Crossover interference and the sex difference in recombination

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Backcross

Diagram showing the genetic components of a backcross breeding scheme, illustrating the interaction between parental lines (P1 and P2) to produce F1 offspring, followed by a backcross (BC) generation.
Meiosis
Learning about recombination

- MLH1 staining in spermatocytes or oocytes
- Genotype data on families / crosses
- Patterns of linkage disequilibrium
Backcross

P₁ × P₂ → F₁

P₁ × F₁ → BC
# Crosses

<table>
<thead>
<tr>
<th>Cross</th>
<th>Sample size</th>
</tr>
</thead>
<tbody>
<tr>
<td>$(B \times C) \times B$</td>
<td>1466</td>
</tr>
<tr>
<td>$(C \times B) \times B$</td>
<td>1528</td>
</tr>
<tr>
<td>$B \times (B \times C)$</td>
<td>1459</td>
</tr>
<tr>
<td>$B \times (C \times B)$</td>
<td>1533</td>
</tr>
</tbody>
</table>

$B = \text{C57BL/6J}$

$C = \text{CAST/EiJ}$
Genotyping

Chr 1 only (for now), by brute force
Genotyping

Chr 1 only (for now), by brute force
Genotyping

Chr 1 only (for now), by brute force
## Counts

<table>
<thead>
<tr>
<th>No. crossovers</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>Ave.</th>
</tr>
</thead>
<tbody>
<tr>
<td>female</td>
<td>25</td>
<td>50</td>
<td>23</td>
<td>1.6</td>
<td>0.1%</td>
<td>1.01</td>
</tr>
<tr>
<td>male</td>
<td>32</td>
<td>51</td>
<td>16</td>
<td>0.2</td>
<td>0.0%</td>
<td>0.84</td>
</tr>
</tbody>
</table>
Recombination rate

The graph shows the recombination rate (cM/Mbp) for both female and male populations across various physical positions (Mbp). The recombination rate is depicted with line graphs, with female data in red and male data in blue. The x-axis represents the physical position (Mbp), and the y-axis represents the recombination rate (cM/Mbp).
Distal 25 Mbp

Physical Position (Mbp)
Recombination rate (cM / Mbp)
female
male
Distal 25 Mbp

Physical Position (Mbp)

Recombination rate (cM / Mbp)

- female BxC
- female CxB

Physical Position (Mbp)

Recombination rate (cM / Mbp)

- male BxC
- male CxB
Double-XO locations
Double-XO locations
Coincidence

\[ C(d) = \frac{\Pr(XO \text{ in } I_2 \mid XO \text{ in } I_1)}{\Pr(XO \text{ in } I_2)} \]
Coincidence

Distance (Mbp)

Coincidence

Female

Male

Distance (Mbp)
Summary

• Clear sex differences in overall recombination rate

• Differences in compaction + interference
  $\rightarrow$ difference in recombination rate?

• Nature of local differences?

• Imprinting effects?

• There are a number of interesting statistical problems
  and a ton more data.
Acknowledgments

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