Supplementary Material

Appendix 1

No effect of partner age and lifespan on female age-specific reproductive performance in blue tits

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$^4$ Department of Animal Behaviour, Bielefeld University, Germany

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Table A1. Summary of experiments carried out between 2001-2013 in the studied population of blue tits with their possible influences on the laying date and the number of eggs laid

<table>
<thead>
<tr>
<th>Year</th>
<th>Experimental treatment</th>
<th>Timing of the experimental treatment with regard to the breeding cycle</th>
<th>Effect on laying date?</th>
<th>Effect on number of eggs laid?</th>
<th>Reference 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>2001</td>
<td>No experiments</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>2002</td>
<td>UV manipulation of male crown plumage</td>
<td>Before laying</td>
<td>No</td>
<td>No</td>
<td>Korsten et al. 2006</td>
</tr>
<tr>
<td>2003</td>
<td>UV manipulation of male crown plumage</td>
<td>Before laying</td>
<td>No</td>
<td>No</td>
<td>Korsten et al. 2006</td>
</tr>
<tr>
<td>2004</td>
<td>Removal of nest material</td>
<td>During nest building, before laying</td>
<td>No</td>
<td>No</td>
<td>SMA unpubl. (P = 0.15, 0.30)</td>
</tr>
<tr>
<td>2005</td>
<td>Egg collection; replacement with dummy eggs</td>
<td>During laying</td>
<td>No</td>
<td>No</td>
<td>Kingma et al. 2009</td>
</tr>
<tr>
<td>2006</td>
<td>Addition of nest-boxes near the focal nest-boxes; removal of nesting material; blocking of original nest-box; egg collection and replacement with dummy eggs</td>
<td>During nest building and laying</td>
<td>Yes</td>
<td>Yes</td>
<td>SMA unpubl. (P = 0.029, 0.046)</td>
</tr>
<tr>
<td>2007</td>
<td>Addition of nest-boxes near the focal nest-boxes; removal of nesting material; blocking of original nest-box; egg collection and replacement with dummy eggs</td>
<td>During nest building and laying</td>
<td>Yes</td>
<td>Yes</td>
<td>SMA unpubl. (P &lt; 0.001, 0.003)</td>
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<tr>
<td>2008</td>
<td>Egg collection and egg addition</td>
<td>During laying</td>
<td>No</td>
<td>No</td>
<td>Vedder et al. 2010</td>
</tr>
<tr>
<td>2009</td>
<td>Egg collection; no replacement with dummy eggs.</td>
<td>During laying</td>
<td>No</td>
<td>Yes</td>
<td>Vedder et al. 2012</td>
</tr>
<tr>
<td>2010</td>
<td>Testosterone implants in females and egg collection; replacement with dummy eggs</td>
<td>Before laying</td>
<td>No</td>
<td>No</td>
<td>de Jong 2013</td>
</tr>
<tr>
<td>2011</td>
<td>Testosterone implants in females</td>
<td>Before laying</td>
<td>No</td>
<td>No</td>
<td>de Jong 2013</td>
</tr>
<tr>
<td>2012</td>
<td>Egg collection</td>
<td>During laying</td>
<td>No</td>
<td>Possibly 3</td>
<td>PK unpubl.</td>
</tr>
<tr>
<td>2013</td>
<td>Egg collection</td>
<td>During laying</td>
<td>No</td>
<td>Possibly 3</td>
<td>PK unpubl.</td>
</tr>
</tbody>
</table>

1 Only experimental treatments carried out before incubation onset are presented.
2 The first and second P-values in the brackets are related to the effect of the experimental treatment on laying date and number of eggs laid, respectively.
3 In 2012-2013, two eggs per nest were collected without replacement with dummy eggs. This was done for almost all breeding attempts. Given breeding birds received the same treatment for almost all nest-boxes, we assumed the collection of eggs did not contribute to between-nest-box variation in the number of eggs laid.
Table A2. Linear mixed models investigating the effect of the age of female blue tits on laying date and number of eggs laid also including breeding attempts where the identity and age of only females are known. Estimated coefficients of each term (Estimate) with associated standard errors (SE) and P-values are presented on the basis of final model. ALR means age of last reproduction. Non-significant (ns) fixed effects, except the age, age$^2$ and ALR terms, were deleted by stepwise deletion, in order of least significance and starting with the interactions

<table>
<thead>
<tr>
<th></th>
<th>Laying date</th>
<th>Number of eggs laid</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Estimate</td>
<td>SE</td>
<td>P</td>
<td>Estimate</td>
</tr>
<tr>
<td>Fixed effects</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Intercept</td>
<td>24.16</td>
<td>1.63</td>
<td>&lt;0.001</td>
<td>10.39</td>
</tr>
<tr>
<td>♀ age</td>
<td>-5.97</td>
<td>1.19</td>
<td>&lt;0.001</td>
<td>0.66</td>
</tr>
<tr>
<td>♀ age$^2$</td>
<td>1.25</td>
<td>0.30</td>
<td>&lt;0.001</td>
<td>-0.12</td>
</tr>
<tr>
<td>♀ ALR</td>
<td>-0.97</td>
<td>0.36</td>
<td>0.007</td>
<td>0.13</td>
</tr>
<tr>
<td>♀ age × ♀ ALR</td>
<td>0.61</td>
<td>0.27</td>
<td>0.025</td>
<td>ns</td>
</tr>
<tr>
<td>♀ age$^2$ × ♀ ALR</td>
<td>-0.14</td>
<td>0.05</td>
<td>0.002</td>
<td>ns</td>
</tr>
<tr>
<td>Random effects</td>
<td>Variance</td>
<td></td>
<td></td>
<td>Variance</td>
</tr>
<tr>
<td>♀ Identity</td>
<td>14.05</td>
<td></td>
<td></td>
<td>1.29</td>
</tr>
<tr>
<td>Nest-box</td>
<td>1.69</td>
<td></td>
<td></td>
<td>0.19</td>
</tr>
<tr>
<td>Year</td>
<td>17.99</td>
<td></td>
<td></td>
<td>0.28</td>
</tr>
<tr>
<td>Residual</td>
<td>9.00</td>
<td></td>
<td></td>
<td>1.90</td>
</tr>
<tr>
<td>Sample sizes</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Individuals ♀</td>
<td>633</td>
<td></td>
<td></td>
<td>621</td>
</tr>
<tr>
<td>Years</td>
<td>12</td>
<td></td>
<td></td>
<td>12</td>
</tr>
<tr>
<td>Breeding attempts</td>
<td>932</td>
<td></td>
<td></td>
<td>893</td>
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Table A3. Linear mixed models investigating the effect of the age of the male partner on female specific reproductive traits for breeding attempts in blue tits where the identity and age of both pair members are known. Estimated coefficients of each term (Estimate) with associated standard errors (SE) and P-values are presented on the basis of final model. ALR means age of last reproduction. Non-significant (ns) fixed effects, except the age, age$^2$ and ALR terms, were deleted by stepwise deletion, in order of least significance and starting with the interactions

<table>
<thead>
<tr>
<th>Fixed effects</th>
<th>Laying date</th>
<th>Number of eggs laid</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Estimate</td>
<td>SE</td>
<td>P</td>
<td>Estimate</td>
</tr>
<tr>
<td>Intercept</td>
<td>17.33</td>
<td>1.36</td>
<td>&lt;0.001</td>
<td>11.13</td>
</tr>
<tr>
<td>$\delta$ age</td>
<td>-0.23</td>
<td>0.68</td>
<td>0.73</td>
<td>0.08</td>
</tr>
<tr>
<td>$\delta$ age$^2$</td>
<td>-0.00</td>
<td>0.13</td>
<td>1</td>
<td>-0.03</td>
</tr>
<tr>
<td>$\delta$ ALR</td>
<td>-0.02</td>
<td>0.19</td>
<td>0.93</td>
<td>0.15</td>
</tr>
<tr>
<td>$\delta$ age $\times$ $\delta$ ALR</td>
<td>ns</td>
<td>ns</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\delta$ age$^2$ $\times$ $\delta$ ALR</td>
<td>ns</td>
<td>ns</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Random effects</th>
<th>Variance</th>
<th>Variance</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\delta$ Identity</td>
<td>3.23</td>
<td>0.43</td>
</tr>
<tr>
<td>Nest-box</td>
<td>2.31</td>
<td>0.20</td>
</tr>
<tr>
<td>Year</td>
<td>17.20</td>
<td>0.27</td>
</tr>
<tr>
<td>Residual</td>
<td>13.91</td>
<td>2.52</td>
</tr>
</tbody>
</table>

Sample sizes

| Individuals $\delta$ | 548 | 536 |
| Years               | 12  | 12  |
| Breeding attempts   | 763 | 736 |
Table A4. Linear mixed models investigating the effect of the age of the male partner on female specific reproductive traits in blue tits (including breeding attempts where the identity and age of only males are known). Estimated coefficients of each term (Estimate) with associated standard errors (SE) and P-values are presented on the basis of final model. ALR means age of last reproduction. Non-significant (ns) fixed effects, except the age, age$^2$ and ALR terms, were deleted by stepwise deletion, in order of least significance and starting with the interactions

<table>
<thead>
<tr>
<th></th>
<th>Laying date</th>
<th>Number of eggs laid</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Estimate</td>
<td>SE</td>
</tr>
<tr>
<td>Fixed effects</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intercept</td>
<td>17.62</td>
<td>1.34</td>
</tr>
<tr>
<td>$♂$ age</td>
<td>-0.43</td>
<td>0.68</td>
</tr>
<tr>
<td>$♂$ age$^2$</td>
<td>0.02</td>
<td>0.13</td>
</tr>
<tr>
<td>$♂$ ALR</td>
<td>0.04</td>
<td>0.19</td>
</tr>
<tr>
<td>$♂$ age × $♂$ ALR</td>
<td>ns</td>
<td></td>
</tr>
<tr>
<td>$♂$ age$^2$ × $♂$ ALR</td>
<td>ns</td>
<td></td>
</tr>
<tr>
<td>Random effects</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$♂$ Identity</td>
<td>2.31</td>
<td></td>
</tr>
<tr>
<td>Nest-box</td>
<td>2.82</td>
<td></td>
</tr>
<tr>
<td>Year</td>
<td>16.46</td>
<td></td>
</tr>
<tr>
<td>Residual</td>
<td>15.01</td>
<td></td>
</tr>
</tbody>
</table>

Sample sizes
- Individuals $♂$: 589
- Years: 12
- Breeding attempts: 820

Variance
Table A5. Linear mixed models investigating the effect immigrant status (locally born versus immigrant), female age, and the age of the male partner on laying date and number of eggs laid for breeding attempts in blue tits where the identity and age of both pair members are known. Estimated effects of each term (Estimate) with associated standard errors (SE) and P-values are presented on the basis of the final model. ALR stands for age of last reproduction. Non-significant (ns) fixed effects, except the immigrant status, age, age² and ALR terms which were always retained in the model, were deleted by stepwise deletion, in order of least significance and starting with the interactions.

<table>
<thead>
<tr>
<th>Fixed effects</th>
<th>Laying date</th>
<th></th>
<th>Number of eggs laid</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Estimate</td>
<td>SE</td>
<td>P</td>
<td>Estimate</td>
</tr>
<tr>
<td>Intercept</td>
<td>22.97</td>
<td>1.74</td>
<td>&lt;0.001</td>
<td>10.68</td>
</tr>
<tr>
<td>♀ resident status</td>
<td>-0.89</td>
<td>0.47</td>
<td>0.06</td>
<td>-0.03</td>
</tr>
<tr>
<td>♂ resident status</td>
<td>-0.40</td>
<td>0.33</td>
<td>0.23</td>
<td>-0.07</td>
</tr>
<tr>
<td>♀ age</td>
<td>-5.54</td>
<td>1.24</td>
<td>&lt;0.001</td>
<td>0.50</td>
</tr>
<tr>
<td>♀ age²</td>
<td>1.22</td>
<td>0.32</td>
<td>&lt;0.001</td>
<td>-0.09</td>
</tr>
<tr>
<td>♀ ALR</td>
<td>-0.51</td>
<td>0.36</td>
<td>0.15</td>
<td>0.07</td>
</tr>
<tr>
<td>♀ age × ♀ ALR</td>
<td>0.52</td>
<td>0.27</td>
<td>0.05</td>
<td>ns</td>
</tr>
<tr>
<td>♀ age² × ♀ ALR</td>
<td>-0.15</td>
<td>0.05</td>
<td>&lt;0.01</td>
<td>ns</td>
</tr>
<tr>
<td>♂ age</td>
<td>-0.31</td>
<td>0.61</td>
<td>0.61</td>
<td>-0.01</td>
</tr>
<tr>
<td>♂ age²</td>
<td>0.09</td>
<td>0.12</td>
<td>0.45</td>
<td>-0.01</td>
</tr>
<tr>
<td>♂ ALR</td>
<td>-0.04</td>
<td>0.17</td>
<td>0.81</td>
<td>0.11</td>
</tr>
<tr>
<td>♂ age × ♂ ALR</td>
<td>ns</td>
<td>ns</td>
<td></td>
<td>ns</td>
</tr>
<tr>
<td>♂ age² × ♂ ALR</td>
<td>ns</td>
<td>ns</td>
<td></td>
<td>ns</td>
</tr>
<tr>
<td>♀ age × ♀ age</td>
<td>ns</td>
<td>ns</td>
<td></td>
<td>ns</td>
</tr>
<tr>
<td>♀ age × ♀ ALR</td>
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<td>ns</td>
<td></td>
<td>ns</td>
</tr>
<tr>
<td>♀ age² × ♀ ALR</td>
<td>ns</td>
<td>ns</td>
<td></td>
<td>ns</td>
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<tr>
<td>♀ age × ♂ ALR</td>
<td>ns</td>
<td>ns</td>
<td></td>
<td>ns</td>
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<tr>
<td>♀ age² × ♂ ALR</td>
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<table>
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<th>Random effects</th>
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<th>Proportion variance explained</th>
<th>Variance</th>
<th>Proportion variance explained</th>
</tr>
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<tr>
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<td>0.07</td>
<td>0.22</td>
<td>0.06</td>
</tr>
<tr>
<td>♂ Identity</td>
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<td>1.39</td>
<td>0.40</td>
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<td>0.13</td>
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<td>0.28</td>
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<td>Residual</td>
<td>5.21</td>
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<td>1.48</td>
<td>0.42</td>
</tr>
</tbody>
</table>

Sample sizes
- Individuals ♀: 548
- Individuals ♂: 541
- Years: 12
- Breeding attempts: 763
Table A6. Linear mixed models investigating age-specific laying date and number of eggs laid in female blue tits $\geq 3$ years where the identity and age of both pair members are known. Estimated effects of each term (Estimate) with associated standard errors (SE) and P-values are presented on the basis of final model. Non-significant fixed effects (ns) except single age and ALR terms were deleted by stepwise deletion, in order of least significance

<table>
<thead>
<tr>
<th>Fixed effects</th>
<th>Laying date</th>
<th>Number of eggs laid</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Estimate</td>
<td>SE</td>
</tr>
<tr>
<td>Intercept</td>
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</tr>
<tr>
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<td>0.38</td>
</tr>
<tr>
<td>♀ ALR</td>
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<td>0.51</td>
</tr>
<tr>
<td>♀ age $\times$ ♀ ALR</td>
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<td>ns</td>
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<tr>
<td>Years</td>
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</tr>
<tr>
<td>Breeding attempts</td>
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</table>
Table A7. Linear mixed models investigating age-specific laying date and number of eggs laid in female blue tits ≥ 3 years also including breeding attempts where the identity and age of only females are known. Estimated effects of each term (Estimate) with associated standard errors (SE) and P-values are presented on the basis of final model. Non-significant fixed effects (ns) except single age and ALR terms were deleted by stepwise deletion, in order of least significance

<table>
<thead>
<tr>
<th></th>
<th>Laying date</th>
<th>Number of eggs laid</th>
</tr>
</thead>
<tbody>
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<td></td>
<td>Estimate</td>
<td>SE</td>
</tr>
<tr>
<td>Fixed effects</td>
<td></td>
<td></td>
</tr>
<tr>
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</tr>
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<td>0.43</td>
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<td>♀ ALR</td>
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<td>♀ age × ♀ ALR</td>
<td>ns</td>
<td></td>
</tr>
<tr>
<td>Random effects</td>
<td></td>
<td></td>
</tr>
<tr>
<td>♀ Identity</td>
<td>10.23</td>
<td></td>
</tr>
<tr>
<td>Nest-box</td>
<td>2.08</td>
<td></td>
</tr>
<tr>
<td>Year</td>
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</tr>
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Supplementary references


