

## ACC Basics: Neuroanatomy, Callosal Functions, and Mental Abilities

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### I. “The Basics” of ACC? (Brain anatomy and subtypes of ACC)

#### 1. Anatomy and Basic Description:

- The corpus callosum is the major structure that interconnects (and allows information to pass between) the left and right sides of the cerebral cortex.
- Agenesis of the corpus callosum means a congenital failure in the development (“agenesis”) of the corpus callosum.
- ACC can be complete (no corpus callosum), partial (some but not all of the corpus callosum), or hypoplastic (all present, but thin and underdeveloped).
- Individuals with ACC may have other brain abnormalities. We call this “ACC Plus.”
- Individuals may ACC as the only brain abnormality. We call this “Primary ACC.”
- The “Primary ACC Syndrome” refers to the following typical areas of difficulties or deficits found in individuals with Primary ACC:
  - Transferring complex sensory information between the 2 cerebral hemispheres.
  - Coordinating the motor activity of the two hands to accomplish a bimanual task.
  - Solving new and complex cognitive problems.
  - Understanding the secondary meaning of language (non-literal expressions, metaphors, stories, jokes).
  - Understanding the subtle aspects of social interactions.

#### 2. Important Issues:

The Problem of ACC that we are addressing in our research:

- Individuals with ACC and normal IQ are usually thought to be “asymptomatic”, i.e., they do not have symptoms that would be detected in a routine neurological or psychiatric examination.
- However, there is a consistent pattern of more subtle cognitive and psychosocial deficits that have not yet been systematically described.
- These deficits are significant for the person with ACC, helpful for the family to understand, and important to take into account for maximizing educational, work, and life success.

A problem in studying ACC is variability and individual uniqueness: Group performance typically overlaps such that some individuals with ACC do as well as some of the individuals in the comparison group without ACC.

Factors that contribute to variability and individual uniqueness:

- Additional brain disorder (ACC Plus)
- Native (genetic) endowment
- Developmental environment (home, schools, activities, interests)
- Test sensitivity
- Test-taking strategy
- Attention, emotion, fatigue etc. during testing



Thus, we should never take group outcomes as necessarily descriptive a single individual, but rather as trends or likely outcomes.

### II. Motor, Mental and Social Ability in Primary ACC

(What aspects of intelligence are apt to be normal, and which are likely to show some deficiency?)

1. Bimanual Motor Coordination in ACC: How well can individuals with ACC coordinate the activity of the two hands in order to accomplish a bimanual task (like tying a shoe)?

Individuals with ACC are both slower and less accurate in coordinating actions of the two hands to follow prescribed trials on an Etch-a-Sketch

2. Basic Intelligence and Academic Achievement in ACC: Which aspects of intelligence are apt to be normal, and which are likely to show some deficiency?

Summary:

- ACC does not, in itself, produce mental retardation.
- ACC does not necessarily lead to either a verbal disability (significantly low Verbal IQ) or nonverbal disability (significantly low Performance IQ), but the pattern in an individual may in some cases look like either problem.
- Tests involving more complex and novel material are more likely to detect cognitive problems in ACC.
- Information processing speed is reduced in ACC.
- Typically, for adults and adolescents with ACC, reading is not a problem, but complex math is a problem.

3. Tests of Other More Specific Mental Abilities in ACC: What are some of the specific areas of likely cognitive deficiency in individuals with ACC?

Summary

- Problem-solving is more difficult with ACC. Deficits in individuals with ACC increase with more difficult problems.
- Individuals with ACC often have greater difficulty understanding nonliteral language (proverbs, metaphors, & other nonliteral expressions).
- Individuals with ACC can think divergently, but the appropriateness of the outcome is often not considered to be creative.

4. Tests of Social Comprehension in ACC: How do individuals with ACC understand themselves, others, and the complexities of social situations?

Individuals with Primary ACC seem to have a particular problem with these more subtle aspects of social processing.

Summary of Tests of Social Comprehension in ACC

- Less likely to look at the eyes of others in judging emotions.
- Problems imagining an appropriate narrative of events surrounding pictures involving people in social situations.
- Problems selecting congruent, yet surprising and funny endings to jokes and cartoons.
- A diminished ability to imagine the mental life of others (making social inferences).
- Diminished ability to imagine consequences of situations and actions.

Parent Observations of Children with ACC: What characteristics of behavior do parents consistently observe in children with ACC?

Summary

- Observations of behavioral problems increase with age during childhood.
- Problems in the areas of attention, thinking, and social behavior are most frequently observed.
- While kinds of problems overlap with autism to some degree, the problems are not as frequently observed nor as severe as those seen in autism.
- *Absence of restrictive and repetitive behaviors best differentiate ACC from autism.*

### III. A Theory of Cognitive and Social Disability in ACC

The model suggests the following interrelated outcomes (top to bottom) that are consistent with the data presented:

- Diminished interhemispheric transfer of complex information.
- Difficulty in complex, novel problem-solving.
- Diminished social judgment and understanding.
- Diminished imagination and creativity.