An Exploration of Structural Differences in Comprehension Groups Formed through a Quantitative Method

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Specific Reading Comprehension Disorder (S-RCD) is characterized by poor reading comprehension despite intact decoding ability (Landi & Ryherd, 2017). While this disorder has been studied for over thirty years, no standardized method of classifying individuals with S-RCD has emerged. Most investigations of this population require their S-RCD participants to have a standard reading comprehension score below some criterion as well as a discrepantly high standard decoding score. However, this method creates an artificial dichotomy where individuals with scores close to the cutoff criterion can be treated as qualitatively different. In addition, the specific standardized assessments of comprehension and decoding used for this classification method greatly influence an individual’s group membership (Keenan & Meenan, 2014). To address these weaknesses, some researchers have begun using a regression-based method to select S-RCD and typically-developing (TD) groups (Tong, Deacon, Kirby, Cain, & Parrila, 2011; MacKay, Levesque, & Deacon, 2017). In this method, reading comprehension ability is predicted from lower-level skills, such as nonverbal IQ, word decoding, vocabulary, and phonological awareness. If an individual’s actual comprehension score is much lower than their predicted comprehension score, they are considered to have S-RCD. If their actual comprehension score is similar to their predicted comprehension score, they are classified as TD. Finally, individuals whose actual comprehension scores are higher than predicted are labeled unexpected good comprehenders (UGC). This method increases the separation between groups and more carefully tailors group selection criteria to the individual. Despite these advantages, this method has only been used in a handful of studies and never in a neurobiological investigation. In fact, only one study to date has looked at brain structure in S-RCD at all. This study found that S-RCD individuals showed less gray matter volume than TD participants in right prefrontal regions as well as cerebellum, implicating potential abnormalities in executive function (Bailey, Hoeft, Aboud, & Cutting, 2016).

In the current study, we investigated multiple structural measures in three comprehension groups (S-RCD, TD, UGC) defined using this quantitative method. We predicted reading comprehension score from age, decoding ability, nonverbal IQ and vocabulary. We used a 15% confidence interval around the regression line to define TDs and a 65% confidence interval to define UGC and S-RCD individuals. From an original sample of 172 adolescents (ages 13-25), we selected 20 TD, 22 S-RCD, and 25 UGC individuals. We conducted an exploratory whole-brain analysis comparing gray matter volume and cortical thickness between these groups. We found that TD individuals showed less gray matter volume than UGCs in left superior parietal lobule, a region involved in allocating visual attention (Peyrin, Demonet, N’Guyen-Morel, Le Bas, & Waldois, 2010). Thus, the current investigation is the first to use this classification method to investigate group differences in brain structure, and highlights the importance of studying UGCs in addition to S-RCD individuals to gain a broader perspective on how brain structure is related to reading comprehension ability in individuals with good decoding.