

BAR-ILAN UNIVERSITY

**Brain Lateralization and Cooperation between the Hemispheres
within a Lexical Decision, among Intellectually Disabled without a
Specific Etiology, and amongst those with Down's Syndrome, in
Comparison to Adults with Regular Development**

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**Submitted in partial fulfillment of the requirements for the Master's
Degree in the School of Education, Bar-Ilan University**

Ramat Gan, Israel

2017

Abstract

The goal of the present research was to test the brain lateralization and the hemispheric cooperation amongst adults with intellectual disability and no specific etiology (NSID) ($N = 18$, $MA = 69.11$, $CA = 34.38$), and adults with down's syndrome (DS) ($N = 12$, $MA = 65.16$, $CA = 33.16$), compared to adults with regular development ($N = 30$, $MA = 101.96$, $CA = 33.83$). The research included two trials of lexical decision-making, where each subject was asked to decide whether the presented word exists in the language or not. The first trial was conducted in a divided visual field paradigm, and examined the brain lateralization. The hemisphere that shows faster response times and higher levels of accuracy than the opposite hemisphere is the one that specializes in language processing. The second trial was conducted in a bilateral visual field paradigm, and examined the hemispheric cooperation. According to this paradigm, words are presented to both hemispheres at the same time. Faster and more accurate responses in the bilateral state, in comparison with the divided visual field word-presentation, are called the bilateral gap, and they testify to the hemispheric cooperation. The words in the trial were presented at a speed of 180 milliseconds. This is fast for subjects with intellectual disability, which is why a gradual training program was developed for their benefit. It's important to note that the current trial was conducted among adults with NSID and with DS for the first time.

The research hypothesis stated that adults with NSID and with DS will show an atypical lateralization in their lexical decision-making. Also, it was speculated that both groups with intellectual disability will show a smaller bilateral advantage compared to adults with regular development.

The trial results indicate a typical lateralization amongst adults with NSID and with DS in the variable of response times, where all the subjects showed faster response times for the left hemisphere, compared with the right hemisphere. In the variable of accuracy percentage, the adults with NSID and with DS showed higher percentages of accuracy when the word was presented to the left hemisphere, compared with the right hemisphere, as opposed to the adults with the regular development, who had a "ceiling effect" and did not show any differences between the accuracy percentages in the hemispheres. This result is quite surprising, since according to neuroanatomical

research, we speculated that subjects with intellectual disability will show atypical lateralization.

One of the explanations is the use of the visual channel. Meaning, this channel was found to be more preserved in these populations in working memory research (Lifshitz, Kilberg, & Vakil, 2016), as opposed to the use of the auditory channel. Another explanation, which may contribute to the understanding of the typical lateralization, is the training program the subjects underwent. Past research showed equality in visual memory achievements amongst adults with intellectual disability and adults with regular development, only if the subjects with intellectual disability underwent training (Lifshitz, et al., 2016).

In addition, the bilateral gap in the response times variable was present in all groups. Meaning, all the subjects showed faster response times when the words were presented in the bilateral state compared to word presentation to the left visual field, i.e. the right hemisphere. However, in the accuracy percentages variable, the group of adults with NSID and with DS showed a bilateral advantage compared with the word presentation to the right hemisphere alone. Meaning, the accuracy percentages in the bilateral state were high in comparison with the accuracy percentages in the left visual field. This means that the right hemisphere, as opposed to the left hemisphere, uses the opposite hemisphere (the left one) for language processing. There was no brain lateralization or gap in the bilateral presentation in the group of adults with regular development. This group showed a higher level of accuracy in both hemispheres, which is why there were no distinct differences in the brain lateralization or the hemispheric cooperation.

In conclusion, adults with NSID and with DS show a typical lateralization and appropriate hemispheric cooperation in language processing. In addition, their response times were fast, similarly to adults with regular development. It may be that these findings are due to the use of the visual channel, which is known to be preserved in these population. The current research points to the great importance of training and its contribution to the success completion of the task. The educational recommendation is to develop intervention programs, which rely upon the visual channel, in order to improve and nurture the linguistic skills.