In this on-line section, we derive Eq. 1 for the switch point theorem given in the paper, and we also give the equations used in the sensitivity analysis of lifetime fitness to changes in each of the model parameters. We also present some graphical results that were not included in the paper to save space.

**Derivation of the Switch Point Theorem**

The switch point theorem is an analytical solution to the question of how many potential mates a focal individual should accept or reject to maximize lifetime fitness. Consider a focal individual with a finite reproductive lifespan, during which the individual searches for potential mates, accepting some and rejecting others, and having to take time out every time it mates and reproduces, a latency period from the onset of one copulation to receptivity to remating. We represent movement of the individual through its reproductive lifetime as a series of states, each lasting one time unit, such as searching but no potential mate is encountered in a given time step, searching and potential mate \( i \) is encountered, mating with potential mate \( i \), and in time period \( j \) of a latency period of length \( l \).

Let \( e \) be the probability that a potential mate is encountered per unit time. Let there be \( n \) potential mates, and let \( p_i \) be the probability that the encountered potential mate is individual \( i \), where \( \sum_i p_i = 1 \). The relative fitness conferred on the focal individual by mating with potential mate \( i \) is a random variable distributed as \( \beta(\omega, \nu) \) where \( \omega \) and \( \nu \) determine the shape of the fitness distribution. Let \( s \) be the probability of survival of the focal individual over one unit of time. The reproductive lifespan of the focal individual is the time from the onset of reproductive maturity until the individual’s death. In terms of the probability of survival per unit time, the expected reproductive lifespan of the focal individual is \( 1/(1-s) \). Note that small changes in the probability of survival when \( s \) is near unity can cause large changes in lifespan. Thus, for example, survival probabilities of 0.9, 0.99, and 0.999 correspond to mean lifespan of 10, 100, and 1000 time units, respectively. In a Markov chain there are discrete time steps. When \( s = 0 \), the individual lives one time step and dies. When \( s = 1 \), the ratio of 1/1-\( s \) is infinite and the reproductive lifespan is infinite, the individual lives forever. Thus, \( s = 1 \) is not a biologically meaningful value. Values of \( s > 0 \) and \( s < 1 \) are the biologically meaningful values and these are the ones we use in our sensitivity analyses.

The relative fitness of potential mates influences whether the focal individual should or should not mate a particular potential mate. To illustrate we analyze a case of three potential mates (\( n = 3 \)). In this simple case, we can distinguish three possible decisions. A focal individual could accept all three potential mates as encountered. Or an individual might accept two and reject one of the three potential mates. Or a focal individual might accept only one of three, rejecting the other two potential mates.

Consider the "accept all three" case first. The state of the focal individual can be receptive and searching for a mate, but it may not encounter a potential mate in the current time step. Label this state \( S_A \). Or the focal individual may encounter a potential mate in the current time step, in which case there are three possible states: encountering potential mate number 1 (state \( S_1 \)), encountering potential mate number 2 (state \( S_2 \)), or encountering potential mate number 3 (state \( S_3 \)). Because the focal individual accepts all three, it will then
mate with the potential mates as encountered (i.e., enter mating states $M_1$, $M_2$, and $M_3$, respectively). Let $l$ be the length of time that the focal individual is in latency before returning to the pool of receptive individuals. Measure the duration of the latency period in the same time units used for measuring $s$ and $e$. In this example, let the latency $l = 1$. Let the state of latency of duration one time unit be labeled $L_1$, and the absorbing state of death $D$. The matrix of transition probabilities for the case "accept all three" is thus:

$$
H =
\begin{bmatrix}
    1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
    1-s & 0 & 0 & 0 & 0 & 0 & 0 & s \\
    1-s & 0 & 0 & 0 & 0 & 0 & 0 & s \\
    1-s & 0 & 0 & 0 & 0 & 0 & 0 & s \\
    1-s & s & 0 & 0 & 0 & 0 & 0 & 0 \\
    1-s & s & 0 & 0 & 0 & 0 & 0 & 0 \\
    1-s & 0 & 0 & s & 0 & 0 & 0 & 0 \\
    1-s & 0 & 0 & s & 0 & 0 & 0 & 0 \\
    1-s & 0 & 0 & 0 & esp_1 & esp_2 & esp_3 & (1-e)s \\
    1-s & 0 & 0 & 0 & esp_1 & esp_2 & esp_3 & (1-e)s \\
\end{bmatrix}
$$

We list “to” and “from” states along the top and left side of matrix $H$, respectively. The column state (“to”) is the next state reached after the states (“from”) listed on the rows. Note that the focal individual has a probability $1-s$ of dying during every time step. If death occurs, this is the terminating point of the absorbing Markov chain. In the "accept all three" case, whenever the focal individual encounters a potential mate, it mates, with a probability simply equal to the survival probability (because the only behavior the individual exhibits next is to mate) (e.g., $Pr\{M_1|S_1\} = Pr\{M_2|S_2\} = Pr\{M_3|S_1\} = s$). During search, the focal individual encounters a potential mate of quality $i$ with probability $Pr\{SA|S_i\} = esp_i$. Since the encounter probability is $e$, the probability that the search fails in the current time step and the focal individual has to continue searching in the next time step is: $Pr\{SA|SA\} = (1-e)s$.

We can solve Eq. 1 for the expected number of times the focal individual passes through each state before death, by computing $E = (I-H)^{-1}$. Matrix $E$ always exists and its element $e_{ij}$ is the expected number of times over its lifetime that the focal individual is in column state $j$ given that the focal individual starts in row state $i$. By convention we assume a newly mature focal individual begins the reproductive portion of its life in state $SA$, searching for a mate. From Eq. 1, the expected number of matings of a focal individual with potential mate $i$ is:

$$
E\{M_i|SA\} = \frac{es^2p_i}{(1-s) + es[1-s^2(p_1 + p_2 + p_3)]}.
$$

[2]
Therefore, the total lifetime mating success of the focal individual over all potential mates is:

\[
E \{M_1 + M_2 + M_3|SA\} = \frac{es^2(p + p_2 + p_3)}{(1-s) + es[1-s^2(p_1 + p_2 + p_3)]} = \frac{es^2}{(1-s) + es(1-s^2)} \quad [3]
\]

To increase the length of the latency period, add states to reflect each time unit of the latency. For example, for a latency \( l = 2 \), there are states \( L_1 \) and \( L_2 \).

Now, consider when a focal individual will accept two of the three potential mates but not the third. In this case, state \( M_3 \) no longer exists (although potential mate 3 is still encountered, which is state \( S_3 \)), so the transition matrix becomes:
Note that when the focal individual encounters potential mate 1 (S1) it moves to the state of mating with individual 1 (M1) and likewise when the focal individual encounters potential mate 2 (S2), it moves to mating that individual (M2). However, note that when potential mate 3 is encountered, the focal individual does not mate with it (there is no state M3), but it resumes search, enters states S1, S2, S3, and SA, depending on what the search results are.

For a focal individual with a latency of one, this decision rule yields a total lifetime mating success of:

\[
E\{M_1 + M_2 | SA\} = \frac{es^2(p + p_2)}{(1 - s) + es[1 - s^2(p_1 + p_2) - p_3]} \tag{8}
\]

and for a focal individual with a latency of \(l\) time units:

\[
E\{M_1 + M_2 | SA\} = \frac{es^2(p + p_{2l})}{(1 - s) + es[1 - s^{l+1}(p_1 + p_2) - p_3]} \tag{9}
\]

In the case in which the focal individual mates with only one of the three possible potential mates, 1 but not 2 or 3, the transition matrix is
Focal individuals with a latency, \( l = 1 \), with this decision rule gain a lifetime mating success of:

\[
E \{ M_1 | SA \} = \frac{e s^2 (p_i)}{(1-s) + es \left[ 1 - s^2 p_1 - (p_2 + p_3) \right]}.
\]  

[11]

For the generalization of this decision rule to focal individuals with latency of \( l \) time units, expected lifetime mating success becomes:

\[
E \{ M_1 | SA \} = \frac{e s^2 (p_i)}{(1-s) + es \left[ 1 - s^{l+1} p_1 - (p_2 + p_3) \right]}.
\]  

[12]

One can find by induction the general solution for the lifetime mating success of a decision rule in which the focal individual mates with \( f \) individuals out of a total of \( n \) total potential mates, where \( f \leq n \). The solution is:

\[
E \{ \sum_f M | SA \} = \frac{e s^2 \left( \sum_{i=1}^f p_i \right)}{(1-s) + es \left[ 1 - s^{f+1} \left( \sum_{i=1}^f p_i \right) - \sum_{i=f+1}^n p_i \right]}.
\]  

[13]

We are now in a position to evaluate the cumulative lifetime fitness for focal individuals exhibiting this decision rule. If the fitness of the focal individual of mating with potential mate \( i \) is \( w_i \), then the focal individual's cumulative lifetime fitness is simply its mating success with potential mate \( i \) multiplied by \( w_i \), summed over all of the focal individuals' mates:

\[
W \{ \sum_f M | SA \} = \frac{e s^2 \left( \sum_{i=1}^f p_i w_i \right)}{(1-s) + es \left[ 1 - s^{f+1} \left( \sum_{i=1}^f p_i \right) - \sum_{i=f+1}^n p_i \right]}.
\]  

[14]

The expression in Eq. 14 is the analytically derived mean of cumulative lifetime fitness computed over an stochastic ensemble of focal individuals, each of whom assesses the fitness distribution of potential mates in the same way, experiences the same values of \( e \), \( s \), and \( l \), and has the same mating decision rule. Eq. 14 takes on different values as we change \( f \), the number of acceptable mates, out of a total of \( n \) potential mates. The objective is to find the value of \( f \), call it \( f^* \), which maximizes Eq. 14. \( f^* \) is the switch point. Given values of \( e \), \( s \), and \( l \) and a distribution of fitnesses \( w_i \) across a set of \( n \) potential mates, the recipe for maximizing Eq. 14 is as follows: (1) Rank the \( n \) potential mates in fitness conferred on the focal individual from high to low. (2) Next, compute the average focal individual’s expected cumulative lifetime reproductive fitness for these parameters and fitness distribution, assuming that the focal individual mates with only one potential mate, the highest fitness-conferring individual, and rejects the remaining \( n-1 \) individuals. This corresponds to \( f = 1 \) in the Eq. 14. (3) Now, repeat step 2, but assume that the focal individual mates with the top
two potential mates, so that \( f = 2 \) in Eq. 14. (4) Continue this process, adding one more
mate at a time and computing the expression in Eq. 14 until \( f = n \). (5) Plot the curve of
reproductive fitness as a function of \( f \), the number of ranked potential mates that are
accepted, and find that value of \( f, f^* \), that produces the highest average reproductive fitness.
This is the switch point, and \( f/n \) is the fraction of acceptable mates that maximizes the
cumulative lifetime fitness.

If the potential mates are equally likely to be encountered, then we can further
simplify Eq. 14, obtaining;

\[
W \left\{ \sum_f M \mid SA \right\} = \frac{es^2 \left( \sum_{j=1}^f w_i \right)}{(1-s) + es\left(1-fs^{j+1} - g\right)}, \text{ where } g = n-f. \tag{15}
\]

This is the expression given by Eq. 1 in the text of the paper.

**Sensitivity Analysis**

We studied the sensitivity of the fitness function to changes in the encounter
probability \( e \), the survival probability \( s \), and the latency \( l \), by computing the derivatives of Eq.
14 with respect to each of the parameters. We evaluated the derivatives at the switch point,
\( f^* \). The sensitivity of the fitness function at \( f^* \) to changes in encounter probability \( e \) is:

\[
dW \left\{ \sum_{f^*} M \mid SA \right\} / de =
\]

\[
\frac{s^2 \sum_{i=1}^{f^*} p_i w_i}{(1-s) + es\left(1-s^{f^*+1} P - Q\right)} - \frac{(1-s^{f^*+1} P - Q)es \sum_{i=1}^{f^*} pw_{ii}}{\left[(1-s) + es\left(1-s^{f^*+1} P - Q\right)\right]^2}, \tag{16}
\]

where \( P = \sum_{i=1}^{f^*} p_i \) and \( Q = \sum_{i=f^*+1}^{n} p_i \).

The sensitivity of the fitness function at \( f^* \) to changes in the survival probability \( s \) is:

\[
dW \left\{ \sum_{f^*} M \mid SA \right\} / ds =
\]

\[
\frac{2es \sum_{i=1}^{f^*} p_i w_i}{(1-s) + es\left(1-s^{f^*+1} P - Q\right)} - \frac{es^2 \left[(1-e) + (2 + l)es^{f^*} P + eQ \right] \sum_{i=1}^{f^*} p_i w_i}{\left[(1-s) + es\left(1-s^{f^*+1} P - Q\right)\right]^2}. \tag{17}
\]

Finally, the sensitivity of the fitness function at \( f^* \) to changes in latency \( l \) is:
\[
\mathcal{W} \left\{ \sum_{f, M} |S_A \right\} \frac{dW}{dl} = \frac{e^2 s^{l+4} \ln(s) P \sum_{i=1}^{r} p_i w_i}{(1-s) + es \left(1-s^{l+1} P - Q \right)}.
\]

**SI Results**

Fig. S1 show the effect of varying latency \( l \) and the population size of acceptable mates \( n \) on the fraction of mates acceptable, for a \( w \)-distribution of \( \beta(1,1) \). The fraction of acceptable mates declines with population size, and with increasing latency, but the effect of latency is minimal for long latency times. Fig. 2 shows how the mean fraction of acceptable mates and its standard deviation change as a function of the \( w \)-distribution and of each of the model parameters. The left-most column of graphs (a - d) are for a uniform \( w \)-distribution of \( \beta(1,1) \). The middle column of graphs (e - h) are for a \( w \)-distribution, \( \beta(3,8) \), skewed to low fitness values, and the right-most columns of graphs (i - l) are for a \( w \)-distribution, \( \beta(8,3) \), skewed to high fitness values. Note that a higher fraction of potential mates is acceptable when the fitness distribution is skewed high than when it is skewed low or is uniform. Fig. S3 presents a graphical representation of the results of the sensitivity analysis. The top row of panels (a, d, g) represents how the sensitivity of lifetime fitness to survival rate \( s \) is affected by variation in \( s \), \( e \), and \( l \). The middle row of panels (b, e, h) show how the sensitivity of lifetime fitness to encounter rate \( e \) is affected by variation in \( s \), \( e \), and \( l \). The bottom row of panels (c, f, i) show how the sensitivity of lifetime fitness to latency \( l \) is affected by variation in \( s \), \( e \), and \( l \). Note that in general, the sensitivity of lifetime fitness to survival is much greater than sensitivity to encounter rate, which in turn is much greater than the sensitivity to latency. Note also that the parameters interact in complex nonlinear ways in their impact on the sensitivity.