How life history theory can be viewed as an organizing framework for understanding variation in birth outcomes, and how the built environment and neighborhood contexts offer opportunities for public health interventions.
Building a healthy baby

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The Genesee County, Michigan REACH US project is a U.S. Centers for Disease Control and Prevention funded program to reduce the African American health disparity in infant mortality. Coalition partners include the local public health infrastructure, academics, and community-based organizations.
Socio-Ecological Model
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Life History Theory
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- Examines how organisms allocate effort over their lifetimes to maximize fitness (contributions to future generations).
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Energy/Resources

- Somatic effort
- Reproductive effort
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  - Growth
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Energy/Resources

- Somatic effort
  - Maintenance
  - Growth
- Reproductive effort
  - Parenting
  - Mating
Life History Theory

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- The co-varying factors of prematurity and low birth weight are the primary cause of neonatal mortality in developed countries.
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- Mechanisms that regulate maternal somatic investment (gestational length, weight at birth) may contribute to adverse birth outcomes.
- Conditions suggesting high infant/child mortality risk may shift investment from current offspring to potential future offspring to increase the chance that at least some offspring will survive and reproduce.
Candidate risk factor: Deterioration of the built environment
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- The physical deterioration of the human built environment is increasingly recognized as an important influence on health.
- Highly deteriorated neighborhoods increase fear of crime and decrease perceptions of personal safely.
- This could reduce maternal somatic investment, as it reflects dangerous conditions for the current offspring.
Hypothesis
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Neighborhood structural deterioration will be inversely associated with maternal somatic investment
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Predictions: The density of very deteriorated neighborhood structures will be directly related to the densities of premature and low birth weight births.
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Method: We tested these predictions for births in Flint, Michigan in 2006 with geographically identified birth records from the Michigan Department of Community Health provided. The Flint Environmental Block Assessment project provided systematic data on the condition of 60,000 neighborhood structures.
Genesee County, Michigan
Flint, Michigan
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- Flint’s population declined 36.5% from 197K in 1970 to 125K in 2000.
- Many vacant and dilapidated properties, especially near the former car factories.
Method

• We used Geographical Information Systems to calculate the proportional density of outcomes in .25 mi$^2$ areas:
  o Highly deteriorated residential structures
  o Pre-mature (<37 weeks) singleton births
  o Low birth weight (<2500g) singleton births

• Extracted variance in birth outcomes accounted for by maternal education, paternal education, and private insurance status at the individual level.

• Separate analyses for Blacks and Whites
Density of deteriorated structures
Density of pre-mature births
Density of low birth weight births
## Results

### Correlations with density of structural deterioration

<table>
<thead>
<tr>
<th>Race</th>
<th>Pre-maturity</th>
<th>Low birth weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>All</td>
<td>.441***</td>
<td>.500***</td>
</tr>
<tr>
<td>Black</td>
<td>.354***</td>
<td>.336***</td>
</tr>
<tr>
<td>White</td>
<td>.228**</td>
<td>.026</td>
</tr>
</tbody>
</table>

*N = 169; ** indicates p < .01, *** indicates p < .001. Controlling for maternal education, paternal education, and private insurance status.*
Results

The density of dilapidated structures was highly skewed across sectors (Skewness = 2.02, $SE = 0.19$).

Black births were overrepresented in areas with high structural deterioration

<table>
<thead>
<tr>
<th>Race</th>
<th>Top 25%</th>
<th>Top 5%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Black</td>
<td>49%</td>
<td>20%</td>
</tr>
<tr>
<td>White</td>
<td>22%</td>
<td>6%</td>
</tr>
</tbody>
</table>
Conclusion
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- Mechanisms regulating investment trade-offs based on environmental conditions may influence adverse birth outcomes.
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• Legacy from times of considerably higher mortality rates, they may not promote reproductive success in modern environments (i.e. mismatch).
Conclusion

• Conditions suggesting high extrinsic mortality rates predicted adverse birth outcomes.

• Mechanisms regulating investment trade-offs based on environmental conditions may influence adverse birth outcomes.

• Legacy from times of considerably higher mortality rates, they may not promote reproductive success in modern environments (i.e. mismatch).

• Interventions promoting desirable birth outcomes may be more effective if they attend to relevant environmental conditions.
Candidate risk factor 2: Low paternal investment
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- Men provide considerably more paternal investment than males in most other primate species.
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- Paternal investment is significantly related to offspring survival and success.
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- Paternal investment is significantly related to offspring survival and success.
- Children growing up with fathers absent are at higher risk for a range of adverse outcomes.
Hypotheses
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1. Women living in areas with relatively lower levels of paternal investment will have higher rates of prematurity and low birth weight.
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2. Scarcity of men in a population will predict lower paternal investment and also higher rates of prematurity and low birth weight (directly and/or indirectly).
Part II
Operational Sex Ratio
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- When the sex ratio is imbalanced, the rarer sex has increased leverage in inter-sexual relationships.
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• Women compete for partners through signals of fecundity and sexual availability.
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Female scarcity: Women are more effective at securing commitment and obtaining higher investment from men.
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- Brideprice paid by husband’s family (Herlihy, 1976).
Male scarcity: Male mating opportunities are enhanced, incentives for long-term commitment and investment are diminished.
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• Dowries paid by bride’s family (Herlihy, 1976).
Hypothesis

Scarcity of men in a population will predict lower paternal investment and also higher rates of prematurity and low birth weight (directly and/or indirectly).

Higher incidence of low birth weight and pre-mature gestation

Lower incidence of low birth weight and pre-mature gestation
Method
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- CDC birth outcome statistics for 450 counties in the year 2000
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  - Sex Ratio
  - % of families with children that are single mother households
  - % Non-White
  - SES:
    - % Income below poverty level
    - Median household income
    - % High School graduates (25 years old and older)
    - % 4-year College graduates (25 years old and older)
Results

![Graph showing the relationship between Proportion Pre-mature (<37 weeks) and OSR Ages 18-64 with an R² Linear value of 0.085.](image-url)
Results
Results
Standardized regression coefficients

- Male Scarcity
- Non-White
- SES

Prematurity
- Single Mothers

Low Birth Weight

$\chi^2_{(5)} = 27.80, p < .001, \text{ GFI} = .980, \text{ NFI} = .981, \text{ CFI} = .985, \text{ RMSEA} = .101$

*p < .01, **p < .001
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### Results

Proportion Premature Gestation

<table>
<thead>
<tr>
<th>Predictor</th>
<th>$B$</th>
<th>$SE$</th>
<th>$\beta$</th>
<th>$t$</th>
<th>$p$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>.121</td>
<td>.014</td>
<td>---</td>
<td>8.73</td>
<td>.001</td>
</tr>
<tr>
<td>% Single moms</td>
<td>.127</td>
<td>.001</td>
<td>.44</td>
<td>7.26</td>
<td>.001</td>
</tr>
<tr>
<td>% Non-White</td>
<td>.022</td>
<td>.006</td>
<td>.17</td>
<td>3.50</td>
<td>.001</td>
</tr>
<tr>
<td>OSR Ages 18-64</td>
<td>.000</td>
<td>.000</td>
<td>.14</td>
<td>3.88</td>
<td>.001</td>
</tr>
<tr>
<td>SES</td>
<td>.000</td>
<td>.000</td>
<td>-.26</td>
<td>3.70</td>
<td>.151</td>
</tr>
</tbody>
</table>

Adjusted $R^2 = .425$
# Results

## Proportion Low Birth Weight

<table>
<thead>
<tr>
<th>Predictor</th>
<th>$B$</th>
<th>$SE$</th>
<th>$β$</th>
<th>$t$</th>
<th>$p$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>.067</td>
<td>.009</td>
<td>---</td>
<td>7.39</td>
<td>.001</td>
</tr>
<tr>
<td>% Single moms</td>
<td>.153</td>
<td>.011</td>
<td>.69</td>
<td>13.32</td>
<td>.001</td>
</tr>
<tr>
<td>OSR Ages 18-64</td>
<td>.000</td>
<td>.000</td>
<td>.13</td>
<td>3.64</td>
<td>.001</td>
</tr>
<tr>
<td>% Non-White</td>
<td>.012</td>
<td>.004</td>
<td>.12</td>
<td>2.83</td>
<td>.005</td>
</tr>
<tr>
<td>SES</td>
<td>.000</td>
<td>.000</td>
<td>.09</td>
<td>2.47</td>
<td>.014</td>
</tr>
</tbody>
</table>

Adjusted $R^2 = .592$
Results

- The proportion of families that are single mother households is the strongest predictor of prematurity and low birth weight.
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• The sex ratio predicts single mother households independently of traditional SES indicators and proportion Non-White (mediated effect).
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• The sex ratio predicts single mother households independently of traditional SES indicators and proportion Non-White (mediated effect).
• The sex ratio predicts prematurity and low birth weight independently of single mother households (direct effect).
Conclusion
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• Conditions suggesting relatively lower levels of paternal investment rates predicted adverse birth outcomes.
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**Energy/Resources**

- **Somatic effort**
  - Maintenance
  - Growth
- **Reproductive effort**
  - Parenting
  - Mating

- **Future offspring**
- **Current offspring**
Conclusion

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