Automatic Techniques for Studying Attention-Deficit/Hyperactivity Disorder

**Context**

- **Attention-deficit/hyperactivity disorder** (ADHD) is among the most common childhood psychiatric disorders affecting around 8–12% of the worldwide population.

- According to standard criteria (DSM-IV-TR and ICD-10 diagnostic criteria) ADHD is a neurodevelopmental disease characterized by:
  - **Inattention**
  - **Hyperactivity**
  - **Impulsivity**

- Currently, many research works are devoted to analyze brain alterations related with ADHD.

- Structural neuroimaging studies identifies the brain circuits altered in ADHD.

**Automatic analysis of anatomical differences in ADHD children MRI**

- The ADHD children presented significant volumetric differences in certain structure as the caudate nucleus [1].
- Manual labeling of MRI slices are used, but reproducibility and feasibility of these studies can be questioned.
- **Aim:** automatic techniques to accelerate and make the procedure clinically feasible.

**Brain Caudate Nucleus Segmentation using Graph Cuts**

We propose an automatic segmentation method based on the graph-cuts energy minimization framework [3]. In this framework, an energy function is minimized in order to find the optimal segmentation of the image, using region and context information.

**Main steps of the algorithm:**
2. Define multiple hypothesis of seeds.
3. Apply Graph cut method to refine the segmentation.

**Materials:**
- 40 children/adolescents with ADHD (ages 6–18),
- 40 healthy control subjects matched on age, gender, and handedness.

**Future work:**
- Automatic extraction of shape descriptors.
- Apply to data in the challenge Caudate Segmentation Evaluation 2007 [4].

**Qualitative Results**

**Automatic analysis of behavior in ADHD children**

- **Aim:** Search for behavioral patterns related to ADHD
- Automatically extract behavioral information using Computer Vision and Machine Learning techniques

**Materials (5 hours recorded):**
- 5 children/adolescents with ADHD
- 5 healthy control subjects

**Automatic detection, tracking and analysis of landmarks**
- **Hurrah hardware → general corporal analysis**

**Future Lines**

- Multi-modal analysis combining:
  - Automatic anatomical analysis of MRI structures in combination with behavioral information
  - Generalization of the Segmentation and Behavioral analysis techniques for different health care applications:
    - Automatic angiography segmentation
    - Physiotherapy, rehabilitation, and sports
    - Impatient monitoring
    - Sign language recognition

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5. 3D Segmentation in the Clinic: A Grand Challenge. Bam van Ginneken, Tobias Heimann, Martin Styn (www.cause07.org)