without these controls (see the electronic supplementary material).

If a prediction was not supported, we conducted exploratory analyses to determine if the outcome depended on the age or sex of participants. All statistical analyses were performed using R version 3.6.3 (29 February 2020) [63]. We tested our predictions using either *t*-tests or linear regression models. For analyses of data in long format, we fitted linear mixed effects models using the *lme4* package [64], with a random intercept for participant. Marginal means and effect sizes were estimated using the *emmeans* package [65]. For summary statistics of variables in phase II, see table 3.

(i) Prediction 1 methods: competitive gossip is domain-specific

If gossip functions to reduce a competitor's reputation, and thus their access to contestable resources, then the gossip content should target dimensions of reputation most relevant to the particular competitive social context. We predicted that in the office condition, participants would relay more office-relevant gossip than they did in the family scenario, and in the family condition, they would rely more family-relevant gossip than they would in the office scenario.

To test this hypothesis, 64 participants read the office scenario and 66 read the family scenario. We then fitted a linear model of the likelihood of transmitting gossip as a function of the two *domains* of gossip (family and work), the two *valences* (positive gossip and negative gossip) and the two *gossip scenarios* (family versus office), and their interactions.

Because negative gossip is hypothesized to be a competitive strategy, and because both scenarios involved competition over a valuable resource (a promotion and valuable artwork), we also predicted a more substantial shift in negative gossip scores relative to positive gossip scores for statements whose

Table 3. Summary statistics for study 1 phases I and II, and study 2. (All values are reported on the original scale (values were converted to Z-scores for all analyses).)

variable	<i>n</i>	range	mean (s.d.)
study 1, phase I			
age (years)	130	18–62	33 (11)
study 1, phase II			
age (years)	600	18–89	34 (11)
positive office gossip score	599	1–9	5.6 (2)
negative office gossip score	599	1–9	5.6 (1.9)
positive family gossip score	597	1–9	3.7 (1.9)
negative family gossip score	597	1–9	3.4 (1.9)
good taste gossip score	325	1–9	5.1 (2.4)
bad taste gossip score	275	1–9	3 (2.2)
perceived friendliness of competitor	600	1–9	5.8 (1.6)
perceived aggressiveness of competitor	599	1–9	4.6 (2)
likelihood that competitor would physically attack	600	1–9	3 (2)
study 2			
age (years)	74	18–23	20.4 (1.2)
likelihood that competitor's reputation would suffer	74	12–80	45 (14)
participant's closeness to four sorority friends	74	17–40	32 (4.6)
closeness among the four sorority friends	74	13–59	39 (9.9)

content matched their competitive environment. To test this hypothesis, we first created a binary *match* variable to indicate if the gossip type matched the scenario (family gossip in the family scenario and work gossip in the office scenario) or mismatched (family gossip in the office scenario and work gossip in the family scenario). We then fit a linear model of likelihood to transmit gossip as a function of *match*, *valence* and their interaction.

Finally, because the dispute in the family scenario involved inheritance of a valuable painting, we also explored if, for the gossip statement involving taste in art and literature, there would be a greater tendency to relate negative gossip, and a reduced tendency to relate positive gossip, in the family versus office scenario (because the family scenario involved the disposition of a valuable painting).

(ii) Prediction 1 results: gossip is domain-specific

As predicted, gossip scores were substantially family-biased in the family scenario and office-biased in the office scenario (see figure 1 and the electronic supplementary material, table S2). The effect size (Cohen's *d*) for the increase in family gossip in the family condition versus the office condition was $d = 1.1$,

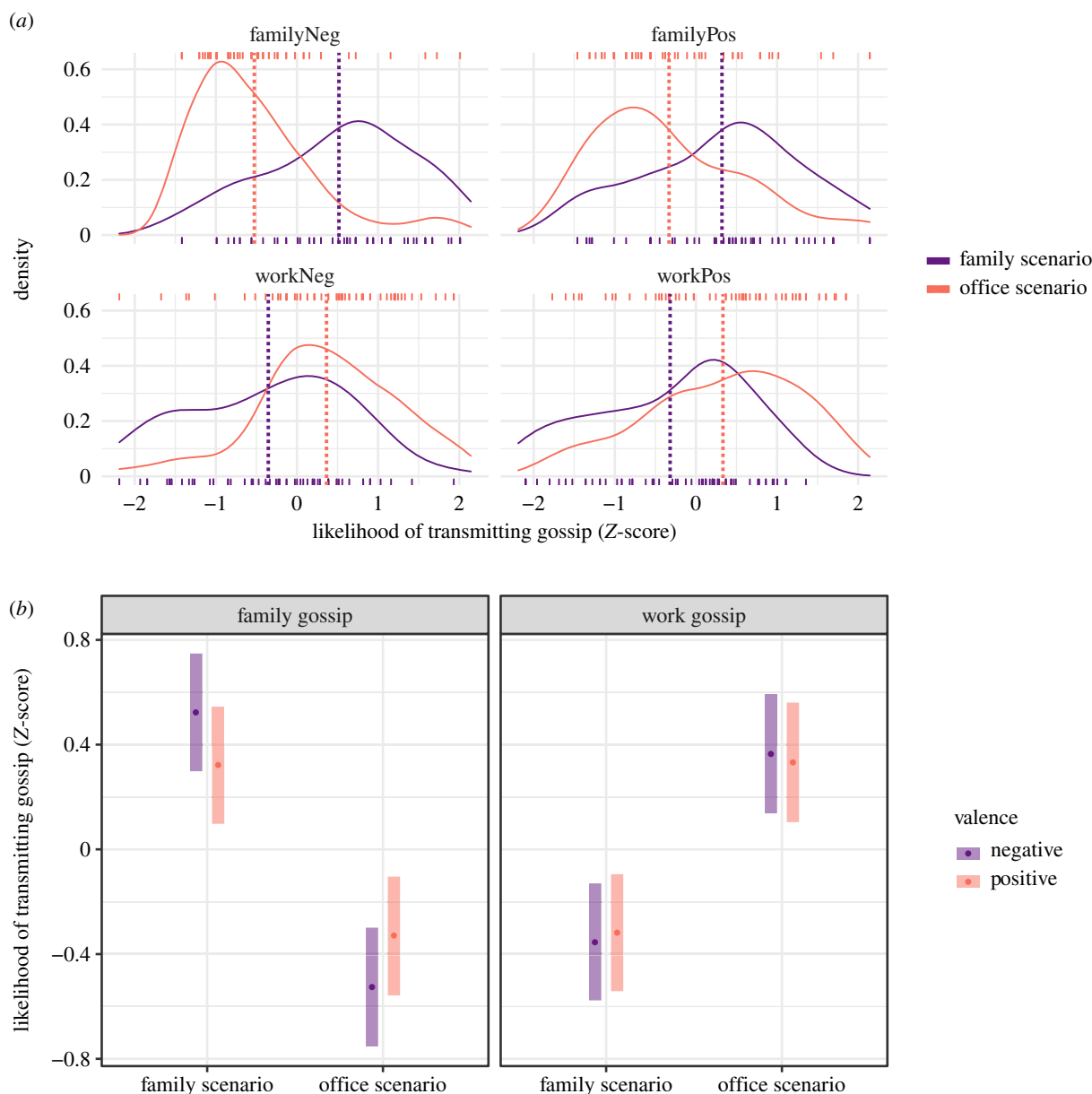


Figure 1. Likelihood of transmitting gossip by type and scenario. Values are Z-scores. Higher values indicate greater reported likelihood of transmitting that type of gossip. (a) Distributions of four gossip scores by scenario. Dotted lines are the means of each distribution. Lower and upper rugs indicate data values. (b) Estimated marginal means from a linear model of likelihood of transmitting gossip as a function of scenario (family, office), domain (family gossip, work gossip) and valence (positive gossip, negative gossip), and their interactions. Bars indicate 95% confidence intervals (CIs). See the electronic supplementary material, table S2 for regression coefficients. (Online version in colour.)

95% confidence interval (CI) (0.77–1.43), and for the increase in work gossip in the office condition versus the family condition, $d = 0.88$, 95% CI (0.55–1.22).

As predicted, the interaction term in the *match* and *valence* model was significant, indicating that there was a greater increase in the transmission of negative gossip from a mismatched to matched scenario than in the transmission of positive gossip. See the electronic supplementary material, table S3 for regression coefficients.

In the exploratory analyses, participants relayed more negative gossip about taste in art and literature in the family scenario than in the office scenario, $M = 1.38$ versus $M = -0.335$; $t_{36.5} = -6.12$, $p < 0.001$, $d = -1.6$. However, there was no significant difference in participants' tendency to relay positive gossip specifically about taste in art and literature in the family, $M = 0.21$ versus $M = 0.13$; $t_{69} = -0.332$, $p = 0.741$, $d = -0.078$.

(iii) Prediction 2 methods: greater resource value increases negative gossip

According to informational warfare theory, higher value resources should increase the use of negative gossip to help defend, or acquire, the resource, and reduce the use of positive gossip. We predicted that participants would transmit more negative gossip and less positive gossip about a competitor when the competed-for resource was highly valuable. We only used the office scenario. The dependent measure was, again, participants' likelihood of relaying negative and positive gossip to a co-worker.

We manipulated the value of the resource (the promotion) in the office scenario by describing the attendant salary increase as either 'small' or 'large.' Participants read (female version):

- imagine you work in an office with about 10 co-workers, half men and half women. Your office is one division of a

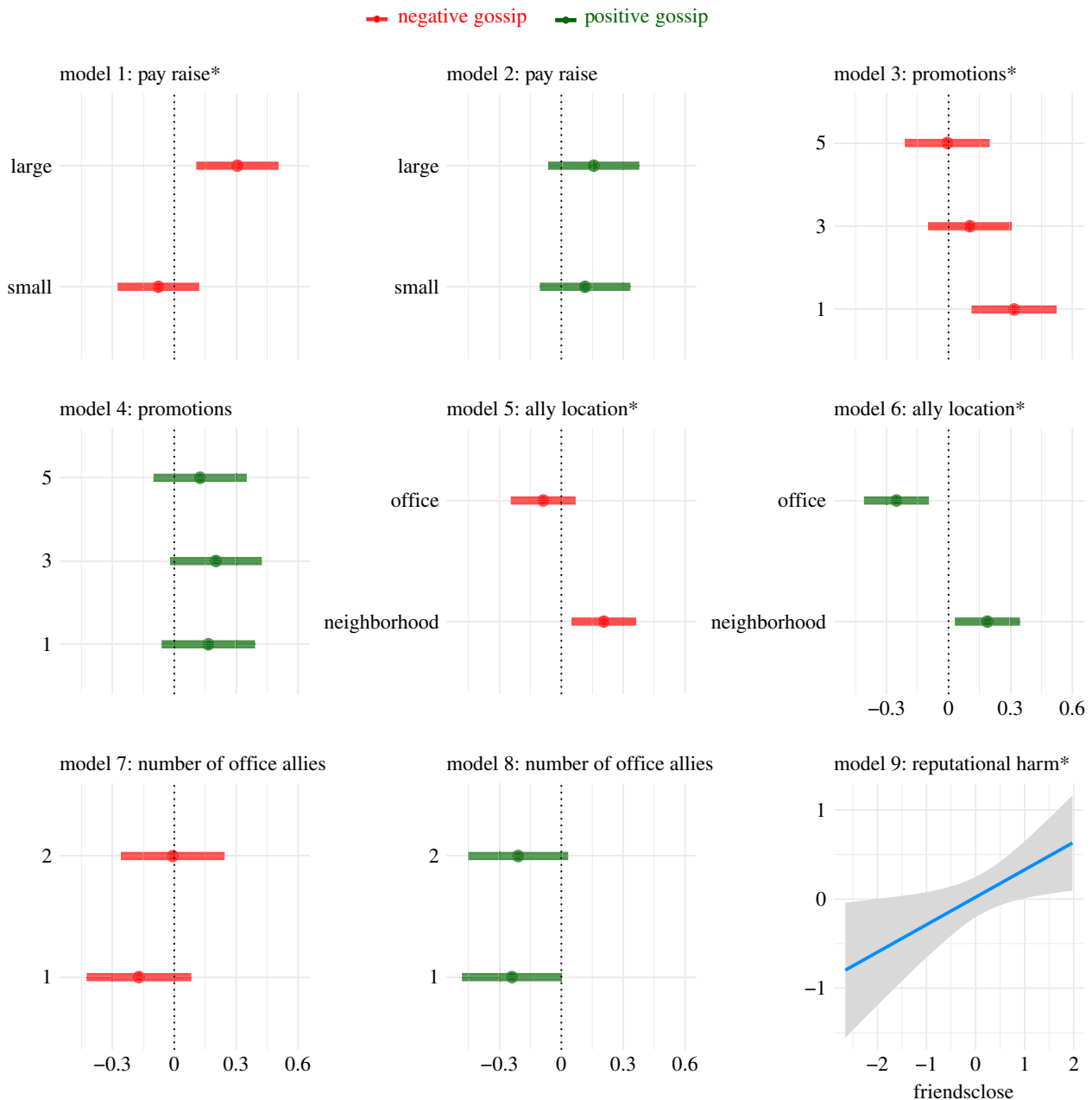


Figure 2. All model effects. Models 1–8: estimated marginal means of the likelihood of transmitting gossip for each manipulated variable in the linear regression models in study 1 (phase II), adjusted for controls. X-axis is the likelihood of transmitting gossip in Z-score units. Red bars, negative gossip. Dark green bars, positive gossip. Model 9: the association of friendsclose with perceived reputational harm Z-score in study 2, controlling for selfclose. Significant effects denoted by an asterisk (*). For all regression model coefficients see the electronic supplementary material, table S4. (Online version in colour.)

company that has done well in the last year. The company has authorized your office supervisor to promote one person in the office, and you are a candidate. The promotion comes with a (small/large) pay raise. Elizabeth, a co-worker, is also a candidate for promotion. Your desk is next to Elizabeth's, so you know more about her than most other people in the company know.

(iv) Prediction 2 results: greater resource value increases negative gossip

As predicted, a 'large' salary increased participants' tendency to relate negative office-related gossip relative to a 'small' salary, $\beta = 0.38$ (0.1, 0.66) (model 1 in figure 2; electronic supplementary material, table S4). Contrary to predictions, there was no significant effect of salary on propensity to relate positive office gossip, $\beta = 0.042$ (-0.27, 0.35) (model 2 in figure 2; electronic supplementary material, table S4). We, therefore,

conducted an exploratory analysis, which found a significant interaction with sex: when the salary was large, men were significantly less likely to relate positive gossip statements (see the electronic supplementary material, figure S3 and table S6).

(v) Prediction 3 methods: greater resource scarcity increases negative gossip and decreases positive gossip

According to informational warfare theory and the competitive use of gossip, more contested resources should increase the use of negative gossip to help defend or acquire the resource, and reduce the use of positive gossip. We manipulated the scarcity (in the office scenario only) by stating that, of 10 co-workers, one, three or five people would receive promotions, with one promotion as the scarcest resource, and five promotions as the least scarce resource (in all of these conditions, the salary was described as 'large'). When there were fewer promotions, we predicted participants would show a greater tendency to

relay negative gossip about the competitor, and lesser tendency to relay positive gossip. Participants were randomly assigned to the office scenario with one, three or five promotions available (between-subjects):

- imagine you work in an office with about 10 co-workers, half men and half women. Your office is one division of a company that has done well in the last year. The company has authorized your office supervisor to promote (one person/three people/five people) in the office, and you are a candidate. The promotion comes with a large pay raise. Elizabeth, a co-worker, is also a candidate for promotion. Your desk is next to Elizabeth's, so you know more about her than most other people in the company know.

(vi) Prediction 3 results: greater resource scarcity increases negative gossip but does not decrease positive gossip

As predicted, a scarcer resource resulted in an increased tendency to relate negative gossip, $\beta = -0.23$ ($-0.44, -0.023$) (model 3 in figure 2; electronic supplementary material, table S4). Contrary to predictions, scarcity had no significant effect on the tendency to relate positive gossip, $\beta = -0.028$ ($-0.25, 0.2$) (model 4 in figure 2; electronic supplementary material, table S4). Exploratory analyses did not find any significant effects of sex or age.

(vii) Prediction 4 methods: ally location and number deters negative gossip

According to informational warfare theory, allies can help defend or acquire valuable contested resources by increasing reputational harm to adversaries, and by limiting reputational harm to coalition members. Our final prediction for study 1 was that participants would be deterred from gossiping negatively about a competitor who had an ally in the social environment in which the competition is occurring rather than an ally in a non-relevant social environment. This is because local allies would be better at aiding the competitor in retaliatory or other defensive gossip against the participant, providing alibis against the participant's negative gossip, etc. It is the nature of the ally's ability to retaliate with gossip within the shared community that should have a deterrent effect on offensive, negative gossip by the participant [23,28]. We also predicted that more allies would increase the deterrent effect.

We wanted to elicit the strongest possible competitive responses in our participants, so we used only the valuable, scarce resource office condition (i.e. one promotion with a large pay raise). Alliance status of the competitor was manipulated between subjects by describing the competitor as either regularly having lunch with a friend from his or her neighbourhood (i.e. no explicit office ally, $n = 135$) or regularly having lunch with a friend from the office (i.e. an explicit office ally, $n = 134$). The number of allies was manipulated by having lunch with one or two friends (office location only). Participants read the following scenario (female version):

- imagine you work in an office with about 10 co-workers, half men and half women. Your office is one division of a company that has done well in the last year. The company has authorized your office supervisor to promote one person in the office, and you are a candidate. The promotion comes with a large pay raise. Elizabeth, a co-worker, is also a candidate for promotion. Your desk is next to Elizabeth's, so you know more about her than most other people in the company know. Elizabeth

regularly has lunch with her good friend(s) from (the office/her neighbourhood), Jennifer (and Melissa) (male version: Mike (and Tom)).

Having a friend in the office might increase the perceived friendliness of the competitor or, conversely, increase perceived physical threat, compared to having a friend from the neighbourhood, and it might be these factors that deter gossip. In addition to the *friendliness* and *aggressiveness* controls described earlier, we also included an additional control for *physical threat*. We also tested if these perceptions differed by condition.

(viii) Prediction 4 results: ally location protects against negative gossip but ally number does not

As predicted, the presence of an explicit ally of the competitor in the office significantly reduced the tendency to relate negative gossip about the competitor compared to the presence of an ally from the neighbourhood $\beta = -0.29$ ($-0.52, -0.071$) (model 5 in figure 2; electronic supplementary material, table S4). In an exploratory analysis, we found that the presence of an explicit ally in the office also reduced positive gossip about the competitor, $\beta = -0.44$ ($-0.66, -0.22$) (model 6 in figure 2; electronic supplementary material, table S4). Contrary to predictions, the number of allies in the office was not a significant predictor of negative gossip, $\beta = 0.12$ ($-0.14, 0.37$) or positive gossip, $\beta = 0.021$ ($-0.22, 0.27$) (models 7–8 in figure 2; electronic supplementary material, table S4).

For a competitor with a friend in the office versus the neighbourhood, there was no significant difference in the perceived friendliness, $M = 5.93$ versus $M = 5.68$; $t_{267} = -1.28$, $p = 0.203$, $d = -0.16$, aggressiveness, $M = 4.39$ versus $M = 4.59$; $t_{266} = 0.783$, $p = 0.434$, $d = 0.096$, or perceived physical threat, $M = 2.8$ versus $M = 3.02$; $t_{266} = 0.941$, $p = 0.347$, $d = 0.11$. These were also included as control variables in the regression models. Hence, reduced gossip towards a competitor with an office ally is unlikely to be explained by differences in perceived friendliness, aggressiveness or physical threat.

(c) Sensitivity of results to inclusion of control variables

Models testing the resource value, scarcity and ally hypotheses included the *friendliness* and *aggressiveness* control variables. To determine the sensitivity of our results to inclusion of these controls, we fitted the same models without these controls. Coefficients and standard errors of the variables of interest were virtually identical to those in the original models, and all results remained significant except for model 3 of the effect of promotions, where $p = 0.069$ (see the electronic supplementary material, figure S5 and table S8).

(d) Exploring effects of sex and age

To explore sex differences in positive and negative gossip, we fitted a model of sex, gossip domain and gossip valence, and their interactions. The interaction of sex with gossip valence was statistically significant, and indicated that men were somewhat more likely to transmit negative gossip than women. Overall, though, the sexes were approximately equally likely to transmit positive and negative gossip. See the electronic supplementary material, figure S2 and table S5.

We then fitted a similar model of age, gossip domain and gossip valence, and their interactions. There was a significant interaction of age with valence only, such that older

individuals were less likely to transmit negative gossip and more likely to transmit positive gossip. See the electronic supplementary material, figure S4 and table S7. Inspection of diagnostic plots indicated that the age effects might be driven by the few individuals aged 60 years and over. We, therefore, fitted a model excluding those individuals. Model coefficients were similar and remained statistically significant (model not reported).

4. Study 2: does the quality of real-world sorority coalitions increase perceived likelihood of reputational harm to a fictional adversary?

To determine whether one's real-world coalitional status influences perceived likelihood of reputational harm to a fictional adversary, we recruited 74 members of one southern California college sorority to participate (mean age = 20.4 years, s.d. = 1.2 years). The data used for study 2 are a subset of a much larger dataset involving several surveys, ego network data and interviews, all collected over 4 years of ethnographic work on female conflict, cooperation and coalitions; hence, we do not have male data (see [23] for an extended description of subject recruitment, payment for participation, etc.).

(a) Method and predictions: higher real-world coalition quality predicts greater expected reputational harm to a fictional adversary

Informational warfare theory proposes that the coalitions of those who attack with gossip and those who are attacked by gossip can provide either more offence or defence in reputational battles. In study 2, we investigated the impact of participants' real-world coalition quality on the reputation of a fictional competitor.

Sorority participants read a scenario and imagined themselves in it. The scenario placed the participant at a party with several members of her sorority, including a fictional member, Nina. The participant talks to Nina's boyfriend throughout the party. At one point during the party, the participant inadvertently walks into a closed room and sees Nina and another man, a known troublemaker, taking cocaine (a 'bad' behaviour to most women in this sorority, as confirmed by ethnographic interviews). Nina's boyfriend walks the participant home after the party. The next day, the participant learns that Nina has been gossiping to other sorority members that the participant was interacting inappropriately with Nina's boyfriend during and after the party. The participant knows, however, that it was Nina who was acting inappropriately by taking illegal drugs.

The dependent variable, *ninabadrep*, was a sum score of the participant's agreement with nine statements about the reputational consequences to Nina of the events in the scenario, such as 'Nina will get a bad reputation in the Greek community' and 'It will get around that Nina is a liar'. Responses were rated on a nine-point scale, so *ninabadrep* could range between 9 (strong disagreement with every statement) and 90 (strong agreement with every statement). High *ninabadrep* scores indicated a perceived high likelihood of reputational harm to Nina.

We could not manipulate participants' coalition status, but we could assess their existing coalitional status. After consulting with sorority informants about what words they would use to describe the quality and value of a friendship, we operationalized coalition quality as the 'closeness' of real-world sorority friends. Participants rated how close they were with each of their four best friends in the sorority house (1, not at all close, to 10, extremely close), as well as how close each of those friends was with each other (e.g. 'How close is your 2nd closest friend with your 4th closest friend?'). The first independent variable, *selfclose*, was the sum of each participant's perceived closeness with her best friends, a simple measure of dyadic relationship quality. The second independent variable, *friendsclose*, was the sum of each participant's perceived closeness among her best friends, another simple measure of coalition quality.

Women with high-quality coalitions should be more willing and able to cooperate effectively than women with low-quality coalitions. We, therefore, predicted that higher *selfclose* and *friendsclose* scores would be associated with higher *ninabadrep* scores.

Previously, Hess [23] found that in this sorority, one member's perception of closeness to the other members correlated positively with those other members' average perceived closeness to her ($r = 0.41$). In addition, the member's perception of closeness among the other members also correlated positively with those members average perceived closeness to one another ($r = 0.57$). These results suggest that sorority members tend to agree about their closeness to one another, a finding that partially validates our method.

(b) Results: real-world coalition quality predicts greater expected reputational harm to a fictional adversary

See table 3 for variable summary statistics. We computed a multiple regression of *ninabadrep* as a function of *selfclose* and *friendsclose* (model 9 in figure 2; electronic supplementary material, table S4 and figure S6). This analysis showed that, as predicted, *friendsclose* was a significant positive predictor of *ninabadrep*, $\beta = 0.31$ (0.047, 0.57). Contrary to predictions, *selfclose* was not a significant predictor of *ninabadrep*, $\beta = 0.096$ (-0.17, 0.36). The closer a sorority member perceives her own real-world friends to be to each other (but not necessarily to herself), the more reputational harm she expects to come to a fictional adversary. To determine if *selfclose*, which was correlated with *friendsclose* ($r = 0.54$, $p < 0.001$), contributed to the model, we fitted a model with just *friendclose* and it outperformed the original model by Akaike information criterion.

5. Discussion

If the dissemination of negative gossip is strategic, its content should be relevant to the domain of competition. study 1 found that gossip about a competing co-worker reflected his or her value as a productive office member more than it did his or her value as a family member, and that gossip about a competing family member reflected his or her reputation as a reliable, cooperative family member more than it did his or her value as an office worker. Gossip, positive and negative, was domain-relevant. In addition, if gossip is a competitive strategy, then negative gossip should increase when competition increases. study 1 found that, in an office context,

increased resource value (larger promotion) and resource scarcity (fewer available promotions) increased negative gossip about a competitor, as predicted. Contrary to predictions, however, only men decreased positive gossip about a competitor for a higher valued resource, and resource scarcity did not affect the tendency to relate positive gossip by either sex.

Two novel predictions of informational warfare theory are that friends of gossip targets protect them from negative gossip (study 1), and that friends of the gossiper increase expectations of reputational harm to gossip targets (study 2). study 1 found, as predicted, that the presence of an explicit ally of the competitor in the office, compared to the presence of an ally from his or her neighbourhood, significantly reduced participants' tendency to relate negative gossip about the office competitor. This result cannot be explained by the 'friendliness' of the competitor because the competitor had a friend in both conditions, and because there was no significant difference in perceived friendliness, aggressiveness or physical threat across conditions. In addition, this effect persisted after controlling for the perceived friendliness, aggressiveness and physical threat of the competitor. We note that having a friend in the office also significantly decreased positive gossip about the competitor, which would not be expected if the effect were owing to increased perceived friendliness. Hence, the deterrent effect of a friend against negative gossip is unlikely to be explained by a confound with friendliness. Contrary to predictions, the number of allies had no significant effect on the tendency to relate gossip. study 2 showed that among sorority women, more tightly knit real-world coalitions (ego networks) predicted higher expectations of reputational harm to an adversary. Taken together, these results provide support for the hypothesis that coalitions enhance offensive and defensive capabilities in informational warfare.

(a) Sex and age differences

Early research on indirect aggression suggested that it was more frequent among females than males, but later research had much more mixed results [36]. We, therefore, did not predict any sex differences, and found few in our exploratory analyses. There were no significant sex differences in the effect of the office ally on gossip, for example, suggesting that, for within-group competition, coalitions may be equally important to women and men. One difference was that men reported higher likelihood of transmitting negative gossip than women, contrary to the widespread perception that women are more indirectly aggressive. Our finding might be related to the broad range of ages of our participants, in contrast with most studies of indirect aggression that rely on child and adolescent samples. Regarding age, we found that the likelihood of transmitting negative gossip decreased with age, but that the likelihood of transmitting positive gossip increased with age (electronic supplementary material, figure S4 and table S7). Perhaps older individuals have less need than younger individuals to compete for resources.

(b) Social cohesion theories

Our results support the social competition group of theories. Another group of influential theories views gossip as a means to increase 'social cohesion'. These include learning cultural norms or one's place in a group (e.g. [66]), norm learning and enforcement, sanctioning, social control or 'policing' (e.g. [31,67,68]), strategy learning [69], maintaining the good

reputations of allies (e.g. [70]) and maintaining the unity, morals and values of social groups (e.g. [71]). Dunbar [72] proposed that gossip (and language more generally) evolved to facilitate social bonding and social cohesion in the very large groups that characterize human primates (but see [73]). The social cohesion versus social competition approaches are not mutually exclusive (for more discussion see [11,23,28]).

(c) WEIRDness versus orientalism

Despite its aspiration to discover universal properties of cognition, the discipline of psychology has rightly been criticized because its studies have mainly involved WEIRD societies, which are characterized by a narrow range of ages, socioeconomic statuses and cultural backgrounds. This was certainly true of our sorority participants, who were young college students in the USA. About three-quarters of our MTurk participants were also from the USA, and some participants were from other WEIRD countries. The extent to which our results will generalize to other populations is, therefore, an open question.

The call for psychological research to be more anthropological and obtain data from the full range of human cultural diversity are laudable [59]. Indeed, we have studied indirect and physical aggression among Congo Basin foragers [6]. Decades before the WEIRD paper, though, many anthropologists were rightly criticized for the opposite problem: a tendency to exoticize and essentialize diverse 'others' as part of its colonial history, e.g. *orientalism* [74]. For some anthropologists, the concept of 'culture' had come to play the same role as race [75,76].

There is a surprisingly large number of human universals [77], however—the 'other' is not so exotic. Our Congo Basin results, for instance, were broadly similar to those seen in WEIRD societies. A large replication effort investigating 28 psychological findings, involving 15 305 participants from 36 countries, similarly found little evidence that results differed between WEIRD and non-WEIRD samples (albeit with important limitations; [78]). There is also perhaps as much variation within societies as there is between them—there is no essential 'other' (e.g. [79]). As psychology wisely incorporates more anthropology and diversifies the populations it studies, it must avoid the mistakes of anthropology and not dichotomize the world into WEIRD versus non-WEIRD [80].

6. Other limitations

Our studies involved self-reported propensities to transmit gossip, as well as self-reported expectations of social harm to an adversary, in response to hypothetical scenarios. Our sample was heavily female-biased, which could have influenced our results. Most tests, however, did not reveal significant sex differences. Across conditions in study 1, perceived *aggressiveness* of the competitor, a control variable, was a significant positive predictor of negative gossip, as we predicted, but perceived *friendliness* was a significant positive predictor of both positive and negative gossip, and unexpected pattern that warrants future investigation.

Though closer real-world coalitions predicted higher expectations of reputational harm to an adversary, our study did not reveal why closeness has this effect. Similarly, although we have largely ruled out 'friendliness' as an explanation for the protective effect of friends against negative gossip, and reduced the possibility that increased physical threat is the explanation, we have not explained why friends have this

protective effect. It could be, contrary to our alliance hypothesis, that the competitor's office friend is perceived as a social resource that could be shared, which might reduce a desire to gossip about the competitor.

7. Concluding remarks

We used experimental and survey vignettes and ego network methods in two adult samples to test predictions about reputational competition (gossip) that were inspired by models of animal competition and cooperation and informational warfare theory. In study 1, we found that, for both sexes, gossip content is specific to the context of the competition, and that gossip, particularly negative gossip, intensifies when contested resources are more valuable and scarce. Participants were gossiping strategically in ways that benefitted their own individual access to contested resources. We also found that, for both sexes, local allies deter negative gossip. In study 2, we found that sorority participants' closer real-

world coalitions predicted higher expectations of reputational harm to an adversary. These results suggest that coalitional competition is not limited to physical, between-group aggression among males, and can involve the coalitional collection, analysis and dissemination of gossip for within-group competition by either sex [11,23,28].

Ethics. Study 1 was approved by the Washington State University Institutional Review Board (IRB). Study 2 was approved by the University of California, Santa Barbara IRB.

Data accessibility. Data and analysis code for both studies are available from: <https://doi.org/10.5281/zenodo.4485001> and <https://doi.org/10.5281/zenodo.4485003>.

Authors' contributions. N.H.H. and E.H.H. designed the studies, analysed the data and wrote the final draft of the manuscript. NHH collected the data and wrote the first draft of the manuscript.

Competing interests. We declare we have no competing interests.

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