Notes for Week 9 – Introduction to costly signaling

I. The phenomena – Signaling with an incentive to lie
    1. Sexual preference
        1. Peacocks tail
        2. Stalked-eyed fly stalks
        3. Nuptual gifts
    2. Aggressive signaling
        1. Threatening
        2. Weapon displays – I.e. antlers
    3. Predator signaling
        1. Stotting
        2. Alarm calls
    4. Signals from offspring
        1. Begging behavior from nestlings
    5. Because of the motivation to lie, the maintenance of signal honesty and response to signals seems odd

II. Old explanations
    1. Sexual selection – Darwin and Fisher (1917, "The evolution of sexual preference")
        1. Suppose a species where females are the "limiting" sex
            1. I.e. the number of offspring a female can produce are significantly lower than those a male can
            2. As a result, males will mate at any opportunity and females will be choosy
        2. Suppose there is (by chance) a female preference for one trait over another
        3. Males who have that trait have a higher fitness as a result (they are more likely to secure mates).
        4. Females who have the preference now have a higher fitness as well
            1. Sexy-son hypothesis: Females who prefer men who have the trait are more likely to produce son's who have children than those who don't
            2. As a result females who have the preference will produce (on average) more grandchildren than those who don't
        5. In the case of continuously variable traits this can lead to a runaway process whereby the trait and the preference for it become stronger and stronger
        6. This only explains sexually selected traits

    2. Group selection
        1. Group selection codifies the "best for the species" analogy
        2. The idea is that groups reproduce in much the same way individuals do, and those groups which do better produce more new groups and evolve
        3. So, individual traits which benefit the group will be selected for because groups are selected for
        4. Here behavior which is good for the group will be selected
        5. Sexual preference – yields better offspring because it helps females find and exploit high quality males
        6. Aggressive signaling – helps to resolve conflicts without the need for a fight

7. Predator signaling -- ??
8. Offspring – helps mothers figure out which nestlings are in need of food
9. This was widely rejected around the time of Zahavi because group selection was theoretically unfounded
    1. Groups don't always reproduce like individuals do
    2. Group selection is much slower than individual selection
    3. It is worth noting the recent resurgence of group selection (Sober and Wilson)

III. Zahavi's new suggestion
1. All such signaling can be explained by the presence of cost.
2. The cost or "handicap" renders it unreasonable for some individuals to signal dishonestly
3. His first suggestion is that signals impose a test that only good types can pass
    1. Either it's impossible for bad types to pass it (stotting)
    2. Or bad types don't find it efficient to pass it (peacock's tail)
4. Zahavi imagines this new solution to be a panacea it explains all of the above types of signaling
    1. Even predator alarm calls, which we'll see later
    2. Also explains, perhaps, altruism and territoriality

IV. A reprise to economics modeling
1. Spence's model
    1. Suppose there are two types of employees in the world: high quality and low quality
    2. Suppose there is an employer who prefers to hire good as opposed to bad and can offer two wages: high and low wages
    3. The payoff for offering high wages to a low employee and low wages to a high employee are 0; 1 otherwise
    4. Only the employee knows his type
    5. The employees can choose to pursue a particular level of education, denoted by x.
    6. If the cost of education is the same for both types, they will choose the cheapest form of education and they employer will offer the wage that nets them the highest expected utility given the proportions in the population
        1. This is the problem with cheap signaling
    7. Alternatively suppose the costs are different: $c(x, h) = x+1$; $c(x, l) = 2x$
        1. This might occur because education is easier for the high quality type

    8. Consider the function $Ph – c(x,y) – Pl$; this function shows for which x's it is worth sending that signal if it will get you the high wage

9. Let w be the point where this function equals zero for the low type. There is an NE where high types send signal w and get the Ph and low types send signal 0 and get Pl.
    1. Show why
2. More general model
    1. This model has several limitations from the economic standpoint
        1. It doesn't model the receiver as having beliefs about the relevant types, in these games some economists view this as insufficient
            1. Perhaps give an example (first page of Gibbons notes)
        2. It supposes there is no relationship between education and quality
        3. It only allows for two wage types
    2. Gibbons presents a more complicated model.
        1. Education now influence productivity along with the type
        2. Wages are continuous, but we assume there is competition that drives the wages to match productivity.
        3. Suppose that there is perfect information; now the worker chooses an education level that maximizes his wage minus his cost. Let this be e*(t) and let their wage be w*(t)
        4. Two cases
            1. No envy -- Even if the low quality worker could convince the firm he was high quality by pursuing e*(H) he doesn't want to because of the cost
            2. Envy – If obtaining e*(H) would result in w*(H) for the low worker, he would do it
                1. Now the high type must choose a signal higher than e*(H) to differentiate himself from the low type
                2. This point is the point where the indifference curves cross:

        5. There are also pooling and hybrid equlibria
    3. This coincides with Graffen's model we discussed ealier

V. Hurd: Are costs necessary
    1. Both of the models considered thus far have imposed cost on the signalers in order to secure truth
    2. Are costs of this sort strictly necessary in competitive situations?
    3. Hurd's model
        1. 2-state; 2-signal; 2-act signaling game
        2. Let the receivers payoff be v(z,r) where z is the state and r the action
        3. Let the senders payoff be v(r) – c(z,s) where c() is a cost function and s the signal
        4. Assume the receivers payoff is such that he would prefer to respond differently in the different states
        5. Assume that the sender always wants the receiver to do the same thing (conflict of interest)

6. But there most be some motivation to signal so, assume the costs are structured appropriately
7. Let ch and cl be the difference in cost between the different signals for different types
8. By assumption cl > ch
9. When is signaling an ESS:

10. Here we have signaling an ESS for positive, zero, and negative ch's. The later two represent situations where there is no cost in equilibrium to the sender. In negative cases, it benefits the sender to send the signal
11. This shows that while “costs” are needed; they may not appear in equilibrium – even in situations where there is conflict of interest
12. Conversely, situations where there are costs will not always result in honest signaling