

**Mixed Signals:****A Game Theory Model of Interactions on Dating Platforms**

Nethra Natarajan, Pooja Ravi, Vrithika Pattapu

Economics Department, Ashoka University

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Prof. Nishant Chadha

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Dating apps give people the ability to meet others whom they may not have otherwise had an opportunity to interact with. Such apps, therefore, act as platforms which connect different users in order to generate value for them. This leads to indirect network effects on dating platforms, where there are two types of users (men and women in heteronormative interactions) and the numbers of each are positively correlated (Stobierski, 2020).

However, little research has been done from an economic perspective to understand how much of a role platforms themselves play in enabling the interactions between users. One way to understand the business models of dating apps is using signalling theory, as users have limited information about potential partners. Users may engage in signalling behaviour to display certain characteristics or behaviours to signal their quality to potential partners. This can be seen as a form of strategic interaction between users, with each trying to present themselves in the best possible light. This paper explores the signalling behaviour of male users on dating platforms, investigating how they signal their quality and how female users may respond to these signals.

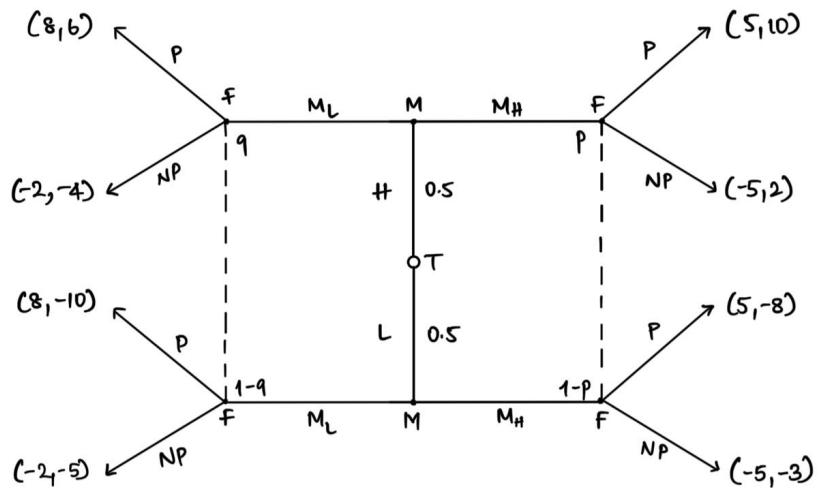
The signalling game explored in this paper makes the assumption that all users join these platforms with the intention of pursuing a relationship. Focussing on heterosexual relationships, the game has two players – Male (M) and Female (F). A Male can be one of two types, High (H) and Low (L), where the latter consists of men who may be considered undesirable<sup>1</sup>. He can choose to send messages that are of High Quality ( $M_H$ )<sup>2</sup> or Low Quality ( $M_L$ ). The latter consists of messages that make the recipient Female uncomfortable. These messages act as signals that the Female uses to update her beliefs: (i) that the Male is of a High type (with probability p) or Low type (1-p) in case of High Quality messages, and (ii) q and (1-q) being the respective

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<sup>1</sup> While this term may indicate some ambiguity, Low quality men can generally be classified as such due to their history of making women feel uncomfortable or unsafe, especially if they have historically displayed predatory behaviour towards women.

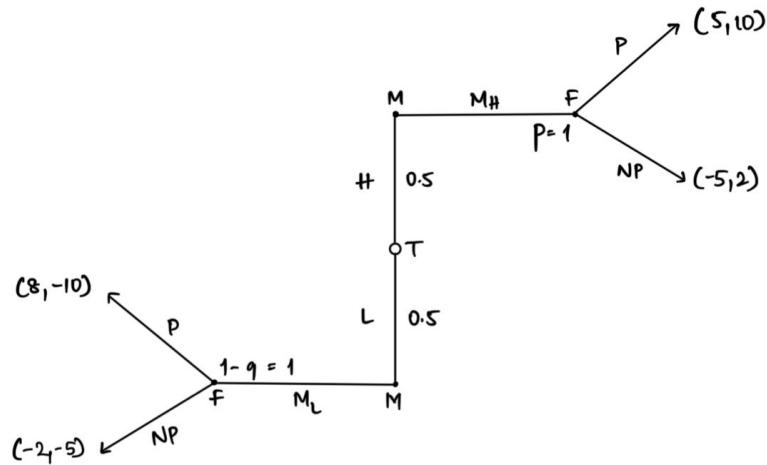
<sup>2</sup> Sending a high quality message involves a time and effort cost.

probabilities in case of Low Quality messages. Given the updated probabilities, she chooses whether to Pursue (P) or Not Pursue (NP) a relationship with the man. The following figure shows the schematic representation of the base game. The calculation of the payoffs is explained in the appendix. Note that the platform is a revenue-maximising agent, while the Female prioritises the quality of the Male.



**Fig. 1** Base Game

Suppose high quality messages are only sent by High quality Males, and low quality messages are only sent by Low quality Males. In the resulting separating equilibrium, perfect signalling is represented by  $p = 1$  and  $q = 0$ , as shown in Figure 2.



**Fig. 2 Separating Equilibrium**

When the signal is clear, it becomes easy for the woman to identify the type of the man and only choose to pursue a relationship with the man that sends the high quality message<sup>3</sup>. Hence, in this case, the low quality men will eventually leave the platform since they would receive no returns for the time and effort spent. This is an unfavourable outcome for the platform because the user base of the platform would substantially decrease, reducing its potential revenue.

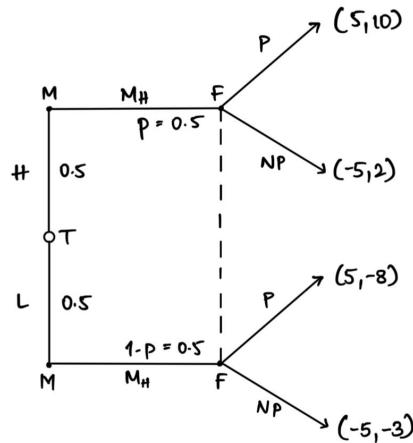
The platform's incentives thus lie in distorting the signals that men can send women and creating ambiguity about the type of men on the platform in order to sustain and grow its user base. It can do this by offering 'additional services' such as the ability to send high quality messages regardless of the type of Male. High quality men can simply use their ability to send high quality messages, and may not need the platform's additional services. It is thus likely that more low quality men would want to 'subscribe' to better services on the platform to gain an

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<sup>3</sup> This is the Best Response for player F given her belief of  $M_H$  being sent by H and  $M_L$  being sent by L.

advantage over men of high quality. This could create possible pooling or non-separating equilibria.

In the case of Pooling Equilibrium, both types of men send only high quality messages, as shown in Figure 3.



**Fig. 3** Pooling Equilibrium

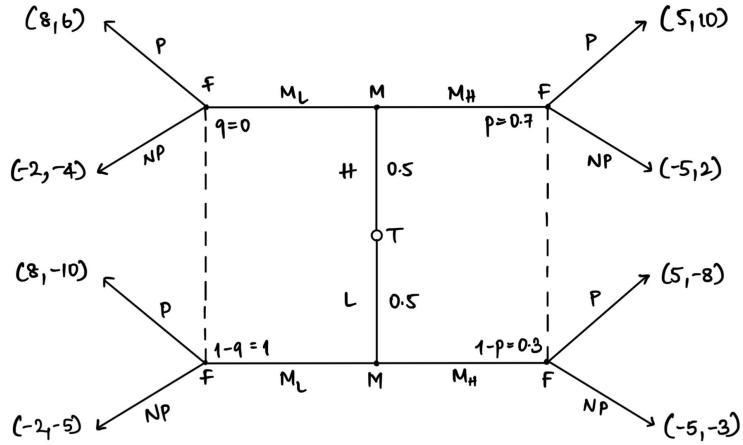
In this equilibrium, the woman will always choose to pursue a relationship<sup>4</sup>. Considering there is a 50% chance that the man is of low quality, the woman's utility from the relationship and the platform will substantially decrease. It is possible that she may entirely leave the platform in order to avoid such men. However, if women leave the platform, this would reduce the incentive for men to join the platform. This is, again, an unfavourable outcome for the platform.

The other possibility is the emergence of a semi-separating equilibrium. In this case, the low quality messages will only be sent by the low quality man while the high quality messages are sent by both types of men. Suppose the Female updates her beliefs such that  $p = 0.7$  and  $q =$

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<sup>4</sup> The Best Response for a Male is  $M_H$ , and that for the Female given her belief of  $M_H$  is  $P$  (based on higher expected utility compared to  $NP$ ).

<sup>5</sup>. Her Best Response would be to Pursue a relationship given her belief of  $M_H$  and Not Pursue the relationship given her belief of  $M_L$ .



**Fig. 4** Semi-Separating Equilibrium

The semi-separating equilibrium would be the most favourable outcome for the platform. This is because (i) low quality men who do not subscribe to the platform's services and continue to send low quality messages would be further incentivised to subscribe to take advantage of the distortionary effect of such services, and (ii) the women would remain on the platform due to their higher expected utility (compared to the Pooling Equilibrium)<sup>6</sup> from using the platform.

The platform can achieve this outcome by making higher quality messages more accessible to low quality men, while sustaining the distinction between a platform-generated high quality message and an original high quality message. Some measures that dating platforms can take in this vein are described using Hinge, a globally popular dating app, as a case study.

<sup>5</sup> Here,  $p = 0.7$  indicates that when the Female receives a high quality message  $M_H$ , she believes the Male is of type H with probability 0.7 and type L with probability 0.3. Conversely, when she receives a low quality message  $M_L$ , she believes the Male is type L with probability 1.

<sup>6</sup> For player F - in the pooling equilibrium,  $EU(P|M_H) = 1$ , and in the semi-separating equilibrium,  $EU(P|M_H) = 4.6$ .

Dating platforms try to reduce the time and effort cost of sending a higher quality message to give the opportunity of sending high quality messages to low quality men. This distorts the signalling mechanism, bringing the game to the semi-separating equilibrium. For instance, Hinge allows a man to send a rose to one woman per week and hearts to 8 women per day. Thus, a rose is an enhanced version of the heart which is meant to signal a particularly higher level of interest of the man in the woman. This generally comes across as a high quality message to the Female. However, since every man gets one rose per week, the woman could be receiving a rose from a low quality man. Considering that sending this rose does not require much time and effort, it distorts the signal of high quality messaging, opening up the possibility of women pursuing relationships with low quality men whom they may have mistaken for a high quality one. This incentivises low quality men to join the platform.

Freemium models are another mechanism through which platforms can distort the signalling mechanism. Hinge has a feature through which more than one rose per week can be purchased for around \$4 each, enabling low quality men to purchase more roses if they value being signalled as a high quality man more than this amount (Rose, 2021). This further distorts the signal, since a man could be sending these roses to multiple women, thus reducing the rose's value as a high quality message. This creates a situation of imperfect information since the woman is unaware of the distortion of the rose as a signalling mechanism. In this scenario, women will find it more difficult to differentiate between the high and low quality men, and may pursue a relationship with the latter. This provides further incentive for low quality men to join the platform and subscribe to the freemium model.

These subscription based freemium models work because men in general tend to pay more for dating apps. A US statistic states that 41% of men engaged in online dating have paid to

be on these sites (Vogels & McClain, 2023). Thus, men are seen to use these premium features and subscription based models enough to be able to manipulate the signalling mechanisms on dating apps which enables low quality men to co-exist with the high quality men on these platforms.

However, as previously discussed, these distortionary measures create a tradeoff wherein the reduced expected payoff for women might disincentivize them from joining the platform. This has an adverse indirect network effect which reduces the number of male users. In order to prevent this, these dating apps have blocking features and prediction features to ensure that certain types of men that a woman has not preferred in the past do not show up on her feed. This attempts to ensure that low quality men can join the platform while preventing female attrition.

While this paper can explain interactions on dating platforms in reality, there exist certain limitations to the model. For instance, the model oversimplifies the quality of men as well as messages as High and Low, while in reality this is highly ambiguous and subjective. Women have been modelled to be of only one type, while they can also be of different (although, again, ambiguous) quality.

However, as seen through the examples discussed, the signalling model explored in this paper does explain the incentive for dating platforms to manipulate interactions between men and women in reality. This enables men of all types to coexist with women, maximising the platforms' user base and thus their revenue. However, this comes at a cost to women, as it enables them to be exposed to catfishing and other scams, which may put their safety at risk. It is therefore the responsibility of dating platforms to balance their profit maximisation goals with the safety and wellbeing of their users.

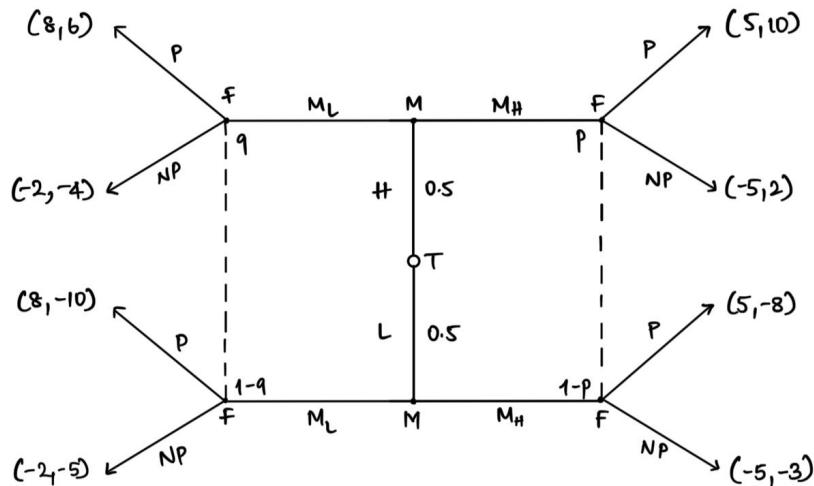
## References

- Rose, T. (2021). How Does Hinge Make Money (Business and Revenue Model). *Entrepreneur 360*. <https://entrepreneur-360.com/how-does-hinge-make-money-18034>.
- Stobierski, T. (2020, November 12). *What Are Network Effects? | HBS Online*. Harvard Business School Business Insights. <https://online.hbs.edu/blog/post/what-are-network-effects>
- Vogels, E. A., & McClain, C. (2023, February 2). Key findings about online dating in the U.S. *Pew Research Center*.  
<https://www.pewresearch.org/short-reads/2023/02/02/key-findings-about-online-dating-in-the-u-s/>

## Appendix

### Explanation of the Payoffs

The payoffs are modelled in a manner that represents ordinality.



**Fig. 1** Base Game

The highest and lowest payoffs a player can get are 10 and -10 respectively. A player gets payoff 10 from pursuing a relationship, as per our initial assumption. The baseline payoff for not pursuing a relationship is 0.

For player M -

- Cost of sending a message of any type is -2
- Additional cost of sending  $M_H$  (in terms of time and effort) is -3

For player F -

- Benefit from receiving  $M_H$  is 2
- Cost of receiving  $M_L$  is -4

- Benefit of being saved from pursuing a relationship with a Low Quality man is 5.

The payoffs are explained as follows -

- For  $(HM_H, P) \equiv (5, 10)$ :
  - $u_M = 5 = 10 - 2 - 3$
  - $u_F = 10$
  - Where 10 is the benefit from pursuing a relationship (for player F, this includes the benefit from receiving  $M_H$ ), (-2-3) is the cost of sending a high quality message
- For  $(LM_L, P) \equiv (8, -10)$ :
  - $u_M = 8 = 10 - 2$
  - $u_F = -10$
  - Where 10 is the benefit from pursuing a relationship and -2 is the cost of sending a message. Player F receives a payoff of -10 (which includes the cost of receiving  $M_L$ ) because pursuing a relationship with a low quality man is the least desirable outcome for her.

We can explain all the payoffs similarly. The table below shows how the payoffs were calculated from the base payoffs of 10, 0, or -10.

	$u_M$	$u_F$
$(HM_H, P)$	$5 = 10 - 2 - 3$	10
$(HM_H, NP)$	$-5 = 0 - 2 - 3$	$2 = 0 + 2$

(HM <sub>l</sub> , P)	$8 = 10 - 2$	$6 = 10 - 4$
(HM <sub>l</sub> , NP)	$-2 = 0 - 2$	$-4 = 0 - 4$
(LM <sub>h</sub> , P)	$5 = 10 - 2 - 3$	$-8 = -10 + 2$
(LM <sub>h</sub> , NP)	$-5 = 0 - 2 - 3$	$-3 = -10 + 2 + 5$
(LM <sub>l</sub> , P)	$8 = 10 - 2$	$-10$
(LM <sub>l</sub> , NP)	$-2 = 0 - 2$	$-5 = -10 + 5$