INTRODUCTION
Pediatric patients with medically intractable epilepsy may be candidates for brain resection to control seizures. Patients with temporal lobe seizures are evaluated for language dominance prior to surgery to minimize the risk of post-surgical language disruption. This evaluation includes a neuropsychological testing, and the sodium amytal test, which is an invasive method of assessing language dominance. FMRI correlates well with invasive measures of language dominance in adult epilepsy patients. In this study we have extended the FMRI method for language lateralization proposed by Binder et al. to a population of pediatric epilepsy patients to determine whether hemispheric dominance for language can be adequately assessed in children using FMRI. Additionally, we compare activation patterns observed by FMRI when using auditory versus visual presentation of prompts in a verb generation task. A new method for displaying differences in activation maps has been developed based on a primary-secondary color coding scheme. Composite FMRI language activation maps from the audio and visual paradigms are presented.

MATERIALS AND METHODS
Pediatric epilepsy patients treated at our center were recruited for FMRI studies after informed consent/assent. Twenty patients have participated in the study to-date. All scanning was performed on a GE Signa 1.5 Tesla Horizon system with Echoplanar gradients, using echoplanar imaging techniques, and functional activation maps using cross correlation statistics were created after Talairach transformation of each patient's anatomical and functional data. A silent verb generation paradigm was presented to the subjects via laptop computer screen (visual) or headphones (auditory) over 5 minutes, with 5 cycles of alternating periods of activation (30 seconds) and rest (30 seconds). A time series of 100, EPI gradient-echo images (TR/TE=3000/40 msec) is acquired during the verb generation task. Six 5 mm, parasagittal slices were obtained in each hemisphere with a FOV=22 cm and matrix=64x64 pixels. A language lateralization index is computed based on counting activated pixels in each hemisphere.

RESULTS AND DISCUSSION
Twenty patients aged 8-18 years (mean age = 12.4 years) participated in the study. Fifteen of the patients completed the auditory paradigm. Eleven right-handed patients (73%) showed left hemisphere lateralization (including one patient with confirmed left hemisphere language dominance on sodium amytal testing), one left-handed patient showed left lateralization, and three patients (20%) were non-lateralized. Thirteen of the patients completed the visual paradigm, but seven patients (54%) did not show clear language lateralization (6 right-handed, 1 left-handed), and three patients had lateralization which disagreed with that predicted by handedness. The more equivocal results from the visual paradigm are attributed to less activation overall and relatively strong bilateral activation produced in the occipital lobes by the visual stimulation.

A Talairach composite activation map for 15 subjects undergoing the audio presentation verb generation paradigm is shown below in Figure 1. A Talairach composite activation map for 13 subjects undergoing the visual presentation verb generation paradigm is shown below in Figure 2. A Talairach composite activation map of both audio and visual presentation data has been constructed with audio activation color coded red, video activation coded green, and pixels activated in both paradigms coded yellow. This color coding scheme uses primary colors of light to indicate activation related to each task and the corresponding secondary color to represent overlapping areas of activation. This method displays in an intuitive manner, regions of activation common to both paradigms. Examples of this new color coding scheme for composite FMRI data will be presented.

CONCLUSIONS
Functional MRI is easily applied in pediatric patients to assess patterns of activation and hemispheric dominance of language. FMRI may provide useful information for assessing language dominance in the planning of epilepsy surgery in pediatric patients. Auditory presentation of a simple verb generation paradigm during FMRI yields more consistent language lateralization than visual presentation. Overlapping areas of brain activation from multiple paradigms can be displayed concisely using primary-secondary rainbow color scheme.

REFERENCES

FIGURE 1 - Talairach composite activation maps for 15 pediatric epilepsy patients undergoing an audio presentation verb generation paradigm.

FIGURE 2 - Talairach composite activation maps for 13 pediatric epilepsy patients undergoing an video presentation verb generation paradigm.