Losing Face

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Abstract

When Al makes an offer to Betty that Betty observes and rejects, Al may suffer a painful and costly "loss of face" (LoF). LoF can be avoided by letting the vulnerable side move second, or by setting up "Conditionally Anonymous Environments" that only reveal when both parties say yes. This can impact bilateral matching problems, e.g., marriage markets, research partnering, and international negotiations. We model this assuming asymmetric information, continuous signals of individuals' binary types, linear marriage production functions, and a primitive LoF term component to utility. LoF makes rejecting one's match strictly preferred to being rejected, making the "high types always reject" equilibrium stable. LoF may have non-monotonic effects on stable interior equilibria. A small LoF makes high types more selective, making marriage less common and more assortative. A greater LoF (for males only) makes low-type-males reverse snobs, which makes high-females less choosy, with ambiguous effects on the marriage rate.

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1 Introduction

In a market that involves two-sided matching (as surveyed in Burdett and Coles, 1999), the fear of rejection can lead to inefficiency. A proposer may not ask someone out on a date, ask for a study partner, apply for a job, make a business proposition, propose a paper co-authorship, or suggest a peace treaty, because she does not want the other party to *know* of her interest and then turn her down. This may have consequences for reputation and future play, or it may have a direct psychological cost. In general, we call the disutility from this outcome "loss of face" (LoF). Consider a game where each player can choose "accept" or "reject" and there is asymmetric information about players' types. Assume that the outcome of the game (actions and payoffs) becomes common knowledge after all actions have been taken. Here LoF may worsen the set of Nash equilibria. There may be a set of mutually beneficial transactions that would occur without LoF, but do not occur with LoF because:

1. the proposer does not know for sure whether the other party will accept or reject *and*

2. a high enough probability of rejection can outweigh the expected gains to a successful transaction.

This goes *beyond* the standard problems of asymmetric information. Even where Al perceives that his *expected* utility from actually *marrying* Betty would be positive, his expected utility from making an *offer* may be negative. Thus he may still reject Betty — to avoid LoF — if he anticipates

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a high enough chance she will reject him. It is also distinct from the "self-image preservation" motive, discussed in Köszegi (2006), that may lead to over- or under-confident task choice. In that model Al "hates to *learn* that Betty deems him to be low quality", as it reduces his self image. In contrast, our LoF comes from "conditional on her rejecting me, I dislike her knowing that (i) I perceive her as being good enough for me and (ii) that I have made an offer to her."

We believe this will be intuitive for most readers. Consider: which scenario below would be more painful? (Suppose you are romantically interested in women.)

1. A friend or colleague, in whom you have an unexpressed romantic interest, while discussing her tastes, informs you that she wouldn't date you because you are not "her type." You have no reason to believe that she knows of your interest in her, and you are certain that she is telling the truth.

2. Without having the conversation in scenario 1, you ask this same person out on a date and she refuses because you are not "her type."

We speculate that the second scenario would be more painful: now both you and she know that you have asked her out and she has refused. Although she may have tried to soften the blow by posing this as a matter of idiosyncratic preference rather than quality, you have lost face, and you are established as her inferior in one sense. In the first case, although you can presume she is not interested in you, and this may hurt your self esteem, she doesn't know you like her, and you have not lost face, as we define it.

We mainly take this as a primitive (but also present a reputation model in appendix B); future work could unpack this in a more extensive model. E.g., her knowing I chose "accept":

1. informs her about my quality, affecting my reputation, which I may care about directly, or through its impact on my payoffs in future interactions (see appendix B);

2. may be undesirable through a reciprocity motive (Falk et al., 2006): I want to harm someone who harms me, and playing "reject" may be seen as harmful and "accept" beneficial.

Simple institutional changes can eliminate this risk: if only mutual "accept" choices are revealed, the rejected party's choice is thus hidden from the rejector. Al will never have to worry that Betty will both reject him and learn that he accepted her. (In contrast, whenever Al accepts Betty *he* will always learn *her choice*; his self-image cannot be easily protected.)

As we discuss in section 2, there is evidence that a desire not to lose face is a *primal* human concern, perhaps a product of evolutionary factors, or perhaps an automatic internalization of a reputation motive. (If reputation concerns are long-term, anticipating the additional short-run pain of losing face may help counteract present-bias as well as overconfidence.) Thus the LoF may enter into an individual's utility function *directly.* There is a special loss from the combined knowledge that you accepted somebody, but they rejected you.[1]

When (e.g.) a woman accepts a man and he rejects her, her material payoffs from this one-shot game are the same no matter what beliefs or information either party has. However, with LoF, her psychic payoffs are lower when *she knows that he knows that* she accepted him and he rejected her. In other words, what the other player knows for sure – the other player's information – is a component of a player's utility function (as in Battigalli and Dufwenberg, 2007). Thus, as long as we know

[1]This assumption puts our model into the category of a *psychological game*, as modeled by Battigalli and Dufwenberg (2007), in which my payoffs may depend on another player's *beliefs* about my action. However, in our model, for a given (exogenous) information structure, the relevant beliefs (are a one-to-one mapping from the players' actions; thus our analysis is standard. As described in section 4), we assume the structure of these "terminal information sets" is common knowledge; we use this terminology to avoid confusion with the standard setup in which information sets are only defined in connection with decision nodes. The simplicity of our game means we do not have to worry about, e.g., actions responding to equilibrium beliefs responding to actions.

the (terminal) information structure, LoF transforms material payoffs into psychological payoffs in a straightforward way.[2]

We focus on the primal LoF interpretation: this is particularly relevant to one-shot games where no outside parties observe the results. However, we suspect that many of our results will carry over to a case where the LoF concern can be justified instrumentally. With asymmetric information, as in our model, in many types of dynamic matching and sorting/screening games, an individual's willingness to "accept" another person be taken by others as a negative signal of her type, reducing her utility and/or her continuation value. To reinterpret Groucho Marx "if I am willing to be part of this club, how good can *I* be?" We give a simple formalization of this in a two-period model in appendix B, where we derive conditions under which a players' previous "accept" choice hurts her continuation value. (However, a complete characterization of equilibria for this model is left for future work).

As noted above, if loss of face depends on the terminal information sets in this way, i.e., on the information each player has at the end of the game over the game's history, then it can be avoided by changing the information structure so that players *only learn about each other's behavior if they both play Accept.* For example, speed dating agencies often ask men and women to mark the partners who they are interested in, and then inform only those couples who both marked each other. Now, after playing accept, *you* will still be able to infer if you have been rejected, but the *other person* will not know that you accepted them; knowing this, you will not suffer a loss of face. Thus, while your ego-utility can not be preserved, your *face* can be. We call such setups *Conditionally Anonymous Environments* or CAE's.

Our paper proceeds as follows. In section 2 we discuss our concept in more detail and offer intuitive, anecdotal, and academic support for it, motivating the *assumptions* of our model. We also give a short survey of the related economic literature. In section 3 we describe our baseline setup (similar to a single stage of Chade, 2006), and formally define LoF. This environment yields only monotonic equilibria, following the theory of games with strategic complementarities (summarized in Vives, 2005). In section 5 we characterize the best response strategies and equilibria, considering both a symmetric case and a case where only males suffer LoF. The latter allows us to consider both direct and indirect effects. We demonstrate that LoF can make a coordination failure equilibrium tatonnement-stable, and present monotone comparative statics as LoF is introduced or increased (applying Milgrom and Shannon, 1994). We show that while a small amount of LoF makes the low types "reverse snobs" and generally reduces the efficiency of the marriage market, a greater LoF may actually *increase* the marriage rate. We conclude in section 6, considering extensions and discussing policy implications. Our appendices (all online) provide longer proofs, details, and numerical examples, a comparison to a "rejection hurts" model, and our model of reputation concerns in a two-stage game.

2 Background

There is abundant psychological evidence that "rejection hurts" (Eisenberger and Lieberman, 2004) and that social ostracism can cause a neurochemical effect that resembles physical pain (Williams, 2007). However, these studies do not distinguish between cases where it is common knowledge that the rejected party has expressed an interest from cases where this is private information. We claim that people fear proposing, and they fear it more when proposals are known.

[2]Furthermore, LoF itself has no obvious interpretation in terms of fairness/reciprocity (Rabin, 1993). Since revelation of "who proposed to whom" or "who was kind to whom" occurs after these decisions were made it should have no impact on beliefs about whether a player knew his play was "fair" in the sense of being congruent with the other player's kindness or unkindness.

Our speculation in the introduction is consistent with a plausible interpretation of much previous work. While some of the examples below admit alternative explanations (e.g., self-image preservation), we believe that the overall picture offers support for our model's assumptions over LoF. Bredow et al. (2008) represent previous research through the formula $V = f(A \times P)$ for the "strength of the valence of making an overture" to a romantic partner, where A represents attraction and P is the estimated probability that an overture will be accepted. Shanteau and Nagy's (1979) experimental work finds that "when the probability of acceptance is low, people's interest in pursuing a relationship is nil, or nearly nil, regardless of how attracted they are to the person." One reason for these attitudes and preferences might be the fear having one's overtures known in the event of being rejected. Such a cost may be intrinsic or reputation-driven, psychological or material.[3]

The fear of losing face or reputation may motivate people to put in effort and incur costs in order to learn whether a potential partner is likely to respond positively. Baxter and Wilmot (1984) described six types of secret tests used in the delicate dance of "becoming more then friends", e.g., "third-party tests" (Hitsch et al., 2010). Douglas (1987) "reports eight strategies that individuals reported using to gain affinity-related information from opposite sex others in initial interactions."

The fear of LoF is closely related to what psychologists call "rejection sensitivity." For example, London et al (2007) provide evidence from a longitudinal study of middle school students that, for boys, "peer rejection at Time one predicted an increase in anxious and angry expectations of rejection at Time 2." They also find that anxious and angry expectations of rejection are positively correlated to later social anxiety, social withdrawal, and loneliness. In explaining the connection to loneliness, they posit that the rejection sensitive may exhibit "behavioral overreactions" such as "'flight' (social anxiety/withdrawal) or 'fight' (aggression)." It is easy to interpret either of these as a way to choose "reject" in our matching game in order to avoid further loss of face.

Erving Goffman (2005) has written extensively about losing and preserving *face:*

> The term *face* may be defined as the positive social value a person effectively claims for himself by the line others assume he has taken during a particular contact ...The surest way for a person to prevent threats to his face is to avoid contact in which these threats are likely to occur. In all societies one can observe this in the avoidance relationship and in the tendency for certain delicate transactions to be conducted by go-betweens ...

In the context of our paper, Goffman's "avoidance" is essentially preemptive rejection: you cannot be matched with a partner if you don't show up.

In the USA over a recent ten-year period, 17% of heterosexual and 41% of same-sex couples met online (Rosenfeld and Thomas, 2012), and the dating industry has been reported to constitute "a $2.1 billion business in the U.S., with online dating services ... representing 53% of the market's value" (MarketData Enterprises, 2012). Internet dating *itself* can be seen as an institution designed to minimize the LoF that comes with face-to-face transactions, allowing people to access a network of potential partners who they are not likely to run into again at the office or on the street. However, going online may not eliminate the LoF; as noted in Hitsch et al. (2010): "If ... the psychological cost of being rejected is high, the man may not send an e-mail, thinking that the woman is 'beyond his reach,' even though he would ideally like to match with her." (Here, this psychological cost could include both the loss of face we consider and self-esteem concerns outside our model.)

[3]For example, in the 2005 "Northwestern Speed-Dating Study" on 163 undergraduate students, "participants who desired everyone were perceived as likely to say yes to a large percentage of their speed-dates, and this in turn negatively predicted their desirability" (Eastwick and Finkel, 2008).

Perhaps in response to this, numerous dating sites and applications have introduced some form of the CAE environment, where member A can express interest in member B and member B only finds out about this if B also expresses an interest in A.[4] However, there is a trade-off between preserving face and getting noticed: with thousands of members, each member may only view a fraction of eligible dates, and if A expresses anonymous interest there is no guarantee that B will even see A's profile. This has been applied to the internet context at least since Sudai and Blumberg (1999), who were granted a patent for such a "computer system", noting "often, even when two people want to initiate first steps in a relationship, neither person takes action because of shyness, fear of rejection, or other societal pressures or constraints."[5]

Perhaps the most widely used dating platform is the smartphone app Tinder. The site claims it has lead to to 1.6 billion swipes per day, 1 million dates per week, and over 20 billion matches (Tinder, 2018). Here, users are presented a sequence of profiles (with pictures and bios), and can "swipe right" to indicate their interest. Only mutual right-swipers are informed "It's a match", are then able to chat directly. Swiping right on someone does *not* imply they will see your profile; the order in which Tinder's optimization algorithm presents profiles does not reveal who liked you. Thus, this app resembles our Conditionally Anonymous Environment. Sean Rad, a founder and CEO, noted his motivation for this "double opt-in" systems as the app's impetus. "No matter who you are, you feel more comfortable approaching somebody if you know they want you to approach them" (Witt, 2014).

"Speed dating" was an earlier innovation in the singles scene. These events usually attract an equal number of customers of each gender; men rotate from one woman to another, spending a few minutes in conversation with each. Here there is also an effort to minimize the possibility of public rejection (and perhaps LoF). In fact, speed dating agencies often promote themselves on these grounds, e.g., Xpress dating advertised "rejection free dating in a non-pressurized environment" (xpressdating.co.uk, accessed 2012).Typically, participants are asked to select whom they would like to go on "real dates" with only *after* the event is over. In most cases the agency will only reveal these "proposals" where there is a mutual match, i.e., where both participants have selected each other. "Speed dating" institutions have been extended outside the realm of romance and marriage, into forming study groups, "speed networking" and business partnering; these may have been established (in part) to minimize LoF (Collins and Goyder, 2008; CNN International, 2005).

LoF may not be limited to the dating world. Both psychological LoF and material losses from publicly observed acceptances and rejections can be seen in many spheres. These concerns may be present on both sides of the job market. A job-seeker may lose face when she makes a special appeal and is rejected, and an employee may lose face when rejected for a promotion or a special firm project. Akerlof's (2000) model of social exclusion is also relevant. If being seen "acting white" involves sacrificing Black identity, a Black person may choose not to attempt "admission to the dominant culture" because she is uncertain about the "level of social exclusion" she will face; e.g., whether she will be accepted by a school, employer, or White social group. On the other hand, if she can attempt this anonymously, she can avoid the risk of a public threat to her identity, and also avoid the

[4]We recognize that other models, e.g., derived from the "rejection hurts" idea stated above, might justify such policies. However, we argue in appendix C that the LoF model is the most plausible justification.

[5]Online dating has been portrayed as a modern analogue to the traditional "matchmaker", who was able to separately interview prospective mates and their families about their likes and preferences, helping arrange marriages while preserving anonymity (see Ariely and Jones, 2010, chapter 8, forgiving the misuse of the term *Yenta*). However, the internet and social media cuts both ways. Although the internet affords the opportunity to make connections outside one's usual network, the "gossip network" may grow, increasing reputation concerns.

potential *material* costs of social exclusion. In fact, race-based rejection sensitivity has been found to negatively correlate with measures of African-American students' success at predominantly White universities (Mendoza-Denton et al., 2002). This concern might help justify outreach programs for underrepresented minorities; in effect "asking them first" or letting them know when they will have a high probability of succeeding.

The employer too may be vulnerable to LoF. Cawley (2003), in his guide for economists on the junior job market, writes that he has "heard faculty darkly muttering about job candidates from years ago who led them on for a month before turning them down." This aggravation may involve LoF in addition to the loss of time and opportunity costs. This LoF is recognized by professional recruiters as well: "recruiters lose face when candidates pull out of accepted engagements at the last minute" (Direct Search Allowance, 2007). Concerns on both sides of the job market may have inspired companies like Switch ("the Tinder for job apps") to develop conditionally anonymous (double opt-in) employment platforms.[6]

For the rejection-sensitive, any economic transaction that involves an "ask" may risk a LoF. This may explain the prevalence of posted prices, aversion to bargaining in certain countries, and the relative absence of neighborhood cooperation, social interaction, consumption and task-sharing in many modern societies (Putnam, 2001). Rejection sensitivity is particularly disabling for sales personnel, who may suffer from "call reluctance".[7]

Our model may also be important in an archetypal situation where preserving face is valued – the resolution of personal and political disagreements. Neither side may want to make a peaceful overture unilaterally – this can be seen as evidence of admission of guilt or weakness, and may be psychologically painful in itself. Again, where a double-blind mechanism is available, it can resolve this dilemma; if not, our model offers insight into why negotiations often fail. Often, peace talks are made in secret, and only announced if a successful agreement has been reached. This contradicts one of Woodrow Wilson's famous "14 points": "Open covenants openly arrived at", became a principle, according to Eban (1983). However, Eban claims that "the hard truth is that the total denial of privacy even in the early stages ... has made international agreements harder to obtain than ever". Tony Armstrong (1993) analyzed three key cases of international negotiations finding a high degree of secrecy and few participants. "In these secret and private negotiations, assurances and commitments were provided, which were essential for the parties to negotiate 'in good faith"' (Jönsson and Aggestam, 2008).

While economists have previously studied related concepts, to our knowledge none have considered the difference between "mutually-observed acceptance and rejection" and "rejection where only one side knows he was rejected" (and the other side does not know whether or not she was proposed to). Becker (1973) introduced a model of equilibrium matching in his "Theory of Marriage." He considers the surplus generated from marriage through a household production function, and allows the division of output between spouses to be divided ex-ante according to each party's outside option in an efficient "marriage market." Anderson and Smith (2010) brought reputation into this context, noting "matches yield not only output but also information about types" (but note that *offers* are not observed in their model). Chade (2006) explored a search and matching environment where participants observe "a noisy signal of the true type of any potential mate." He noted "as in the winner's curse in auction theory – information about a partner's type [is] contained in his or her acceptance decision." However,

[6] Switch has claimed more than 400,000 job applications and 2 million "swipes" as of 2015 (Crook, 2015).

[7] "Call reluctance, which strikes both individuals and teams, develops in many forms. Representatives may be 'gun shy' from an onslaught of rejection or actively avoid certain calling situations such as calling high-level decision makers or asking for the order. Call reluctance is the product of fear; fear of failure, fear of losing face, fear of rejection or fear of making a mistake. If the fear perpetuates, productivity suffers" (Geery, 1996).

in Chade's model there is only a single interaction between the same man and woman, and outside parties do not observe the results; thus there is no scope for either party's actions to affect their future reputations, nor any direct cost of being rejected.

Simundza (2015) embeds a two-stage matching game in a marriage model. He finds an equilibrium where saying "no" in a first round can increase the continuation value in the next round. Our focus and modeling choices differ in important ways. Simundza considers a binary signal, leading to a focus on stationary strategies. Simundza's model isolates the strategic value of reputation (which is endogenous), and thus has no comparable "Loss of Face" parameter. Thus, unlike Simundza, we can consider the welfare and distributional implications of changes in the information environment (CAE to FRE to ARE), changes that are relevant to many real-world contexts, as we note. Our differences lead to distinct results. For example, Simundza's high-types have no incentive to "play hard to get," i.e. no incentive to reject when observing high signals in the first round. In contrast, our high types are affected by their *own* potential LoF, raising their own thresholds or even shutting down completely. Simundza can compare the co-existing "Nonstrategic" and "Socially Strategic" equilibria; the latter yield greater assortative matching (sorting); as he assumes productive complementarity, this implies "mating is more efficient". In contrast, we compare the marriage rate and assortativeness of stable interior equilibria (as well as stability of corner equilibria) as the *cost* of LoF increases.[8]

3 Model Setup

3.1 Agents

The economy is populated by a continuum of individuals on market sides M and F ("male and female genders") endowed with measure 1 each. An individual $m \in M$ or $f \in F$ is characterized by a binary type $x_g \in \{\ell, h\}$; the type—"low" or "high"—is an agent's private information (and $g \in \{m, f\}$).[9] For brevity, we will sometimes refer to "an h" or "an ℓ", depicting an individual's type, and to "an m" or "an f", reflecting an individual's gender, and to "male ℓ-types", or "a low f", etc. We will also refer to a generic individual as "she/her", except where this would cause confusion. Let the share of high types be the same on both sides of the market, and denote it by p. (This assumption, for notational simplicity, does not affect our results qualitatively.)

3.2 Matching

Each individual in M is randomly matched to an individual in F; all matches are chosen by nature with equal probability. Individual i obtains a noisy signal s_j about the type x_j of her match j, but does not observe s_i, the signal of her *own* type that j received. After observing the signals, individuals accept (A) or reject (R) the match. We distinguish three informational settings (depicted in figure 1):

1. a *Full Revelation Environment* (FRE) where both observe each others' actions (proposals) after they have both been made,

[8]Simundza's model somewhat resembles our two-stage "reputation" model (appendix B) However, Simundza considers the *same* individuals playing the accept/reject game twice, with no new signals, unlike in our motivating examples. Our reputation model assumes a new second-round match who observes a new signal; we consider the impact of this match *also* observing her match's *previous-round game play.*

[9]While our discussion in the above sections also encompasses one-sided matching, we exclusively model a two-sided market (labeled "male" and "female" with apologies for political incorrectness). This choice is relevant to many examples and also allows us to isolate direct and indirect effects of (a fear of) LoF on one side. Note that our prior mimeo (Hugh-Jones and Reinstein, 2010) derived related results with *continuous* types under specific functional restrictions.

2. an *Asymmetric Revelation Environment* (ARE) where females observe the action A or R taken by a male but males do not observe females' proposals (but can infer them ex-post in some contingencies), and

3. a *Conditionally Anonymous Environment* (CAE) where neither side directly observes the other side's action (proposal), but each player only observes whether or not *both parties* have played accept.

I.e., the FRE captures a setting where both males and females are informed of the action of their match and know that their match will be informed of their own action. By contrast, in the CAE males and females can infer their match's actions (proposals) if and only if they themselves play accept. In an ARE only one market side (here females) is informed about the action of their match; the (male) player on other side is informed only if the female accepts. Hence, a female will never be observed accepting a male who rejects her. The ARE is strategically equivalent to a sequential game where both are vulnerable to LoF, but the male moves first—a second-mover can always avoid losing face by always playing R after observing R. We discuss this further below (page 9).

3.3 Signals

Individuals in a matched pair each obtain a signal $s \in [\underline{s}, \overline{s}]$ of the other agent's type. Signals are drawn independently and their distribution depends on the type of the sender: type x's ($x \in \{\ell, h\}$) signal is distributed according to $F_x(s)$ with continuously differentiable density $f_x(s)$. We also assume, for convenience only, that the densities are bounded, $f'_x(s) < \infty$. Suppose that the signal is informative in the sense that $f_\ell(s)$ and $f_h(s)$ satisfy the monotone likelihood ratio property (henceforth mlrp), i.e.,

Assumption 1. *$f_h(s)/f_\ell(s) > f_h(s')/f_\ell(s')$ for all $s > s'$ where defined.*

We assume that the signals are fully revealing at their limits, i.e., observing the best (worst) signal implies that the type is h (ℓ), i.e.,

Assumption 2. *$f_h(\underline{s}) = 0$, $f_\ell(\underline{s}) > 0$, $f_\ell(\overline{s}) = 0$, and $f_h(\overline{s}) > 0$.*

Assuming that the probability of a high (low) type converges to one (zero) is needed to ensure that the game has an interior equilibrium (i.e., signal thresholds for accepting a match will be interior).[10]

3.4 Payoffs

If both individuals in a matched pair accept they become "married" and each individual's payoff depends positively on the *pizzazz* (see Burdett and Coles, 2006) of their partner: $x \in \{l, h\}$. low types have pizzazz ℓ and high types have pizzazz h, where $0 < \ell < h$.[11] Types (and thus pizzazz) become fully observable during the marriage. Marriage payoffs for a match (m, f) are given by $u_m(x_f) = x_f$ and $u_f(x_m) = x_m$. That is, payoffs are linear in the match's type, which implies that total surplus does not depend on the precise assignment of types, but only on the number of marriages formed. Agents who remain solitary obtain a payoff of $u_j(x_j) = \delta x_j$ for $j \in \{m, f\}$ with $\delta < 1$. For intuition,

[10] Otherwise, in the case of overlapping supports, i.e. for all $s \in [\underline{s}, \overline{s}]$ $f_h(s) > 0$ if and only if $f_\ell(s) > 0$, we could not rule out equilibria where high types do not respond to the signal and instead "always accept" or "always reject," and these could be stable. However, even under overlapping supports our remaining results carry over for "responsive" equilibria where high types have interior thresholds. Details are available by request.

[11] We use the same terms, h and ℓ, to represent both the type index and the pizzazz of this type; this slight abuse of notation should not cause confusion.

suppose types represent productivity, production is shared by the married couple, and those who are more productive alone are also more productive in a marriage.[12] Therefore low types always prefer a marriage to remaining alone. To make the model non-trivial, we suppose h's prefer to remain unmarried to marrying an ℓ, i.e., high types have a good outside option:

Assumption 3. *$\delta h > \ell$.*

In summary, homogenous marriages benefit both partners and mixed marriages benefit ℓ's more than they hurt h's, because $h + \ell > \delta(h + \ell)$.

3.5 Loss of Face

Loss of face as described in section 2 is an intrinsic psychological pain, which can only matter if a player's potentially embarrassing action is observed by the other player. Therefore we define loss of face as follows.

Definition 1. *A player j who suffers from loss of face experiences a loss L when*

1. *j played accept. j knows that his match, player k, played reject, and*

2. *j knows that k knows (for certain) that j played accept.*

The "j knows that" part of Point 2 of may be necessary for a *primal* LoF, but not for the reputational LoF we model in appendix B; a player's reputation and future payoffs may suffer whether or not she knows that her decision is observed.[13]

Since LoF results from the *common knowledge* (or at least the higher order beliefs described above) of one party accepting and the other rejecting, to model LoF we need to make payoffs depend not only on actions, but also on the information players hold at the end of the game. These *terminal information sets* for players m and f are defined as standard information sets, but they are not at a decision node: they characterize a player's knowledge about the complete history of the game after all actions have been taken.

4 Terminal information sets and game trees

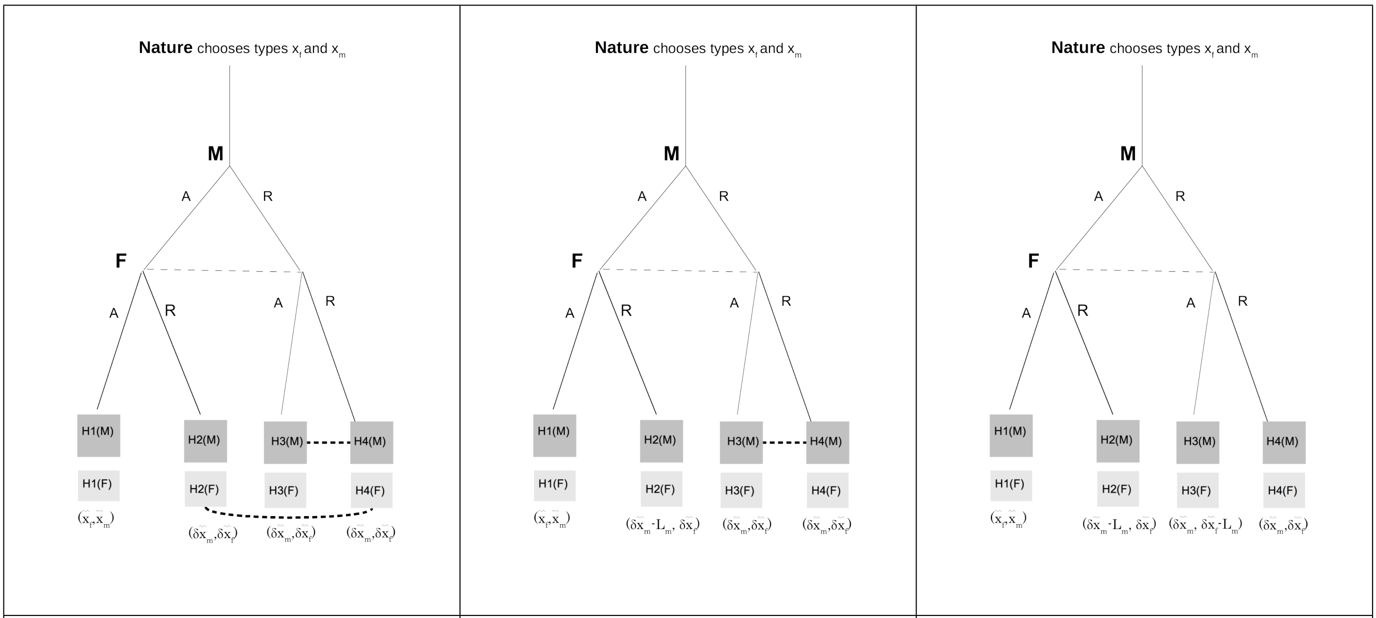
As shown in figure 1, the set of end nodes of the game, defined by their histories, is $H = \{H1, H2, H3, H4\} = \{AA, AR, RA, RR\}$.[14] Let $\bar{I}_f$ be the collection of f's terminal information sets over these end nodes, and $\bar{I}_m$ be m's information partition. Since neither player "has the move" at the terminal node, we give each history two boxes to depict each player's terminal information set; $H_j(m)$ and $H_j(f)$ are the same (for $j \in \{1, 2, 3, 4\}$).

In the games defined above terminal information sets depend on the information environment in place. The three different environments are illustrated in the trees in figure 1, specifying the terminal

[12] An alternative justification: The payoff to no match may represent the continuation value in an indefinitely repeated matching game, as in, e.g., Adachi (2003), or as in our two-period model in appendix B. Simundza's 2015 model finds a similar related result, as does Chade (2006): higher-type players tend to have higher signals and others accept them more often.

[13] We conjecture that making LoF a continuous function of "the probability k puts on j having played accept" would imply a secular decrease in payoffs for both sides in the CAE, but have no impact on the best-response functions derived below, implying qualitatively identical outcomes; informal proof available by request.

[14] We leave nature's move out of these histories; it does not affect our discussion. For completeness we can assume that players never learn the other players' types. Thus, in our model LoF will only depend on the conditional expectation of the other player's type, not the type itself.



(i) CAE | (ii) m-Blind (ARE) | (iii) FRE

Figure 1: Terminal Information structures

(i) Conditionally Anonymous (CAE): $\bar{I}_m = \{(AA), (AR), (RA, RR)\}$ and $\bar{I}_f = \{(AA), (AR, RR), (RA)\}$.
(ii) Asymmetric Revelation (ARE): $\bar{I}_m = \{(AA), (AR), (RA, RR)\}$; $\bar{I}_f = \{(AA), (AR), (RA), (RR)\}$.
(iii) Full revelation Environment (FRE): $\bar{I}_m = \bar{I}_f = \{(AA), (AR), (RA), (RR)\}$.

information partitions for each case. The payoffs shown include LoF terms whenever the terminal information structure implies this may be relevant, by our definition above.

Denote an action tuple by $(a_m a_f) \in \{A, R\}^2$. If both players in a match only observe their own actions and whether or not there is a marriage (the conditionally anonymous environment, CAE), both players' information sets are (AA), $\{(RA), (AR)\}$, or (AR), depicted on the left of figure 1. Note that the (AA) terminal information set is a singleton for both players, while the histories where a player played "reject" are part of the same terminal information set (for that player). This implies that females cannot distinguish between action profiles (AR) and (RR), and males cannot distinguish between (RA) and (RR). Therefore there is no loss of face under the CAE.

In an asymmetric revelation environment (ARE) one market side observes the actions of the other side, but not vice versa; the other side only learns whether or not a marriage occurred. Here we will assume that females observe males' actions in a match, but not vice versa. I.e., consider "males" as synonymous with "the side vulnerable to LoF." Hence, in the ARE possible terminal information sets are (RA), (RR), (AA), or (AR) for females, and (AA), (AR), and $\{(RA), (RR)\}$ for males. That is, females can distinguish the action profile (AR) from (RR), whereas males cannot distinguish between (RA) and (RR). Here, the males lose face when the action profile (AR) is played, but females cannot lose face under the ARE.

In a full revelation environment (FRE) both genders have four terminal information sets, (RA), (RR), (AA), or (AR), as shown on the right in figure 1; i.e., both players in a match observe the choice of their partner, and know that their partner observes their own choice.

Note that while we depict a game with simultaneous actions (or equivalently, incomplete information – players don't observe each other's actions when they make their choices), in many applications the game will be sequential, with one side having to make the first offer. If the terminal information sets are complete and the males must move first, this will be is strategically equivalent to the ARE

above. The males—moving first— would be vulnerable to LoF. Females, moving second, would only consider playing accept if the male first-mover also did; thus they will never suffer LoF.
Therefore individual payoffs of the game played by a randomly matched pair (m, f) can be summarized by the following payoff matrix:

$$\begin{array}{c|ll} {}_{m}\ \ {}^{f} & A & R \\ \hline A & x_f, x_m & \delta x_m - L_m, \delta x_f \\ R & \delta x_m,\, \delta x_f - L_f & \delta x_m, \delta x_f \end{array}\ . \tag{1}$$

Setting $L_f = L_m = 0$ will correspond to the payoffs in the CAE, where no loss of face can occur by design. In an ARE with males moving first $L_f = 0$ and $L_m = L > 0$, and in a FRE with the same LoF on both sides, $L_m = L_f = L > 0$. We limit our attention to the case of symmetric loss of face and to symmetric equilibria of the game in the FRE.

While our setting does not allow for a generic analysis of matching games, it captures a large set of interactions in matching environments where loss of face may be relevant. Our assumptions embody agreed-upon preferences over a partner's type – partners are better or worse along a single dimension, although this may be a reduction of several characteristics.

Individuals' acceptance decisions will depend on the inference they make about their match's type given the signal and given the event of being accepted. We will look for Perfect Bayesian Equilibria and consider tatonnement stability, i.e., stability with respect to the iterative responses to deviations or "cobweb dynamics" (see Hahn, 1962; Dixit, 1986; and Vives, 2005). In this setting tatonnement stability will require that, if one player slightly deviates from equilibrium play, the other player's best response, and the best response to this, ad-infinitum, will gradually move best responses back to the equilibrium play. (We will also mention when our results hold under the trembling-hand perfection refinement.)

5 Solving the Model

We note first that the game always has a trivial coordination failure equilibrium where both players always reject.[15] If i's match rejects with certainty, then for i, rejecting yields payoff δx_i, which is at least as high as i's payoff when accepting, and strictly greater when i is vulnerable to loss of face.

5.1 Individual best reply functions

High types' best replies

For an individual i of type h and gender g in a match (i, j), playing R yields a payoff δh, whereas playing A either yields x_j (if j accepts) or $\delta h - L_g$ (if j rejects). High types of both genders find it weakly profitable to accept after observing a signal s if and only if the expected payoff from accepting meets or exceeds the outside option. I.e., for a high type of gender $g \in \{m, f\}$, letting $g' \in \{m, f\} \neq g$,

[15] This is distinct from a case where low types always accept and high types always reject, which we call the C-F Equilibrium; we return to this below.

A is weakly preferred if

$$\underbrace{\frac{pf_h(s)}{(1-p)f_\ell(s)+pf_h(s)}}_{pr(x_j=h|s)}[\underbrace{q_{g'}(h,h)h}_{marry\ h}+\underbrace{(1-q_{g'}(h,h))(\delta h-L_g)}_{rejected\ by\ h}]$$
$$+\underbrace{\frac{(1-p)f_\ell(s)}{(1-p)f_\ell(s)+pf_h(s)}}_{pr(x_j=\ell|s)}[\underbrace{q_{g'}(\ell,h)\ell}_{marry\ \ell}+\underbrace{(1-q_{g'}(\ell,h))(\delta h-L_g)}_{rejected\ by\ \ell}]\geq\underbrace{\delta h}_{solitude}, \tag{2}$$

where $q_g(x_j, x_i)$ is the probability that an agent j of type x_j and gender g accepts an (opposite-gender) agent i of type x_i. Rearranging the above: an h considers the "gains"—relative to solitude—from marrying another h to the losses from marrying an ℓ, taking into account the probability of rejection and weighting the relative probabilities of each type, and taking into account the information conveyed by the event of being accepted (i.e., the acceptance curse). Hence, an h of gender g accepts if

$$pf_h(s)\underbrace{[q_{g'}(h,h)(h-\delta h)-(1-q_{g'}(h,h))L_g]}_{\text{E(an h's "gains" if playing A vs. an } h)}\geq(1-p)f_\ell(s)\underbrace{[q_{g'}(\ell,h)(\delta h-\ell)+(1-q_{g'}(\ell,h))L_g]}_{\text{E(an h's "losses" if playing A vs. an } \ell)}, \tag{3}$$

noting that the first terms on each side express the relative conditional probability the partner is of each type and "losses" are defined as the negative of gains.

Note that the overall probability of a player i being accepted by some j as a function of types, $q_g(x_j, x_i)$, does not depend on the signal s that player i *observes*, as signals are drawn independently and individuals do not observe the signals of their own type. I.e., in condition 3, only $f_h(s)$ and $f_\ell(s)$ depend on the observed signal s. The mlrp then implies that there is a unique $\hat{s}$ such that an h accepts if and only if (s)he observes $s \geq \hat{s}$. That is, high types (of both genders) use "floor" threshold strategies, accepting only if the signal exceeds their threshold, $\hat{s}_m$ and $\hat{s}_f$ respectively. This implies that an h of gender g accepts an agent of type x with probability

$$q_g(h,x)=1-F_x(\hat{s}_g),\ \text{with } g\in\{m,f\}.$$

Low types' best replies

The condition for low types of gender g to prefer to accept is similar to (3); using $q_g(h,\ell) = 1 - F_\ell(\hat{s}_g)$ it is given by

$$pf_h(s)\underbrace{[(1-F_\ell(\hat{s}_{g'}))(h-\delta\ell)-F_\ell(\hat{s}_{g'})L_g]}_{\text{E(an } \ell\text{'s "net gains" if playing A vs. an } h)}\geq(1-p)f_\ell(s)\underbrace{[q_{g'}(\ell,\ell)(\delta\ell-\ell)+(1-q_{g'}(\ell,\ell))L_g]}_{\text{E(an } \ell\text{'s "losses" if playing A vs. an } \ell)}, \tag{4}$$

where $g' \neq g$. Again the mlrp implies that the condition is monotone in s and implies there is at most one value of s such that the condition holds with equality. However, it may *never* hold with equality: as low types prefer a marriage to *either* type partner, for L_g close to zero an ℓ (of gender g) will prefer to play A regardless of the signal received, and *strictly* prefer this unless both types of the opposite gender play "reject always".

Rearranging the above, we can characterize the low type's best response. For L_g sufficiently small "always accept" is a weakly dominant strategy for low types, and a strict best response where any type of the opposite gender sets an interior threshold. More generally, "low types always accept" strategies (leading to $q_m(\ell,\ell) = q_f(\ell,\ell) = 1$), are mutual best replies if

$$p\frac{f_h(s)}{f_\ell(s)}[(1-F_\ell(\hat{s}_{g'}))(h-\delta\ell) - F_\ell(\hat{s}_{g'})L_g] \geq -(1-p)(\ell-\delta\ell) \text{ for } g \in \{m,f\}, \forall s \in [\underline{s},\bar{s}], \tag{5}$$

which will hold if and only if[16]

$$\underbrace{(1-F_\ell(\hat{s}_{g'}))(h-\delta\ell)}_{\text{an } \ell\text{'s expected gain if plays } A \text{ vs. an } h} \quad \geq \quad \underbrace{F_\ell(\hat{s}_{g'})L_g}_{\ell\text{'s expected LoF if plays } A \text{ vs. an } h} \quad . \tag{6}$$

Condition: ℓ-types prefer to accept against a *certain h*

This condition also implies that the left-hand side of (4) is non-negative. Intuitively, if low types expect a (weak) gain from accepting against a *certain* h, and they know other low types always accept, then no signal will deter them from accepting.

However, even where (6) holds, there may also be an equilibrium where low types do *not* always accept. If low types of the opposite gender are very selective, the expectation of the gain from marrying an ℓ may not outweigh the risk of LoF (i.e., the right-hand side of (4) may be positive). Thus, just as the high types do, low types may also use a floor threshold $\hat{s}_{g\ell}$, rejecting after observing signals that are "too low". Intuitively, even though other ℓ's are less selective, accepting against a certain-h may yield an expected net benefit, while accepting against a certain-ℓ may yield an expected loss, because the gain to *marrying* high exceeds the gain to marrying low.

Next consider the case where (6) fails, implying that the left-hand side of (4) is negative, and low types expect a *loss* from accepting against a certain h. Here, even if low types of the opposite gender always accept, if there is a large enough chance the match is an h, an ℓ will prefer to reject. Formally, there is an $\tilde{s} \in (\underline{s}, \bar{s})$ such that a low type (of gender g) prefers to reject after observing $s > \tilde{s}$, implying $q_g(\ell,\ell) < 1$. In turn, if $q_{g'}(\ell,\ell) < 1$ (and (6) fails), there is either a unique value of s such that (4) holds with equality, or it never holds.

The former case implies that a male ℓ uses a single interior threshold, the latter implies that he never accepts. As low types here seek to *avoid* accepting when matched with a high-type, this threshold must be a *ceiling*, with low types accepting only after observing *lower* signals, i.e., if $s < \check{s}_{g\ell}$, with $\check{s}_{g\ell} = \underline{s}$ for the shut-down response. (We use the inverted hat to distinguish ceiling thresholds.)[17] We call such behavior "reverse snobbery".

Summary of best replies

Lemma 1 (Individual behavior)**.** *In a Nash equilibrium players use threshold strategies: high types use floors, i.e. "accept iff $s \geq \hat{s}_g$" for $g = m, f$, and low types may use either floors ("accept iff $s \geq \hat{s}_{g\ell}$") or ceilings ("accept iff $s \leq \check{s}_{g\ell}$"). If low-type males (females) prefer to play A against a certain-h of the opposite sex (i.e., if condition (6) holds for this gender), then low types of this gender use floors. Here, if L_g is sufficiently small, then if females (males) accept with positive probability, then male (female) low-types always accept (i.e., this floor is $\hat{s}_{g\ell} = \underline{s}$) otherwise $\hat{s}_{g\ell} > \underline{s}$. If condition (6) does not hold for males (females), then low types of this gender use ceilings.*

[16]Proof of equivalence: The bracketed term in 5 represents an $\ell's$ expected net gain, relative to solitude, from accepting when faced with a known h. If this is positive, the left-hand side is minimized at $s = \underline{s}$, where it equals zero (zero relative probability of a high-type); this is thus equivalent to 6. If the bracketed term is negative, it is minimized at $s = \bar{s}$, which implies that this condition fails whenever 6 also fails.

[17]Note that all equilibrium strategies will involve only at most a single nontrivial threshold, a floor or a ceiling. Thus, to save notation, where we denote a ceiling threshold $\check{s}$ one can assume a trivial floor threshold $\hat{s} = \underline{s}$ and vice-versa.

The proposition describes the players' best replies: the *mlrp* ensures every type will have a unique optimal threshold value given any behavior of the other types (see appendix for detailed best-response functions). Summarizing, low types are either *picky*, using floors, they act as *reverse-snobs*, using ceilings, or they are *indiscriminate*, accepting any signal. Note that the responses as characterized in Lemma 1 allow for multiple equilibria. For instance, all types playing "reject" independently of observed signals is an equilibrium. Moreover, plugging $L_f = L_m = L$ into the above and using symmetry, we see that symmetric LoF implies there is a symmetric equilibrium, where $\hat{s}_m = \hat{s}_f$ and $\hat{s}_{m\ell} = \hat{s}_{f\ell}$, although this may take the form of a coordination failure.

5.2 Equilibria and stability

We next derive a sufficient condition for the existence of "interior equilibria": equilibria where high types of both genders accept with positive probability, i.e., where $\hat{s}_m, \hat{s}_f \in [\underline{s}, \overline{s})$. All work is in Appendix A.

We consider the best reply functions derived from (3). Note that, independent of $\hat{s}_{f\ell}$ and $\hat{s}_{m\ell}$, a high-type male's best response to $\hat{s}_f = \underline{s}$ is $\hat{s}_m > \underline{s}$, as, even if h-type females always accept, a low enough signal implies the match is almost surely an ℓ. Taking the total differential with respect to $\hat{s}_m$ and $\hat{s}_f$ yields the slope of a high m's best reply function (henceforth, *brf*) in terms of $\hat{s}_f$ (equation 22 in the appendix). This *brf* has zero slope at $\underline{s}$ and the slope becomes positive for higher values of $\hat{s}_f$ (independent of $\hat{s}_{f\ell}$, $\hat{s}_{m\ell}$, the ℓ-types' thresholds). Hence, if this slope exceeds unity at $\hat{s}_f = \overline{s}$ (again, independent of ℓ-types' strategies) then the *brf* crosses the 45° line at least once, implying that an interior equilibrium exists (for graphical intuition, see Figure 2).

Since a player's best reply only depends on his or her *own* LoF parameter L_g this logic applies to all the environments that we consider. The slope of the *brf* at $\hat{s}_f = \overline{s}$ will also determine whether an equilibrium at $\hat{s}_f = \hat{s}_m = \overline{s}$ is tatonnement-stable. This case, where high types "always reject" (although low types still may accept) has the flavor of a coordination failure; we call this the "C-F equilibrium". With large enough L_g, this becomes risk-dominant, as increasing LoF decreases the possible loss when unilaterally deviating from an interior equilibrium, and increasing LoF increases the possible loss when deviating from the C-F equilibrium. Proposition 1 states this formally.

Proposition 1 (Existence and Stability of Interior and C-F Equilibria)**.**

(a) If L_g is sufficiently close to 0 *for both genders and, for both genders $g \in \{m, f\}$*

$$f_h(\overline{s})^2 > -f_\ell'(\overline{s})\frac{1-p}{p}\frac{\delta h - \ell}{h - \delta h + L_g}, \tag{7}$$

i.e., if $f_\ell'(\overline{s}) \leq 0$ is sufficiently close to 0*, then a tatonnement-stable interior equilibrium with $\hat{s}_m, \hat{s}_f \in (\underline{s}, \overline{s})$ exists.*

(b) If condition (7) holds, then all "C-F equilibria"— i.e., equilibria where $\hat{s}_f = \hat{s}_m = \overline{s}$—are tatonnement-stable and trembling-hand perfect if and only if $L_g > 0$ for some $g = m, f$.

(c) For large enough L_g, the C-F equilibrium must risk-dominate all other equilibria.

Condition (7) requires the right tail of $f_\ell(s)$ to be sufficiently flat, or the right tail of $f_h(s)$ sufficiently high (implying that the likelihood of having met a high type still increases even for high signal realizations), or the high type's loss from matching with a low type sufficiently low compared to remaining solitary. It would be implied by $\frac{\partial f_\ell(\overline{s})}{\partial s} = 0$, i.e., if the ℓ's signal distribution becomes flat at $\bar{s}$. This is sufficient, but by no means necessary, see the numerical example in section 5.2.4. For the remainder of the paper we focus on the case where (7) holds and thus where an interior equilibrium is guaranteed without LoF.[18]

5.2.1 CAE: No Loss of Face

Proposition 1 shows that loss of face has a dramatic effect on equilibrium behavior: in particular, a strategy profile involving coordination failure among high types becomes a stable equilibrium, and possibly the only one. We thus inspect the case of $L_g = 0$ for both genders (corresponding to the CAE, where players know that other players do not observe their action) and examine the effects of increasing LoF. As the corner equilibria are unstable when $L_g = 0$ for both genders, we consider a (stable) interior equilibrium. As noted above (and implied by Lemma 1), without LoF, and where high types do not shut down, the low type's strict best response is to play "always accept". Here, high types of both genders face the same optimization problem. A male h will find accepting profitable if

$$\frac{f_h(\hat{s}_m)}{f_\ell(\hat{s}_m)} \geq \frac{1-p}{p} \frac{\delta h - \ell}{(1 - F_h(\hat{s}_f))(h - \delta h)},$$

and analogously for a female h. The resulting best-reply function is shown in Figure 2, where the male h's best reply crosses the 45° line exactly once.

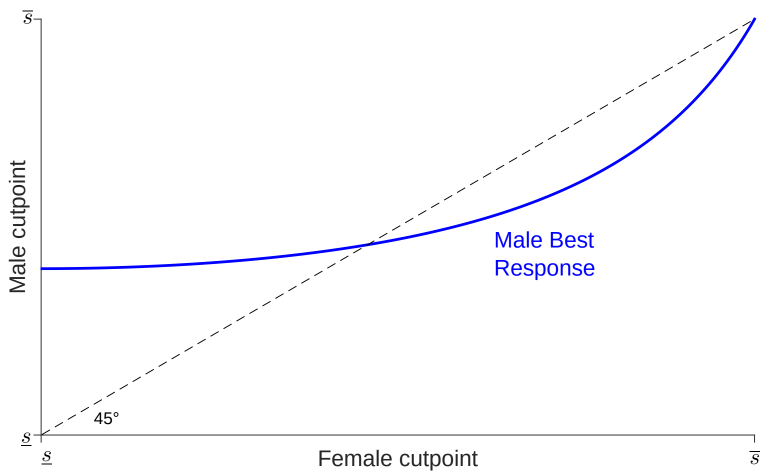


Figure 2: Male high type's best response to high type female cutpoints; the condition (7) in Proposition (1) holds here.

As low types always accept and the game is symmetric by gender, $\hat{s}_m = \hat{s}_f := \hat{s}^*$ must hold in a Nash equilibrium (supposing the contrary leads quickly to a contradiction). As noted above, $\hat{s}^* > \underline{s}$ in any stable equilibrium. Since agents' actions do not affect other agents' information sets, beliefs are always formed according to Bayes' rule, and the issue of out-of-equilibrium beliefs will not arise. This yields the following proposition.

Proposition 2. *If $L_g = 0$ for $g \in \{m, f\}$ and Condition (7) holds then at least one interior stable equilibrium exists, and in any <u>stable</u> equilibrium*

1. *low types always accept,*

2. *high types use symmetric cutoff strategies, accepting if $s > \hat{s}_m = \hat{s}_f := \hat{s}^*$, and*

[18]If (7) does *not* hold for $L_g = 0$, the C-F equilibrium will be stable, and there may or may not also exist stable interior equilibria.

3. $\hat{s}^* \in (\underline{s}, \overline{s})$ *defined by*

$$\frac{f_h(\hat{s}^*)}{f_\ell(\hat{s}^*)}\frac{p}{1-p} = \frac{\delta h - \ell}{(1-F_h(\hat{s}^*))(h-\delta h)}. \tag{8}$$

The above also implies that the *trivial* coordination failure (where both types always reject) is unstable without LoF. Simple calculations yield the following results. Where Condition (7) holds, expected payoffs for types ℓ and h in a stable equilibrium of the game without LoF (or for any strategy profile where low types always accept) are

$$\begin{aligned} v(\ell) &= \delta\ell + p(1-F_\ell(\hat{s}^*))(h-\delta\ell) + (1-p)(\ell-\delta\ell) \text{ and} \\ v(h) &= \delta h + p(1-F_h(\hat{s}^*))^2(h-\delta h) - (1-p)(1-F_\ell(\hat{s}))(\delta h - l). \end{aligned} \tag{9}$$

Note $v(h) > v(\ell)$. The number of marriages is $(1-p)^2 + 2p(1-p)(1-F_\ell(\hat{s}^*)) + p^2(1-F_h(\hat{s}^*))^2$, which strictly decreases in $\hat{s}^*$.

Intuitively, an ℓ will not marry (and will thus get $\delta\ell$) unless he meets another ℓ or fools an h. An h will marry only if she meets another h and they both send very positive signals, or if she is fooled by an ℓ (i.e., she meets an ℓ who sends a high enough signal).

As noted, in a stable interior equilibrium without LoF, an ℓ always accepts; in fact, even if there is no stable equilibrium,"reject always" is weakly dominated for low types. This implies an h rejects at least against the lowest signals. Thus the acceptance behavior of players of type h and ℓ differs in equilibrium, implying that *being accepted* also conveys some information about the match's type (the "acceptance curse" in Chade, 2006).

5.2.2 Symmetric Full Revelation Environment: (FRE) Positive Cost of Loss of Face

We next consider an environment in which both genders are symmetrically vulnerable to loss of face, implying $L_m = L_f \equiv L$. Considering L increasing from $L = 0$, condition (4) ensures that for small enough L, low types still find it optimal to play "accept" unconditional on the signal in an interior equilibrium. This implies that for a small enough L an h of gender $g \in \{m, f\}$ will have a threshold $\hat{s}_g$ implicitly defined by:

$$\frac{f_h(\hat{s}_g)}{f_\ell(\hat{s}_g)}\frac{p}{1-p} = \frac{\delta h - \ell}{(1-F_h(\hat{s}_{g'}))(h-\delta h) - F_h(\hat{s}_{g'})L}, \tag{10}$$

if $(1-F_h(\hat{s}_{g'}))(h-\delta h) > F_h(\hat{s}_{g'})L$ and $\hat{s}_m = \overline{s}$ otherwise, where $g \neq g'$. Figure 3 shows the male h-type's best response to $\hat{s}_f$ with and without positive loss of face.

Since the best replies are symmetric, $\hat{s}_f = \hat{s}_m = \hat{s}_h$ defined by (10), or by $\hat{s}_h^* = \overline{s}$ (the C-F equilibrium).

Proposition 1 states that the C-F equilibrium may arise as a stable equilibrium as one moves from the benchmark setting (the CAE, or in general whenever $L_g = 0$) to an environment with a positive LoF term. Without LoF (where condition 7 holds), only an interior equilibrium is stable; for positive L the C-F equilibrium is always stable. If the C-F equilibrium is plausible, this suggests that LoF may worsen outcomes:

Remark 1. *Compared to an interior equilibrium allocation without loss of face, the C-F equilibrium in an environment with LoF induces*

1. *a lower overall marriage rate,*

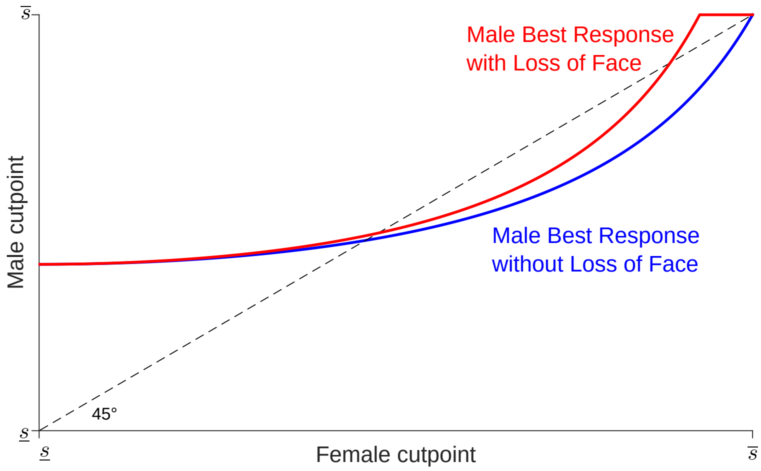


Figure 3: Male high-type's best response to (high type) female cutpoints, with and without loss of face; condition 7 holds here

2. lower aggregate surplus (even without directly including LoF in the surplus calculation), and

3. lower expected surplus (again, even without subtracting the LoF) for both types of both genders.

(Details of this remark are in the appendix.)

We next consider the monotone comparative statics of the equilibrium in L. For small enough L, low types always accept, implying that equation (10) determines the high types' equilibrium play. We examine the behavior of (10) (as a system of two equations for $g = m, f$) in the neighborhood of the equilibrium threshold $\hat{s}^*$ as we increase L. This yields the following statement (proof in the appendix).

Proposition 3. *Suppose (7) holds where $L_g = L = 0$. Then there is $\bar{L} > 0$ (defined by condition 6 and expression 10) such that for all $L \in [0, \bar{L}]$ there is an interior, stable equilibrium where low types play "accept" unconditionally, and high types use thresholds $\hat{s}^*$ implicitly defined by (8).*

Under these conditions, for a small increase in L to $L' \in (L, \bar{L}]$ low types still always accept, i.e. $\hat{s}_\ell = \bar{s}$, and the symmetric equilibrium floor cutoffs for high types will increase in a stable interior equilibrium (and will decrease in an unstable interior equilibrium).

For $L > \bar{L}$, in any interior stable equilibrium low types use ceilings, i.e. play "accept if $s \leq \check{s}_\ell$", and high types use thresholds $\hat{s}_h$ implicitly defined by (20) and (21). If $\bar{L} > \delta h - \ell$, for a small increase in L to $L' \in (L, \bar{L}]$ the symmetric equilibrium ceiling cutoff for low types will decrease, while the symmetric equilibrium floor cutoffs for high types will increase, i.e., both types play "accept" less often.

For intuition, consider that for equilibrium dynamics, becoming more selective by increasing one's cutoff has a twofold effect on the expected quality of a marriage partner. First, there is a screening effect, increasing the expected quality of a match *holding constant* the acceptance behavior of the other gender. Second there is a supply effect in the opposite direction: if one side becomes more selective, then the other side will react by also becoming more selective, implying a greater acceptance curse on both sides.[19] In the above case, while L remains small, the supply effect only stems from the high

[19]The equilibrium tradeoff between screening and the acceptance curse was present without LoF. However, in the ARE LoF makes accepting less attractive for males, and this effect is stronger the more females reject, implying a steeper reaction function.

types on the other market side.[20]

Next consider where $L > \bar{L}$. Here, the condition $\bar{L} > \delta h - \ell$ implies that the LoF from being rejected exceeds a high type's cost of marrying down, so a high-type who plays *accept* prefers that a low type *accepts* her. This implies that as low types become more reverse-snobbish, high types are *less* motivated to play accept against them, thus they become more selective. The above proposition presents a sufficient condition for this intuitive comparative static.

However, a counter-intuitive response also is possible. If $\bar{L} < \delta h - \ell$, then, for $L \in [\bar{L} \delta h - \ell]$, while L is large enough to make low types become reverse snobs, it is small enough that high types prefer that low types play *reject.* Thus, in this range, as L increases, and low types become more reverse-snobbish, high-types find lower signals less risky, and thus may *decrease* their threshold, becoming *less* choosy. We offer a numerical example of this in the appendix (page 30) .

5.2.3 Asymmetric Revelation Environment (ARE): Positive Cost of Loss of Face

We turn now to the ARE, where only one market side is subject to LoF. For the sake of concreteness suppose that males move first and know they are observed by females, and thus $L_m = L$ but $L_f = 0$. The ARE is of particular interest. Firstly, it allows us to separate out the direct and indirect effects of LoF; for the vulnerable side and for the opposite side. Secondly, it describes a common situation, and one that can be easily engineered by requiring one side to move first. Thirdly, it provides a simpler environment to show the intriguing possibility that the high-types equilibrium cutoffs may be nonmonotonic in L, and that LoF may even increase the rate of successful matches beyond the benchmark (CAE) case!

Propositions 1 to 3 carry over to the ARE almost unchanged. Under Condition (7) the CF-equilibrium is again tatonnement-stable even if only males are vulnerable to LoF.

With asymmetric LoF, equilibrium behavior is also asymmetric. Analogously to Lemma 1 the three nontrivial thresholds (for high-type females, high-type males, and low-type males) are defined by the system of equations defining the observed signal that makes each indifferent between accepting and rejecting:

$$\frac{p}{1-p}\frac{f_h(\hat{s}_f)}{f_\ell(\hat{s}_f)} = \tfrac{\delta h-\ell}{h-\delta h}\tfrac{F_h(\check{s}_{m\ell})}{1-F_h(\hat{s}_m)}, \tag{11}$$

$$\frac{p}{1-p}\frac{f_h(\hat{s}_m)}{f_\ell(\hat{s}_m)} = \tfrac{\delta h-\ell}{h-\delta h}\tfrac{1}{1-F_h(\hat{s}_f)(1+L/(h-\delta h))}, \text{ and} \tag{12}$$

$$\frac{p}{1-p}\frac{f_h(\check{s}_{m\ell})}{f_\ell(\check{s}_{m\ell})} = \tfrac{l-\delta \ell}{h-\delta \ell}\tfrac{1}{(1-F_\ell(\hat{s}_f))(1+L/(h-\delta\ell))-1}. \tag{13}$$

Once again high types use floors, $\hat{s}_f$ and $\hat{s}_m$.

In contrast to the FRE, since females face no LoF, by (4) low females always accept (in any stable equilibrium); i.e., $\hat{s}_{f\ell} = \bar{s}$, $\check{s}_{f\ell} = \underline{s}$. Thus (again by (4)) low males must always accept for small $L \geq 0$ that satisfies (6).[21] With severe LoF, (i.e., $L > \bar{L}$ as defined in Proposition 3) they attempt to avoid being rejected and use the signal to screen for low females, using a ceiling threshold $\check{s}_{m\ell}$. Thus, in the ARE, for large L the low males act as *reverse snobs.*[22]

[20]Note that we cannot rule out a "perverse" equilibrium in the FRE where low types use nontrivial floors even though $L < \bar{L}$; if low-types on one side are very selective, low-types on the other side may may prefer to play reject against them to avoid the risk of LoF, (noting that the *marriage gain* is also higher in the latter case).

[21]This rules out the potential "perverse" equilibrium in the FRE (see previous footnote), making the non-monotonic response below a more general result.

[22]Reverse snobbery (on both sides) was also possible in the symmetric FRE, if low-types of both genders preferred to

As L increases further low males become more reluctant to accept. This reduces high females' risk of being fooled, making them more eager to accept (lowering their thresholds). This in turn drives down the male h-types' thresholds. The implications are intriguing: as L increases from 0, high types become first *less* and then *more* inclined to accept. In contrast, as L increases from 0, low-type male's behavior first remains constant (always accepting) and then becomes more strict (reverse snobbery).[23,24] This implies that each type's surplus is non-monotonic. The aggregate matching frequency may *also* be non-monotonic, first decreasing and then increasing in L, and positive LoF in an ARE may even *increase* the number of successful matches (relative to no LoF), as demonstrated in the next section.[25]

5.2.4 ARE: triangular distribution example illustrating non-monotonicity in L

The effect of changes in L on equilibrium behavior depends on the parameters and the distribution function; it is ambiguous in general. As we were not able to generally characterize all equilibrium comparative statics, we focus on a convenient specification. Suppose the signal distribution is a triangular distribution of the form $F_h(s) = s^2$ and $F_\ell(s) = 2s - s^2$ with $s \in [0, 1]$. Under this assumption an equilibrium without LoF is given by all low types playing "accept" and high types using the threshold:

$$\hat{s}^* = \frac{1}{2}\left(\sqrt{1 + 4\frac{1-p}{p}\frac{\delta h - \ell}{h - \delta h}} - 1\right). \tag{14}$$

The equilibrium is interior and stable if $\frac{1-p}{p}\frac{\delta h-\ell}{h-\delta h} < 2$, i.e., if condition (7) is satisfied, implying that the slope of the high types' *brf* is greater than 1 as s approaches $\bar{s}$. Proposition 3 carries over (details in appendix) and thus both $\hat{s}_m$ and $\hat{s}_f$ increase in L for $L \in [0, \bar{L}]$ as defined in the proposition.

With a larger loss of face $L > \bar{L}$ term the equilibrium thresholds must satisfy:

$$\hat{s}_f : \quad \tfrac{p}{1-p}\tfrac{\hat{s}_f}{1-\hat{s}_f} = \frac{\delta h - \ell}{h - \delta h}\frac{\check{s}_{m\ell}^2}{1 - \hat{s}_m^2}, \tag{15}$$

$$\hat{s}_m : \quad \tfrac{p}{1-p}\tfrac{\hat{s}_m}{1-\hat{s}_m} = \frac{\delta h - \ell}{h - \delta h}\frac{1}{1 - \hat{s}_f^2(1 + L/(h - \delta h))}, \text{ and} \tag{16}$$

$$\check{s}_{m\ell} : \quad \tfrac{p}{1-p}\tfrac{\check{s}_{m\ell}}{1-\check{s}_{m\ell}} = \frac{l - \delta \ell}{h - \delta \ell}\frac{1}{(2\hat{s}_f - \hat{s}_f^2)(1 + L/(h - \delta \ell)) - 1}. \tag{17}$$

We offer a numerical case of this parametric example. Setting $p = 1/2$, $h = 1$, $\ell = 1/4$ and $\delta = 2/3$ (satisfying condition 7), figure 4 shows the equilibrium outcome as L increases. Indeed both high types' cutoffs first increase in L up to $\bar{L}$, and then both decrease as the low male's cutoff starts decreasing. This implies that as L increases, high-types' chance of getting married first decreases and then increases; as does low types' chance of marrying high (both in absolute and relative terms).

reject against a known-high-type (see Lemma 1).

[23]Finally, for *very* large L the CF-equilibrium becomes risk-dominant, as noted above, and the male ℓ-types' ceiling approaches $\underline{s}$, implying that the overall marriage rate converges to zero.

[24]We conjecture that the ARE has an interior equilibrium for any L. As $L \to \infty$, low males accept against only the lowest signals, while low females always accept. High males only accept for high enough signals, while high females (who don't face LoF) accept against all but the lowest signals, as low males have nearly dropped out. Thus high males can accept against higher signals without fear of LoF.

[25]We speculate that for stable, interior equilibria in the ARE, an increase in L reduces marriage payoffs for all low types. For small L, high-types' cutoffs increase in L (prop. 3). For $L > \bar{L}$, low males become reverse snobs and lower their ceiling in $\bar{L}$, and high types reduce their floors in response. The net effect of this latter increase in L must harm all low types. This is because high types decrease their floors only when this implies a greater probability of matching other high types, so the decrease in the floor is overcompensated by the decrease in the low type's ceiling, making a mixed marriage less likely.

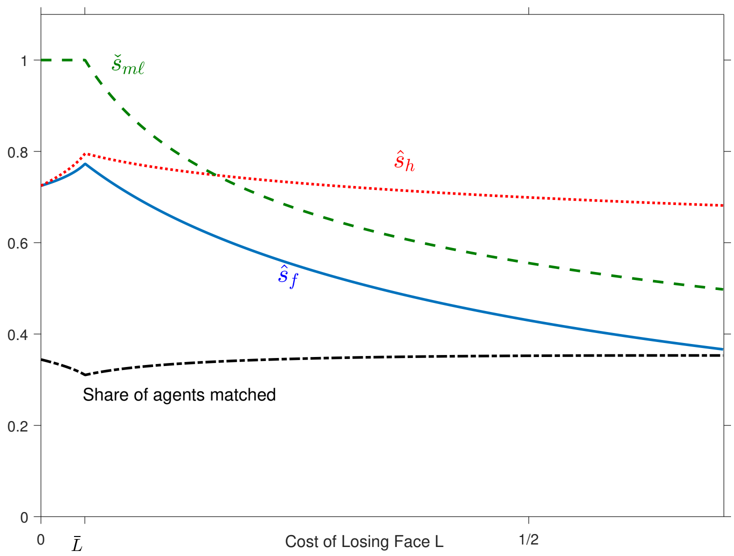


Figure 4: Thresholds and percentage of possible marriages formed as functions of loss of face

Turnover—i.e., the number of marriages formed as a share of possible matches—first declines and then increases in L. It may even increase beyond the turnover achieved for $L = 0$; for example no LoF corresponds to a 34.4% turnover, while at $L = 2/3$ turnover is 35.3%.[26] Increases in L are also accompanied by more assortative mating: homogamous ((h, h) or (ℓ, ℓ)) marriages increase as a share of all marriages.

We can extend this to the general parametric example. Suppose that $\frac{1-p}{p}\frac{\delta h-\ell}{L+h-\delta h} \geq 1$ holds for the critical value $\bar{L}$ defined by condition 6, and suppose a sufficiently great "pizazz ratio" h/ℓ. Then (for this parametric example) $\hat{s}_f$ and $\hat{s}_m$ increase in L for $L < \bar{L}$ and decrease for $L > \bar{L}$, as shown in the appendix (page 30). Let $m(x_f, x_m)$ indicate the measure of marriages between females of type x_f and males of type x_m. These responses imply that for $L < \bar{L}$, $m(h, h)$, $m(h, \ell)$ and $m(h, \ell)$ all decrease in L, while $m(\ell, \ell)$ remains constant. They also imply that for $L > \bar{L}$, $m(h, h)$ and $m(h, \ell)$, $m(\ell, h)$ increase in L, while $m(\ell, \ell)$ decreases in L.

This triangular distribution example and the specific case plotted in figure 4 demonstrate the possibility of several non-intuitive outcomes, summarized below (details in the appendix).

Remark 2. *In an ARE under equilibrium behavior, several crucial outcomes may be non-monotonic in L, both increasing and decreasing as LoF increases. These outcomes include (i) the high types' probability of getting married, (ii) the low types' probability of marrying a high type, and (iii) the overall marriage rate (turnover).*

[26]We derive overall turnover for the numeric example only, in the appendix.

Which side is affected more?

Only the market side that *proposes* may incur loss of face, suggesting a contrast from Gale and Shapley (1962), where the *proposers* in their deferred-acceptance algorithm secure better matches in equilibrium. For instance, if men propose to women the men-optimal matching outcome will attain. This method is often used in practice, e.g. the student-optimal algorithm in school choice. (If LoF is relevant here, our setup suggests a potential cost to students, which a CAE can avoid.) However, as noted below, the side that *doesn't* face direct LoF (here, females) may still suffer indirect harm, and this may even exceed the direct cost (to the males).

We consider, for the ARE in general: Is the side that bears the loss of face, (here, males) more affected than the other side? Note first that low males are always at least as selective as low females, as the latter always accept. For high types, the possibility of losing face may make males more reluctant to accept than females. On the other hand, this effect will increase the females' acceptance curse: it will decrease the probability that, given a female is accepted, her match was high; thus making high females more cautious. The first effect dominates:

Proposition 4. *In any equilibrium in an ARE with Loss of Face, high males are more selective than high females, i.e., $\hat{s}_f \leq \hat{s}_m$; this holds strictly if $\hat{s}_m < \overline{s}$, i.e., if we rule out the C-F equilibrium.*

Proof. Let $L > 0$. Suppose that $\hat{s}_f \geq \hat{s}_m$. Then the monotone likelihood property and equations (12, 11 and 13) imply that

$$F_h(\hat{s}_\ell) \geq \frac{1 - F_h(\hat{s}_m)}{1 - F_h(\hat{s}_f)(1 + L/((1-\delta)h))} > 1,$$

a contradiction. □

Thus, considering high types of both genders, unless LoF induces a coordination failure, the gender facing direct LoF will be more "snobbish" than the gender sheltered from it. This has a surprising extension: under certain conditions the side *not* facing direct LoF (females) may suffer *more* from it!

Note that when L is small enough that $\hat{s}_\ell = \overline{s}$, the probability that a high male marries "below his station": $1 - F_\ell(\hat{s}^*_m)$, is less than $1 - F_\ell(\hat{s}^*_f)$, the probability that a high female does so.

Remark 3. *In any stable equilibrium in an ARE with a small amount of LoF: (i) high males marry less often than high females but get better spouses on average, and (ii) low males marry more often than low females and get better spouses on average; thus for low types, a small amount of LoF on one side reduces the marriage payoffs on the* other *side more.*

The vulnerable side may suffer less even including the direct LoF costs:

Remark 4. *In an ARE, for, δh sufficiently close to ℓ, a small LoF term causes low males' expected total payoffs to decrease less than those of low females even including the direct cost of losing face.*

Proof. In the ARE, the change in low types' *total* payoffs as L increases from zero is, for low males and females, respectively:

$$\frac{\partial v(\ell, m)}{\partial L} = -pF_\ell(\hat{s}^*_f) - p(h + L - \delta\ell)\frac{\partial F_\ell(\hat{s}^*_f)}{\partial s}\frac{\partial \hat{s}^*_f}{\partial L} \text{ and}$$
$$\frac{\partial v(\ell, f)}{\partial L} = -p(h - \delta\ell)\frac{\partial F_\ell(\hat{s}^*_m)}{\partial s}\frac{\partial \hat{s}^*_m}{\partial L}.$$

For $L = 0$ the equilibrium is symmetric, so that we know that $\hat{s}^*_f = \hat{s}^*_m$. Moreover, by Proposition 4, in a $\frac{\partial \hat{s}^*_f}{\partial L} < \frac{\partial \hat{s}^*_m}{\partial L}$. Hence (as noted in the previous remark), starting at $L = 0$ a marginal increase in L

will decrease male ℓ types' expected *marriage* payoffs less than those of female ℓ types. Suppose δh is arbitrarily close to ℓ, so high types only slightly prefer solitude to marrying low. This leads high types to become very permissive in the no-LoF equilibrium, i.e., $\hat{s}^*$ will approach $\underline{s}$ (as clearly seen in equation (14) for the parametric example), implying that $F_\ell(\hat{f}^*)$ will be arbitrarily close to 0 for δh close enough to ℓ. Then $\frac{\partial v(\ell,m)}{\partial L} > \frac{\partial v(\ell,f)}{\partial L}$ for L in a neighbourhood of $L = 0$. $\square$

6 Conclusions and suggestions for future work

Our simple models illustrate how the presence and level of loss of face may worsen (or improve) outcomes, providing conditions and intuition for each. There are clear real-world applications. Some mechanisms and policies may be more efficient than others in the presence of LoF concerns, and firms and policymakers should take this into account. Although setting up a *Conditionally Anonymous Environment* may take some administrative effort, and may require a third-party monitor, we imagine many cases in which it will lead to more and better matches and improve outcomes. Consider, for example, the matching of advisors and students in a Ph.D. program. A "tick box system" might work, although some might be reluctant to participate in such an impersonal system. More generally, the use of a knowledgable, reliable, and discrete intermediary, might be more effective. Our paper motivates the use of such "matchmakers" in many contexts.[27] We further note (considering the *ARE*) that if only one side is vulnerable to LoF costly intermediaries may not be necessary; it would be sufficient to let the other side choose first ("propose").

However, in considering implementing a *CAE*, designers should look closely at the extent to which LoF seems to be shutting down markets and how it is affecting participants' strategies. As seen in the parametric example, LoF may also *improve* outcomes if it induces low types to become reverse snobs, and this leads high types to become less selective. However, such gains come at the expense of low types and, at least in the parametric example, lead to increased assortative mating and perhaps greater inequality.

Our modeling can be expanded and generalized. For example, while we assume linear payoffs in the match's type, future work could consider super- or sub-modularities in the marriage production function.

In a model allowing both inherent LoF and reputation, the effects of revealing offers on match efficiency may be complex. If a player is known to be vulnerable to LoF, his making an offer might actually be interpreted as a signal of his *confidence* that he will be accepted, thus a positive signal about his own type. Whenever a player rejects another, there is some possibility that he did so merely to avoid losing face; noting this possibility should presumably "soften the blow" to a player's reputation when he is rejected.

Relaxing the assumptions further, preferences over types may be heterogeneous or involve a horizontal component, this may change the equilibrium reputation effects of revealing offers. We might also consider the effects of a player who is either altruistic—suffering when the other player loses face—or spiteful, relishing in making others lose face. Consider a sequential game where only the first

[27] Merely encouraging face-to-face meetings may allow colleagues to reveal their potential interest slowly and conditionally, lessening the risk of LoF from a "desperate bid". This may help explain Boudreau et al (2012); who exogenously facilitated brief meetings between local scientists, and found significant increases in their probability of collaborating.

mover is vulnerable to LoF and the second mover is a known altruist. Here the first-mover might manipulate this altruism, playing "accept" and in effect guilting the second-mover into marrying her; this could lead to inefficient matching.

Empirically, our anecdotal and referential evidence for LoF should be supplemented by experimental evidence. Field experiments (or contextual lab work) in the mold of Lee and Niederle (2015) will help identify preferences and beliefs. Abstract "induced values" experiments may also shed light on strategic play and coordination in our simple environment. While a variety of experimental papers, (see footnote) consider such environments, these do not (i) rely on homegrown preferences and beliefs over social interactions or partnerships, (ii) have face-to-face interaction, (iii) test the single-shot matching of our model, (iii) compare environments such as our CAE and ARE, nor (iv) have a subjects' previous choices and history reported to later matches.[28] By varying whether choices are revealed on one side, both sides, or neither side, we can identify how fear of LoF affects strategic play independent of self-image concerns and curiosity motives. However, distinguishing inherent LoF from reputation concerns may be more challenging; this will require an environment where LoF seems likely to be psychologically meaningful, but full anonymity is common knowledge.

As well as strengthening the evidence for the existence of the LoF motivation, these experiments should examine the causes and correlates of LoF, and its efficiency consequences in various environments. Do people act strategically to minimize their own risk of LoF? Will they be willing to pay to preserve the anonymity of their offers? Who is most affected by loss of face and when (considering sex, race, popularity, status, psychometric measures, etc.)? How can these issues be addressed to improve matching efficiency in real-world environments?

Our results, supplemented by empirical work, will have important implications for government and managerial policy. Search and matching models examining the workings of labor market policies may need to adjust for the presence of LoF. Our research suggest that policies that subsidize or encourage sending applications will appear more advantageous. Organizations may want to closely consider when offers, payments, proposals, and attempts should be made transparent, and when they should be obscured. Matchmakers and middlemen in many areas, from actual marriage brokers to career "headhunters" to venture capital intermediaries may want to guarantee that unrequited offers will be kept secret. As previously noted, secrecy may be helpful for the success of both international negotiations and negotiating over business mergers. Both parties may want a mutual guarantee that no offers or proposals will be leaked. Finally, we note a hub of "sharing economy" organizations promoting forms of cooperation and sharing that appear efficient but are not yet widely practiced. The fear of LoF may have served as a barrier to these activities in the past; setting up a "risk-free partnering exchange" may be helpful.

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[28]Recent work considers symmetric horizontal matching preferences in an anonymous laboratory setting. E.g., Echenique and Yariv (2011) and Pais et al. (2012) allow subjects to make and reject/accept offers sequentially over a certain duration, in small groups. The former offers evidence that stability is a good predictor of market outcomes with complete information over preferences. The latter finds that making offers costly leads to fewer and slightly less ambitious offers, less efficiency and less stable matchings. Incomplete information boosts both stability and efficiency.

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Note: For space concerns, all of the appendices below should be placed online.

A Proofs and characterizations

Best responses (Lemma 1)

The following conditions describe male best responses *given female strategies*, and expresses these for the case of symmetric behavior. Responses for females are analogous (switching m and f).

1. If a male ℓ prefers to play A against a certain-h female, i.e., if condition (6) holds for males, i.e., $(1-F_\ell(\hat{s}_{g'}))(h-\delta\ell)-F_\ell(\hat{s}_{g'})L_m \geq 0$, then male ℓ-types use floors, i.e. "accept iff $s \geq \hat{s}_{m\ell}$". If the comparable condition holds for female ℓ-types, they also use floors, and $\hat{s}_{m\ell} = \max\{\underline{s}, \min\{\overline{s}, \hat{s}\}\}$, where $\hat{s}$ satisfies:
$$\frac{f_h(\hat{s})}{f_\ell(\hat{s})}\frac{p}{1-p} = \frac{F_\ell(\hat{s}_{f\ell})L_m - (1-F_\ell(\hat{s}_{f\ell}))(\ell-\delta\ell)}{(1-F_\ell(\hat{s}_f))(h-\delta\ell) - F_\ell(\hat{s}_f)L_m}. \tag{18}$$
Under these conditions, male h-types play "accept iff $s \geq \hat{s}_m$". The floor threshold $\hat{s}_m = \max\{\underline{s}, \min\{\overline{s}, \hat{s}\}\}$, where $\hat{s}$ satisfies:
$$\frac{f_h(\hat{s})}{f_\ell(\hat{s})}\frac{p}{1-p} = \frac{(1-F_h(\hat{s}_{f\ell}))(\delta h-\ell) + F_h(\hat{s}_{f\ell})L_m}{(1-F_h(\hat{s}_f))(h-\delta h) - F_h(\hat{s}_f)L_m}. \tag{19}$$

2. Otherwise ℓ-type males use ceilings, i.e., "accept iff $s \leq \check{s}_{m\ell}$". Again, in a symmetric equilibrium, where the comparable condition holds for females, $\check{s}_{m\ell} = \max\{\underline{s}, \min\{\overline{s}, \check{s}\}\}$, where $\check{s}$ satisfies:
$$\frac{f_h(\check{s})}{f_\ell(\check{s})}\frac{p}{1-p} = \frac{(1-F_\ell(\check{s}_{f\ell}))L_m - F_\ell(\check{s}_{f\ell})(\ell-\delta\ell)}{(1-F_\ell(\hat{s}_f))(h-\delta\ell) - F_\ell(\hat{s}_f)L_m}. \tag{20}$$
Under these conditions, male h-types use floor thresholds $\hat{s}_m = \max\{\underline{s}, \min\{\overline{s}, \hat{s}\}\}$, where $\hat{s}$ satisfies:
$$\frac{f_h(\hat{s})}{f_\ell(\hat{s})}\frac{p}{1-p} = \frac{F_h(\check{s}_{f\ell})(\delta h-\ell) + (1-F_h(\check{s}_{f\ell}))L_m}{(1-F_h(\hat{s}_f))(h-\delta h) - F_h(\hat{s}_f)L_m}. \tag{21}$$

Proof of Proposition 1

Totally differentiating (3), using $q_g(h,h) = F_h(\hat{s}_g)$, and rearranging, the slope of a high male's (the female case is analogous) best reply function (henceforth "*brf*") must follow:

$$\frac{\partial \hat{s}_m}{\partial \hat{s}_f} = \frac{f_h(\hat{s}_m)f_h(\hat{s}_f)(h-\delta h+L_m)}{f_h'(\hat{s}_m)[(1-F_h(\hat{s}_f))(h-\delta h+L_m)-L_m] - \frac{1-p}{p}f_\ell'(\hat{s}_m)[q_f(\ell,h)(\delta h-\ell)+(1-q_f(\ell,h))L_m]}. \tag{22}$$

Therefore $\frac{\partial \hat{s}_m}{\partial \hat{s}_f} = 0$ if $\hat{s}_f = \underline{s}$. Inspecting (3) we see that $\hat{s}_m > \underline{s}$ if $L_m > 0$ or if $q_f(\ell,h) > 0$. Recall that if $L_m = 0$, low males always accept (other than in a trivial coordination failure equilibrium). This implies low females prefer to accept at least against the lowest signals, implying $q_f(\ell,h) > 0$. Thus $\hat{s}_m > \underline{s}$ for any high female brf, implying a high male's brf is strictly positive at $\underline{s}$. Using (3), the best-reply $\hat{s}^*_m(\hat{s}_f)$ strictly increases in $q_f(h,h)$ and thus in $\hat{s}_f$ and $\hat{s}^*_m(\overline{s}) = \overline{s}$.

Given this, for an interior equilibrium to exist $\hat{s}^*_m(\hat{s}_f)$ must cross the 45° line at least once for some interior $\hat{s}_f$ (and similarly for $\hat{s}^*_f(\hat{s}_m)$). The male brf is flat at its origin, i.e., $\frac{\partial \hat{s}_m}{\partial \hat{s}_f} = 0$ must hold at $\hat{s}_f = \underline{s}$. It follows that if $\hat{s}_m$ intersects the 45° line, there must be at least one intersection such that $\frac{\partial \hat{s}_m}{\partial \hat{s}_f} < 1$. Hence, if a symmetric interior equilibrium exists, there is one that is tatonnement stable. Existence is guaranteed if the slope of $\hat{s}^*_m(\hat{s}_f)$ is greater than one at $\hat{s}_f = \overline{s}$ (and analogously for females), i.e., if

$$\frac{f_h(\overline{s})^2(h - \delta h + L_m)}{f'_h(\overline{s})[(1 - F_h(\overline{s}))(h - \delta h + L_m) - L_m] - \frac{1-p}{p} f'_\ell(\overline{s})[q_f(\ell, h)(\delta h - \ell) + (1 - q_f(\ell, h))L_m]} > 1.$$

Note here that for $L_m > 0$ (independent of L_f) there is some $\epsilon > 0$ such that $\hat{s}_f \in [\overline{s} - \epsilon, \overline{s}]$ implies $F_h(\hat{s}_f)L_m > (1 - F_h(\hat{s}_f))(h - \delta h)$, implying h males' best response threshold is $\overline{s}$. Thus $\partial \hat{s}_m / \partial \hat{s}_f = 0$ at $\overline{s}$. Moreover, $\partial \hat{s}_m / \partial \hat{s}_{f\ell} = 0$ at $\hat{s}_f = \hat{s}_m = \overline{s}$ as well. Since this implies that $F_h(\hat{s}_f)L_m > (1 - F_h(\hat{s}_f))(h - \delta h)$ with *strict* inequality, a marginal change of $q_f(\ell, h)$ still yields the male best reply $\overline{s}$.

Summarizing, $\forall L_m > 0 \exists \epsilon > 0$ s.t. $\forall \hat{s}_j \in [\overline{s} - \epsilon, \overline{s}]$, $j \in \{f, f\ell\}$, the h males' best reply is $\overline{s}$. Coordination failure equilibria of the type $\hat{s}_m = \hat{s}_f = \overline{s}$ are thus tatonnement stable for $L_g > 0$, $g \in \{m, f\}$, since small changes in other types' thresholds won't change h types' best replies. This includes the coordination failure where $\hat{s}_j = \overline{s}$ for $j \in \{m, f, m\ell, f\ell\}$. This proves the "if" in proposition part b.

Since $F_h(\overline{s}) = 1$ the condition $\frac{\partial \hat{s}_m}{\partial \hat{s}_f}(\hat{s}_f = \overline{s}) > 1$ becomes

$$f_h(\overline{s})^2 > -\frac{f'_h(\overline{s})L_m + f'_\ell(\overline{s})[\frac{1-p}{p}(q_f(\ell, h)(\delta h - \ell)) + (1 - q_f(\ell, h))L_m]}{h - \delta h + L_m} \geq 0,$$

where the last inequality ensures $\frac{\partial \hat{s}_m}{\partial \hat{s}_f}(\hat{s}_f = \overline{s})$ is positive. Assumption 1 implies $f'_\ell(s)f_h(s) < f_\ell(s)f'_h(s)$ and given $f'_h(\overline{s}))$ is bounded; thus $f'_\ell(\overline{s})) < 0$ by $f_\ell(\overline{s}) = 0$ and $f_h(\overline{s}) > 0$ (Assumption 2). Returning to part (a) of the proposition, we note $q_f(\ell, h) = 1$ for $L_m = 0$, implying the above simplifies to $f_h(\overline{s})^2 > -f'_\ell(\overline{s})\frac{1-p}{p}\frac{\delta h - \ell}{h - \delta h}$. By continuity under the condition there is also a neighbourhood $L_m = \epsilon$ with $\epsilon > 0$ such that an interior equilibrium exists. This proves part (a).

Moreover, this condition holds for all $s_f \in (\underline{s}, \overline{s}]$ if $f'_\ell(\overline{s}) \leq 0$ sufficiently close to 0, so that a coordination failure equilibrium with $\hat{s}_f = \hat{s}_m = \overline{s}$ is not tatonnement stable, because a small change in the female threshold will generate a larger change in the male best reply. This proves the "only if" in part (b).

Trembling-hand perfection and risk-dominance

Trembling hand perfection requires the equilibria of a sequence of games with ϵ trembles to converge to the equilibrium of the game without trembles as ϵ approaches zero. In a game perturbed by an ϵ tremble agents play mixed strategies that place at least probability ϵ on each pure strategy. In the unperturbed game with $L > 0$ high males strictly prefer to reject with certainty if high females do so as well. Thus, for small perturbations resulting in $q^\epsilon_j(h, h) > 0$ (but still small) high types still strictly prefer to reject with certainty. This implies that a high male's best response converges to its counterpart in the equilibrium in the unperturbed game as ϵ converges to 0. An analogous argument holds for females, implying the female h types' best reply also converges to its counterpart in the equilibrium in the unperturbed game. Hence, the equilibrium is indeed trembling hand perfect. By the same token, for $L = 0$, small perturbations resulting in $q^\epsilon_j(h, h) > 0$ will lead to the interior equilibrium if condition (7) holds, for any $\epsilon > 0$.

We consider the risk dominance concept of Harsanyi et al. (1988). By deviating from an interior equilibrium and shutting down, high-types earn their reservation payoff δh with certainty, no matter the strategies of other players. Subtracting δh from equation 9 yields a lower bound on the absolute value loss from this deviation (as this ignores the equilibrium cost of LoF, this bound is not tight). By this calculation, the absolute value loss from this deviation is no larger than $p(1-F_h(\hat{s}))^2(h-\delta h) - (1-p)(1-F_\ell(\hat{s}))(\delta h - l)$. We compare this to the absolute loss from unilaterally deviating from the CF-equilibrium to interior play, which is at least $pL_g - \delta h$; noting that high types on the other side always reject, leading to the loss L_g. (Again, this bound not tight, as we did not subtract the loss from marrying low types.) As L_g grows, the latter deviation loss must exceed the former.

Risk dominance (ibid.) considers the relative *products* of the deviation losses for both types. Thus, whether or not L_g is symmetric (considering the CAE and ARE), as *either* gender's L term increases, the *product* of the losses from unilateral deviations *away* from the CF-Equilibrium must grow to exceed the product of the losses from deviations in the reverse direction.

Details for Remark 1

(i) In the benchmark case all ℓ-types accept and some h-types do. In the C-F equilibrium with LoF no h-types accept, but all ℓ-types accept. This yields the reduced marriage rates given in the corollary.

(ii) The reduction in aggregate payoffs follows directly from the linear marriage production function.

(iii) The argument for the reduced expected surplus of each gender/type relies on a revealed preference argument. Consider going in the opposite direction, from the C-F equilibrium to the benchmark. The strict increase in the rate of acceptance for high types requires that they must be better off when they accept (as their outside option remains the same) and are thus better off in expectation. (An analogous argument would hold for any increase in the acceptance rate for ℓ types). Furthermore, when playing A, both ℓ and h types are better off when h-types are in the market; their expected mate will be of higher quality.

Proof of Proposition 3

The changes in $\hat{s}_h^*$ from $\hat{s}^*$ associated with the ϵ increase in L from $L=0$ are determined by equation (10) where $\hat{s}_g = \hat{s}_{g'} = \hat{s}_h^*$. Taking the total differential in $\hat{s}_h^*$ and L, with changes represented by Δ terms, yields:

$$\frac{\partial \frac{f_h(\hat{s}_h^*)}{f_\ell(\hat{s}_h^*)}}{\partial s} \frac{p}{1-p} \Delta \hat{s}_h^* = \frac{(\delta h - l)\left[f_h(\hat{s}_h^*)(h-\delta h + L)\Delta \hat{s}_h^* + F_h(\hat{s}_h^*)\Delta L\right]}{(h-\delta h - F_h(\hat{s}_h^*)(h-\delta h+L))^2},$$

for $L=\epsilon$ small enough such that condition (4) holds (so low types still play "always accept"). Rearranging yields:

$$\frac{\Delta \hat{s}_h^*}{\Delta L} = \frac{(\delta h - \ell)F_h(\hat{s}_h^*)}{\frac{\partial \frac{f_h(\hat{s}_h^*)}{f_\ell(\hat{s}_h^*)}}{\partial s} \frac{p}{1-p}[h-\delta h - F_h(\hat{s}_h^*)(h-\delta h+L)]^2 - (\delta h - \ell) f_h(\hat{s}_h^*)(h-\delta h+L)}.$$

By taking the total differential of (10), we see that the high male's best reply $\hat{s}_m$ to the high female's threshold $\hat{s}_f$, given L, has the slope:

$$\frac{\Delta \hat{s}_m}{\Delta \hat{s}_f} = \frac{(\delta h - \ell) f_h(\hat{s}_f)(h - \delta h + L)}{\frac{\partial \frac{f_h(\hat{s}_h^*)}{f_\ell(\hat{s}_h^*)}}{\partial s} \frac{p}{1-p} [h - \delta h - F_h(\hat{s}_h^*)(h - \delta h + L)]^2},$$

and analogously for high females.

Hence, $\frac{\Delta \hat{s}_h^*}{\Delta L} > 0$ if $\frac{\Delta \hat{s}_m}{\Delta \hat{s}_f} < 1$ at $\hat{s}_f = \hat{s}_m = \hat{s}_h^*$, and vice versa. Hence, starting from an equilibrium $\hat{s}_h^*$ at some $L \geq 0$ such that condition (4) holds, a marginal increase in L will increase $\hat{s}_h^*$ if the equilibrium was stable, and decrease $\hat{s}_h^*$ otherwise.

Existence of:

$\bar{L} > 0$, such that (4) holds for $L \leq \bar{L}$ and the associated the$\hat{s}_h^*$ in a stable, interior equilibrium, but not for $L > \bar{L}$

...follows from

(i) the fact that condition (4) holds with strict inequality for $L = 0$,

(ii) continuity and strict monotonicity of $\hat{s}_h^*$ in L in a stable interior equilibrium, and

(iii) continuity of the condition (4) in $\hat{s}_h^*$ and L.

For the second part: Suppose $L = \bar{L}$ and there is a stable interior equilibrium. Let L increase to $L' > \bar{L}$. Note first that assuming that $L' > \bar{L}$ and condition (4) holds leads to a contradiction, because condition (4) implies that ℓ types play "always accept", in which case $\hat{s}_h^*$ must increase, implying that condition (4) cannot hold. Therefore $L' > \bar{L}$ implies that condition (4) does not hold and ℓ and h types' best response is given by expressions (20) and (21), respectively.

When condition (4) fails, differentiation of (20) reveals that a gender g low-type's ceiling $\hat{s}_{g\ell}$ decreases in L, increases in the other gender $-g$'s cutoff for ℓ types $\hat{s}_{-g\ell}$, but decreases in $\hat{s}_{-gh}$. Differentiation of (21) reveals that $\hat{s}_{gh}$ increases in L and, if $L > \delta h - \ell$, decreases in $\hat{s}_{-g\ell}$. Moreover, $\hat{s}_{gh}$ increases in $\hat{s}_{-gh}$.

Suppose that $L > \delta h - \ell$. In a stable interior equilibrium $\hat{s}_{gh}^* < \overline{s}$ and $\check{s}_{g\ell}^* > \underline{s}$, which is characterized by $\frac{\Delta \hat{s}_{gx}}{\Delta \hat{s}_{-gx}} < 1$ at $\hat{s}_{mx}^* = \hat{s}_{fx}^*$ for $x = \ell, h$, $\hat{s}_h^*$ increases in L and decreases in $\check{s}_\ell^*$, whereas $\check{s}_\ell^*$ decreases in both L and $\hat{s}_h^*$. This implies that $\hat{s}_h^*$ increases and $\check{s}_\ell^*$ decreases in L.

Proof that Proposition 3 extends to the ARE

The changes in $\hat{s}_f$ and $\hat{s}_m$ from $\hat{s}^*$ associated with the ϵ increase in L are determined by the system of equations (11) and (12). The total differential of (11) is

$$\frac{\partial \frac{f_h(\hat{s}_f)}{f_\ell(\hat{s}_f)}}{\partial s} \frac{p}{1-p} \frac{(1-\delta)h}{\delta h - \ell} \Delta \hat{s}_f = \frac{f_h(\hat{s}_h)}{(1 - F_h(\hat{s}_m))^2} \Delta \hat{s}_m,$$

where the Δ terms denote the changes in $\hat{s}_f$ and $\hat{s}_m$. Note that this already implies that the equilibrium cutoffs for high females and males move in the same direction as long as L is sufficiently small to ensure that the ceiling $\hat{s}_\ell = \overline{s}$. For marginal changes we have

$$\frac{\partial \hat{s}_f}{\partial \hat{s}_m} = \frac{\frac{f_h(\hat{s}_h)}{(1-F_h(\hat{s}_m))^2}}{\frac{\partial \frac{f_m(\hat{s}_f)}{f_\ell(\hat{s}_f)}}{\partial s} \frac{p}{1-p} \frac{(1-\delta)h}{\delta h - \ell}} > 0. \tag{23}$$

Conducting a similar exercise for (12) yields

$$\frac{\partial \frac{f_h(\hat{s}_m)}{f_\ell(\hat{s}_m)}}{\partial s} \frac{p}{1-p} \frac{(1-\delta)h}{\delta h - l} \Delta \hat{s}_m = \frac{f_h(\hat{s}_f)(L + (1-\delta)h)\Delta \hat{s}_f + F_h(\hat{s}_f)\delta\ell}{(1-\delta)h(1 - F_h(\hat{s}_f)(1 + L/((1-\delta)h)))^2}. \tag{24}$$

Plugging in $\Delta \hat{s}_f$ from above and focusing on the neighborhood of $L = 0$, where $\hat{s}_f = \hat{s}_h = \hat{s}^*$, yields that for marginal variations in L

$$\frac{\partial \hat{s}_f}{\partial L} = \frac{f_h(\hat{s}^*) \frac{F_h(\hat{s}^*)}{(1-\delta)h}}{(1 - F_h(\hat{s}^*))^4 \left(\frac{\partial \frac{f_h(\hat{s}^*)}{f_\ell(\hat{s}^*)}}{\partial s} \right)^2 \left(\frac{p}{1-p} \frac{(1-\delta)h}{\delta h - l} \right)^2 - f_h(\hat{s}^*)^2}.$$

That is, a marginal increase of L at $L = 0$ yields a (weak) increase of $\hat{s}_f$ (and $\hat{s}_m$ by (23)) if, and only if

$$\frac{\partial \hat{s}_f}{\partial \hat{s}_m} = \frac{\frac{f_h(\hat{s}^*)}{(1-F_h(\hat{s}^*))^2}}{\frac{p}{1-p} \frac{(1-\delta)h}{\delta h - \ell} \frac{\partial \frac{f_h(\hat{s}^*)}{f_\ell(\hat{s}^*)}}{\partial s}} < 1.$$

Counter-example: $\hat{s}_h^*$ may decrease in L where conditions of Prop. 3 do not hold

If $\bar{L} < \delta h - \ell$ then for $L \in [\bar{L}, \delta h - \ell]$ we have that $\hat{s}_h^*$ increases in both L and $\check{s}_\ell^*$, suggesting the possibility that both $\hat{s}_h^*$ and $\check{s}_\ell^*$ might *decrease* in L. Suppose the signal distribution is a triangular distribution of the form $F_h(s) = s^2$ and $F_\ell(s) = 2s - s^2$ with $s \in [0, 1]$. Suppose further the parametrization $p = 1/2$, $h = 1$, $\delta = 2/3$, and $\ell = 1/4$. Solving (10) for $\hat{s}_h^*$, which increases in L, yields that condition (4) holds for $L \leq 0.0267 = \bar{L}$. At $\bar{L}$, $\hat{s}_h^* = .829$. Increasing L further yields $\hat{s}_h^*$ and $\hat{s}_\ell^*$ satisfying (20) and (21). The numerical simulation yields that $\hat{s}_h^*$ strictly decreases in L for $L > \bar{L}$ to reach $\hat{s}_h^* = 0.6504$ at $L = 0.1507$. This demonstrates that the sufficient condition in the proposition is not an empty statement.

Details for Remark 2

Taking the total differential of the equilibrium thresholds yields:

$$\begin{aligned}
\frac{p}{1-p} \frac{h - \delta h}{\delta h - \ell} \frac{1}{(1 - \hat{s}_f)^2} d\hat{s}_f &= \frac{2\check{s}_{m\ell}}{1-\hat{s}_m^2} d\check{s}_{m\ell} + \frac{2\check{s}_{m\ell}^2}{(1-\hat{s}_m^2)^2} d\hat{s}_m, \\
\frac{p}{1-p} \frac{h - \delta h}{\delta h - \ell} \frac{1}{(1 - \hat{s}_m)^2} d\hat{s}_m &= \frac{2\hat{s}_f(1+L/(h-\delta h))d\hat{s}_f + \hat{s}_f^2/(h-\delta h)dL}{(1-\hat{s}_f^2(1+L/(h-\delta h)))^2}, \\
\frac{p}{1-p} \frac{h - \delta \ell}{l - \delta \ell} \frac{1}{(1 - \hat{s}_\ell)^2} d\check{s}_{m\ell} &= \frac{-2(1-\hat{s}_f)(1+L/(h-\delta\ell))d\hat{s}_f - (2\hat{s}_f - \hat{s}_f^2)/(h-\delta\ell)dL}{((2\hat{s}_f - \hat{s}_f^2)(1+L/(h-\delta\ell))-1)^2}.
\end{aligned}$$

For the high-types' thresholds to increase as L increases from zero

For L small enough such that (5) holds, all low types play "accept" unconditional on the signal, which means $d\check{s}_{m\ell} = 0$. We can compute:

$$(\delta h - \ell) \left(1 - 4 \frac{p}{1-p} \hat{s}_m^3 \hat{s}_f^2 (1 - \hat{s}_f) \frac{L + h - \delta h}{\delta h - \ell} \right) d\hat{s}_m = \hat{s}_f^2 \hat{s}_m^2 \frac{p}{1-p} dL. \tag{25}$$

Since $\hat{s}_f(1 - \hat{s}_f) \leq 1/4$, a sufficient condition for $d\hat{s}_m/dL > 0$ is $1 \leq \frac{1-p}{p} \frac{\delta h - \ell}{L + h - \delta h}$.[29] Note that

[29] E.g., for L small, this holds if population shares are equal and $h + \ell \leq 2\delta h$.

$d\hat{s}_m/dL > 0$ implies $d\hat{s}_f/dL > 0$, since both thresholds move in the same direction while $\check{s}_{m\ell} = \check{s}_{f\ell} = 1$.

For the high-types' thresholds to decrease as L increases from $\bar{L}$

The condition for $\hat{s}_\ell = 1$ is (5), which under our parametrization becomes

$$(2\hat{s}_f - \hat{s}_f^2)(L + \delta h - \ell) \leq \delta h - \ell).$$

The LHS of the condition increases in $\hat{s}_f$ and in L. If $d\hat{s}_f/dL > 0$ then the LHS will increase in L. That is, there exists $\bar{L}$ defined by condition 6, as in Proposition 3, such that the condition is satisfied for $L \leq \bar{L}$ and does not hold for $L > \bar{L}$, for L in a neighborhood of $\bar{L}$.

If $L > \bar{L}$ then $d\check{s}_{m\ell} \neq 0$, which is only possible if $1 - \sqrt{L/(L+h-\delta\ell)} \leq \hat{s}_f \leq \sqrt{(h-\delta h)/(L+h-\delta h)}$. Then the total differential implies that

$$\left(1 - 4\frac{p}{1-p}\hat{s}_f^2\hat{s}_m^3(1-\hat{s}_f)\frac{L+h-\delta h}{\delta h - \ell} + \frac{16\left(\frac{p}{1-p}\right)^2 \hat{s}_f^3\hat{s}_m^3(1-\hat{s}_f)^3\hat{s}_\ell^2\frac{(L+h-\delta h)(L+h-\delta\ell)}{(\delta h-\ell)(\ell-\delta\ell)}}{\hat{s}_\ell + 4\frac{p}{1-p}\hat{s}_f(1-\hat{s}_f)^2(L+h-\delta\ell)/(\ell-\delta\ell)}\right) d\hat{s}_m$$
$$= \frac{p}{1-p}\frac{\hat{s}_f^2\hat{s}_m^2}{\delta h - \ell}dL - \frac{4\left(\frac{p}{1-p}\right)^2 \hat{s}_f^3(1-\hat{s}_f)(2-\hat{s}_f)\hat{s}_m^2\check{s}_{m\ell}^2\frac{L+h-\delta h}{\delta h - \ell}}{\check{s}_{m\ell} + 4\frac{p}{1-p}\check{s}_{m\ell}^2\hat{s}_f(1-\hat{s}_f)^2(1+L/(h-\delta\ell))}\frac{1}{l-\delta\ell}dL.$$

Notice that the first line is positive if $d\hat{s}_h/dL$ in (25) is positive. The second is negative, however, if

$$1 + 4\frac{p}{1-p}\check{s}_{m\ell}\hat{s}_f(1-\hat{s}_f)^2(1+L/(h-\delta\ell)) < 4\frac{p}{1-p}\hat{s}_f(1-\hat{s}_F)(2-\hat{s}_f)\check{s}_{m\ell}(1+L/(h-\delta h))\frac{h}{\ell}.$$

That is,

$$1 < 4\frac{p}{1-p}\check{s}_{m\ell}\hat{s}_f(1-\hat{s}_f)\left\{(2-\hat{s}_f)(1+L/(h-\delta h))\frac{h}{\ell} - (1-\hat{s}_f)(1+L/(h-\delta\ell))\right\}. \tag{26}$$

Notice that the expression in curly brackets is greater than $(1 + L/(h-\delta h))\frac{h}{\ell}$. For all interior $\hat{s}_f$, which must satisfy $1 - \sqrt{L/(L+h-\delta\ell)} \leq \hat{s}_f \leq \sqrt{(h-\delta h)/(L+h-\delta h)}$, $\hat{s}_f(1-\hat{s}_f)$ is bounded away from zero for $L > 0$. Therefore there must be some h/l large enough that condition (26) will hold.

Putting this together, if ℓ is sufficiently small relative to h and $\frac{p}{1-p}\frac{L+h-\delta h}{\delta h - \ell} \leq 1$, then for all interior threshold values, both $\hat{s}_f$ and $\hat{s}_m$ will decrease in L in the neighbourhood of $\check{s}_{m\ell} = 1$.[30] This establishes the statement in the text immediately before Remark 2.

Turnover response

The measures of (h,h), (ℓ,ℓ), (h,ℓ) and (ℓ,h) matches, where the first entry indicates the female type, are given by:

$$m(h,h) = \frac{1}{2}p^2(1-F_h(\hat{s}_f))(1-F_h(\hat{s}_m)),$$
$$m(\ell,\ell) = \frac{1}{2}(1-p)^2F_\ell(\check{s}_{m\ell}),$$
$$m(h,\ell) = \frac{1}{2}p(1-p)(1-F_\ell(\hat{s}_f))F_h(\check{s}_{m\ell}), \text{ and}$$
$$m(\ell,h) = \frac{1}{2}(1-p)p(1-F_\ell(\hat{s}_m)).$$

[30]Simulations indicate that the conditions are fairly tight; for instance, assuming $h - \delta h > \delta h - \ell$ can induce $\hat{s}_m$ to increase in L, but $\hat{s}_f$ to decrease in L.

For $L < \bar{L}$ as defined above, the results above imply $d\check{s}_{m\ell} = 0$, while both $\hat{s}_f$ and $\hat{s}_m$ increase in L, and thus $m(h,h)$, $m(h,\ell)$ and $m(h,\ell)$ all decrease, while $m(\ell,\ell)$ remains constant. For $L > \bar{L}$, if $\hat{s}_f$ and $\hat{s}_m$ both decrease and $\check{s}_{m\ell}$ decreases in L (implied by the conditions derived above), then $m(h,h)$ and $m(\ell,h)$ increase, while $m(\ell,\ell)$ decreases in L. The sign of the change in $m(h,\ell)$ is ambiguous, but it will increase if $\hat{s}_f \geq 1/2$. $\hat{s}_f \geq 1/2$ is ensured in the neighbourhood of $\bar{L}$ if $\hat{s}_f > 1/2$ for $L = 0$ under our assumption. Solving for the $L = 0$ equilibrium yields $\hat{s}_f = \hat{s}_h = \frac{1}{2}\left(\sqrt{1 + 4\frac{\delta h - \ell}{\pi(h - \delta h)}} - 1\right)$. The assumption $p/(1-p)\frac{L + h - \delta h}{\delta h - \ell} \leq 1$ ensures that $\hat{s}_f > 1/2$ at $L = 0$. Hence, $m(h,\ell)$ will increase for $L > \bar{L}$ in the neighbourhood of $\bar{L}$.

B A Repeated Matching Market

As argued earlier, even without a primal loss of face, being observed playing *accept* may have a negative reputational consequence (which itself may be painful). In a multi-period interaction this may also lead to *material* losses, including worse matching prospects in later periods. We demonstrate this below in a two-period model. We compare the case where a player's choice in the first period is private, to a case where it is revealed to her second-period match. We show that in the latter case playing *accept* in the first period worsens one's continuation value, making first-period incentives equivalent to our primal LoF model in the main text.

Basic payoffs and the information structure follows from section 3. However, we now assume that the market remains open for two periods. We give the timing below; note that stages 1-3 are essentially the same as above.

We focus on settings that result in stable, interior equilibria, i.e., settings where Condition 7 holds.

Timing

1. Individuals in M and F are matched to each other randomly. In each match (m, f) each individual i obtains a noisy signal s_j about the other one's type x_j.

2. After observing the signal individuals simultaneously decide on whether to accept or reject the match.

3. Pairs in which both individuals played *accept* form a marriage and are removed from the market and receive payoffs.

4. The remaining individuals are again matched into pairs (m, f) randomly. Again, in each match (m, f) each individual obtains a noisy signal s_j about the other's type x_j.[31]

5. *In an "Asymmetric Partial Revelation Environment" (APRE), but not the "Conditionally Anonymous Environment" (CAE), females observe their (male) match's action in the previous stage, but not vice-versa.*

6. After observing the signal individuals simultaneously decide on whether to accept or reject the match.

[31] For brevity, we do not separately index the first and second period match, nor the first and second period signals – these will be clear from context.

7. Pairs in which both individuals accepted form a marriage, all others remain single. The market closes and payoffs are realized.

B.1 Repeated matching market: Conditionally anonymous environment (CAE)

We solve backwards from the second stage; this solution is identical to that of the one-period model in the main text without LoF, re-labeling some variables; we thus give only a few key equations and results below. Denote the share of h agents on each side in period 2 by p_2, which will depend on players' equilibrium strategies. From the assumption that $f_h(\underline{s}) = 0$ we know that a strictly positive measure of agents remain in the market at $t = 2$.[32] Thus $0 < p_2 < 1$. In the second period, an agent who receives a signal s_j assesses the probability of facing a high type as

$$pr(h|s_j) = \frac{p_2 f_h(s_j)}{p_2 f_h(s_j) + (1 - p_2) f_\ell(s_j)}.$$

B.1.1 Equilibrium Behavior

CAE: Second period

As there is no further reputation motive in the final period, nor an intrinsic LoF, nor is previous play observed in the CAE, this period is equivalent to the CAE (or benchmark model without LoF) from section 3, replacing p with p_2, and noting that s refers to the second-period signal. The results follow (restating the earlier lemma and corollary with minor adjustments to notation).

Lemma 2. *[CAE Second Stage] In a CAE, if an interior stable equilibrium exists (conditions for this are as in the main text), then for the subgame starting in period 2:*

1. *low types always accept,*
2. *high types use symmetric cutoff strategies, accepting if $s > \hat{s}_m = \hat{s}_f := \hat{s}^*$, and*
3. *$\hat{s}^* \in (\underline{s}, \overline{s})$.*

Note $\hat{s}^*$ is defined by equation (2), replacing p with p_2.

This yields the following results. Expected payoffs for types ℓ and h in an interior stable equilibrium of the second-period subgame of the CAE (or for any strategy profile where low types always accept) are

$$\begin{aligned} v_2(\ell) &= \delta\ell + p_2(1 - F_\ell(\hat{s}^*))(h - \delta\ell) + (1 - p_2)(\ell - \delta\ell), and \\ v_2(h) &= \delta h + p_2(1 - F_h(\hat{s}^*))^2(h - \delta h) - (1 - p_2)(1 - F_\ell(\hat{s}^*))(\delta h - l). \end{aligned} \tag{27}$$

Note $v_2(h) > v_2(\ell)$.[33] The number of marriages is $(1-p_2)^2 + 2p_2(1-p_2)(1-F_\ell(\hat{s}^*)) + p_2^2(1-F_h(\hat{s}^*))^2$, which strictly decreases in $\hat{s}^*$.

[32] To violate this both types would have to play "always accept" in the first stage, expecting to remain unmarried with probability 1 conditional on reaching stage 2. This would be an equilibrium if the expected match quality in period 1 were high enough for a high type to accept regardless of the signal:

$$p \geq \frac{f_\ell(\underline{s})(\delta h - \ell)}{f_\ell(\underline{s})(\delta h - l) + f_h(\underline{s})(1 - \delta)h}.$$

This case is excluded by the assumption that $f_h(\underline{s}) = 0$. Moreover, if this assumption were not made and this were an equilibrium, it would not be stable nor trembling hand perfect, since an agent facing a signal $s = \underline{s}$ in $t = 1$ would prefer to take another chance in $t = 2$ if the proportion of ℓ and h agents were to remain the same, as it would under a random tremble.

[33] This must hold as high types could always adopt the same "always accept" strategy as low types and gain a strictly

CAE: First Stage

A similar reasoning applies to the first stage: an agent of type x_i who observes a signal s_j finds it profitable to accept if and only if the expected payoff exceeds her continuation value $v_2(x_i)$ after playing reject. As, in the CAE, the continuation value from rejecting or being rejected are both zero, we only need to see if the payoff from an expected marriage exceeds this. Stating this in terms of gains relative to the continuation value we have:

$$pf_h(s)q_1(x,h)(h - v_2(x)) + (1-p)f_\ell(s)q_1(x,\ell)(\ell - v_2(x)) \geq 0. \tag{28}$$

Recall, a high type prefers marrying a high type over remaining single, which she prefers over marrying a low type; thus her continuation value satisfies $\ell < \delta h < v_2(h) < h$ (the strictness of the latter inequalities follows from $0 < p_2 < 1$, previously demonstrated, and from an interior equilibrium in period 2, under conditions specified). Thus, for a high type the first additive term in inequality (28) must be positive and the second term negative. By the monotone likelihood property, as the signal s increases the first term increases in magnitude and the second term decreases in magnitude (and this holds for both types). Thus the high type will set a floor threshold. By a similar argument, for a low type ($x = \ell$) the first term must be positive but the second term may have either sign. If it is negative the low type must also set a floor threshold. If both terms are positive the low type will always accept in the first period (a trivial floor at $\underline{s}$).

Thus both types will set a floor threshold: there are values $\hat{s}_x \in [\underline{s}, \overline{s}]$ for $x = \ell, h$, such that the agent accepts only if $s \geq \hat{s}_x$. Similarly to the second stage, where interior, these are implicitly defined by

$$pf_h(\hat{s}_x)(1 - F_x(\hat{s}_h))(h - v_2(x)) = (1-p)f_\ell(\hat{s}_x)(1 - F_x(\hat{s}_\ell))(v_2(x) - l), \tag{29}$$

where the left side represents the expected benefit from marrying high relative to staying alone, and the right side the expected "loss" from marrying low relative to staying alone.

Lemma 3. *The first period cutoffs satisfy $\hat{s}_h > \hat{s}_\ell$.*

Proof: Rearranging (29) yields cutoff values $\hat{s}_h$ and $\hat{s}_\ell$ defined by

$$\frac{pf_h(\hat{s}_h)}{(1-p)f_\ell(\hat{s}_h)} = \frac{v_2(h) - l}{h - v_2(h)} \frac{1 - F_h(\hat{s}_\ell)}{1 - F_h(\hat{s}_h)} \text{ and}$$
$$\frac{pf_h(\hat{s}_\ell)}{(1-p)f_\ell(\hat{s}_\ell)} = \frac{v_2(\ell) - l}{h - v_2(\ell)} \frac{1 - F_\ell(\hat{s}_\ell)}{1 - F_\ell(\hat{s}_h)}.$$

Since $v_2(h) > v_2(\ell)$ as shown above, the contradiction to the lemma, $\hat{s}_h \leq \hat{s}_\ell$ implies that

$$\frac{1 - F_h(\hat{s}_\ell)}{1 - F_h(\hat{s}_h)} \leq \frac{1 - F_\ell(\hat{s}_\ell)}{1 - F_\ell(\hat{s}_h)}.$$

Rewriting this in terms of integrals yields

$$1 + \frac{\int_{\hat{s}_h}^{\hat{s}_\ell} f_\ell(s)ds}{\int_{\hat{s}_\ell}^{\overline{s}} f_\ell(s)ds} \leq 1 + \frac{\int_{\hat{s}_h}^{\hat{s}_\ell} f_h(s)ds}{\int_{\hat{s}_\ell}^{\overline{s}} f_h(s)ds}.$$

higher payoff than low types. In doing so, both high and low types would always marry when they meet a low type, but high types would be more likely to marry when meeting another high type (and high type's unmarried payoff are also higher).

This becomes

$$\frac{\int_{\hat{s}_h}^{\hat{s}_\ell} f_h(s)ds}{\int_{\hat{s}_h}^{\hat{s}_\ell} f_\ell(s)ds} \geq \frac{\int_{\hat{s}_\ell}^{\overline{s}} f_h(s)ds}{\int_{\hat{s}_\ell}^{\overline{s}} f_\ell(s)ds}.$$

The monotone likelihood ratio property implies the contrary, since

$$\frac{f_h(s)}{f_\ell(s)} < \frac{f_h(\hat{s}_\ell)}{f_\ell(\hat{s}_\ell)} < \frac{f_h(s')}{f_\ell(s')},$$

for all $s < \hat{s}_\ell < s'$.

Thus high types will be more selective than low types in stage 1. □

Equation (29) leads to several results. Recalling assumption 2, that extreme signals fully reveal types, low types will "accept always" only if $v_2(\ell) \leq l$. This cannot be ruled out: the low types' continuation value may be below the value of marrying low, as they may be rejected in stage 2, which would leave them worse off.

In contrast, high types do not "accept always" – this would require $v_2(h) \leq l$, but as we have shown $v_2(h) > h$ and $\delta h > l$ by assumption. High types will also not "reject always"; this would be optimal only if $v_2(h) \geq h$, which could hold only if there are no low types in stage 2. But we know $p_2 < 1$: even if all ℓ's accept in stage 1 some will meet high types, give off low signals, and be rejected, surviving to stage 2. Hence, $\underline{s} < \hat{s}_h < \overline{s}$, and $\underline{s} \leq \hat{s}_\ell < \hat{s}_h$. This fully characterizes equilibrium strategies, summarized in the following proposition.

Proposition 5. *[CAE Equilibrium] In an equilibrium of the repeated matching market under the CAE low types always accept in stage* 2 *and accept in stage 1 only if $s_j \geq \hat{s}_\ell$. $\hat{s}_\ell$ solves equation 29 (with $x = \ell$), and $\underline{s} \leq \hat{s}_\ell < \overline{s}$. High types accept in stage 2 if and only if $s_j \geq \hat{s}_2$ (where $\hat{s}_2$ solves the equivalent of equation 2) and accept in stage 1 if and only if $s_j \geq \hat{s}_h$, where $\hat{s}_h$ solves equation 29 (with $x = h$). $\hat{s}_h \in (\underline{s}, \overline{s})$ and $\hat{s}_h > \hat{s}_\ell$.*

B.2 Repeated matching market: Asymmetric partial revelation environment

We next consider an environment analogous to the ARE in the main text. In an Asymmetric Partial Revelation Environment (APRE) a male's stage 1 choice will be observed if he is present in stage 2. If we assume, conforming to intuition, that in stage one high types are at least as selective as low types, then the stage 2 reputational consequences of playing *Accept* will lead to a loss of continuation value similar to the intrinsic LoF.[34] (However, here the loss of continuation value may depend on one's type; we discuss this below.)

Thus we now suppose that in stage 2 a female i matched to a male agent j not only observes a signal s but also j's stage 1 action $A_j \in \{A; R\}$. Hence a male is characterized by pairs $xA \in \{\ell A; \ell R; hA; hR\}$, which we will refer to as an "attribute." Denote the measure of a male with each attribute by p^m_{xA}. Then $p^m_2 = p^m_{hA} + p^m_{hR}$ and as above $0 < p^m_2 < 1$.

Suppose a female agent i observes signal s_j and past action A_j. Conditionally on being accepted and on the other observables, a female i assesses the probability that her match is type h with

$$Pr_f(h|s, x_i, A_j, acc) = \frac{f_h(s)p_{hA_j}q_2^f(x_i, A_j, h)}{f_h(s)q_2^f(x_i, A_j, h)p_{hA_j} + f_\ell(s)(1 - p_{hA_j})q_2^f(acc|x_i, A_j, \ell)},$$

[34] We show the existence of this more intuitive equilibrium, but we do not rule out other equilibria. We save this for later work more focused on modeling reputation.

where $q_2^f(x_i, A_j, x_j)$ is the probability that in stage 2 a female of type x_i is accepted by a male of type x_j who played action A_j in stage 1.

A male j will assess the probability that, given he is accepted and his prior action, his match is type h with

$$Pr_m(h|s, x_j, A_j, acc) = \frac{f_h(s)p_2q_2^m(x_j, A_j, h)}{f_h(s)p_2q_2^m(x_j, A_j, h) + f_\ell(s)(1-p_2)q_2^m(x_j, A_j, \ell)},$$

where $q_2^f(x_i, A_j, x_j)$ is the probability that in stage 2 a male of type x_j who played action A_j in stage 1 is accepted by a female of type x_i.

As usual, low-type agents of both genders will always find a marriage profitable regardless of the signal they observe and the previous action of their match, since $u_x(\ell) > \ell$. Thus, for both genders, in stage 2 low types always accept. A high type agent finds accepting profitable (as before) if and only if, conditional on being accepted, the expected marriage is a favorable one. I.e., for a high-type female i, if

$$\frac{p_{hA_j}f_h(s)q_2^f(h, A_j, h)h + (1-p_{hA_j})f_\ell(s)q_2^f(h, A_j, \ell)\ell}{p_{hA_j}f_h(s)q_2^f(h, A_j, h) + (1-p_{hA_j})f_\ell(s)q_2^f(h, A_j, \ell)} > h,$$

and for a high-type male j, if

$$\frac{p_2f_h(s)q_2^m(h, A_j, h)h + (1-p_2)f_\ell(s)q_2^m(h, A_j, \ell)\ell}{p_2f_h(s)q_2^m(h, A_j, h) + (1-p_2)f_\ell(s)q_2^m(h, A_j, \ell)} > h.$$

Since the acceptance probabilities of one's match do not depend on the realization of the signal s one observes, the monotone likelihood ratio property implies that the left-hand side strictly increases in the observed signal s and a high-type agent uses a threshold strategy of the type "accept if and only if $s \geq \hat{s}_2$" as above. Let $\hat{s}_m(h, A_j)$ denote the cutoff for a high-type male who played A_j in stage 1, and $\hat{s}_f(h, A_j)$ denote the cutoff for a high-type female (the low types always accept) matched to a male who played A_j.

Using the conditions above the threshold values are thus implicitly defined by

$$\frac{p_{hA_j}f_h(\hat{s}_f(A_j))(1-F_h(\hat{s}_m(A_j)))h + p_{\ell A_j}f_\ell(\hat{s}_f(A_j))\ell}{p_{hA_j}f_h(\hat{s}_f(A_j))(1-F_h(\hat{s}_m(A_j))) + p_{\ell A_j}f_\ell(\hat{s}_f(A_j))} = \delta h, \tag{30}$$

for females, and by

$$\frac{p_2f_h(\hat{s}_m(A_j))(1-F_h(\hat{s}_f(A_j)))h + (1-p_2)f_\ell(\hat{s}_m(A_j))\ell}{p_2f_h(\hat{s}_m(A_j))(1-F_h(\hat{s}_f(A_j))) + (1-p_2)f_\ell(\hat{s}_m(A_j))} = \delta h \tag{31}$$

for males. This yields four different cutoff values: $\hat{s}_f(A)$ for a female when facing a male who accepted in stage 1, $\hat{s}_f(R)$ for female facing a male who rejected, $\hat{s}_m(A)$ for a male who accepted in stage 1 and $\hat{s}_m(R)$ for a male who rejected.

Note that, in contrast to the CAE, we must consider cases where types are known for certain, conditional on previous acceptance behavior. This yields $\hat{s}_f(A_j) = \underline{s}$ if $Pr(h|A_j) = 1$ and $\hat{s}_f^{A_j} = \overline{s}$ if $Pr(h|A_j) = 0$. I.e., there is a possibility of a fully separating equilibrium where h and ℓ play different actions in the first stage allowing perfect revelation of type in the second stage. It is, however, straightforward to bring this possibility to a contradiction with equilibrium play.[35] ; The cutoff values

[35]Two possibilities emerge: h's play "always accept" and ℓ's "always reject" in stage 1, in which case an ℓ would have a profitable deviation by playing 'always accept" in stage 1. Second, h's play "always reject" and ℓ "always accept" in stage 1, in which case an ℓ could do better by playing "always reject" in stage 1, which gives players of both genders

defined in equations 30 and 31 satisfy

$$\frac{p_{hA}}{p_{\ell A}}\frac{f_h(\hat{s}_f(A))}{f_\ell(\hat{s}_f(A))}(1-F_h(\hat{s}_m(A))) = \frac{\delta h-\ell}{(1-\delta)h} = \frac{p_{hR}}{p_{\ell R}}\frac{f_h(\hat{s}_f(R))}{f_\ell(\hat{s}_f(R))}(1-F_h(\hat{s}_m(R)))$$
$$\text{and } \frac{f_h(\hat{s}_m(A))}{f_\ell(\hat{s}_m(A))}(1-F_h(\hat{s}_f(A))) = \frac{\delta h-\ell}{(1-\delta)h} = \frac{f_h(\hat{s}_m(R))}{f_\ell(\hat{s}_m(R))}(1-F_h(\hat{s}_f(R))).$$

The second statement in turn implies that $\hat{s}_f(A) > \hat{s}_f(R) \Leftrightarrow \hat{s}_m(A) > \hat{s}_m(R)$, i.e., if high type females are more choosy with respect to males who chose a certain action, males who chose that action will be more choosy than males who did not. Suppose that $p_{hA}/p_{\ell A} < p_{hR}(p_{\ell R}$. Then (with the equivalent of condition 7 from the main text holding, ensuring an interior equilibrium exists) $\hat{s}_f(A) \leq \hat{s}_f(R)$ yields a contradiction. Hence, $\hat{s}_f(A) > \hat{s}_f(R)$ if $p_{hA}/p_{\ell A} < p_{hR}/p_{\ell R}$.

To verify that this screening behavior may indeed lead to a reputational loss of face, motivating our setup above, note that expected stage 2 payoffs for the different types of male players are

$$v_2(\ell A_i) = \delta\ell + (1-p_2)(1-\delta)l + p_2(1-F_\ell(\hat{s}_f(A_i)))(h-\delta\ell) \text{ and}$$
$$v_2(hA_i) = \delta h + (1-p_2)(1-F_\ell(\hat{s}_m(A_i))(\ell-\delta h) + p_2(1-F_h(\hat{s}_m(A_i))(1-F_h(\hat{s}_f(A_i))(1-\delta)h.$$

This means that low males will face a reputational loss of face (i.e., $L = v_2(\ell A) - v_2(\ell R) > 0$) if $\hat{s}_f(A) > \hat{s}_f(R)$, i.e., females are pickier when facing a male who accepted in round 1. Note that also high type males will face a reputational loss of face (i.e., $v_2(hA) > v_2(hR)$) if $\hat{s}_f(A) > \hat{s}_f(R)$, using an envelope argument, noting that the effect of marginal changes of $\hat{s}_x(\cdot)$ will satisfy (31).

That is, $L > 0$ if $\hat{s}_f(A) > \hat{s}_f(R)$. From above we know that for any $L \leq 0$ high type males are more selective than low males, so that $p_{hA} < p_{hR}$ and $p_{\ell R} < p_{\ell A}$, which implies that indeed $\hat{s}_f(A) > \hat{s}_f(R)$. The following proposition summarizes these derivations.

Proposition 6. *In an APRE in stage* 2 *a male player who has played accept in stage* 1 *has lower expected payoff than if he had played reject. That is, there is reputational loss of face in the two period matching market.*

C LoF versus "Rejection Hurts"

One could define a *Rejection Hurts* (RH) model as one of the following.[36]

"RH-0: I lose whenever I am rejected, even if I don't know that I was rejected". In particular, this implies (R,R) will yield a lower payoff to the first guy than (R,A). Here the CAE should have no direct effect, as what I *learn* does not matter.

Alternatively, "RH-1: I lose when I *know* I was rejected, I lose nothing if I'm uncertain about whether I am rejected." In either case I don't care whether the *other* side knows what I did. The FRE payoffs are the same (as in R1's upper right table) for either of these versions. Under the CAE I learn if I was rejected only if I play Accept. If I reject in the CAE I never learn if I was Rejected. Thus, under RH-1 in the CAE (but not in the FRE), by playing Reject I can protect myself from the "sting" of learning I might have been rejected. (Note that this implicitly implies that updating my belief downwards —about the probability I was accepted—hurts, but updating it in a positive direction does not help me, or at least the former outweighs the latter in expectation).

(through imitating the good signal for male, and staying in the game to access a better pool for females) a positive probability to marry an h-type in stage 2, and does not decrease the probability of being accepted by an ℓ-type.

[36] We thank an anonymous referee for this suggestion.

Suppose this were the case, considering, e.g., a speed dating agency. Under the FRE clients always learn who rejected them, so they have no "sting-avoidance" reason to accept or reject anyone. If they do not care about what the *other side* learns, they will Accept if and only if they anticipate their marriage utility (taking into account the acceptance curse) to be positive. This will presumably lead to the maximum number of marriages given the information structure, and, in our model, the highest material welfare. However, people will also sometimes learn they were rejected, and feel a sting. Introducing the CAE would give people a way to avoid this sting, by rejecting and remaining ignorant (perhaps particularly when they anticipate likely being rejected). Presumably this would lead people to tick *fewer* partners, and lead to a lower rate of marriage (but we would need to look into this more carefully and formally). However, this still might make participants better off (if the sting is very costly), leading dating agencies to adopt it.

However, if RH-1 held as stated above, then presumably a dating agency or site could find a different policy to remove this sting without also substantially reducing the number of offers/marriages. For example, they could promise that they will never tell people that the other person rejected them "for sure". When a man plays "Accept" and his partner Rejects, you could report "you may have been rejected, or we may have randomly selected to not report this match." To make this truthful, when both play "Accept", the agency could inform them "you have a mutual match" 99.5% of the time, but 0.5% of the time they will give the previous message. If people only feel a sting from the knowledge that they were *certainly* rejected, this would completely avoid it, while giving people no "strategic ignorance" incentive to misreport their true preferences (as the CAE would induce).

Still, there may be reasons why such sites and agencies should want to allow people to strategically remain ignorant, at least in certain situations. We acknowledge that this provides an interesting empirical test between these two models, which would be worth exploring in future.

As an overall empirical matter, we expect that both motivations are relevant; both the desire not to know I was rejected and the desire not to have others know that I accepted them particularly when they have rejected me. However, the former has been fairly extensively modeled, while the latter is our own innovation (to the best of our knowledge). These sometimes seem to point in the same direction, e.g., both might justify the CAE as a welfare-improvement, but they also have distinct implications. We hope future work may put these together into an integrated model, and bring further evidence on these.