KELLEY SCHOOL OF BUSINESS
INDIANA UNIVERSITY
Department of Business Economics and Public Policy

False Modesty:
When Disclosing Good News Looks Bad*

Rick Harbaugh
Indiana University

Dr. Theodore To
Bureau of Labor Statistics

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Abstract

Is it always wise to disclose good news? We find that the worst sender with good news has the most incentive to disclose it, so reporting good news can paradoxically make the sender look bad. If the good news is attainable by sufficiently mediocre types, or if the sender is already expected to be of a relatively high type, withholding good news is an equilibrium. Since the sender has a legitimate fear of looking too anxious to reveal good news, having a third party disclose the news, or mandating that the sender disclose the news, can help the sender. The predictions are tested by examining when economics faculty at different institutions use titles such as "Dr" and "Professor" in voicemail greetings and course syllabi.

Key words: disclosure, persuasion, communication, verifiable message, countersignaling, private receiver information
JEL codes: D82, C78

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1 Introduction

If you have good news should you disclose it? The standard answer is yes because otherwise people will skeptically assume that you have nothing favorable to report (**?????**). But people are often unsure about whether to reveal good news, and nondisclosure is frequently observed in practice. For instance, talented students are often reluctant to brag about their grades, highly educated people do not always list their degrees, donors sometimes make anonymous donations, overachievers often engage in understatement, advertisers of high quality products frequently use a "soft sell" approach, and people accused of an offense sometimes withhold mitigating information rather than "protest too much" or "make excuses."

Most of the literature explains such anomalies by examining why the absence of good news is not always treated skeptically. Answers include that messages are costly (**????**), there are strategic reasons for withholding information (**????**), the sender herself is not always fully informed (**?????**), or the receiver is naïve (**?**), uninformed (**?**), or boundedly attentive (**?**).

While these approaches explain many cases of nondisclosure, they do not capture the idea that boasting about good news might itself be treated skeptically. To see how revealing good news can paradoxically make one look bad, we consider situations where the sender can reveal good news that is unambiguously favorable and perhaps even the best available, but still not impressive. When good news is relatively common, is boasting about it still a good idea? Or is boasting treated with such skepticism that modesty is the best policy?

Consider whether a restaurant should disclose its health department ratings. Starting in 1998, Los Angeles health officials began requiring restaurants to post large hygiene grades at their entrances, with a high proportion of grades being an A (see **?**). Why was it necessary to require even A restaurants to disclose their grade? Suppose diners have their own opinions based on experience or reputation, so good restaurants tend to do well even without disclosure. In this case it is the worst restaurants within the A category who have the strongest incentive to prove that they meet basic hygiene standards. Given this incentive, disclosure of even an A grade can be interpreted by diners as a bad sign.

Or consider whether a person with a PhD should use the title "Dr." In many environments PhDs are relatively rare so using a title is a strongly favorable signal of the person's professional credentials and we would expect titles to be used frequently. But in other environments, such as research universities, PhDs are quite common. In some fields faculty interact frequently with non-academics so a PhD might still be worth boasting about, but in other fields most interactions are between academics who expect each other to have PhDs. In these fields using a title might then be interpreted not just as redundant, but as a signal of insecurity that the person fears being thought of as unqualified without the title.

To capture the intuition of these examples we relax the assumptions of standard disclosure models in two ways. First, rather than assuming that the sender can fully reveal her type with a verifiable message, we assume that verifiable messages can only reveal a range within which the sender's type falls. This coarseness of the message space is natural for most applications since there is likely to be a fixed set of messages that have some institutional mechanism for verfication. For instance, a person cannot reveal her exact ability, but can reveal the good news of having received a degree. Or a restaurant cannot reveal its exact quality, but can reveal its hygiene grade.[1]

Second, we differ from the literature in allowing the receiver to evaluate the sender based in part on his own private information about the sender, e.g., a diner has his own impression of a restaurant's quality or a student has his own impression of a professor's ability. If there is any such information, no matter how weak, the receiver will have a more favorable impression of higher quality senders even without disclosure, so higher quality senders have less incentive to disclose. In contrast, if the message space does not reveal type exactly and there is no such private receiver information then, since disclosure is costless, each type with the same message has the same incentive to disclose. Therefore, allowing for private receiver information can be thought of as a robustness requirement for disclosure games that eliminates the knife-edge case where each sender has exactly the same incentive to disclose.

With this added realism, we find that disclosure need not be the unique equilibrium.[2] Instead, we find that a nondisclosure equilibrium surviving standard refinements always exists if good news is attainable by sufficiently mediocre types. For instance, in the case of restaurant hygiene cards, the system allows a high proportion of restaurants to receive an A. Similarly,

[1] **?** show sufficient conditions for disclosure to be the unique equilibrium when for each type there is a verifiable message for which that type is the worst type that can send the message. Here we are finding conditions for disclosure and non-disclosure when that assumption does not hold.

[2] The multiplicity of equilibria allows the model to capture the possibility that certain equilibria are focal for traditional or cultural reasons. For example, while full professors in Germany often use the full title "Herr Professor Doktor," medical doctors in Britain switch from "Dr" to "Mr" upon becoming a member of the Royal College of Surgeons.

the phenomenon of grade inflation means that even moderately serious high school and college students receive primarily A grades. Since the worst types with good news have the most incentive to reveal it, boasting about good news is not necessarily a positive sign and nondisclosure can be an equilibrium.

From an empirical perspective, the model predicts that the frequency of nondisclosure should be negatively correlated with the rarity of the good news. For instance, in the restaurant example if it became more difficult to receive an A then we would expect more disclosure. Even if the standard for good news does not change, the model implies that the frequency of disclosure should be negatively correlated with any public signal that is positively correlated with sender type. That is, if the conditional distribution of sender types is weighted toward higher types because of a favorable public signal, then good news is no longer that impressive so disclosure is less likely. In contrast with many sender-receiver models, the predictions can therefore be readily tested using public information.[3]

Based on this implication, we test the model by looking at when faculty use the title of "PhD," "Dr" or "Professor" and when they forgo such a title. In particular we look at the use of these titles in voicemail greetings and course syllabi by PhD-holding full-time faculty in the 26 economics departments in the University of California system and California State University system. We predict that the use of titles will be less common in the eight departments with doctoral programs than in the 18 departments without doctoral programs for two reasons. First, faculty in the departments with doctoral programs have less need to distinguish themselves from non-PhD faculty and lecturers since these groups are much less common in their universities. Second, faculty in these departments are likely to interact more frequently with other faculty who already expect that they hold a PhD. Consistent with predictions, we find that faculty in departments with doctoral programs are significantly less likely to use a title in voicemail greetings and syllabi than faculty in departments without doctoral programs. In fact, consistent with the idea that advertising only mildly positive good news is viewed negatively, faculty appear to deliberately avoid titles, e.g., stating "You have reached the office of X" instead of "This is Professor X" in voicemail greetings, or substituting "Instructor" for "Professor" in course

[3] In a signaling model the size of the signal is normally increasing in the sender's type which is the sender's *private* information. Since sender type is not known by the receiver it is typically not known by the econometrician, so empirical tests often use indirect methods to evaluate the theory (**?**). Here we predict that understatement is more likely based on *public* signals of the sender's type.

syllabi.

The model offers new insight into several policy issues that have been extensively debated from different perspectives. First is the long-standing question of when disclosure should be mandatory. The existence of nondisclosure equilibria implies that mandatory disclosure, or having a third party disclose the news, can reduce communication problems due to nondisclosure and due to confusion over multiple equilibria. By allowing the sender to enjoy the benefits of favorable information without looking overly anxious to disclose it, mandatory or third-party disclosure can also have positive incentive effects. For instance, **?** found that restaurant hygiene, as measured by inspectors and also as reflected in the incidence of food-related illnesses, improved after restaurants were forced to post their grades. Similarly, if students are reluctant to brag about their grades, then directly posting their grades ensures that the information is released, thereby increasing study incentives for students.

A second policy issue is how difficult it should be to meet different standards such as those for school diplomas or other certificates of quality. The literature on standard setting typically trades off the gains from forcing higher quality among those who meet the standard against the losses of lower rates of attainment (**?**). Our model suggests higher standards have the additional advantage of being less likely to induce a nondisclosure equilibrium. For instance, a tougher grading system might induce more rather than fewer students to try to make good grades.

Finally, the model offers new insight into the question of how fine or coarse standards should be, e.g., whether to use numerical grades or letter grades. Our nondisclosure results depend on there being a sufficiently large range of types who can meet the standard. If the message space is sufficiently fine and accurately measures quality, we show that full disclosure is the unique equilibrium.[4] This generalizes the standard "unravelling result" that types with the best news reveal it, so types with the next best news will also reveal it so as not to be thought of as even worse, and so on until all types reveal their information (**??????**).

This result on the fineness of verifiable messages also has implications for how prior information about the sender affects the incentive to disclose. If the receiver already has a relatively accurate estimate of the sender's quality based on a public signal, then the message space conditional on this information is effectively less fine in that it provides less additional infor-

[4] Note though that finer information revelation does not always benefit the sender, e.g., a school might prefer to withhold grade information (**?**).

mation. If the public signal is accurate enough we find that non-disclosure is an equilibrium, so this support the intuition that boasting is most likely when there is little public information about the sender. This complements a similar argument made by **?** in the context of a signaling environment where boasting is costly.

The idea that an eagerness to show off can reflect unfavorably on the sender was first formalized by **?** who analyzed a two-period game in which a firm decides whether or not to immediately disclose news that will eventually be made public anyway. They show that holding back on good news hurts a firm temporarily, but eventually separates a high quality firm from a low quality firm that is less likely to have additional good news in the future.[5] In contrast, we consider a standard disclosure game in which there is only one period and the receiver does not learn of news that is withheld.[6] Our approach is closest to that of **?** who analyze how private receiver information affects signaling games. The main difference is that we consider a disclosure game with a restricted space of free and truthful messages while they consider a signaling game with an unrestricted space of increasingly expensive messages that depend on their cost for their credibility. They find that senders who are of high quality based on their own private information might "countersignal," i.e., pool with low quality types, in order to show their confidence. We find that a similar pattern can arise in our model, but most importantly we find that senders who are already expected to be of high quality based on *public* information tend to withhold good news. Therefore our model captures the simple intuition that those who are recognized as high quality are less likely to engage in self-promotion, even when it is entirely costless. Because the predictions are based on public rather than private information, the model is readily subject to empirical testing using field data.[7]

In addition to **?** and **?**, the question of understatement in sender-receiver

[5] In addition to the assumption that the sender's news is eventually revealed independently of the sender's disclosure decision, Teoh and Hwang's two-period game has two additional assumptions that reflect the institutional environment they consider. First, the sender receives a payoff both immediately after the choice to disclose and later after the original news and any additional news is revealed. The equilibrium depends on the rate at which the second payoff is discounted. Second, the sender's news has a direct effect on sender payoffs beyond the usual indirect effect via receiver estimates of the sender's type.

[6] Allowing the receiver to learn the news from another source with some probability does not affect our results unless this probability is decreasing in sender type. In this case higher rather than lower types can have a greater incentive to disclose.

[7] **?** test their model in an experimental setting where the experimenter can control the subjects' private information.

games is investigated in several other papers. **?** shows how countersignaling can arise when multiple receivers have different information. **?** show that an already successful type might engage in false modesty regarding a new endeavor when success is likely but not assured. Other models consider why signals might not be monotonically increasing in type when the costs and benefits of signals are viewed more generally, e.g., there are opportunity costs of signaling (**???**), social costs to not conforming (**?**), or additional non-monotonic benefits from signaling (**?**). Understatement in one dimension can also arise when there are multi-dimensional signals, e.g., the combination of high prices and modest advertising can signal high quality (**??**), and the combination of high prices and low observable quality can signal high unobservable quality (**?**). Good news in one dimension might also be withheld when it attracts attention to bad news in other dimensions (**?**). And understatement can result when a one-dimensional signal is the only way to convey information on multiple attributes (**?**). In particular, if people vary in their concern both for being good and for being perceived as good, they might conceal good deeds to avoid the appearance of caring too much about appearances (**?**).[8]

In the following section we provide a simple model following the PhD example introduced above. In Section 3 we develop a model with multiple levels of good news that allows us to address more aspects of the problem. In Section 4 we provide an empirical test of the model based on how titles are used by academic economists and in Section 5 we conclude the paper.

2 An example

To see how even a little private receiver information can lead to a nondisclosure equilibrium when messages cannot full reveal type, consider the example of an instructor (the sender) and a student (the receiver). For simplicity assume that instructor quality q is distributed uniformly on $[0, 1]$ and that the instructor's payoff is just her expected quality. Assume that instructors with quality above some standard q^* have a PhD while others do not. Instructors cannot directly reveal their quality q, but they can choose to reveal the less informative signal that they have a PhD if in fact they have one.

First consider the case where the student does not have any private information. If the student expects the instructor to reveal her PhD if she has

[8] Dynamic principal-agent models where high types try to pool with low types to avoid harder assignments, e.g., ratchet effect models (**?**), also capture an incentive to be understated. Avoiding jealousy is of course another factor.

one, then an instructor's payoff is $E[q \mid q \geq q^*] = (1+q^*)/2$ from disclosure but only $E[q \mid q < q^*] = q^*/2$ from nondisclosure. So clearly an instructor with a PhD is better off revealing it and disclosure is an equilibrium. What if the student does not expect disclosure? Then the instructor's payoff is $E[q] = \frac{1}{2}$ from nondisclosure and the payoff from disclosure depends on what the student believes if the instructor unexpectedly discloses. The equilibrium refinements literature argues that receiver beliefs should reflect the relative incentives of different types to deviate, but in this disclosure game sending messages is costless so all types of instructors $q \geq q^*$ have exactly the same incentive to deviate. As discussed by **?**, in this case standard refinements used in signaling games do not apply to disclosure games so it is unclear what beliefs are appropriate.[9]

This indeterminancy arises from the knife-edge, nature of disclosure games when messages cannot fully reveal type. In practice, it is improbable that the incentives for different types to disclose are exactly the same. To see this, suppose the student has any private information about the instructor. By private information, we mean information available to the student at the time of evaluating the instructor, but not known by the instructor at the time of making the disclosure decision. For instance, the student could make a judgement about the professor based on perceived similarities with other professors the student has encountered. Or the student could form an impression of the instructor's ability over the course of the semester. We assume that the student's information is at least slightly informative about the instructor so that the knife-edge nature of the game is broken, but not so informative that the disclosure decision is irrelevant.

In particular, assume the student has a binary private signal L or H where the chance of an H signal is higher for better instructors. For simplicity, assume $\Pr[H \mid q] = q$, although the results hold as long as $\Pr[H \mid q]$ is strictly increasing in q. This information does not affect the existence of the disclosure equilibrium in which types $q \geq q^*$ reveal their good news, but what about a nondisclosure equilibrium in which instructors never disclose their PhD? In such an equilibrium if the student has an H signal the instructor's expected quality is $E[q \mid H] = \int_0^1 q \Pr[q \mid H]dq / \int_0^1 \Pr[q \mid H]dq = \int_0^1 q \Pr[H \mid q]dq / \int_0^1 \Pr[H \mid q]dq = 2/3$, and if the student has an L signal the instructor's expected quality is similarly $E[q \mid L] = \int_0^1 q \Pr[L \mid$

[9] Perhaps the most natural assumption is that the student has "passive beliefs" (**?**) .nd maintains his prior belief that the instructor's quality is distributed uniformly on $[q^*, 1]$. In this case the instructor's payoff from disclosure is, as before, $E[q \mid q \geq q^*] = (1+q^*)/2$ which is greater than $E[q] = 1/2$ so all instructors will deviate and non-disclosure is not an equilibrium.

$q]dq/\int_0^1 \Pr[L \mid q]dq = 1/3$.[10] Therefore, an instructor of type q has an expected payoff from nondisclosure of $qE[q \mid H]+(1-q)E[q \mid L] = q\frac{2}{3}+(1-q)\frac{1}{3}$, which is increasing in q. For instance, if $q^* = \frac{1}{3}$ then the worst type with a PhD ($q = q^*$) receives a payoff from nondisclosure of $\frac{1}{3}\frac{2}{3} + (1 - \frac{1}{3})\frac{1}{3} = 4/9$, while the best type with a PhD ($q = 1$) receives a payoff from nondisclosure of $1\frac{2}{3} + (1 - 1)\frac{1}{3} = 2/3$.

Since the worst instructor with good news receives the lowest payoff from nondisclosure, the worst instructor will deviate and disclose for a wider range of belief supportable payoffs for disclosure than other instructors. Therefore, we can now apply standard refinements which say that the student should put more weight on a deviation having come from this instructor. For instance, D1 (**???**) says that all weight should be put on type $q = q^*$, implying that the payoff from disclosure is $q^* = 1/3$. But when disclosure is viewed so skeptically, the payoff from disclosure is less than from nondisclosure, $1/3 < 4/9$, so nobody will deviate and the nondisclosure equilibrium survives.[11]

This is seen in Figure 1(a) where the return from nondisclosure is increasing in sender type. Among those who can disclose, for any q^* type $q = q^*$ receives the lowest payoff from nondisclosure so she has the most incentive to deviate. Therefore, as shown more formally in the next section, skepticism regarding types who unexpectedly disclose is appropriate based on standard belief refinements. Figure 1(b) shows the disclosure equilibrium for $q^* = 1/3$ in which all types with good news disclose, and Figure 1(c) shows a countersignaling equilibrium[12] for $q^* = 1/3$ in which only medium types within the range $[1/3, 0.885)$ disclose. The countersignaling equilibrium arises because the highest types expect to be partially separated from low types due to the receiver's private information. As seen in Figure 1(d), in this example the disclosure equilibrium offers all types $q \geq q^*$ a higher payoff, but in general the payoffs cannot be ranked.[13]

Given the multiplicity of equilibria, confusion over whether one should disclose, and who might have disclosed if disclosure is observed, is clearly

[10] In these calculations we have used the fact that, with the uniform distribution, $\Pr[q \mid x] = \Pr[x \mid q]/\int_0^1 \Pr[x \mid q]dq$ for $x = L, H$.

[11] The nondisclosure equilibrium also survives the Intuitive Criterion (**?**) because any type is willing to deviate if it will be perceived as the best type by doing so, implying that no type can be ruled out as the source of a deviation.

[12] We use this terminology due to the equilibrium's similarity to the countersignaling equilibria identified by **?** in signaling games.

[13] For instance if $\Pr[H \mid q] = q^3$, then some types $q \geq q^*$ prefer the nondisclosure equilibrium to the countersignaling equilibrium, and the highest types prefer the countersignaling equilibrium to the disclosure equilibrium.

nondisclosure.mps11

(a) Nondisclosure equilibrium

disclosure.mps11

(b) Disclosure equilibrium

countersignaling.mps11

(c) Countersignaling equilibrium

compare-equil.mps11

(d) Equilibria compared

Figure 1: Expected payoffs as a function of q for different equilibria

understandable. With respect to deviations from the nondisclosure equilibrium, note that strong, D1-like refinements play the opposite role in this model than they do in standard signaling games. In particular, D1 eliminates pooling equilibria in standard signaling games because better types have lower signaling costs so they are willing to deviate for a larger range of payoffs. In this model the presence of private receiver information and the absence of signaling costs reverses the incentives to deviate. Better types do not have any lower costs of disclosing so they are no more eager to deviate than worse types. Instead, because of the private receiver information, better types expect to be evaluated more favorably in the nondisclosure equilibrium, so they must be given a larger payoff to induce them to deviate. Therefore, skeptical beliefs are not just permitted under D1 but are actually *required*.[14]

As this simple example highlights, allowing for any private receiver in-

[14] **?** find that in the presence of private receiver information D1 can lose its power to ensure a unique equilibrium in signaling games. However, D1 still implies a unique equilibrium in signaling games if the private receiver information is not too important and signaling costs are decreasing in type at a sufficient rate. In disclosure games the role of signaling costs is not present so the effect of private receiver information always dominates even if the information is very weak.

formation at all changes disclosure games considerably when the sender's quality cannot be fully revealed by the verifiable message. As a result, the question is not just identifying conditions under which nondisclosure equilibria can exist, but finding reasonable conditions under which nondisclosure equilibria can be ruled out. For instance, if the standard q^* for receiving a PhD is high enough then even if the student viewed disclosure of a PhD with complete skepticism and thought the instructor was of type q^*, the payoff from disclosure would still be higher than from nondisclosure. In the following section we develop a more general model with multiple levels of good news to examine when nondisclosure of some form is an equilibrium and when disclosure is the unique equilibrium.

3 The model

In this sender-receiver game the sender knows her type $q \in [0, 1]$, the sender sends a message v that is potentially informative about q, and the receiver has his own signal x that is informative about q. The timing of the game is that the sender first learns her type q and then sends the message v. The receiver learns his private information x either before or after hearing the sender's message v. After learning x and hearing v the receiver then takes an action a.

In contrast with most of the literature, we do not assume that each sender type can send a unique verifiable message. Instead, we assume that there is a finite set of verifiable messages that disclose a subinterval of the sender's typespace, e.g., a system of diplomas or of letter grades. In particular, we assume that the sender typespace is partitioned into $N + 1$ nonempty subintervals by a set of strictly increasing standards $\{q_1^*, q_2^*, \ldots, q_N^*\}$ and that the sender can send the verifiable message $v = v_j$ if and only if $q \in [q_j^*, q_{j+1}^*)$ for $j = 1, 2, \ldots, N$.[15] In addition, there is a "blank" message v_0 that can be sent by any type, including types $q \in [0, q_1^*)$ who do not have a verifiable message.[16] Therefore the message profile is $v(q) \in \{v_0, v_j\}$ for $q \in [q_j^*, q_{j+1}^*)$ and $j = 0, 1, \ldots, N$. We refer to sending v_0 as "nondisclosure" and to sending any other message v as "disclosure."

The fact that the receiver has some private information x further distinguishes the model from most of the literature. The effect of such information

[15] Following convention, we define $q_0^* = 0$ and $q_{N+1}^* = 1$ and ignore the open/closed set distinction in the notation for the final subinterval $[q_N^*, q_{N+1}^*]$.

[16] For instance, a person has a certificate to prove that she passed an exam but nothing to prove that she failed it. This assumption that the lowest types do not have a verifiable message simplifies the presentation.

is to exclude the knife-edge case where different senders with the same verifiable message have exactly the same incentive to disclose. Therefore, we do not require this information to be particularly informative. Instead, we only require that a higher q is associated with a higher x and that x is never fully revealing about q. In particular, we assume that $x \in X \subset$ where the joint distribution $F(q, x)$ has full support, has no mass points, and displays strict affiliation on $[0, 1] \times X$.[17]

Regarding payoffs, to simplify the presentation we make the standard assumption that the receiver maximizes his payoff when the action a equals his estimate of the sender's type and that the sender's payoff equals this estimate. That is, we assume that the receiver's payoff function takes the quadratic loss form, $u^R = -(q - a)^2$ and the sender's payoff function takes the linear form $u^S = a$.[18] Note that in this disclosure game v does not have a direct impact on either player's payoff. Its only influence is via the receiver's estimate of q and consequent action a.[19]

We consider only pure strategy equilibria so a strategy is a mapping between types and messages. Let the function $\mu(q \mid x, v)$ be a conditional cumulative distribution function representing receiver beliefs about the sender's type given the message v and private information x. Our equilibrium concept is that of a pure-strategy perfect Bayesian equilibrium.

A *pure-strategy perfect Bayesian equilibrium* is given by a verifiable message profile $v(q)$, a receiver action profile $a(x, v)$, and receiver beliefs $\mu(q \mid x, v)$ where:

i) For all q, $v(q) \in \arg\max_{v'} E[u^S(a(x, v')) \mid q]$;

ii) For all x and v, $a(x, v) = \arg\max_{a'} E_\mu[u^R(q, a') \mid x, v]$;

iii) $\mu(q \mid x, v)$ is updated from the sender's strategy and F using Bayes' rule whenever possible.

[17] Our results also hold for the case without private information if the receiver is assumed to be skeptical despite senders having the exact same incentive to disclose. However, as discussed in the example, standard refinements offer no direction on what beliefs are appropriate in this knife-edge case.

[18] Based on Theorem 2 of **?**, it can be shown that affiliation of x and q implies that our results hold as long as the receiver's payoff function $u^R(q, a)$ satisfies the single-crossing property and the sender's payoff function $u^S(a)$ is strictly increasing in a. The model can also be generalized to allow for messages and actions by multiple players following **?**.

[19] In this respect disclosure games are similar to cheap talk games (**?**). However, because of the verifiability restriction, they can also be thought of as an extreme form of signaling games in which signaling for low types is infinitely expensive and signaling for high types is costless.

Condition i) requires that the sender's message is a best response to the receiver's expected actions. Condition ii) requires that the receiver's action is a best response to the sender's message. Condition iii) requires that for any information set that can be reached on the equilibrium path, the receiver's beliefs are consistent with Bayes' rule and the equilibrium sender strategy. We are often interested in the simple case where the receiver believes that a certain subset of types either disclose or do not disclose. Therefore we define the expected quality of the sender given x and given that the sender is believed to be in set $Q \subset [0,1]$ as $\bar{q}_Q(x) = E[q \mid x, q \in Q]$.

In this model it is always an equilibrium for all types who can disclose to disclose. The proof (and all subsequent proofs) is in the Appendix.

A full disclosure equilibrium always exists.

In standard disclosure models without private receiver information and with a verifiable message for each type, full disclosure is the unique equilibrium due to "unravelling." Since types with the best news will always reveal it, types with the next best news will therefore also reveal it, and so on until all news has been revealed. In the example of Section 2 with only binary news, it was shown that unravelling in our model can fail at the very first step—even the types with the best available news might not reveal it. We are interested in conditions under which the best types will in fact reveal their news and, when there are multiple levels of news, how far unravelling will continue.

To this end, for any $0 < q' \leq q'' \leq 1$, define

$$q^{\circ}(q', q'') = \sup_{Q} \{E[\bar{q}_Q(x) \mid q = q''] : [0, q') \subset Q \subset [0, q'')\}. \tag{1}$$

This is the maximum possible nondisclosure payoff for sender $q = q''$ over the set of beliefs where the receiver believes senders with quality below q' never disclose and senders with quality above q'' always disclose.[20] Since $E[\bar{q}_Q(x) \mid q]$ is increasing in q by the affiliation of x and q, this is also the maximum such payoff for any sender $q \leq q''$. Note that $q^{\circ}(q', q'')$ is continuous in q' since $F(q, x)$ has no mass points, is nonincreasing in q' since higher q' implies a tighter restriction on Q, and is increasing in q'' since $E[\bar{q}_Q(x) \mid q]$ is increasing in $q = q''$ and since higher q'' implies a weaker restriction on Q.

First consider the simplest case where $N = 1$. Since $q^{\circ}(q_1^*, 1)$ is the highest possible payoff to any type from nondisclosure, and since q_1^* is the

[20] We exclude cases where the receiver believes that the sender plays mixed strategies, but this is of no consequence as any expected mixed-strategy payoff can be attained through the appropriate choice of Q.

lowest possible payoff to any type from disclosure, disclosure is ensured if $q_1^* > q^\circ(q_1^*, 1)$. Since $q^\circ(\cdot\,,\cdot)$ is continuous and nonincreasing in its first argument, a q such that $q^\circ(q, 1) = q$ exists and is unique. Therefore, if we define $\tilde{q}_1$ as this fixed point, disclosure is ensured in any equilibrium for $q_1^* > \tilde{q}_1$. For instance, from the example of Section 2, computations show that $\tilde{q}_1 = 2/3$.

More generally, for any N we want to capture this idea that there is some set of standards such that disclosure is ensured if the actual standards are higher. Define

$$\tilde{q}_j = \begin{cases} q : q^\circ(q, q_{j+1}^*) = q & \text{if } j = 1 \\ q^\circ(q_1^*, q_{j+1}^*) & \text{if } j > 1 \end{cases} \tag{2}$$

where the upper bound for nondisclosing types in the definition of $\tilde{q}_1$ is now q_{j+1}^* rather than 1 and the same argument for existence and uniqueness still applies. For $j > 1$ the definition of $\tilde{q}_j$ depends on a given q_1^* because the presence of types $q < q_1^*$ who cannot disclose always affects the incentives of higher types to disclose or not.

Using this definition, now consider unravelling. If $q_N^* > \tilde{q}_N$ then types with the best news v_N will disclose, which means that the attractiveness of nondisclosure by types with news v_{N-1} decreases. So they will always disclose under the weaker condition that $q_{N-1}^* > \tilde{q}_{N-1}$. If they then disclose then this same logic applies to types with news v_{N-2}, etc. Because the $\tilde{q}_j$ are nondecreasing in j, unravelling implies that the standard for impressiveness becomes less strict as unravelling progresses from the best news down. For instance, if a PhD is sufficiently rare that it is disclosed, then it becomes more likely that an MA is disclosed, in which case it is also more likely that a BA is disclosed.

The following proposition uses these arguments to show when an equilibrium must involve a certain degree of disclosure. Unlike the classic unravelling results, this proposition does not imply that full unravelling or even any unravelling at all will necessarily occur. Instead, it gives conditions under which different levels of news are sufficiently favorable that they are always disclosed. In particular, a given level of news will be disclosed if it is sufficiently impressive conditional on higher levels of news being disclosed because they too are sufficiently impressive.

News $v \geq v_j$ is disclosed in any equilibrium if standards are sufficiently high, $q_k^* > \tilde{q}_k$ for all $k \geq j$.

This proposition shows that full disclosure can be an equilibrium if the verifiable news is sufficiently favorable. The following result extends the unravelling argument to show that full disclosure is the unique equilibrium if the verifiable information is sufficiently fine and accurately measures quality. When the verifiable messages separate the different types sufficiently well, the highest types have an incentive to disclose their (exceptionally) good news v_N even if they are thought of as being only of type q_N^* rather than from the range $[q_N^*, 1]$. Given that the highest types disclose v_N, the next highest types have an incentive to disclose v_{N-1} even under skeptical beliefs if q_{N-1}^* is sufficiently close to q_N^*, etc. If the difference between standards is sufficiently close for all the verifiable messages, i.e. the message space is sufficiently fine, then the unravelling continues until all news is disclosed. This result generalizes the usual unravelling result which relies on there being a verifiable message for each type.

News $v \geq v_j$ is disclosed in any equilibrium if the message space is sufficiently fine, $\max_{k \geq j}\{q_{k+1}^* - q_k^*\}$ is sufficiently small.

So far we have examined when full disclosure is the unique equilibrium or when any equilibrium must involve disclosure by those with sufficiently good news. Now consider nondisclosure. We expect that nondisclosure arises when q_j^* is relatively low so revealing good news is not so impressive. To check this intuition we consider the simplest case of a monotone nondisclosure equilibrium in which it is always the relatively bad news that is withheld. In particular, we are interested in sufficient conditions on q_j^* such that an equilibrium exists in which v_j and any worse news is not disclosed. To see this, consider the minimum value of q such that the expected payoff under nondisclosure of news v_j and lower is equal to q,

$$\hat{q}_j = \min\{q : E[\bar{q}_{[0,q_{j+1}^*)}(x) \mid q] = q\}, \tag{3}$$

where the existence of $\hat{q}_j$ follows from the fact that $E[\bar{q}_{[0,q_{j+1}^*)}(x) \mid q]$ is continuous in q and has range $[0, 1]$.[21] If the receiver skeptically believes that a sender who deviates from nondisclosure is of the lowest type who could deviate, then the highest payoff from disclosure of news v_j (or lower) is q_j^*. Therefore, nondisclosure is clearly an equilibrium if $q_j^* < \hat{q}_j$. The following proposition confirms this logic and shows that skeptical beliefs are appropriate under standard refinements.

An equilibrium in which news $v \leq v_j$ is not disclosed both exists and survives the Intuitive Criterion and D1 if the standard for it is sufficiently low, $q_j^* \leq \hat{q}_j$.

[21] Since $E[\overline{Q}_{[0,q_{j+1}^*)}(x) \mid q]$ is strictly increasing in j, it follows from Theorem 1 of **?** that $\hat{q}_j$ is strictly increasing in j.

This result implies that a full nondisclosure equilibrium exists if $q_N^* \leq \hat{q}_N$. In the example of Section 2 where $N = 1$, $\hat{q}_1$ is just the point where the minimum assured payoff from disclosure equals the expected payoff from nondisclosure. This is the intersection of the nondisclosure payoff line in Figure 1(a) with the 45° line, or $\hat{q}_1 = 1/2$ for this case of the uniform distribution. As we show more formally in Proposition 3, if the distribution of q is biased towards higher types then the nondisclosure payoff line is higher and $\hat{q}_1$ is higher, so if the receiver already believes the sender is likely to be of high quality then nondisclosure can be an equilibrium even if q_1^* is quite high. Note also that Proposition 3 gives a sufficient condition for the existence of a monotone nondisclosure equilibrium, but there may also be other more complex equilibria involving nondisclosure such as countersignaling equilibria.[22]

Regarding the appropriateness of the skeptical beliefs used in Proposition 3, the question is whether they are reasonable based on "forward induction" arguments about which types have the strongest incentive to deviate.[23] The Intuitive Criterion states that the receiver should put zero probability on a type having deviated if it would not benefit from deviation under the most favorable possible beliefs about who deviates. Clearly the Intuitive Criterion does not restrict any type from disclosing since every type would be very happy to disclose if they would be thought of as the highest type by doing so. So skeptical beliefs supporting a nondisclosure equilibrium cannot be ruled out. Regarding the D1 condition, in our contest it implies that if one type benefits from deviation for a smaller set of possible type estimates than another type, zero weight should be put on the former type (**???**). In a nondisclosure equilibrium higher types expect to be evaluated more favorably than lower types because of the private receiver information, so they have less incentive to deviate than lower types. Therefore, not only does D1 have no power to refine away the nondisclosure equilibrium, it actually reinforces it by dictating that *out-of-equilibrium actions must be viewed*

[22] If, as in the example, $N = 1$, q is distributed uniformly, and X is binary, a countersignaling equilibrium exists in which types $q \in [q_1^*, q']$ disclose while types $q \in (q', 1]$ do not for some $q' \in (q_1^*, 1)$ if $q_1^* < \hat{q}_1$. This is the same sufficient condition as for existence of a nondisclosure equilibrium. Moving beyond this special case, sufficient conditions for such equilibria are difficult to attain.

[23] Recall from the discussion in Section 2 that without private receiver information the incentive to deviate from nondisclosure would be the same for each type, so forward-induction refinements have no impact and any beliefs are technically possible. However, in this knife-edge case it makes more sense for the receiver to maintain his original priors concentrated on the range of types who can send the verifiable message, in which case nondisclosure is never an equilibrium.

skeptically.

Proposition 3 shows that if standards are set high enough then nondisclosure cannot be an equilibrium. Proposition 3 shows that if standards are set low enough then nondisclosure is always an equilibrium. The following proposition uses these results to show how the distribution of sender types affects the potential for nondisclosure equilibria. In particular it shows that if there is any common knowledge information that makes the conditional distribution more favorable, then the conditions for the uniqueness of disclosure equilibria become stricter and the conditions for the existence of nondisclosure equilibria become less strict. It also shows that if the information is sufficiently favorable then the existence of nondisclosure equilibria is assured, while if the information is sufficiently unfavorable then any equilibrium involves some disclosure. We will use this proposition in our empirical test in the next section.

Let y be a random variable that is common knowledge.

i) The values $\tilde{q}_j$ and $\hat{q}_j$ are strictly increasing in y if y is strictly affiliated with q.

ii) News $v > v_j$ is disclosed in any equilibrium if $F(q_j^* \mid y)$ is sufficiently large.

iii) An equilibrium surviving the Intuitive Criterion and D1 exists in which news $v \leq v_j$ is not disclosed if $F(q_j^* \mid y)$ is sufficiently small.

Note that part ii) implies that full disclosure is the unique equilibrium if the information y is so unfavorable about the sender that $F(q_N^* \mid y)$ is sufficiently large, and part iii) implies that full nondisclosure is an equilibrium if the extra information y is so favorable that $F(q_1^* \mid y)$ is sufficiently small.

Proposition 3 can also be interpreted in terms of the accuracy of extra information about sender type. As shown earlier in Proposition 3, for a given distribution of sender types full disclosure is ensured if the message space is sufficiently fine. However, if the distribution becomes sufficiently concentrated then full disclosure is no longer ensured. For instance, if the distribution of q conditional on y is highly concentrated around some q' then $F(q_j^* \mid y)$ is close to zero for all q_j^* slightly less than q', so from part iii) nondisclosure of news $v \leq v_j$ is an equilibrium. By part ii), better news will be disclosed, but only because of its rarity. Therefore Proposition 3 supports the intuition that a sender will be less likely to boast if the receiver already has a relatively accurate estimate of her quality, a result that is similar to arguments made by **?** in the context of a signaling environment where boasting is costly.

qtilde.mps11 qhat.mps11

(a) $\tilde{q}_1(y)$ (b) $\hat{q}_1(y)$

Figure 2: Impact of extra information y on $\tilde{q}_1$ and $\hat{q}_1$.

One way to test the model is through observing how behavior changes when q_j^* changes. For instance, in the restaurant example if grading standards change so that an A becomes more common then that is equivalent to q_N^* decreasing. This makes it less likely that $q_N^* > \tilde{q}_N$ so that disclosure is assured, and more likely that $q_N^* \leq \hat{q}_N$ so that a nondisclosure equilibrium exists. Alternatively, Proposition 3 shows that, even if standards do not change, $\tilde{q}_j$ and $\hat{q}_j$ change based on any public information. For example, the public information might be whether or not a faculty member works at an elite university. The more favorable is this public information the higher are $\tilde{q}_j$ and $\hat{q}_j$, so the less likely it is that $q_j^* > \tilde{q}_j$ and the more likely it is that $q_j^* \leq \hat{q}_j$.

To see how public information produces testable implications of the model, let $N = 1$ and assume there is an additional signal $y \in \{l, h\}$ where $\Pr[y = h \mid q] = q$ and y is independent of x conditional on q. If $y = h$ ($y = l$) is observed by both the sender and receiver, then the distribution of types conditional on this information is weighted upwards (downwards), so for any non-degenerate Q, $E[\bar{q}_Q(x) \mid q, y = h] > E[\bar{q}_Q(x) \mid q] > E[\bar{q}_Q(x) \mid q, y = l]$, thereby implying $\tilde{q}_1$ and $\hat{q}_1$ are higher for $y = h$ and lower for $y = l$ as implied by Proposition 3. Figure 2 shows $\tilde{q}_1$ and $\hat{q}_1$ for the example from Section 2. The left panel shows the highest possible payoff to nondisclosure for any receiver beliefs about who discloses, and the right panel shows the payoff to nondisclosure when no types are expected to disclose. In each case the middle line is for the base case without extra public information, the top line is when $y = h$, and the bottom line is when $y = l$. The points where these lines intersect the $45°$ line determine $\tilde{q}_1$ and $\hat{q}_1$. When $y = l$ the receiver starts with such a low opinion of the sender that there is a good chance that $q_1^* > \tilde{q}_1$ so the sender will always disclose even relatively mediocre news. But when $y = h$ the receiver starts with a more favorable opinion and there is a good chance that $q_1^* < \hat{q}_1$ so that nondisclosure is an equilibrium.

4 Empirical test

We now examine a simple test of the model's predictions following the example of title usage discussed in the introduction. In particular we are interested in when full-time, tenure-track faculty use the title "Dr," "PhD," or "Professor" and when they go by their names alone. This decision arises in many contexts including curricula vitæ, business cards, office doors, web sites, email signatures, etc. We look at two cases where a sufficiently large sample is obtainable and where the choice is likely to be under the control of the faculty—office voicemail greetings and class syllabi.

To minimize the impact of different traditions in different disciplines we focus on economics departments, and to minimize regional variation we look at all state universities in California. In particular, based on faculty lists from department websites in the summer of 2004, we consider full-time, tenure-track faculty (assistant, associate, and full professors whom we refer to collectively as "faculty") with PhDs at all 26 universities in the University of California and California State University systems with economics departments.[24] Based on whether or not the economics department has a doctoral program, we divide the sample into eight "doctoral universities" and 18 "non-doctoral universities."

We start with a sample of 430 faculty with a primary position in one of the economics departments, 226 at doctoral universities and 204 at non-doctoral universities. For voicemail greetings we called at odd hours and on holidays when the faculty member was unlikely to be present. Excluding cases where voicemail was not working, was automated without a personal greeting, or was recorded by a secretary, we obtained valid voicemail greetings data for 129 of the faculty in doctoral universities and 120 in non-doctoral universities. For course syllabi we followed links available on faculty web pages and used the first listed undergraduate syllabus.[25] We obtained syllabi for 124 of the faculty at doctoral universities and 67 of the faculty at non-doctoral universities. Note that the decision to record voicemail or to post syllabi might not be random. Since we observe demographic data for all 430 faculty in the sample, including those for whom valid voicemail and syllabi data was not obtainable, we can check whether selection based on individual characteristics affects the results.

Based on Proposition 3, the main prediction we test is that an individual

[24] We exclude one department where the department chair was the only listed faculty member.

[25] When a syllabus for a given class was in multiple formats, we chose the format most likely to be handed out in class, e.g., the .pdf or .doc format over the .html format.

will be more likely to use titles when their status as a PhD-holding faculty member represents more positive news relative to expectations. All of the economics faculty in our sample hold PhDs, but they are not immediately distinguishable to students and other observers from faculty without PhDs and from part-time instructors. Since it is less common for doctoral universities to employ non-PhD[26] and part-time faculty,[27] this implies that there should be more positive expectations regarding the status of faculty at doctoral universities. In terms of Proposition 3, being at a doctoral university is a favorable signal y that increases the likelihood that a faculty member will engage in"false modesty" and not advertise good news.

Table 1 provides evidence that is consistent with this prediction. For voicemail greetings, the use of a title is far less common at doctoral universities. Less than 4% of faculty use a title at doctoral universities while about 27% use a title at non-doctoral universities. A similar pattern holds in course syllabi. About 52% of faculty at doctoral universities use a title while about 77% do so at non-doctoral universities.[28] These differences in faculty behavior at doctoral and non-doctoral universities are significant at the 1% level according to a one-sided t-test using individual-level data.[29]

The differences in title usage at doctoral and non-doctoral universities could reflect demographic differences in the composition of the faculty. How-

[26] For the 11 non-doctoral universities with available data, the average percent of full-time faculty with a PhD or the highest degree in their field was 80.1% in 2004. For part-time faculty the comparable number was 24.5%. The doctoral universities do not collect this data individually, but those that report a percentage use an estimate from the University of California system that 98% of faculty have PhDs or the highest degree in their field. Data are from the annual *Common Data Set* reports for each university.

[27] For the 13 non-doctoral universities with available data, the percent of all faculty that were full-time faculty was 55.6% in 2004. For the seven doctoral universities with available data, the same figure was 80.0%. Data are from the annual *Common Data Set* reports for each university.

[28] Note that faculty at doctoral universities have a strong tendency to substitute "Professor" for "Dr" and "PhD." Only one faculty member used "Dr" or "PhD" in a voicemail greeting and only one used such a title in a syllabus. In contrast, at non-doctoral universities 10 faculty used such a title in voicemail greetings and 29 faculty used such a title in syllabi.

[29] The differences are also highly significant ($p < 0.0001$ and $p < 0.0005$, respectively) using the one-sided non-parametric Fisher test. Individual-level data assumes that each faculty member's behavior is independent and therefore does not allow for "focal" department-specific equilibria. Using department-level rather than individual-level data, differences in title usage remain significant in one-sided tests using the difference-in-means t-test ($p < 0.0001$ and $p < 0.0005$), the non-parametric Wilcoxon-Mann-Whitney test ($p < 0.0005$ and $p < 0.05$), and the non-parametric robust rank-order (**?**) test ($p < 0.0005$ and $p < 0.05$).

Table 1: Summary statistics

	Doctoral Universities	Non-Doctoral Universities	t-stat. for diff. in mean
Voicemail title usage (%)	3.876	26.667	5.311***
	(19.377)	(44.407)	
Years since PhD	17.016	17.942	0.638
	(11.763)	(11.112)	
Male (%)	78.295	73.333	0.913
	(41.385)	(44.407)	
Number of faculty	129	120	
Syllabus title usage (%)	52.419	77.612	3.501***
	(50.144)	(41.999)	
Years since PhD	17.242	15.985	0.693
	(12.084)	(11.738)	
Male (%)	80.645	74.627	0.964
	(39.668)	(43.843)	
Number of faculty	124	67	

Standard deviations in parentheses.

*** indicates that the mean differs between Doctoral and Non-Doctoral Universities at the 1% level of significance.

ever, as seen from the summary statistics in Table 1, this is an unlikely explanation since the demographics of the two groups are quite similar. Nevertheless, to check for this possibility, Table 2 reports logit regressions where the dependent variable equals 1 if a title is used and the right-hand side variables are the doctoral university dummy, years since earning a PhD, and gender. The results confirm that faculty at doctoral universities are less likely to use titles even conditioning on demographic information.[30] In column one the coefficient of the doctoral dummy is highly significant and of the predicted sign for both voicemail greetings and course syllabi. This difference is also seen in columns two and three where we separately estimate logit regressions for doctoral universities and non-doctoral universities. A one-sided t-test finds that the constant term for non-doctoral universities is significantly greater (at the 1% level) than for doctoral universities for both voicemail and syllabi.

As indicated earlier, there may be sample selection issues with the data since the decision to record a voicemail greeting or post syllabi online might be correlated with the use of a title. One way to check if the results are significantly impacted by non-response bias is to treat the absence of a usable voicemail or syllabus as a third choice for each faculty member so that data on all 430 faculty in the sample is used. We therefore run multinomial logit regressions where, in addition to the binary choice of whether or not to use a title, each faculty member can also choose not to record a voicemail greeting or not to post course syllabi online. The estimated coefficients change only slightly, and Hausman specification tests confirm that there are no systematic differences. Therefore there is no evidence that non-response bias affects the results.

Considering alternative explanations for the behavior that we observe, the differences in voicemail greetings may arise because the likely callers at doctoral and non-doctoral universities are different. For instance, a caller to a doctoral university is probably more likely to be a PhD economist who expects that the answerer is also a PhD economist. However, the model incorporates such cases where the sender determines a disclosure decision in knowledge of the likely distribution of receivers. If callers to a doctoral university have a higher expectation that the answerer is a PhD economist this is equivalent to there being more favorable public information about the sender as examined in Proposition 3. Note that the model can also be

[30] Regarding this information, note that women are significantly more likely to use titles than men. Since women are underrepresented among economics faculty and therefore more likely to be confused with graduate students, part-time faculty, and non-academic staff, Proposition 3 predicts that they are more likely to use titles.

Table 2: Logit results for title usage

(Dependent variable equals 1 if title used)

	All Universities	Doctoral Universities	Non-Doctoral Universities
Voicemail title usage			
Doctoral dummy	-2.220^{***}		
	(0.514)		
Years since PhD	0.067^{***}	0.038	0.077^{***}
	(0.018)	(0.042)	(0.022)
Male	-1.122^{**}	-1.305	-1.074^{**}
	(0.462)	(1.063)	(0.512)
Constant	-1.540^{***}	-2.993^{***}	-1.769^{***}
	(0.460)	(0.905)	(0.527)
Number of faculty	249	129	120
Pseudo-R^2	0.206	0.040	0.106
Syllabus title usage			
Doctoral dummy	-1.121^{***}		
	(0.350)		
Years since PhD	-0.021	-0.022	-0.018
	(0.014)	(0.016)	(0.025)
Male	-0.798^{*}	-1.030^{*}	-0.274
	(0.435)	(0.531)	(0.737)
Constant	2.238^{***}	1.325^{***}	1.760^{**}
	(0.488)	(0.502)	(0.711)
Number of faculty	186	124	67
Pseudo-R^2	0.078	0.067	0.013

Standard errors in parentheses.

*, ** and *** denote significance at 10%, 5% and 1% levels.

interpreted as the caller inferring from the greeting what kind of calls the faculty member normally receives. Although using the title “Dr” reveals some favorable status information, it also suggests that the faculty member frequently receives calls from people who are impressed by a PhD.

Another possible explanation for understatement in both voicemail greetings and syllabi is that faculty at doctoral universities do not want to waste time using titles given their small information content, i.e., the message is not costless as assumed in the model. However, in many cases a simple title is as easy or easier to state than other formulations. For instance, in voicemail greetings faculty often inform the listener that “you have reached the office of X” in place of simply stating “this is Professor X.” And in course syllabi faculty often substitute “Instructor” for “Professor.” Moreover, failure to use a title is itself costly in terms of misunderstandings by poorly informed students and others.[31] If it were not for the negative inferences that can arise from promoting one’s own status, it seems unlikely that so many faculty would avoid titles.[32]

5 Conclusion

A large body of research concludes that costless disclosure of good news should benefit the sender. In this paper we consider a standard disclosure game assuming that good news does not fully reveal the sender’s quality and that the receiver also has private information about sender quality. We show that the presence of *any* private receiver information, no matter how weak, implies that equilibria with nondisclosure by some or all types exist unless the good news is restricted to sufficiently high quality senders. From a policy perspective the model supports the setting of higher and more finely distinguished standards in order to reduce the scope for nondisclosure equilibria. It also provides support for mandatory or third-party disclosure of information as a way to reduce the damage that “false modesty” can have on communication.

[31] For instance, use of “Assistant Professor” on a syllabus has been known to induce unhappy students to demand to see the “real” professor.

[32] Consistent with the result that disclosure by a third party does not suffer from the same problems as self-promotion, faculty seem happy to let others refer to them by titles. In the 23 instances of voicemail greetings recorded by staff, either “Dr” or “Professor” was used 13 times, and there was no difference between usage in doctoral and non-doctoral universities. Similarly, faculty don’t seem to object to the use of titles on department pages, but usually avoid them on their own home pages. Because of the difficulty of determining the authorship of home pages, we did not formally analyze this difference.

Appendix

Proof of Proposition 3: In the full disclosure outcome the receiver believes the sender to be of type $q \in [0, q_1^*)$ when nondisclosure is observed and of type $q \in [q_j^*, q_{j+1}^*)$ when message v_j is observed. Therefore, since $\bar{q}_{[q_j^*, q_{j+1}^*)}(x) > \bar{q}_{[0,q_j^*)}(x)$ for all x, $E[\bar{q}_{[q_j^*, q_{j+1}^*)}(x) \mid q] > E[\bar{q}_{[0,q_j^*)}(x) \mid q]$ for all $q \in [q_j^*, q_{j+1}^*)$, so full disclosure is an equilibrium. ∎

Proof of Proposition 3: Starting with the highest types, if $q_N^* > \tilde{q}_N$ then types $q \in [q_N^*, 1]$ strictly prefer to disclose v_N by the definition of $\tilde{q}_N$ and the fact that $q_{N+1}^* = 1$. In this case if $q_{N-1}^* > \tilde{q}_{N-1}$ then types $q \in [q_{N-1}^*, q_N^*)$ strictly prefer to disclose v_{N-1} by the definition of $\tilde{q}_{N-1}$. The unraveling continues until types $q \in [q_j^*, q_{j+1}^*)$ disclose v_j for $j > 1$. For the case where $j = 1$, we know that $q_1^* > \tilde{q}_1 \geq q^\circ(q_1^*, q_2^*)$ since $q^\circ(q', q'')$ is nonincreasing in q' so that types $q \in [q_1^*, q_2^*)$ strictly prefer to disclose v_1. ∎

Proof of Proposition 3: Let $\varepsilon = \min_{q \geq q_j^*}\{q - q^\circ(q_1^*, q)\}$. Since $[0, q_1^*)$ has positive mass, $\varepsilon > 0$. Starting with the highest types, suppose $1 - q_N^* < \varepsilon$. By the definition of ε and $\tilde{q}_N$, this implies $1 - q_N^* < 1 - \tilde{q}_N$, or $q_N^* > \tilde{q}_N$. By Proposition 3, news v_N is disclosed. Now suppose $q_N^* - q_{N-1}^* < \varepsilon$, which similarly implies $q_N^* - q_{N-1}^* < q_N^* - \tilde{q}_{N-1}$, or $q_{N-1}^* > \tilde{q}_{N-1}$. So by Proposition 3 news v_{N-1} is also disclosed. Continuing this process for the difference $q_{N-1}^* - q_{N-2}^*$, etc. down to the difference $q_{j+1}^* - q_j^*$, Proposition 3 implies news v_j is disclosed as long as $q_{k+1}^* - q_k^* < \varepsilon$ for $k \geq j$. ∎

Proof of Proposition 3: Consider the particular equilibrium in which news $v \leq v_j$ is not disclosed while news $v > v_j$ is disclosed. First consider senders $q \in [q_k^*, q_{k+1}^*)$ for $k \leq j$. Assume that following an unexpected disclosure of v_k for $k \leq j$, the receiver skeptically believes that $\mu(q_k^* \mid x, v_k) = 1$. This yields the lowest possible out of equilibrium payoff of q_k^*. Since $q_k^* \leq \hat{q}_j$, it follows by the definition of $\hat{q}_j$ that $E[\bar{q}_{[0,q_{j+1}^*)}(x) \mid q = q_k^*] \geq q_k^*$. Since $E[\bar{q}_{[0,q_{j+1}^*)}(x) \mid q]$ is strictly increasing in q it then follows that $E[\bar{q}_{[0,q_{j+1}^*)}(x) \mid q] \geq q_k^*$ for all $q \in [q_k^*, q_{k+1}^*)$. Therefore the payoff from nondisclosure is weakly greater than the payoff from disclosure of v_k.

Now consider senders $q \in [q_k^*, q_{k+1}^*)$ for $k > j$. The expected equilibrium payoff from disclosure for these senders is bounded below by $q_k^* \geq q_{j+1}^*$, while the expected nondisclosure payoff is strictly bounded above by q_{j+1}^*. Therefore the payoff from nondisclosure is strictly less than the payoff from disclosure of v_k and the proposed equilibrium holds.

Regarding the Intuitive Criterion, the question is whether the skeptical beliefs $\mu(q_k^* \mid x, v_k) = 1$ for $k \leq j$ are permissible. The least upper-bound on the out-of-equilibrium payoff to a sender of type $q \in [q_k^*, q_{k+1}^*)$ is q_{k+1}^*. That is, for out-of-equilibrium beliefs that put sufficient weight on the upper end of $[q_k^*, q_{k+1}^*)$, the sender's payoff can be made arbitrarily close to q_{k+1}^*. Let $\bar{q} = \{q \in [q_k^*, q_{k+1}^*) : E[\bar{q}_{[0,q_{j+1}^*)}(x) \mid q] \geq q_{k+1}^*\}$. If $\bar{q} = [q_k^*, q_{k+1}^*)$ then no type would ever deviate under the most favorable beliefs so there is no restriction on beliefs. If, however, $\bar{q} \neq [q_k^*, q_{k+1}^*)$, then the Intuitive Criterion requires that out-of-equilibrium beliefs put zero probability on the event that a sender of type $q \in \bar{q}$ deviated by disclosing v_j. Therefore, for the equilibrium to fail the Intuitive Criterion, it must be that $q_k^* \in \bar{q}$ and $\bar{q} \neq [q_k^*, q_{k+1}^*)$. However, since $E[\bar{q}_{[0,q_{k+1}^*)}(x) \mid q]$ is increasing and continuous in q, if $\bar{q}$ is nonempty, it must be an interval of the form $[\bar{q}, q_{k+1}^*)$ for some $\bar{q} > 0$. Thus the Intuitive Criterion places no restrictions on out-of-equilibrium beliefs.

Regarding D1, again the question is whether the skeptical beliefs $\mu(q_k^* \mid x, v_k) = 1$ for $k \leq j$ are permissible. Under this refinement beliefs must put zero weight on any type which is willing to deviate for a strictly smaller range of actions by the receiver than another type when the actions must be a best response for some admissable beliefs. In our context where the receiver's only action is to estimate the sender's type, this means that beliefs must put zero weight on any type which is willing to deviate for a strictly smaller set of possible type estimates given the message. Since the estimate $E[\bar{q}_{[0,q_{j+1}^*)}(x) \mid q]$ for nondisclosure is strictly increasing in q and since $E[\bar{q}_{[0,q_{j+1}^*)}(x) \mid q = q_k^*] \geq q_k^*$ by the condition $q_k^* \leq \hat{q}_j$, the set of type estimates in $[q_k^*, q_{k+1}^*)$ that dominates this estimate is either empty or is the interval $[E[\bar{q}_{[0,q_{j+1}^*)}(x) \mid q], q_{k+1}^*)$. In the the former case nondisclosure is an equilibrium for any beliefs. In the latter case, this set is largest for type $q = q_k^*$ since $E[\bar{q}_{[0,q_{j+1}^*)}(x) \mid q]$ is increasing in q, so D1 implies skeptical beliefs where $\mu(q_k^* \mid x, v_k) = 1$ for $k \leq j$. ∎

Proof of Proposition 3: (i) Regarding $\tilde{q}_j$, strict affiliation implies that $E[\bar{q}_Q(x) \mid q, y]$ is strictly increasing in y for all non-singleton Q. Therefore $\sup_Q\{E[\bar{q}_Q(x) \mid q, y] : [0, q') \subset Q \subset [0, q'')\}$ is strictly increasing in y, so $q^\circ(q', q'')$ is strictly increasing in y, which proves the result for $j > 1$. For $j = 1$, since $q^\circ(q, q'') - q$ is continuous in q and $q^\circ(q', q'') \in [0, 1]$ for all q and y, the conclusion follows directly from Theorem 1 of **?**. Similarly, regarding $\hat{q}_j$, $E[\bar{q}_{[0,q_{j+1}^*)}(x) \mid q, y] - q$ is continuous in q and strictly increasing in y and $E[\bar{q}_{[0,q_{j+1}^*)}(x) \mid q, y] \in [0, 1]$ for all q and y. So again the conclusion follows directly from Theorem 1 of **?**. (ii) The question is whether, if the mass of F is sufficiently concentrated below a given q_j^*, it is assured that $\tilde{q}_j < q_j^*$. If $F(q_j^* \mid y)$ is sufficiently close to 1, then $q^\circ(q_1^*, q_{j+1}^*) < q_j^*$ since there is full support, since $q_1^* > 0$, and since nearly all of the mass is below q_j^*. Thus $\tilde{q}_j < q_j^*$ for $j > 1$. Similarly for $j = 1$ the fixed point $q = q^\circ(q, q_2^*)$ must be less than q_1^* so $\tilde{q}_1 < q_1^*$. (iii) The question is whether, if the mass of F is sufficiently concentrated above a given q_j^*, it is assured that $\hat{q}_j > q_j^*$. If $F(q_j^* \mid y)$ is sufficiently close to 0, $E[\bar{q}_{[0,q_{j+1}^*)}(x) \mid q] > q_j^*$ for all q since there is full support and nearly all of the mass is above q_j^*. Thus $\hat{q}_j > q_j^*$. ∎