March 30, 2018

RE: Cheap talk by multiple senders in the presence of network externalities

Dear Editor,

Thank you for your invitation to revise. Attached please find our revision of the aforementioned paper, which we resubmit to your journal. We provide our point-by-point responses to the referee report below.

<u>Responses to the referee's comments</u>

Structure

1. Related literature: We relocated literature review to Section 2.
2. Reference of proof: The first part of the proof in the appendix is for proving the about the solution for the example provided in p.13 which is very crucial to deriving the main results. See the 10th line of p.14 in the main text and the head right after the appendix title.
3. References to figure 3-5: Figure 3 is inside the Example. Figure 4 - 6 are used in the example proof in the appendix. (Figure 5 is new.) Figure 4 appears in the 9th line of p.17 and Figures 5 - 6 appear right before the proof of Proposition 4 in p.19.

   - What is the added value of the figures?: Figure 3 helps readers understand the first order condition. Figures 4-6 help readers understand the complex proof for the 2^{nd} order condition and global optimality.
4. Network externality: In the model section (Section 3), dependence of U^{Si} on *a* and its increases in *a* reflect the presence of a (positive) network externality, because *a* is interpreted as the number of compatible technologies that are used. We mentioned this in Section 3. See the 1st line and 18^{th} line of p.7, the 3^{rd} line of p.8 and Footnote 5.
5. Examples: In the introduction, we introduced the example of experience goods, and specifically the example of Macintosh. Many authors including Tirole (Footnote 41, p.118, in his famous IO textbook), Ellison & Fudenberg (1995), Satterthwaite (1979) and Farrell (one of the pioneers in research on network externality), as we argued in Section 2, mention the possibility of the word-of-

mouth mechanism for signaling the quality of experience goods without paying attention to strategic incentive of consumers to lie. This paper addresses the important issue which has been missing in literature since the literature has begun in 1980s.

Contribution

1. Unclear contribution and missing references: We added the literature, McGee and Yang (2013), Amtrus and Takahashi (2008) and Galeotti et al. (2013). As we put in Footnote 1, the network externality in the model with multiple senders is the key feature of our model which is addressed in none of the papers in the above literature.
2. Two sender model vs. n sender model: Thank you for pointing it out. In this revision, we decided to change the title to “Cheap talk by two senders” rather than “Cheap talk by multiple senders”. The analysis is made mainly for the case that n=2. It is too complicated to provide a complete analysis of the model of general n senders. Note that the variable associated with the network externality in this paper is *a*, not *n*. So, we think it is fine to assume that n=2. We do not agree that full learning about theta occurs if n goes infinity as long as senders have an incentive to exaggerate their information.
3. Kartik (2009) assumes the lying cost, so the message in his paper is not cheap talk. We cited the paper in footnote 4. By definition, “cheap talk” is a payoff-irrelevant, non-binding and non-verifiable message. (See, for example, Farrell and Gibbons (1986) “Cheap talk in bargaining games”) Since it is not verifiable, it cannot be subject to legal sanction, either.

Analytic comments

1. Possibility of a punishment: We do not understand the sentence “we exclude the probability of a punishment of senders (because they send different messages)”. We do not understand the sentence “the utility functions do not show any punishment”, either. We <u>did</u> include the probability of a punishment by entering *a* inside the utility function. Although senders use symmetric strategies, they can send different messages if vi and vj are different. If they are so much different, both of them may be penalized by getting a response of unfavorable *a*, even if both of them are honest. If you mean that there is no punishment in

equilibrium, yes, you are right in the noiseless case, because they always send the same message in equilibrium in the noiseless case, whereas there can be punishments in equilibrium in the noisy case.

2. The implementation of punishments for sender is not in the utility function but in the beliefs of the receiver?: Actually, the implementation is ultimately in the utility function. If the punishments are made in the belief of the receiver, the receiver takes an action unfavorable to the sender (which implies a punishment in the receiver's action.), and then it enters the sender's utility function (which implies implementation of punishment in the utility function of the sender.) Such a mechanism of punishment in cheap talk games is very common, because the only way to punish a sender is through the belief in cheap talk games.
   - What are the implications of this method for the outcome of the model? : Due to the punishment, senders are induced to send honest messages which lead to the very efficient outcome. Such a punishment method could have other implications for other models. For example, if two suspects say different messages in a prisoner dilemma situation, the prosecutor (receiver) believes that one of them is lying and recommend both of them to be imprisoned. This is a direct application, although there is no network externality in this case.
3. Do Proposition 4 and 5 hold for every distribution of u(a)?: In our model, u(a) is a utility function, not a distribution function. Since it is a utility function, it is natural to assume that u'(a)>0 (positive network externality) and u''(a)≤0 (risk neutral or risk averse).
   - It is not clear whether u(a) has to be linear or not: Yes, you are right. Our result does not hold for the linear case (u''(a)=0), which is Proposition 3, and does hold for u''(a)<0, especially for any negative affine transformation of exp^{-a}. Since it is just a sufficient condition, a fully revealing equilibrium is not guaranteed for other utility functions.
   - Does linearity meet the condition in the model section of u'(a)>0 and u''(a)<0?: Yes, it does. The condition in the model section is u''≤0, not u''(a)<0. See the 3rd line of the 4th paragraph of the model section in p.7.
4. The abstract mentions (i) multiple senders and (ii) monotonicity of senders' utility the network size: Yes, you are right. As we said above in our response, we changed "multiple senders" to "two senders" because our analysis is mostly done on the case that n=2. Regarding the second point, in our model, the network size is not *n*, but *a*. The network externality implies that U^{Si} is a function of *a* in the

fashion of dU/da>0, because *a* is the network size. It is important for senders that consumers (receivers) who have not yet bought buy, not that another sender who already bought has one. So, the important network externality is concerned with the receiver's network size. R could be interpreted not as a single receiver, but as the audience consisting of many. Then, *a* can be interpreted as the number of products receivers buy. U^{Si} is not a function of n.

5. Senders can receive negative utility and this may not be consequence of the crosschecking strategy: Yes, you are right. Senders may get negative utility if consumers get huge disutility due to the poor quality of the product, i.e., theta is very low (having negative value). This is not a consequence of taking a crosschecking strategy.

Detailed comments

1. Meaning of a network size: In literature on network externalities, a network means the set of users adopting the same compatible technologies, and a network size means the number of such users adopting the same technologies. So, in our context, *a* which has the interpretation of the number of products to be purchased, is the network size.
2. Truth-revealing equilibrium is a misnomer: According to your suggestion, we changed the term "truth-revealing" to "fully revealing". See Definition 2 and footnote 6 in p.8 .
3. Assumption 3-II: 3-II is not an assumption. It is part of the equilibrium we derived. Together with 3-III, it consists of a cross-checking strategy.

Thank you.

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