Genotype-Environment Correlation and Novel Approaches to Twin and Sibling Research

Jenae M. Neiderhiser, Ph.D.

Center for Family Research
Department of Psychiatry & Behavioral Sciences
George Washington University
Genetic Tools & Prevention
Mechanisms

• Major risk and protective factors are genetically influenced

• Genetic influences are MODERATED and MEDIATED by the environment

• Interventions can be targeted on these mediating and moderating environments
Risk & Protective Factors That Show Genetic Influences

- Temperament & Personality
- Psychopathology & Addiction
- IQ & Academic Functioning
- Parent-Child Relationships
- Self-Worth & Competence
How are genetic influences estimated?

- Examine **family members** who differ in degree of genetic relatedness
  - e.g. identical twins, fraternal twins, parent-biological child, adoptive parent-adoptive child

- **Compare similarity** in family members (correlations)
• Genetic influences
  • Indicated by increased similarity for increased genetic relatedness
  • MZ twins > DZ twins > adopted sibs

• Shared environmental influences
  • Indicated by within family similarity
  • ANY similarity in adopted sibs

• Nonshared environmental influences
  • Indicated by differences in family members
  • ANY differences between MZ twins
Twin and Sibling Correlations for Antisocial Behavior
Genetic & Environmental Influences on Antisocial Behavior

*from Reiss, Neiderhiser, Hetherington & Plomin (2000) The Relationship Code*
Risk & Protective Factors That Show Genetic Influences

- Temperament & Personality
- Psychopathology & Addiction
- IQ & Academic Functioning
- **Parent-Child Relationships**
- Self-Worth & Competence
Twin and Sibling Correlations for Mother’s Negativity

bar chart showing correlations across different categories: MZ, DZ, FI, FS, HS, US

Correlation values for each category are as follows:
- MZ: 0.70
- DZ: 0.50
- FI: 0.40
- FS: 0.30
- HS: 0.20
- US: 0.10
Genetic and Environmental Influences on Mother’s Negativity

- **Mom Neg T1**
  - Heritability: 56%
  - Shared Env.: 21%
  - Nonshared Env.: 23%

- **Mom Neg T2**
  - Heritability: 57%
  - Shared Env.: 17%
  - Nonshared Env.: 26%
Genetic Influences on Parenting

General Trends

• Warmth/Support & Conflict/Negativity
  • Tend to show *genetic influences*

• Monitoring & Control
  • Tend to show *shared environmental influences*
Possible Explanation of Genetic Influences on Parenting

Genotype-Environment Correlation

- **Passive**: parents & children share genes & share environments

- **Evocative**: parents respond to genetically influenced characteristics of children

- **Active**: children seek out environments correlated with their genotype
Why does it matter?

1) Helps to understand *process*

2) If GE correlations are primarily *passive* change may be harder

3) If GE correlations are primarily *evocative* then changing parental response is more likely to change the child’s outcome
How can types of GE correlation be disentangled?

Most BG studies of parenting have been child-based twin or sibling designs

Cannot disentangle passive from evocative GE correlation

Parent-based twin or sibling designs provide additional information about process
Comparison of Two Studies

Child-based study of adolescent siblings and parents – NEAD, Nonshared Environment in Adolescent Development study (Reiss et al., 2000)

Parent-based study of twin women and their adolescent child – TM, Twin Moms study (Reiss et al., 2001)
NEAD and TOSS Designs

**NEAD**

- Mom
- Dad
- Child 1
- Child 2

1.0 = MZ twins; .50 = DZ twins & full siblings; .25 = half siblings; 0 = step siblings

**TOSS**

- Spouse 1
- Twin Parent 1
- Twin Parent 2
- Spouse 2
- Child of Twin 1
- Child of Twin 2

1.0 = MZ twin parents; .50 = DZ twin parents

.25 = children of MZ twin parents; .125 = children of DZ twin parents
### Expectations and Interpretation

<table>
<thead>
<tr>
<th></th>
<th>Child-based</th>
<th>Parent-based</th>
</tr>
</thead>
<tbody>
<tr>
<td>Passive GE Corr</td>
<td>Shared Env</td>
<td>Genetic</td>
</tr>
<tr>
<td>Evocative GE Corr</td>
<td>Genetic</td>
<td>Shared and/or Nonshared Env</td>
</tr>
<tr>
<td>No GE Corr</td>
<td>Shared and/or Nonshared Env</td>
<td>Shared and/or Nonshared Env</td>
</tr>
</tbody>
</table>
G & E Influences on Mother’s Behavior

- Negativity - NEAD
- Negativity - TM
- Positivity - NEAD
- Positivity - TM

- Evocative GE Correlation
- Passive & Evocative GE Correlation

Legend: G, Es, En
Children Of Twins Design (conceptual)

- Twin 1 (Parent) with 1.0 MZ; .5 DZ connections to:
  - Spouse 1 (Parent) with .5 MZ parents; .25 DZ parents
  - Twin 2 (Parent) with .5 MZ parents; .25 DZ parents
  - Child 1
- Twin 2 (Parent) with .5 MZ parents; .25 DZ parents connections to:
  - Spouse 1 (Parent) with .5 MZ parents; .25 DZ parents
  - Twin 1 (Parent) with .5 MZ parents; .25 DZ parents
  - Child 2
- Spouse 1 (Parent) with .5 MZ parents; .25 DZ parents
- Spouse 2 (Parent) with .5 MZ parents; .25 DZ parents

- Child 1 and Child 2 with connections to each other and to Spouse 1 and Spouse 2.
Children of Twins Model

(conceptual)
- testing for GE correlation
- incorporating child-based sample

p = cultural inheritance
m = direct effect of parenting
s = passive ge-corr
n = evocative ge-corr
Extended Children of Twins Model

- testing for GE correlation
- incorporating child-based sample

p=cultural inheritance
m=direct effect of parenting
s=passive ge-corr
n=evocative ge-corr
First test of ECoT

Measures:
- Mother reports of maternal overinvolvement
- Youth Self-Report on the Child Behavior Checklist

Findings & interpretation:
- No GE correlation
- Direct environmental effects of maternal overinvolvement on adolescent internalizing problems

Second test of ECoT:
- Currently underway
- Parental criticism and adolescent externalizing problems
- Preliminary findings suggest evocative GE correlation

From Narusyte et al. (submitted).
How can genetic research inform prevention?

- Emphasizes the importance of targeted interventions
- Emphasizes important role of the family in shaping genetically influenced behaviors
- Provides an experimental design to test the causal role of genetic influences
How Can Genetic Research Be Informed by Prevention and Family-based Designs?

• Acknowledge distinct roles of each family member in shaping behavior

• Molecular genetics may be focusing on “wrong” genes – genetic influences on positive characteristics are likely to prove more fruitful