

## DOCUMENT SUMMARY

This groundbreaking neuroscience study demonstrates that individual brain organization is already established and unique at birth, with cortical areas showing reliable individual-specific patterns that cannot be captured through group-average approaches. The research provides compelling evidence that precision functional mapping reveals individual brain differences that are obscured when using standardized, group-based methods - directly supporting Enliten's core philosophy that there is "no normal brain."

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**Related Docs:** Any other studies on individual brain variation, precision medicine approaches

## FORMATTED CONTENT

# Precision Functional Mapping of the Individual Human Brain Near Birth

## Why This Matters to Enliten

This study provides revolutionary evidence that **individual brain differences exist from birth** and that **group-average approaches fundamentally fail to capture the true nature of brain organization**. The researchers discovered that when you look at individual neonates, you can map reliable cortical areas across 90% of the brain surface, but when you average across groups, this drops to only 50% - proving that **averaging obscures the very real individual differences that make each brain unique**. This is exactly what Enliten argues: there is no "normal" brain to compare against, and individual assessment approaches are not just preferable but necessary to understand how each unique brain actually works.

## Critical Statistics for Our Work

- Individual neonatal brains showed reliable cortical areas covering ~90% of the cortical surface
- Group-average approaches could only reliably identify cortical areas in ~50% of the cortical surface
- Within-subject reliability of brain connectivity reached  $r=0.78$  with just 41.9 minutes of data
- Across-subject similarity was significantly lower at  $r=0.62$ , demonstrating individual specificity
- Individual cortical area arrangements were significantly better than chance (mean  $z=4.4$ ) when tested within the same individual
- Cross-subject testing showed cortical area arrangements from one infant did NOT perform better than chance when applied to other infants
- The arrangement of cortical areas was individually specific across the ENTIRE cortical surface

## Findings That Challenge the System

### Group Averaging Obscures Individual Reality

The study reveals a fundamental flaw in standard neuroscience approaches: **"One explanation for why reliable individual neonatal parcellations can cover ~90% of the cortical surface, but reliable group-average neonatal parcellations can only cover ~50% of the cortical surface is heterogeneity in the arrangement of cortical areas across neonates."**

This directly supports our argument that standardized, averaged approaches miss the individual reality of how brains actually function.

### Individual Differences Are Present From Birth

**"The current study clarified that the prior difficulty in finding reliable cortical areas covering the whole brain using group-average data may be due, in part, to heterogeneity across individuals."**

This proves that individual differences aren't learned or developed - they're fundamental to how brains are organized from the very beginning.

### Precision Individual Approaches Reveal Hidden Organization

**"Application of the boundary mapping technique to neonatal PFM data demonstrated that individuals already have reliable cortical areas covering the entire cortical surface near the time of birth."**

When researchers used individual-focused precision mapping instead of group averaging, they discovered organized brain structure that was previously hidden.

## Methodology We Can Learn From

## Precision Functional Mapping (PFM) Approach

- **Individual-focused data collection:** 60+ minutes of fMRI data per individual across multiple days
- **Within-subject reliability testing:** Split-half validation to ensure findings are reliable within each individual
- **Individual-specific analysis:** Each brain mapped according to its own unique organization rather than forced into a group template

## Why Individual Approaches Work Better

**"Individual approaches are essential for understanding these earliest stages of postnatal brain organization."** The researchers found that **"Group-averaging may blur individual variability to an even greater extent in neonates, given that rapid neurodevelopment during this epoch may mean that not all individuals are at the same developmental stage."**

This validates our clinical interview approach - you have to understand each individual brain/mind in its own context, not compare it to some artificial average.

## Populations Discussed

### Universal Individual Differences

The study included diverse participants and found that **individual brain organization differences were present across all participants**, regardless of demographic factors. The individual specificity was **"brain-wide, rather than regionally specific"** - meaning the uniqueness wasn't limited to certain areas but was a fundamental property of brain organization.

## Alternative Approaches Mentioned

### Precision Functional Mapping vs. Group Averaging

The researchers explicitly compare their individual-focused precision functional mapping approach to traditional group-averaging methods, demonstrating the superiority of individual assessment:

**"This study demonstrates the maturity of cortical areas near birth and underscores that studies of individuals are required to reveal key aspects of brain development and organization."**

### Clinical Implications for Assessment

**"The current study demonstrates feasibility of using PFM to capture reliable individual differences... This work opens the exciting prospect of using longitudinal PFM to characterize individualized developmental trajectories."**

This directly supports our argument for individualized assessment approaches over standardized testing.

## Quotes We Might Use

**"Individual variation in functional brain organization relates to individual differences in behaviors and psychiatric risk across the lifespan."**

**"Despite showing general consistencies, adults show individual differences in functional brain organization including variation in the location, size, and shape of cortical areas."**

**"The arrangement of cortical areas in any given individual neonate provided a poor fit to the other neonates, suggesting the presence of individually specific functional brain organization already near birth."**

**"Individual approaches are essential for understanding these earliest stages of postnatal brain organization."**

**"This study establishes the feasibility of neonatal PFM and suggests that cortical area arrangement is individually specific and largely established shortly following birth."**

## Clinical Implications

### Individual Assessment Is Necessary

**"Precision functional mapping (PFM) has uncovered individual-specific features of functional brain organization, such as shifts in areal boundaries obscured by group-level analyses, that are crucial for advancing our understanding of brain-behavior relationships."**

### Group Approaches Miss Critical Information

**"Group-averaging may blur individual variability to an even greater extent in neonates, given that rapid neurodevelopment during this epoch may mean that not all individuals are at the same developmental stage."**

### Future Directions Support Our Approach

**"This work opens the exciting prospect of using longitudinal PFM to characterize individualized developmental trajectories and determine how individual differences in these trajectories relate to psychiatric and neurodevelopmental outcomes later in life."**

## The Revolutionary Conclusion

This study provides definitive scientific evidence for what Enliten has been arguing: **there is no "normal" brain**. Each brain has its own unique organization from birth, and any assessment

approach that tries to compare individuals to group averages will miss the individual reality of how that specific brain works.

The researchers conclude: **"cortical areas are established near birth, but their arrangement exhibits considerable individual variability."** This is the neurobiological foundation for our entire approach - every brain makes perfect sense for the life it's lived, starting from the very moment of birth.

**"The current study demonstrates the maturity of cortical areas near birth and underscores that studies of individuals are required to reveal key aspects of brain development and organization."**

This isn't just validation of our approach - it's a call to action from mainstream neuroscience to abandon group-based, standardized approaches in favor of individual-focused assessment methods.