The Role of Specific and Non-Specific Genetic Factors in Language Development

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Key Genetic Questions

- Do genetic factors affect people’s ability to acquire and use language?
- Do these factors affect ‘normal’ people’s linguistic abilities or just those with language disorders?
- Do language-specific genes exist?
- Are genetic factors involved in all aspects of language?
- Are the same genetic factors involved in all aspects of language?
- [How do genes and the environment interact?]

Twin Study Rationale

- Genetic factors play a greater role for language-impaired people (~12-25% than “normal” ~14-12%)
- Genetic factors affect all aspects of language
- Probable existence of some language-specific genes
- Possible existence of some genes specific to different aspects of language

We need to know more about...

- The heritability of phonology
- The heritability of syntax
- The specificity of the heritable factors affecting language
  - Do the heritable factors affect language abilities (e.g., cognitive, social, gross motor, fine motor, and oral motor development)
  - Are there specific language, phonology specific, vocabulary specific, heritable factors?
- [Interactions among heritable and environmental factors]

Participants in Current Study

Same sex twin pairs from the Perinatal Environment-Genetics Interactions (PEGI) study who were between 2 and 6 years of age.

N = 267 same sex twin pairs
145 monozygotic (MZ); 122 dizygotic (DZ)
Sex: 53% male, 47% female
Birth Weight
MZ: 2294 grams (SD = 563 grams)
DZ: 2368 grams (SD = 563 grams)
Gestational Age at Birth
MZ: 35.1 weeks (SD = 2.8 weeks)
DZ: 35.4 weeks (SD = 3.0 weeks)

Linguistic Measures

4 Linguistic milestones
  - First word
  - Crawl
  - Walk
  - Run

Non-Linguistic Measures

2 General measures:
  - Total ASQ score
  - All Therapist and Special Services/year
7 Gross motor measures:
  - M2y gross motor score
  - 5 milestones (sit, crawl, walk, run, stand)
  - Physical Therapy/year
5 Fine motor measures:
  - M2y fine motor score
  - 5 milestones (finger precision, hand-eye, coordination, grasp, prehension)
  - Occupational Therapy/year
2 Oral motor measures:
  - 1 milestone (feeding)
  - Speech Therapy/year
3 Social measures:
  - M2y milestone score
  - 1 milestone (social smiling, Peck & Baker Therapy/year
2 Cognitive measures:
  - M2y comprehensive score
  - Special Education Services/year

The amount of genetic overlap between language and non-linguistic abilities varies for different aspects of language:

Gene-specific overlap is moderate by both vocabulary-Syntax and Articulation-Syntax measures.

Conclusion 1: Genes Are Important

1. Heritable factors play a role for both normal and language-impaired children’s language, though heritable factors play a larger role for language-impaired children.
2. Heritable factors play a substantial role for all aspects of language, but the role is greater for syntax and articulation than for vocabulary.
3. Heritable factors play a substantial role for non-linguistic abilities, with the exception of oral motor skills.

Conclusion 2: General & Specific Genes are Important for Language

1. There is genetic overlap for linguistic and non-linguistic skills (particularly between language and fine motor, oral motor, and social skills).
2. There are also specific-to-language (and subcomponents of language) genetic factors.
3. The genetic overlap between syntax and articulation is greater than the genetic overlap between vocabulary and syntax or vocabulary and articulation. This may reflect the hierarchical nature of both syntax and phonology.
4. Taken as a whole, our results are most consistent with language acquisition models that invoke both general and language-specific learning mechanisms.