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Epistemic gratitude and the provision of information

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ABSTRACT

Human society rests on communicated information, much of which is shared without an expectation of reward. We suggest that, like other forms of prosociality, this type of information provision is fueled by gratitude. To reflect the fact that information differs in some ways from other goods, we call this form of gratitude epistemic gratitude. In a first experiment (all preregistered, with US participants), we show that participants are more grateful for information that provides more benefits, at a greater cost to the sender, that was sent intentionally, and gratuitously. Experiment 2 shows that information shared with a large audience generates less gratitude in individual audience members. Experiment 3 shows that information that can be further passed on to others elicits more gratitude. In the supplementary materials, we also report a series of inconclusive experiments testing whether gratitude increases when an initially doubted piece of information is confirmed, and whether participants think others communicate in a way that maximizes gratitude in the audience. In conclusion, we speculate on the consequences of epistemic gratitude—in particular, which type of information is more likely to elicit epistemic gratitude—for diverse cultural phenomena, from personalization in marketing to rumor diffusion.

Information acquired from others plays a tremendous role in human lives (e.g., Harris, 2012; Tomasello, 1999). Much of that information is provided 'for free', in that people do not expect immediate payment or reciprocation: informal advice, on-the-job training, Wikipedia contributions, to name a few. Why is information often provided without expecting immediate payoffs? Gratitude, which has been shown to promote other types of prosocial behaviors, could also fuel the provision of information. We start by reviewing work on gratitude, and the role gratitude plays in prosocial acts in general. We then introduce the concept of epistemic gratitude - gratitude for information provided by others. Although epistemic gratitude should function in a way that is broadly similar to gratitude, we highlight some specific traits of epistemic gratitude, which relate to differences between information and other types of goods or services. In a series of experiments, we test our predictions regarding when participants feel more grateful for information. In conclusion, we suggest that the concept of epistemic gratitude could help understand various features of our informational environment.

1.1. Gratitude and prosociality

Gratitude is a moral affect that is a likely essential ingredient of

social life, and in particular of prosocial behavior—behavior that benefits a receiver at an immediate cost for a provider (for review, see, McCullough et al., 2001). When people find themselves on the receiving end of a prosocial action (under conditions specified presently), they feel grateful. This feeling of gratitude has two consequences. First, it motivates the recipient of the prosocial act to adjust their estimate of the cooperative dispositions of the giver, either confirming or evaluating that the giver is a valuable partner. Second, this evaluation motivates the recipient to engage in prosocial acts in turn, in particular, but not exclusively, towards the benefactor (e.g., Bartlett & DeSteno, 2006). Third, if signaled in some way, the recipient's gratitude may lead the individual who acted prosocially that their behavior was recognized and appreciated, which motivates them in turn to engage in more prosocial acts (e.g., Rind & Bordia, 1995). If nobody felt grateful, prosocial behavior would be jeopardized, since (a) people would lose one of the motivations for behaving prosocially (to reciprocate), and (b) people who have behaved prosocially would be less incentivized to keep doing so. Evidence regarding (a) takes at least two forms: people who tend to be more grateful tend to score higher on measures of prosocial behavior (McCullough et al., 2002); and participants made to feel grateful pay higher costs to help their benefactor (Bartlett & DeSteno, 2006; Tsang, 2006a). (b) largely follows from (a), as any behavior that makes others

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provide us with benefits should be reinforced.

Gratitude has been studied in an evolutionary perspective at least since [Trivers \(1971\)](#), who suggested that gratitude was one of the cognitive-emotional mechanisms that evolved to help make reciprocal altruism possible, by motivating people to reciprocate towards those who have helped them. Trivers also suggested that feelings of gratitude should be proportional to the cost-benefit ratio of the prosocial act that triggered them. Although the basic insight is somewhat retained in more recent evolutionary perspectives on gratitude (e.g., [McCullough et al., 2001](#)), there has also been a shift towards thinking of gratitude as an emotion that enables long-term reciprocal interactions, rather than short-term tit-for-tat. In particular, gratitude has been analyzed within the evolutionary framework of social emotions as responding to variations in perceived Welfare Tradeoff Ratios [WTR] (see, e.g., [Delton & Robertson, 2016](#)). Within this framework the function of gratitude is to further reciprocal long-term prosocial behavior between individuals (e.g., [Algoe et al., 2013](#); [A. Smith et al., 2017](#); [Tsang, 2006a](#)). This leads to the prediction that gratitude should be triggered by cues that someone places more weight on our welfare than we thought they did. As Trivers originally suggested, these cues should integrate the costs and benefits of the act: someone who cares about our welfare should want to provide us with more benefits, and should be willing to do so at a higher cost to themselves. However, this is not sufficient: they should do this intentionally. Incidental benefits (or costs) are hardly diagnostic of how someone feels towards us and whether they are likely to continue providing benefits in the future. Finally, the costs of the prosocial behavior should be borne without expecting immediate reciprocity (i.e. gratuitously), since they are otherwise offset by the benefits from reciprocation. In the latter case, they can lead to a net benefit for the provider, and no gratitude should be expected (on these four factors, see, [McCullough et al., 2008](#), p. 252).

Empirical studies confirm these predictions. Actions that bring more benefits to the recipient, or require more effort for the provider, generate more gratitude in the recipient ([Okamoto & Robinson, 1997](#); [Tesser et al., 1968](#)). People also feel more grateful when they benefit from someone's intentional help, as opposed to when the help is a side-effect of a self-serving action ([Tsang, 2006b](#)). To the best of our knowledge, the gratuitousness of prosocial behavior has not been specifically investigated (but see below for some indirect evidence).

One of the rewards of prosocial behavior is the gratitude of the recipient. Accordingly, as [McCullough et al.](#) put it, "some people might engage in prosocial behavior partially in hopes of eliciting gratitude from the beneficiary" ([McCullough et al., 2001](#), p. 258). People could engage in strategic, conscious attempts to maximize gratitude in others. For instance, one of the manipulation techniques described in [Cialdini's Influence \(Cialdini, 1993\)](#) is reciprocity: when someone has granted us a small favor, we feel that we should reciprocate. This strategy might work because the small favor elicits gratitude, which triggers the desire to reciprocate. Besides directly engaging in actions that should elicit gratitude, we can also communicate about features of our actions that should make others realize they ought to be grateful to us—for instance, pointing out how costly the action was for us. However, it is important that such efforts not be too transparent, as otherwise they might defeat their purpose by making the prosocial act appear less gratuitous. One study seemed to have observed such a phenomenon, not when observing attempts to directly elicit gratitude, but attempts to elicit reciprocity by displaying gratitude. In this study, customers at a jewelry store were more likely to visit the store if they had received a thank you call for past patronage (a typical response to the expression of gratitude). However, this effect disappeared when the call also mentioned that the store would have a sale ([Carey et al., 1976](#)). This might be because, in the latter case, the objective of the call—to elicit a new store visit by displaying gratitude—might have been too transparent when the sale was mentioned.

Although the cases described by [Cialdini](#), or the jewelry store's thank you call, are conscious attempts at eliciting gratitude and the following

behavior response, the same process likely happens in all of us, unconsciously. Since we stand to benefit from others being grateful to us, we should be more likely—everything else equal—to act in ways that will make others feel more grateful, and to stress features of our actions that should elicit gratitude, at least as long as it doesn't jeopardize the actions' perceived gratuitousness.

1.2. Epistemic gratitude

In the experimental literature, prosocial acts have typically been operationalized as goods (e.g. money) or services (e.g. performing a task in one's stead). However, prosocial acts can also take the form of the provision of information. We benefit when someone gives us a useful tip, or teaches us a new skill. It might seem as if the provision of information doesn't entail a cost, but in fact it often does; either an opportunity cost (we might be doing something else instead of transmitting the information), or the cost of acquiring the relevant information (developing certain skills, etc.). Since much information is communicated without expectation of immediate repayment, as noted above, we can ask: why do people provide others with information?

Reputational benefits for providers of information have received the most attention as a relevant factor in this regard. In particular, people who possess, and share, rare and useful information can gain prestige (for review, see, [Henrich & Gil-White, 2001](#)). For instance, this appears to be the case for people who possess knowledge of medicinal plants in small-scale societies ([Lightner et al., 2021](#)). Similarly, people use the quality of online contributions to infer the general intelligence of the authors; as a result, authors are more motivated to write high quality articles when they are not anonymous ([Yoder & Reid, 2019](#)).

Although such reputational gains likely explain a significant portion of the acquisition and provision of information, they cannot explain all of it. For instance, people often pass on useful information ("I heard on the radio that the bus drivers are on strike") that did not require a particular skill to acquire. Provision of such information should be incentivized because it benefits the receivers, but passing along such material doesn't warrant granting prestige to the provider.

In addition to prestige, we suggest that the provision of information, similarly to other prosocial acts, is often fueled by gratitude. In particular, information provision should elicit what we call epistemic gratitude, meaning both that the receiver of the information might be motivated to reciprocate later by providing information in turn (or acting prosocially towards the source of the information more generally), and that displays of gratitude should motivate the source to keep sending information.

Epistemic gratitude is triggered by the same psychological mechanisms as gratitude more generally. As a result, we expect that the epistemic gratitude a receiver feels will be affected by the benefits they get from the information provided, the provider's cost of acquiring or transmitting the information, whether it was meant for them in particular (intentionality), and whether the provider ostensibly expects immediate reciprocation (gratuitousness). Although gratitude should function in ways that are similar to prosocial acts in general, we believe it is worth referring to it as 'epistemic gratitude' since (i) when people consider prosocial acts, they might not immediately think of information provision; (ii) the provision of information plays a major role in human life; (iii) information has properties that tend to differ from those of other goods, as we argue presently.

By comparison with other goods, information is more likely to be non-rival, in that people who already possess a piece of information do not automatically suffer a cost if they share this information with others. Consequently, if one receives a useful piece of information they can pass along and elicit gratitude in turn, this should increase the gratitude they feel upon first receiving it (see Experiment 3).

Again, by contrast with other goods, information can be shared widely and made to benefit many people, which suggests that people can elicit a lot of gratitude by sharing information as widely as possible.

However, in such a situation, the fact that the individual benefits many people at once makes their action less diagnostic of the weight they put on one's own welfare in particular (Barclay & Barker, 2020). As a result, information that has been shared with many people, by contrast with only with us, should elicit less gratitude, even if it benefits us as much (see Experiment 2).

Another way in which information differs from other goods is that the marginal value of information we already possess is very low, while it might not decrease much for other goods. For instance, if someone provides you with a piece of information you need, the benefit of receiving it again from another source is usually very small: therefore, gratitude towards the second provider should be reduced (see Experiment 1). By contrast, if you need money, even if the need has been met, more money is still beneficial (even if its marginal value decreases). This suggests that people should be particularly keen on being first when providing information (to reap nearly all the gratitude), by comparison with the provision of other types of help. Note that in all of these cases, information is merely at one end of a continuum (e.g. how non-rival it is), rather than being completely unique.

To the best of our knowledge, the predictions regarding epistemic gratitude have not been experimentally tested. One indirect exception is a study in which participants tended to share more useful content when they were talking to smaller audiences (Barasch & Berger, 2014). One way of interpreting these findings within the current framework is that when the audience is smaller, the same benefit provided will lead to more gratitude (since the act is perceived as more intentional), which should incentivize people to provide more beneficial information to smaller audiences. We believe there are observed patterns of behavior that fit with the current predictions, which are explored in conclusion.

Besides having an influence on how people react to information, epistemic gratitude should also influence how people present information to others, or what information they decide to share. This means that attempts at increasing epistemic gratitude in others might explain patterns in the transmission of information, and thus in culture—a topic we return to in conclusion.

1.3. The current experiments

The current experiments have several goals. The main goal is to test whether feelings of gratitude are evoked in the same context in the case of information–epistemic gratitude—as for other prosocial acts. In so doing, we test predictions about the factors that affect feelings of gratitude that have, to the best of our knowledge, never been addressed (in particular, gratuitousness), or that have only been tested in a piecemeal manner (benefit, cost, and intentionality). In a series of experiments reported in the Electronic Supplementary Materials (ESM), we also test whether participants expect others to communicate in ways that maximize feelings of gratitude in their audience.

In Experiment 1, we test whether the four factors that have been hypothesized to affect feelings of gratitude (benefits, costs, intentionality, and gratuitousness) affect epistemic gratitude—for instance, whether people feel more grateful to a source that has provided beneficial information gratuitously.

Experiments 2 and 3 deal with situations in which the special properties of information should have consequences for feelings of gratitude. Experiment 2 tests whether addressing a larger audience is interpreted as a sign of a lower intentionality, and thus generates less gratitude in each audience member. Experiment 3 tests whether people feel more grateful for information that they can pass along to elicit gratitude in turn.

All experiments (materials, hypotheses, analyses) were pre-registered.

Experiments 1–3 (https://osf.io/z4dnr/?view_only=b09d16ea6a6a4afe87b01a59ac4ce7d6).

2. Experiment 1

Experiment 1 tests whether feelings of gratitude triggered by the provision of information vary in line with the four factors suggested to influence feelings of gratitude by McCullough et al. (2008), leading to the four following hypotheses:

H1: Participants will feel more grateful towards the source that provides them with information leading to more benefits.

H2: Participants will feel more grateful towards the source that expended more effort to find or provide them with the information.

H3: Participants will feel more grateful towards the source that provided them with the information intentionally rather than accidentally.

H4: Participants will feel more grateful towards the source that gave them information without signaling expectations for immediate reciprocity.

3. Methods

3.1. Participants

A power analysis showed that for a binomial test with an expected frequency of 0.65, an α -level of 5% and a power of 95%, we would need a minimum of 147 answers per dependent variable (excluding the answers that express no gratitude). Given that we planned to exclude “not gratitude” responses (see below), we collected data from 185 participants (90 female, 91 male, 1 other, M age = 36.58) from the US, UK and Ireland using the Prolific platform.

3.2. Materials and procedure

On the Prolific platform, participants were informed they would answer some simple questions in a psychological survey. They first filled out a consent form and an attention check, in which they were instructed – mid-text – to write “I pay attention” as an answer to a prompt about a videogame (this attention check was the same across all studies, see ESM for the full task).

They then proceeded to the main part of the experiment, where they read one vignette from each of the five conditions at random, such that each vignette was set in a different context (taxes, postage stamps, hobby, computer problem, music concert). Participants thus saw a total of five (out of twenty-five) vignettes, in a random order.

All the vignettes were written in the second person. In each situation, participants would receive two pieces of information, one from each of two sources. The two pieces of information were manipulated so that one should (theoretically) elicit more gratitude. In some vignettes, participants might understand that one piece of information was provided before the other. With everything equal, we would expect participants to be more grateful to the first source in these cases (an assumption we test in the Redundancy Condition). To make sure that this potential preference for the first source could not provide an alternative explanation for the hypothesized findings, in our vignettes (except those of the Redundancy Condition), the second source was always the one to provide the information predicted to elicit more gratitude (in this sense, the order was working “against” our predictions). The first names used varied with the contexts, but were not systematically counterbalanced within the contexts (this applies across all the experiments).

We provide here examples of the five versions of the taxes story. In each vignette, we highlight the source which we predicted more gratitude towards in bold.

[Benefit Condition] You're having trouble filing your taxes and turn to two colleagues, **Andrew** and Jonathan, for help. Both research your question on their own and give you some advice. You take both

pieces of advice into account. They both prove helpful. In particular, thanks to Andrew's advice, you save several hundred dollars in taxes.

[Cost Condition] You're having trouble filing your taxes and turn to two colleagues, Jonathan and Andrew, for help. They don't give you an answer right away, but get back to you a couple of days later. Jonathan happens to face the same problem when filing his own taxes, and he shares with you the answer he's found for himself. **Andrew** has spent a couple of hours online to look for an answer and what he's found happens to be the same as the answer found by Jonathan. The answer provided by both proves helpful.

[Intentionality Condition] You're having trouble filing your taxes. You ask your colleague Jonathan for help. He doesn't give you an answer right away, but says he will get back to you a couple of days later. In the meantime, at lunch, you're sitting next to your other colleague Andrew, and you overhear him talking to someone. He describes having had exactly the same problem, and the solution he found. Later, **Jonathan** gets back to you with the same solution. That solution, found by both Andrew and Jonathan, proves helpful.

[Gratuitousness Condition] You're having trouble filing your taxes and turn to two colleagues, Jonathan and Andrew, for help. They don't give you an answer right away, but get back to you a couple of days later. Andrew gives you the answer, and adds that he would appreciate it if, in return, you could help him with a computer problem. **Jonathan** gives you the same answer as Andrew. The answer provided by both proves helpful.

[Redundancy Condition] You're having trouble filing your taxes and turn to two colleagues, Jonathan and Andrew, for help. Both look for information on their own. Later that day, **Jonathan** gives you some advice. The day after, Andrew gets back to you, with the same advice as Jonathan. Jonathan and Andrew both spent as much time looking for the information, and the suggestion they make proves helpful.

After reading each vignette, participants were asked:

Do you feel grateful towards either of these colleagues? If yes, towards which colleague do you feel more grateful? [answers:] I don't feel grateful towards either of them // I feel more grateful towards [name protagonist 1] // I feel more grateful towards [name protagonist 2].

Do you feel grateful towards either of these colleagues? If yes, towards which colleague do you feel more grateful?

4. Results and discussion

For each dependent variable, we first removed those participants who answered "I feel grateful towards neither" and performed a binomial test ($H_0 = 0.5$) on answers aggregated across all cover stories. All reported analyses are two-tailed.

The frequencies of choices in each condition are depicted in Fig. 1 (the percentages reported here exclude the "grateful to neither" answers). In the Redundancy Condition, we find an effect of order: participants chose the first source as the one they were more grateful to 87%

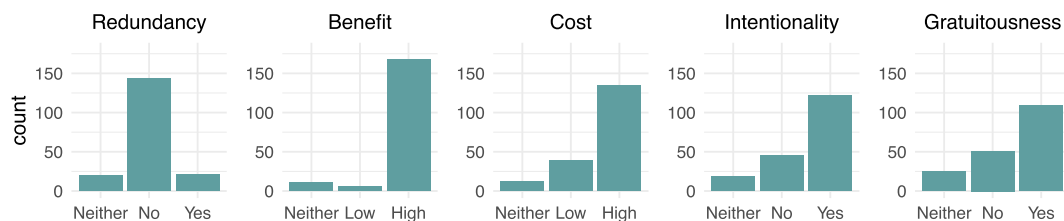


Fig. 1. Frequency of reporting more gratitude to first or second source (or neither), Experiment 1. The second source is always the one we predicted participants should feel more grateful to, except in the redundancy condition (i.e. the source providing high benefits, low costs, with intentionality, and gratuitously).

of the time (95% CIs [0.81, 0.92]; $p < .001$; 20 participants chose "grateful to neither"). This means that if we observe any preference for the second source in the other conditions, it is due to the experimental manipulations of the relevant factors, and not to order effects. In the Benefit Condition, 97% of participants were more grateful to the source who provided more benefits (95% CIs [0.93, 0.99]; $p < .001$; 11 participants chose "grateful to neither"). In the Cost Condition, 77% participants were more grateful to the source who had incurred higher costs (95% CIs [0.70, 0.83]; $p < .001$; 12 participants chose "grateful to neither"). In the Intentionality Condition, 73% participants were more grateful to the source who had transmitted the information intentionally (95% CIs [0.65, 0.79]; $p < .001$; 18 participants chose "grateful to neither"). Finally, in the Gratuitousness Condition, 68% participants were more grateful to the source who had transmitted the information gratuitously. (95% CIs [0.60, 0.75]; $p < .001$; 25 participants chose "grateful to neither").

These results confirm our predictions, showing that the four factors put forward by McCullough et al. (2008) do predict feelings of gratitude, and that they do so in the case of epistemic gratitude.

5. Experiment 2

As noted above, it's easier to benefit several people at once with information as with most other goods. However, if a source provides information to many people at once, the cost they pay to do so is less diagnostic of their feelings towards us, as we do not know whether they would have bothered providing the information only for us. This leads to the following hypothesis:

H5: Increases in the size of the audience to whom the message is directed, that stands to benefit from the information, will reduce each audience member's gratitude towards the source.

6. Methods

6.1. Participants

A power analysis showed that for a z-test on two proportions, with an expected proportion for choosing the first source in the neutral condition set to 0.80 and the expected proportion of choosing the same in the audience size condition set to 0.55, with an α -level of 5% and a power of 95%, we would need a minimum of 178 answers (excluding the answers that express no gratitude). Given this, we chose to collect data from a total sample of 200 participants (100 in each condition). Our final sample size was 199 participants (98 female, 99 male, 2 other-identifying, M age = 40.97) from the US, UK and Ireland using the Prolific platform.

6.2. Materials and procedure

Participants completed a consent form and an attention check. They were then randomly assigned to one condition, so that they either saw a vignette from the Private Condition, where both sources shared the information with them exclusively, or a vignette from the Public Condition in which the first source also shared the information with others. We

adapted the vignettes from Experiment 1 in which participants were asked to imagine receiving two pieces of information, so that in the current experiment, the number of people receiving each piece of information from the source was varied. In the Private Condition, both sources provided the requested information to the participant alone, whereas in the Public Condition, the first source also shared the information with others (e.g. by posting on a social network).

We had four different cover stories for each condition (taxes, hobby, computer problem, and music concert), and each participant saw only one vignette, which was a random condition and cover story combination, in a between-participants design. For example, in the taxes cover story we showed above, the two conditions were adapted as follows:

[Private Condition] You're having trouble filing your taxes and turn to two colleagues, Jonathan and Andrew, for help. Both look for information on their own. Later that day, **Jonathan** gives you some advice. The day after, Andrew gets back to you, with the same advice as Jonathan. Jonathan and Andrew both spent as much time looking for the information, and the suggestion they make proves helpful.

[Public Condition] You're having trouble filing your taxes and turn to two colleagues, Jonathan and Andrew, for help. Both look for information on their own. Later that day, Andrew sends you an email with some advice. The email is also addressed to a few other people who had faced the same issue. The day after, **Jonathan** gets back to you in a private message, with the same advice as Andrew. Jonathan and Andrew both spent as much time looking for the information, and the suggestion they make proves helpful.

After reading a version of the vignette, participants were asked to indicate which source they felt more grateful to, with the option of choosing "neither," as in Experiment 1.

7. Results

We removed the "I feel grateful towards neither" responses ($N = 9$ in the Public condition, $N = 13$ in the Private condition) and performed a Z-test on proportions of the aggregate answers across cover stories between the two conditions (two-tailed). Confirming our predictions, our results showed that the proportion of participants more grateful to the first source was significantly different between the two conditions: 86.05% in the Private Condition vs. 34.07% in the Public Condition ($X^2 = 47.377$; $p < .001$). See Fig. 2 below.

8. Experiment 3

One of the potential benefits of information is that we can pass it on to others, who might in turn feel grateful to us—whereas doing so is

typically more difficult with other goods that need to be consumed for the benefits to accrue (e.g. money). In our next experiment, we wanted to test whether people feel more grateful for information they can later "reuse" in their social circle. We made the following prediction:

H6: People will feel more grateful towards someone who gives them a piece of information they can share with others who might feel grateful towards them, compared to someone who gives them a piece of information that brings them the same benefit, but that they cannot share with others.

9. Methods

9.1. Participants

A power analysis showed that for a z-test on two independent proportions, with an expected proportion for choosing the second source in the audience condition set to 0.75 and the expected proportion of choosing the same in the no audience condition set to 0.5, with an α -level of 5% and a power of 95%, we would need a minimum of 190 answers (excluding the answers that express no gratitude). Given this, we chose to collect data from a total sample of 200 participants (100 per condition). Our final sample size was 200 participants (99 female, 100 male, 1 other-identifying; M age = 37.96), recruited through Prolific from US, UK and Ireland.

9.2. Materials and procedure

We constructed a new set of vignettes with five cover stories (computer problem, group project, academic courses, recipes, sports) similar to those in the above experiments. After the consent form and attention check, participants either saw a vignette in which the information provided by the second source could be passed on to others from their social circle and be (implicitly) reputationally beneficial for them; or a vignette in which the information provided by the second source does not lead to reputational benefits. In both cases, the personal benefits from the first and second source were held constant. Each participant only saw one vignette using one cover story, in a between-participants design. For example, in a cover story in which we asked participants to imagine getting help with a computer problem, the two conditions were adapted as follows (more gratitude predicted for sources in **bold**):

[Reputational Benefit Condition] Your company's switch to a new software has created two new issues for you: you aren't able to use the office printer, and have trouble signing in to your workspace remotely. Both are equally annoying. Talking to other members of your team, you realize they've also encountered issues with the printer. During lunch with two friends who work in IT, Anthony and

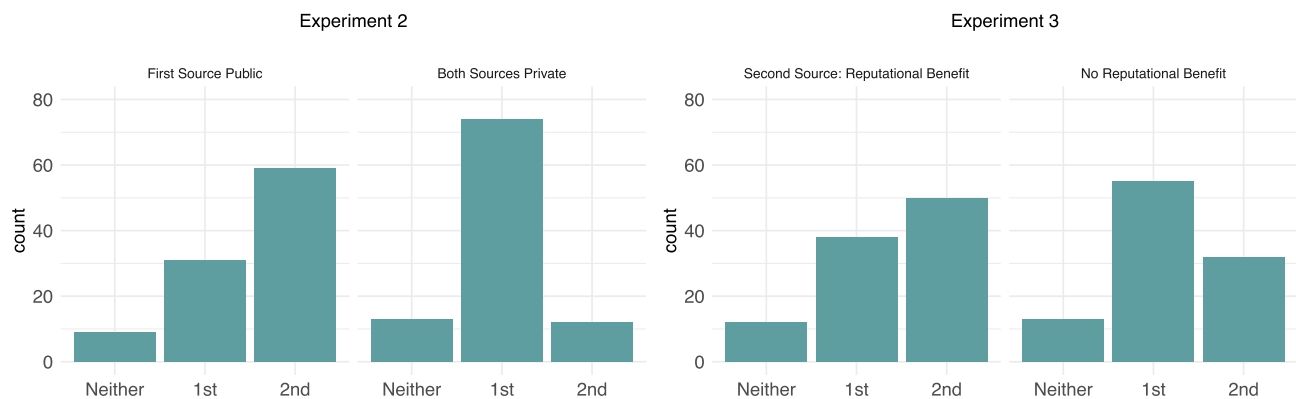


Fig. 2. Frequencies of reporting more gratitude to first or second source (or neither), Experiments 2 and 3. In Experiment 2, we predicted that participants would be less grateful to the first source when they shared their information to a broader audience, and not just the participant. In Experiment 3, we predicted that participants would be more grateful to the second source when they shared information that allowed the participants to gain reputational benefits in turn.

Sean, you mention both issues and ask for help. Later that day, Anthony gives you some advice and you manage to sign in remotely. The day after, Sean gets back to you, with a different piece of advice concerning the printer issue both you and your team members encountered. You share the solution with your team members on Monday and it proves helpful for everyone.

[No Reputational Benefit condition] Your company's switch to a new software has created two new issues for you: you aren't able to use the office printer, and have trouble signing in to your workspace remotely. Both are equally annoying. Talking to other members of your team, you realize they've also encountered issues with the printer. During lunch with two friends who work in IT, Anthony and Sean, you mention both issues and ask for help. Later that day, Anthony gives you some advice and you manage to sign in remotely. The day after, Sean gets back to you, with a different piece of advice concerning the printer issue both you and your team members encountered. You want to share the solution with your team members on Monday, but it turns out the company IT crew has already sent an email providing the same solution.

After reading the randomly assigned vignette, participants were asked to indicate which source they felt more grateful to, with the added option of choosing "neither," as in the previous experiments.

10. Results

Like in the previous analyses, we removed those answers that indicated no gratitude ($N = 12$ in the Reputational Benefit condition, $N = 13$ in the No Reputational Benefit condition) and analyzed the data using a Z-test on proportions of the aggregated answers. Confirming our hypothesis, the results showed that the proportion of participants more grateful to the first source was significantly lower (43.18%) when the second source's advice led to reputational benefits, than when the second source's advice provided no reputational benefits (63.21%; $X^2 = 6.27$; $p = .01$, Fig. 2).

11. General discussion

Experiment 1 showed that participants felt more grateful to those who had provided them with information that was (i) more beneficial (to the recipient), (ii) more costly to acquire (for the source), and that was delivered (iii) intentionally, and (iv) gratuitously, without expectation of immediate return. In Experiment 2, participants felt less grateful to sources that addressed a larger audience, presumably because they felt that the information was not transmitted for their benefit in particular (decreasing perceived intentionality). Experiment 3 showed that participants felt more grateful for information they could pass along to others themselves, thus eliciting gratitude in turn.

We also conducted an Experiment 4 (reported in the ESM) testing whether people revise their estimates of gratitude towards a source when the information they communicated is confirmed at a later point. The underlying intuition was that people (e.g., pundits) might formulate an idea with no evidence backing it up, yet receive gratitude as the idea's first proponent when the idea is later proven right by someone else. However, Experiment 4 could not demonstrate that participants revise upwards their estimate of how grateful they feel towards a source when the information they had communicated is later confirmed. It is possible that we attempted to test Experiment 4 in context that were too abstract, with an overly complex design.

We also conducted a series of experiments testing whether people would expect others to alter their communicative behavior in order to increase the gratitude felt by their audiences (reported in the ESM). With the exception of one study, these experiments failed to demonstrate such expectations. We do not draw strong conclusions from these experiments, as it is possible that participants would be, on the whole, reluctant to explicitly consider strategic uses of information to elicit

gratitude, as such considerations would jeopardize their very goal: if an audience learns that we communicated information in a specific manner to elicit gratitude, the information would likely elicit much less gratitude (on the contrary, it might elicit resentment; on the general dislike for explicitly processed moral decisions, see, Jordan, Hoffman, Nowak, & Rand, 2016). We had attempted to circumvent that issue by asking participants not what they would say in a given situation, but what they expected someone else to say. It appears even in these conditions, however, the attempted manipulation of gratitude in the audience might have been too obvious.

12. Conclusion

Human societies could not function if people did not engage in prosocial behavior with no immediate benefit expected in return. This includes the prosocial provision of information, from informal advice to on-the-job training. Gratitude fuels prosocial behavior: it motivates the recipients of prosocial behavior to reciprocate, and the providers of prosocial behaviors to keep providing. We suggest that epistemic gratitude plays an analogous role for the transmission of information.

In a series of experiments, we show that epistemic gratitude behaves as expected based on our current understanding of the function of gratitude (Algoe et al., 2013; McCullough et al., 2008; A. Smith et al., 2017; Tsang, 2006a), on the one hand, and the special properties of information on the other. In the present experiments, participants declared feeling more grateful when they received information that was more beneficial (which includes information that can be passed along in turn), that had been more costly to acquire, that was transmitted more intentionally (which includes being transmitted to a smaller audience), and more gratuitously. By contrast, we were unable to properly elicit participants' intuitions about how to communicate so as to elicit maximum gratitude in the audience. We also note that we did not attempt to test whether epistemic gratitude actually led to more prosocial acts, by contrast with past experiments with gratitude more generally (see, e.g., Bartlett & DeSteno, 2006; Tsang, 2006a).

These experiments are (to the best of our knowledge), the first to show that people feel more grateful when they receive something gratuitously, and the first to show in the same experimental set-up that gratitude reacts to the four factors mentioned above (benefits, costs, intentionality, gratuitousness). The current studies also extend the concept of gratitude to the reception of information, and investigate specific properties of information—in particular, its potential non-rival nature—that should affect how grateful people feel for the information they receive. Finally, even if our attempt at showing people communicate strategically to elicit gratitude failed, we hope the experiments reported here might serve as a conceptual basis for future studies, using different paradigms. In conclusion, we now speculatively explore the potential effects of epistemic gratitude on how information is transmitted, before briefly turning to the limitations of the current studies and offering suggestions for future directions.

12.1. Potential effects of epistemic gratitude on the transmission of information

More beneficial information elicits more gratitude. This feature of epistemic gratitude should have several consequences that might appear counter-intuitive. Firstly, it suggests that we would feel more grateful for information that leads to more belief revision (assuming the information is accurate and has tangible consequences on one's outcomes). This is likely what happens in some cases—if you're considering investing in a scam, you should be more grateful to someone who warns you about the scam if you were completely sure to invest otherwise, than if you were merely considering the option. This suggests that people should seek and share information that will lead their friends, colleagues, etc. to change their minds. This may seem contradicted by the fact that much information gathering and transmission, which on the contrary, tends to

comforts people in their pre-existing point of view (e.g., S. M. Smith et al., 2008). However, we must note that, for a given class of beliefs, such as political opinions, the accuracy of the belief has little or no immediate consequences for the believer. Instead, holding these beliefs is more likely to have social, reputational consequences. In this context, we might feel grateful not to someone who tells us that our beliefs are inaccurate, but to someone who tells us that our beliefs would, contrary to what we thought, be poorly perceived by relevant audiences, or someone who provides information which can justify or rationalize the beliefs we hold (Mercier, 2020; Williams, 2023).

Second, as negative information tends to be more beneficial than positive information (hence the negativity bias in information search, see, e.g., Robertson et al., 2023), we should be more grateful when we receive negative than positive information (everything else equal). For instance, we should feel more grateful to someone whose advice stops us from losing 1000€, than information that allows us to earn an extra 1000€ (see, e.g., Kahneman & Tversky, 1991). However, everyday discourse exhibits a positivity bias (Dodds et al., 2015), and people appear to resent the bearer of bad news (John et al., 2019). Regarding the positivity bias in everyday discourse, this might be related to the fact that much of this discourse has a phatic function (e.g., Berriche & Altay, 2020), that is, the goal is not to transmit information, but to display one's positive intentions. Moreover, sharing positive information can have positive reputational consequences (Altay et al., 2024). Regarding the bearer of bad news, it is plausible that the experimental evidence did not properly take into account the pragmatic dimension of the delivery of bad news. When we deliver bad news, we tend to be very careful, and to stress that we empathize with the audience, something that was not reflected in the vignettes. Moreover, in these experiments the bad news being shared was not necessarily very useful (i.e. it couldn't usefully guide future behavior). In these conditions, it might make sense that people feel resentment, instead of gratitude, towards the bearers of bad news.

Third, as shown in Experiment 3, one feature of information that makes it more beneficial to the audience is that they can pass it along. This, combined with the fact that sharing a piece of information with a large audience tends to elicit less gratitude (Experiment 2), might help explain the main mode of transmission of rumors, which are often propagated in long "narrow" chains, from one person or very small group to the next. This mode of transmission might help maximize how grateful the people who receive the rumor feel, and it might also help explain why rumors become inaccurate (as each episode of transmission increases the odds of inaccuracies, exaggerations, etc.), and why they are not corrected (in the absence of a broadcast of the rumor, people in a position to refute it might not hear of it until it's too late, see, e.g., Morin, 1969).

Finally, given the stark decrease of the marginal value of acquiring the same information, we can predict that those who want to incite epistemic gratitude in their audience will be especially motivated to provide the information quickly to ensure being first and reap most of the public gratitude. This might explain why journalists dislike being "scooped" and why they consider breaking a story quickly as important (Van der Wurff & Schoenbach, 2014). This motivation might play a role in the dissemination of unchecked or incomplete information, especially in situations where competition for providing information is salient, such as the news sector or scientific publishing. It might also be a contributing factor to why replications aren't more popular in science: because they don't obviously increase the benefit to other scientists through belief revision, even if they can provide better evidence for a known effect.

More costly-to-acquire information elicits more gratitude. We might expect the apparent cost of acquiring a piece of information to lower attributions of competence, even though they increase gratitude (see Experiment 1). For example, a doctor who provides the correct diagnosis immediately might be perceived as more competent than one who has to search extensively to reach the same conclusion. As a result, there might

be interesting tradeoffs in the way we present the costs of information search and acquisition: if we want to maximize gratitude in the audience (e.g., in order to signal how much we care for them or how much weight we put on their well-being), we should stress the costs, while if we want to appear competent, we should on the contrary minimize the costs (at least in terms of the intellectual difficulty of the task). To take extreme examples, this might help explain why some religious figures are presented as having paid a very high cost to deliver their message (Jesus Christ and the gospel being the paradigmatic example, see, e.g., Ross, 1997), while by contrast scientists might be more keen on describing their discoveries as a flash of insight (neglecting the many hours of reading, studying, pondering, etc. that led to that insight, see, e.g., Cohen, 1985).

There are likely ways of maximizing both how grateful the audience might feel, and how competent they perceive the source to be. One possible strategy could be emphasizing the costs of transmission, rather than acquisition: in this case, one can still reap the reputational rewards of competence attributions (it took one no time to think of something very clever) while at the same time showing they care about the audience (they incurred a substantial cost to give them the information).

By taking credit for others' ideas, people can be perceived as more competent (Altay et al., 2020). It might also elicit more gratitude, if the audience assumes that coming up with the (apparently) new idea was more effortful than reporting what someone had said. This might help explain why participants, in a variety of experimental settings, fail to mention that their ideas came from others (Claidière et al., 2017; Dockendorff & Mercier, 2024; Mercier et al., 2019). It is thus possible that reputational concerns might encourage people to fail to display intellectual humility (see, Porter et al., 2022) by properly acknowledging the debt they owe others for their ideas.

Information transmitted intentionally elicits more gratitude. There are several ways through which people attempt to mimic the intentional transmission of information to an individual in particular, when in fact information was mass produced. In particular, that might be one of the perceived advantages of personalized marketing: people would feel (somewhat) more grateful for messages that look as if they have been sent to them specifically (on personalization in marketing, see, Chandra et al., 2022).

If the gratitude of the audience decreases the more a message is broadcast (by contrast with being directed to a specific individual), the attributed competence of the source should not behave in the same way. That is, we should deem (say) a scientist who makes a discovery equally competent, regardless of how many people they shared their discovery with. As a result, people who address broader audiences might be more tempted to seek to appear competent (which can be done at scale), than to elicit gratitude in their audience (which is much harder to do at scale). For instance, sharing information about threats that have little or no practical import for the audience can make the source appear more competent (Boyer, 2021), but it might not elicit much gratitude from the audience (since the information is of no practical import). We would thus expect that information about such threats is more readily broadcast than shared in face to face settings. This might help explain the prevalence of information about threats in the media (e.g., Lundman, 2003), by contrast with the tendency to share positive information in face-to-face discussion (Dodds et al., 2015) or, when sharing information electronically, with a small number of people (Bright, 2016).

Information transmitted gratuitously elicits more gratitude. Providing others with information while suggesting we expect something in return should elicit less gratitude. As a result, we can expect to have two main equilibria for information transmission. Either something is obviously expected in return for providing a piece of information, or it is presented as being offered completely gratuitously. We can compare, for instance, information people pay for (from newspapers to textbooks), for which not much gratitude should be expected, and information for which gratuitousness is emphasized. For instance, religious proselytizers are typically keen on providing information for free, in the form of

pamphlets, lectures, etc. (e.g., Stark, 1984).

12.2. Limitations and future directions

Our experiments were pre-registered and sufficiently powered, so we can be relatively confident in their results. However, we also have to be mindful of the limitations of vignette-based studies. In particular, we are asking participants to imagine being in a given situation, and ask them about feelings of gratitude they would have in this situation. Our experiments would have had greater ecological validity if the participants had been actually made grateful through the provision of information—this would also have made it possible to measure whether these feelings prompt actual prosocial behavior. As a result, it is possible that our results stem from participants' expectations regarding when they would or should feel grateful, rather than from the actual cognitive mechanisms that trigger feelings of gratitude. Given that most of predictions, which are derived from theories about the cognitive mechanisms of gratitude, have been verified, we believe that the most economical interpretation of our results is that the cognitive mechanisms related to gratitude were triggered in the current experiment, but we cannot rule out alternative interpretations. Moreover, if expectations about gratitude had been driving our results, we would have expected the experiments in which participants were asked how they expected others would communicate to maximize gratitude to yield the predicted results, which they didn't (see ESM). By contrast, it is unlikely that demand effects could explain our results, as they do not seem to affect the results of this type of study more generally (Mummolo & Peterson, 2019).

We also note that all our experiments required participants to choose between two sources. We chose this design because we were concerned participants might be reluctant to indicate that they feel less grateful towards someone who has just provided them with useful information. However, if this social desirability concern proved unwarranted, then we would make the same predictions if, for instance, a different Likert scale of gratitude felt had been used for each source.

Finally, although experiments carried out with convenience online samples tend to replicate in representative samples (Coppock, 2018), they are still limited to a given culture. Past experiments have already highlighted interesting commonalities and differences in the way gratitude is expressed across cultures (e.g., Mendonça et al., 2018). Given that our predictions are derived from hypotheses about the function of feelings of gratitude, they should apply across human societies, but this remains to be tested.

More ecologically valid experiments could further test our conclusions. In particular, such experiments could aim at directly triggering gratitude, instead of asking participants to imagine how much gratitude they would feel, as in the present study. Besides these extensions of the present experiments, future experiments could find more subtle ways of studying whether people attempt to increase the gratitude of their audience when they present information (for instance by using between-participant designs). Finally, speculation above about the effects of epistemic gratitude on the transmission of information in a culture could also be tested, either through experiments, or through analysis of the spread of information, on social media for instance. We thus hope that the concept of epistemic gratitude will foster further research, and help make sense of our informational landscape.

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Mia Karabegovic: Writing – review & editing, Writing – original draft, Supervision, Methodology, Formal analysis, Data curation, Conceptualization. **Léo Wang:** Methodology, Conceptualization. **Pascal Boyer:** Writing – review & editing, Writing – original draft, Methodology, Conceptualization. **Hugo Mercier:** Writing – review & editing, Writing – original draft, Supervision, Resources, Project administration, Methodology, Conceptualization.

Declaration of competing interest

None.

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.evolhumbehav.2024.04.010>.

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