EFFECTS OF FEMALE QUALITY ON MATE CHOICE TRADEOFFS UNDER PREDATION RISK IN HOUSE CRICKETS (*ACHETA DOMESTICUS* L.)
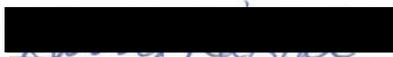
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Abstract

There are a myriad of factors that can affect how a female makes mating decisions

including male quality, environmental variables, and factors intrinsic to the female. We

examined the effects of female quality within the contexts of predation and mate choice.

To do this, we performed two-choice tests using a rectangular experimental arena with

one side containing protective cover and the other side open. A speaker at either end of

the arena played out artificially created low quality or high quality male calls. The low

quality call was always associated with the covered side of the arena. This design forces

the female to make a tradeoff between level of risk and the quality of a potential mate.

We tested high and low quality females three times. A repeated measures logistic

regression revealed no significance in the relationship between female quality and

tradeoff preferences. Instead, there was a significant preference overall for females to

move through open space towards the high quality male. Females took significantly

longer to reach the high quality male through open space compared to females moving

through cover towards the low quality male. Additionally, females were not consistent in

exhibiting tradeoff preferences, supporting the idea that there is no variation in mating

preferences among females.

Introduction

There are a myriad of factors that can affect or modulate female mate choice.

Although these factors can be conceptualized in several ways, one may consider

grouping them as extrinsic or intrinsic, with respect to the female. In the house cricket,

Acheta domesticus, intrinsic variables such as time cost and age have been associated

with mate choice in females (Gray 1999). Extrinsic factors like male quality and

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predation risk can also alter or modulate female mate choice. In the mate attraction system of *A. domesticus*, the male produces a calling song that broadcasts his sexual receptivity to females. An interested female will approach a male's call, exhibiting positive phonotaxis and subsequently make a copulation decision. Certain aspects of the male calling song indicate genetic quality and receptive females can detect and select for these phenotypic indicators (Gray 1997). Two of the most crucial indicators are high amplitude, and a specific number of pulses (or syllables) per chirp (Gray 1997). High amplitude callers may also convey distance information, as loud amplitude might not be a signal of high quality genetics, but perhaps an indicator of proximity and therefore less energetically expensive to reach.

When considering predation risk, in the field cricket, *Gryllus integer*, females adjust their mating strategies based on changes in perceived risk of predation (Hedrick and Dill 1993). In phonotaxis experiments, females tradeoff quality of potential mates for a decrease in predation risk (Hedrick and Dill 1993). The level of predation risk seems to be the stronger influence in these decisions given that as cover increases, more females choose the safe route towards the lesser quality male as opposed to a more exposed route towards a higher quality male. This work indicates that females modulate mate choice decisions based on certain extrinsic variables (i.e. perception of risk and the quality of a potential mate). Moreover, the results suggest that females may become less selective when predation risk increases.

For us these results prompted further investigation of the potential effects of intrinsic female factors on mate choice. To our knowledge there is an intrinsic factor of the system that is previously untested in the context of predation and mate choice, i.e.

female quality. Females primarily choose mates based on apparent quality communicated through the male calling song as well as tactile and chemical signals (Stoffer and Walker 2012), however, females may also modify mate choice decisions based on their own quality level (Hedrick and Kortet 2012a; Reynolds and Cote 1995; Slagsvold et al. 1988). Quality of the female cricket corresponds with her relative mass, in that heavier females are categorized as high quality and lighter females as low quality (Hedrick and Kortet 2012a). Although there is no published evidence of this correlation in *A. domesticus*, it has been confirmed through several empirical studies that female mass is positively correlated with fecundity in at least two species of field cricket, *G. integer* and *G. bimaculatus*, as well as in many other insect species (Hedrick and Kortet 2012a; Honek 1993).

We are interested in whether the intrinsic factor of female quality modulates mate choice decisions given variation in predation risk. We have outlined two hypotheses that may help explain possible outcomes of female tradeoff preferences. The additive effects of genetic variation hypothesis postulates that because certain traits of interest (i.e. attractiveness traits) contribute to variation in an additive manner, females who lack attractive alleles for these traits would benefit more by mating with a high quality male in order to pass those alleles on to offspring (Brown WD, personal communication; Hill et al. 2008). This suggests that low quality females might take greater risks in moving towards higher quality males because they have more to gain through the additive variation of those attractive alleles (i.e. their own low quality genes can only contribute to a low quality offspring, unless they pair with a higher quality male). Therefore we might expect lower quality females to become choosy and bold in a situation where the

potential benefits of additive genetic variation surpass the decrease in selectivity tied to predation risk. Since high quality females already possess the genetic material to pass on attractive alleles to their offspring they do not need to take significant risks in order to mate with high quality males. Therefore we might expect high quality females to move through a safer environment towards a lower quality male.

The energy stores hypothesis suggests that individuals who possess larger energy reserves in addition to superior physical abilities have a greater capacity for escape and/or defense in the event of a predator attack. Females who tend to possess these larger energy stores are typically of larger size (Hedrick and Kortet 2012a). Because of these physical capabilities, these females may be more confident in their ability to evade predation. Under this hypothesis, we would expect high quality females to risk moving through open space towards a high quality male rather than choosing a covered path towards a low quality male. Low quality females possess relatively small energy reserves that may not provide enough energy storage to afford them more costly mate searching habits. Therefore, we would expect low quality females to prefer the safer route in moving towards a low quality male. The additive effects of genetic variation and energy stores hypotheses are not mutually exclusive; therefore either of the hypotheses' lines of reasoning could apply to either group of females.

In examining a potential link between female quality and resulting tradeoff preferences, adding repeatability as a factor can provide insight on variation in mating preferences across a species (Jennions and Petrie 1997). According to Jennions and Petrie, exhibition of repeatable mate choice decisions is tied to the existence of variation in female mating preferences (1997). For example, in a population where females do not

show repeatable mate choice decisions, one would predict that variation in mating preferences would not occur among females. However, if females do show repeatability in their mate choices, variation in female mating preferences is expected to occur (Jennions and Petrie 1997).

The study of behavioral repeatability, animal personality traits and behavioral syndromes has received increasing scientific attention over the last decade (Wilson et al. 2010; Sih et al. 2004). Behavioral syndromes are defined as groups of correlated behaviors that are either expressed within one context or across multiple contexts (Wilson et al. 2010). The existence of a boldness syndrome in house crickets is probable, as exploration and risk-taking (i.e. key features of boldness) are positively correlated across mating and antipredator contexts (Wilson et al. 2010). This result suggests that some crickets may exhibit consistency in bold behaviors over time. Our study focuses on consistency of boldness in the context of mate choice and predation.

In a study on the field cricket, *G. integer*, both sex and ontogeny proves to have large effects on consistency in boldness over time (Hedrick and Kortet 2012b). Results suggest that females display a greater level of consistency in exhibiting boldness across metamorphosis compared to males (Hedrick and Kortet 2012b). Although this study was focused on comparative sex differences, we can draw empirical support from the fact that females exhibit a baseline level of consistency in boldness behaviors. However, this study was specifically testing for ontological effects, and only tested for consistency twice, once during the nymph stage and once post-adult-molt. Our experiment sheds light on behavioral consistency during the adult stage only, but in a unique bivariate context.

We tested for behavioral consistency in adult female house crickets across time but within the same sex, ontological stage, and context. We examined consistency of female tradeoff preferences in the context of mate choice and predation. If female house crickets exhibit consistency in their mate choice tradeoff preferences while under risk of predation there is a strong likelihood that these consistent preferences are also repeatable, which corresponds with variation among females in their mating preferences (Jennions and Petrie 1997). There are two key components in the rationale for the consistent preferences hypothesis. First, since females base their mate choice decisions on specific intrinsic (Gray 1999) and extrinsic factors (Hedrick and Dill 1993; Hedrick and Kortet 2012a) that will remain constant across time (in trial repetitions females will be presented with the same potential mates in the same environmental circumstance) it is logical to expect a consistency in female preference (Kazial KA, personal communication). Second, there is evidence that females exhibit repeatability across contexts (behavioral syndromes; Wilson et al. 2010) and through development (Hedrick and Kortet 2012b); therefore it is reasonable to expect females to also express consistency in one context. If consistency is not exhibited in mate choice tradeoff preferences there will be a strong likelihood that these preferences are not repeatable, which corresponds with a lack of variation in mating preferences among females (Jennions and Petrie 1997). This could indicate that all females are exhibiting the same preference or exhibiting random preferences.

The repeatability question is intriguing because although there is evidence of boldness as a trait across contexts in house crickets (Wilson et al. 2010) to our knowledge it has not been studied in the context of predation and mate choice together. In terms of

the possible association between female quality and tradeoff preference, although predation risk has been studied in crickets, the effects of female quality have not been examined in the context of the particular tradeoff between mate choice and risk of predation.

Methodology

Crickets

House crickets, *A. domesticus*, were obtained from Reptilefood (reptilefood.com, Englewood, Ohio) as 3/4" (1.905 cm in length) juveniles. Juveniles were kept in a large plastic bin (50 x 33 x 28 cm) until last larval stage instars molted, which were then separated by sex and individually housed in small plastic terrariums known as Kricket Keepers (15 x 8 x 10 cm; Lee's Aquarium & Pet Products, San Marcos, California) once emerged as adults. All crickets were provided with water and *ad libitum* Nutro Max Natural Chicken Meal & Rice Recipe (The Nutro Company, Franklin, Tennessee) and TetraFin Goldfish Flakes (Tetra, Blacksburg, Virginia). Crickets were housed under a 12:12 light/dark regime, at a temperature of 22±1°C, and relative humidity between 40-45%. Females were categorized into low and high quality groups based on mass, where low quality females ranged from 0.264 – 0.379 g and high quality females ranged from 0.425 – 0.570 g. Masses were based on top and bottom 15th percentiles of an initial sample group. All females were weighed and categorized on day 7 post-eclosion using an HR-202 Dual Range Balance (A&D Company Limited, Lancaster, New York). Fourteen high quality and thirty-eight low quality virgin female subjects were tested between days 8 and 16 of adulthood. Each female underwent the experimental trial three

times on nonconsecutive days (1±2 days in between each trial repetition) in order to test for consistency of tradeoff preferences. Female crickets used in the control experiments were housed in the same fashion as the females used in the experimental trials.

Experimental Setup & Protocols

Trials were performed under red-light illumination in an aluminum-screened arena with wooden frames and a cardboard base (160 x 60 x 60 cm) (Figure 1). A sheet of clear plastic was laid over top of the cardboard base to allow for a 70% Ethanol wipe-down between each trial. One Cyber Acoustic speaker (Cyber Acoustics LLC, Vancouver, Washington) was centered on each of the arena endscreens, flush with the outside of the screen. One half of the arena was covered with Charcoal Fiberglass Screening (New York Wire, Grand Island, New York) rolled into 6 individual cylinders, so as to provide passageways for subjects to move through. This netting serves as cover, which apparently provides crickets with the perception of safety from risk of potential predators (Hedrick and Dill 1993). An artificially created low quality male calling song played out from the speaker at the end of the covered half of the arena, while an artificially created high quality song played out from the speaker at the end of the open half of the arena (See Calling Song Construction for details on songs). This forces the female cricket to make a tradeoff between level of perceived safety and the quality of her potential mate. It is a two-choice paradigm offering either a high-risk situation yielding a high-quality mate or a low-risk situation tied to a low-quality mate. Due to the design of this experiment and the nature of tradeoff preferences, the variables of predation risk and male quality are inextricably tied thereby rendering hypothetical reasoning difficult to

attribute to either variable as a singular function. Thus, it is an assumption of this study that any hypothesized reasons for tradeoff preference predictions are correlates of both predation risk and male quality together.

Cricket subjects were initially placed in an aluminum-screened central chamber (6 x 6 x 6 cm) containing two small exit holes on either side. A screen holding device (also made of aluminum screening) was fitted over the chamber to prevent the subject from exiting during acclimation. The secured screen holding device and chamber were placed in the center of the arena, oriented so that exit holes were facing the speakers, and a three-minute acclimation period began. After this period, playout began from both speakers simultaneously yet slightly out of phase with each other to avoid prolonged periods of non-calling. After five minutes of playout, the screen holding device was carefully lifted up and away from the central chamber, allowing the subject freedom to exit the chamber at will and access the arena. The trial ended when the subject made contact with either end screen; at this point the tradeoff preference was recorded as risk-taking (open space/high quality male) or risk-aversion (cover/low quality male). If the subject did not exit the central chamber after 15 minutes of playout, the trial was terminated and retried later that day. The side of the arena containing cover and playing out the low quality song was randomized for each trial. We purposefully followed the original design and protocols by A.V. Hedrick and L.M. Dill (1993).
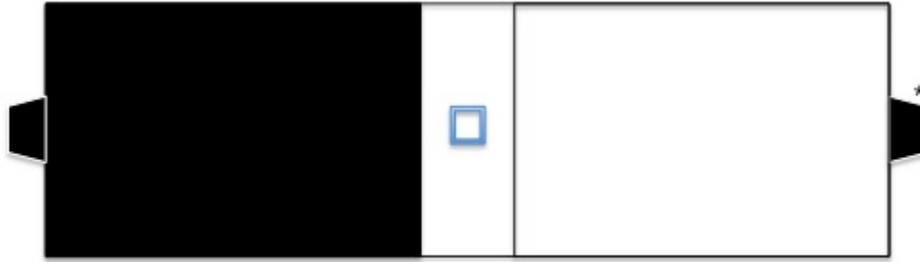
Figure 1. Experimental arena setup (160 x 60 x 60 cm). Black indicates cover while the white indicates open space. Asterisk (*) indicates the speaker playing out high quality calling song. The centrally-located square represents the central holding chamber.

Control Protocols

Three control experiments were performed to test the validity of the experimental design. Since presence of cover and quality of calling song were tied throughout the experiment, control experiments were completed to confirm that female preferences align with the expectations that the design was built upon. First, a control experiment was carried out to determine whether females significantly preferred the high quality calling song to the low quality calling song. To determine this, cover was removed from the arena and trials were run using the protocols described above (thereby eliminating the cover variable and testing only the preference for calling song). Next, a control experiment was carried out to determine whether females prefer to travel through cover compared with open space. The cover was returned to the arena and trials were run as usual with the exception that both speakers played out either high quality song or low quality song. This eliminated any difference in quality of the calling song while leaving the cover variable to be tested. Lastly, a control experiment was completed to determine whether the cover itself was attenuating or degrading the low quality calling song that travelled through it, as it could

have an effect on female preference. To test this, two recordings were made from the center of the arena, a recording of the low quality calling song playing through open space, and a second recording of the low quality calling song playing through cover. Cover was removed from the arena, and trials were run as usual except that the speakers played out these two recordings. If females did not show a preference, this would support the assumption that cover was not altering playback of the low quality calling song and subsequently the female preference for that calling song.

Calling Song Construction

Artificial calling songs were created using Raven Pro 1.4 (Bioacoustics Research Program, Cornell Lab of Ornithology, Ithaca, New York) starting with a single pulse as the basis for both the high and low quality calls. One prototypic pulse was chosen from a random prerecorded male's calling song. This pulse was then manipulated to fit the form of a high and low quality call based on known female preferences that emphasize two parameters, amplitude and pulses per chirp (Gray 1997). The low quality calling song was created by increasing the amplitude of the pulse by 0.25 and copying the pulse once yielding a two pulses per chirp call. The high quality call was manipulated by increasing the amplitude of the pulse by 1.5 and copying it twice, creating a three pulses per chirp call, which is found to be most preferable by females (Gray 1997). The operational sound pressure level (SPL) for the high and low quality calling songs played out through Cyber Acoustic speakers (Cyber Acoustics LLC, Vancouver, Washington) were 70 dB and 59 dB, respectively at 25 cm, both of which are in the natural range of variation for the male's calling song.

Data Analysis

Microsoft Excel (Microsoft Corporation, Redmond, Washington) and IBM Statistics

SPSS (IBM Corporation, Armonk, New York) software were used for data analysis.

Female responses from the control experiments were analyzed using binomial tests.

Tradeoff preference data, including 3 tradeoff decisions for each female along with her

quality, were analyzed using Repeated Measures Logistic Regression (RMLR). RMLR

was used because it allows us to run logistic regression on a binary outcome that has

multiple measures from single subjects, thereby avoiding the statistical issue of having

multiple outcomes for each individual. It predicts the probability of an outcome (tradeoff

preference) using an independent variable (female quality). For this analysis, we used

generalized estimating equations to fit a RMLR with a binomial probability distribution

and logit link function. Response time was analyzed using an Independent Samples T-

Test, comparing response times of females choosing opposing tradeoff preferences. As

each female was tested three times, preference was represented as a single outcome by

taking the female's majority preference while response times were determined by

calculating a female's average response time over the three trials. Results stating the

difference in average response time is represented as mean difference ± the standard error

mean.

Since the variables in this study are dichotomous and categorical, the use of

nonparametric statistics is necessary, as typical parametric repeatability statistics are not

workable. In order to get around this issue, consistency data were analyzed using the

Chi-Square Goodness of Fit Test. For this test we partitioned females into three groups

based on the outcomes of their tradeoff preference responses. Females were grouped based on the following outcomes: (1) consistent on all 3 trials in moving through open space towards the high quality male, (2) inconsistent outcomes (combination of both tradeoff preferences) and (3) consistent on all 3 trials in moving through cover towards the low quality male. Calculating expected frequencies required us to first compute the probabilities of a female choosing each tradeoff preference individually, for example, the probability of choosing the open space/high quality male preference = (the number of females who chose this) / (the total number of preferences recorded). To calculate the expected frequencies for the consistent choice outcomes, we cubed the probability of a female choosing that response and multiplied by the total number of female subjects; the expected frequency calculation for the inconsistent choice outcome was found by taking the total number of female subjects and subtracting both expected frequencies for the consistent choice outcomes.

Results

The binomial test was used to compare observed responses to a test proportion of 0.5 for the control experiments. We confirmed that females chose moving towards cover significantly more than they chose travelling through open space ($n = 9$, $p = 0.039$), females preferred the high quality calling song compared to the low quality song ($n = 11$, $p = 0.006$) and females did not distinguish between a call recorded through open space and a call recorded through the cover ($n = 11$, $p > 0.999$).

Since we recorded three tradeoff responses for each female, we used the response that was in the majority to represent that female's tradeoff preference as a singular datum

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for Table 1 and Figure 2. We found that 26 out of 35 low quality females preferred

travelling through open space towards the high quality male while 12 out of 17 high

quality females also preferred the open space/ high quality male option (Table 1, Fig. 2).

Table 1. Contingency table containing percentages of female tradeoff preferences. Since
each female was tested three times, the majority response was used.

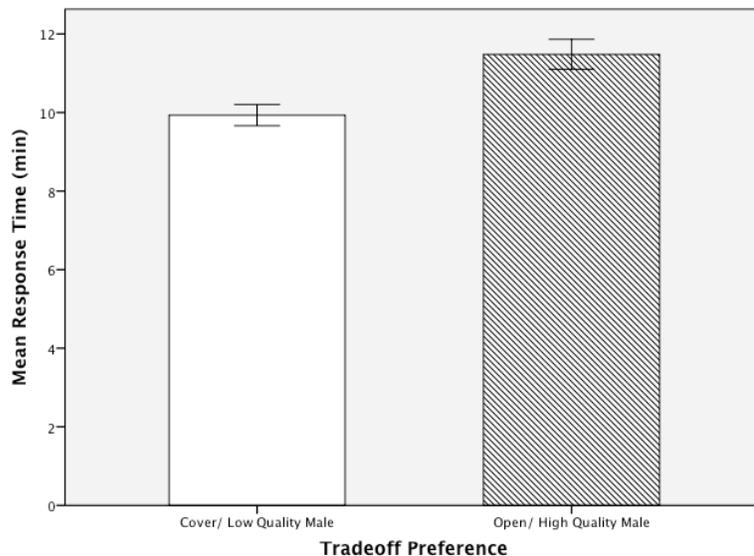|	Cover/Low quality male choice	Open/High quality male choice
Low quality females	25.7%	74.3%
High quality females	29.4%	70.6%
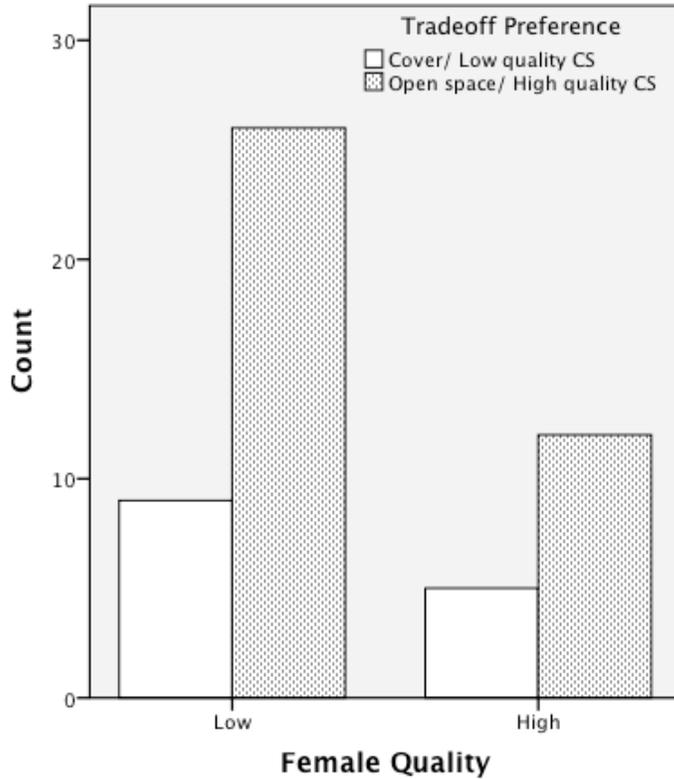
Figure 2. Bar chart with tradeoff preference counts for low and high quality females. The majority of females preferred moving through open space towards the high quality male calling song (CS).

We used Repeated Measures Logistic Regression (RMLR) to determine whether female crickets make tradeoff decisions based on their own quality. This test allows us to analyze the repeated measures of the three responses collected from each subject per trial without the statistical problems of pseudoreplication. In running this model we found that female quality is not statistically significant in predicting the outcome of tradeoff preference (Wald Chi-Square = 0.002, df = 1, p = 0.964). In fact, with a p-value of 0.964, we can conclude with confidence that based on our data there is almost no association whatsoever between female quality and tradeoff preference. In analyzing the intercept,

RMLR determined that females significantly prefer moving through open space towards the high quality male (Wald Chi-Square = 6.73, *df* = 1, *p* = 0.009).

We used an Independent Samples T-Test to look for a difference in mean response time between females that moved through open space towards a high quality male and females that moved through cover towards a low quality male. We found that females moving through open space towards a high quality male took significantly longer on average (1.55 ± 0.47 min) in their decision compared to those who moved through cover towards a low quality male (t = -3.31, *df* = 50.1, *p* = 0.002) (Fig. 3).

Figure 3. Mean response time in females choosing cover/ low quality male vs. open/ high quality male with error bars displaying standard error of the mean. Individual response times were calculated by averaging each subject's response time over three trials and preference was determined using each subject's majority choice. Total response time for all females includes 8 minutes of acclimation periods.

In order to determine if females were consistent in their tradeoff decisions, we used the Chi-Square Goodness of Fit Test to examine deviation between observed and expected tradeoff preference frequencies between 3 consistency-based outcome groups (2 groups for consistent outcomes, 1 group for inconsistent outcomes) where our expected frequencies follow a hypothesized distribution based on overall female preference. The test revealed minimal differences between observed and expected frequencies for each of the 3 consistency-based outcome groups (with residuals ranging from 0.3 – 2.3). The test revealed that females in all 3 groups showed the same degree of preference on each successive test as they did when combined as a whole (Chi-Square = 0.47, *df* = 2, *p* = 0.791). Therefore female crickets do not display consistency in their tradeoff preferences of mate choice under predation risk. If females had exhibited consistency in their preferences, the consistent preference groups would have seen a much larger deviation between observed and expected frequencies. Due to the low probability of a female choosing the preference of cover/ low quality male in all three tests, the expected frequency for this consistency-based outcome group was 1.67, thereby violating a Chi-Square assumption that all expected frequencies should be ≥ 5. However the implications of this violation are negligible since there is no significant difference between the expected and observed values for all three groups (as demonstrated by the low values of residuals).

Discussion

In this study, we examined two aspects of female house cricket tradeoff preferences in the context of predation and mate choice, i.e. the effects of female quality and consistency of tradeoff preferences. We found that the probability of a female choosing a certain tradeoff preference was not based on her quality, and that females significantly preferred moving through open space towards the high quality male. Through goodness of fit analysis we found that female house crickets are not consistent in their tradeoff decisions.

According to our results, we found no evidence that female quality has an effect on female tradeoff preferences between mate choice and predation. For instance, in a situation where a female is under threat of predation, her body size is not a determining factor of her mate choice decisions. Although female body size is known to be a significant modulating factor for female choosiness in a field cricket (*G. integer*, Hedrick and Kortet 2012a) it does not seem to have any power in modulating mate choice decisions under predation risk in *A. domesticus*. In Hedrick and Kortet's work with *G. integer*, they found that body size is a significant indicator of acoustic selectivity, but they also examined the interaction between body size and selectivity for chemical cues, and found no significance in this relationship (2012a). This opens up the possibility that female house cricket body size could have significant effects on chemical selectivity, even though field cricket body size apparently does not. While the reason for the lack of interaction between female quality and mate choice is unclear, it is probable that house crickets were not under any selective pressure to allow for the evolution of this

interaction between body size and mate choice, possibly due to the environmental circumstances of their man-made habitats.

Female house crickets, regardless of their quality, preferred travelling through open space towards the high quality male. This result allows us to reject the additive effects of genetic variation hypothesis and the energy stores hypothesis, as these hypotheses do not predict that both high and low quality females will behave in the same manner. In order to explain the result that females exhibit similar tradeoff preferences in taking risks to reach a high quality mate, we must consider the use of artificially constructed calls and how those call's parameters compare to natural call variation in *A. domesticus*. The major factor behind this possible explanation lies in the amplitude of the low quality male's calling song. Female house crickets judge the attractiveness of male songs predominantly based on amplitude and the number of pulses per chirp (Gray 1997). If the amplitude of a male's calling song is at or below the lower limit of the natural range, this could lead to a shift in female preference toward the high amplitude caller, despite factors that might normally moderate this preference (i.e. female quality and predation risk). Since the calling songs used in this experiment were artificially created and because the operational SPL for the low quality calling song was approximately 59 dB, this call likely represents a male within the lower extreme of natural variation in amplitude, since the natural male *A. domesticus* calling song amplitude ranges from 55 – 85 dB at 25 cm (Stout et al. 1983). It is possible that the artificially created low quality male calling song provided in these experiments is simply too quiet, and thus, seemingly inferior in comparison to the high quality calling song. This reasoning can explain the

general trend in female preference towards the high quality male, despite the higher risk of predation associated with that choice.

Females choosing opposing tradeoff preferences exhibited significantly different response times in that females who chose moving through open space towards the high quality male took a significantly longer period of time to decide compared to those who chose moving through cover towards the low quality male. This result is consistent with Gray's finding that choosy female house crickets spend significantly more time making a decision compared to less choosy females (those who chose lower quality males) (1999). A potential explanation for why choosy females spent significantly more time deciding compared to their less choosy counterparts suggests that less choosy females may simply be quickly and randomly orienting themselves towards either male call (Gray 1999). However, because our study employs predation risk as a correlate of calling song quality this explanation may not be as powerful because even after a female randomly orients herself towards a particular calling song, the presence or absence of protective cover will likely modulate her decision at that juncture.

Through analysis of the data from the repeated trials for each female, we found that female house crickets do not exhibit consistency in their tradeoff preferences. Because of this result, we can reject our hypothesis predicting consistent preferences due to constant motivating factors and evidence for across-context repeatability. Our data corresponds with the assumption that if repeatability (or perhaps consistency) does not occur in a mate choice behavior, then there will be no variation in mating preferences among females (Jennions and Petrie 1997). In comparing this concept to our tradeoff preference data, we see that females showed a significant preference for the same

response (travelling across open space towards the high quality male) indicating a lack of variation in their mating preferences. However, the consistency data are based on tradeoff preferences, not on mate choice decisions alone. Because there is another variable (level of predation risk) tied to the mate choice decision, we should not assume through this logic that female mating preferences would be completely static. Additionally, there are other factors that can affect measures of behavioral consistency, particularly those that are intrinsic to the female, i.e. receptivity and motivation (Jennions and Petrie 1997).

Despite evidence for a boldness behavioral syndrome in house crickets, this population of females does not exhibit consistency in their mate choice tradeoff preferences. It is true that females significantly preferred the bold and risky tradeoff choice of open space for the high quality male in comparison to the less risky choice of protective cover for the low quality male. However, we cannot tease apart the mate choice aspect of this boldness behavior from the predation aspect and therefore, preference for the bold choice is likely due to the high level of attraction exhibited towards the high quality male calling song relative to the unattractive male song. Consequently, the near-range-limit low amplitude of the low quality calling song explanation, which provides reason for the tradeoff preference results, could also explain the above discrepancy in the consistency data.

Our work suggests the need for further investigation of other potential factors that might modulate female choice and behavior in house crickets. Future work should focus on examination of how female quality affects selectivity for other modes of sexual communication as it could yield further insight into how intrinsic female factors affect

mate choice in a multimodal sense. Furthermore, the outcome of a strong female

preference in one direction allows us to draw inferences about how artificially created

calling songs and parameter values within the extremes of natural variation can affect

female mate choice in a laboratory setting, despite the influence of predation risk.

Acknowledgements

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