



# The McGurk Effect in Dyslexic and Normal-Reading Children: An Experimental Study

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## Abstract

The McGurk effect was investigated in a group of ten-year-old dyslexic children and in two control groups of normal readers. Audio and audiovisual stimuli were presented in silence or with a masking noise. The results indicated no significant differences between the three groups for the auditory stimuli. For the audiovisual stimuli, the dyslexic group showed fewer illusory percepts than the group of same-age normal readers but performed similarly to the group with the same reading level.

**Index Terms:** McGurk effect, dyslexics, reading age, speech perception, speech reading

## 1. Introduction

The aim of this study was to find out whether audiovisual integration works in the same way in dyslexic and normal-reading children. Based on the fact that the way people interpret conflicting audiovisual speech stimuli provides insight into audiovisual integration, we used a McGurk paradigm to assess the level of audiovisual integration in three groups of children: one dyslexic group and two control groups.

## 2. Methods

### 2.1. Participants

The dyslexic group (DYS) consisted of 12 children (mean age 119.8 months; reading age 90.5 months) and included 8 males and 4 females with developmental dyslexia. The first control group contained 12 children (3 males, 9 females) of the same chronological age (CA) (mean 199.9 months) as the DYS group; the second contained 12 children, 6 males and 6 females (mean age 83.3) of the same reading age (RA) (92.7) as the DYS group. Reading age was assessed using the reading and deciphering items of a standardized battery (Kaufman & Kaufman, 1993). All participants had normal vision and no known hearing deficit.<sup>1</sup>

### 2.2. Procedure and Materials

The audio stimuli (A) were of the /aCa/ type, where C was /p/, /t/, or /k/, said by a young woman. They were recorded digitally in our soundproof room. The visual stimuli (V) were taken from numerical recordings of the lower part of the young woman's face as she pronounced the auditory stimuli. These stimuli were combined to produce coherent (e.g., /apa/√ + /apa/√) or conflicting (/apa/√ + /aka/√) audiovisual stimuli for use in the experiment. All stimuli had a duration of

350 ms. This set of stimuli was chosen because it could generate illusory percepts. Other VCV stimuli like /oto/ or /aki/ were used to familiarize the subjects with the task.

The stimuli were presented via a personal computer. The video part was displayed on a 13" screen located 35 cm in front of the subject; the audio part was presented through two loudspeakers at a normal speech level (60 dB RMS).

Three types of stimuli were presented: audiovisual stimuli, their audio components, and their video components. The auditory and visual components were presented alone for comparison. The audiovisual and the audio-only stimuli were presented in three listening conditions: silent, with a signal/noise ratio of 0 dB, and with a signal/noise ratio of -12 dB. The masking noise was a white noise.

The participants' task was to identify the stimuli presented. For the audiovisual and audio stimuli, they were instructed to respond orally by repeating aloud what the speaker had said. For the visual stimuli, they were told to guess what the speaker had said. The participants' oral answers were written down by an experimenter and also tape-recorded for later checking if necessary.

## 3. Results

The data obtained were analyzed in various ANOVAs, which gave the following results.

*Auditory-only condition.* There was no significant difference between the three groups. The stimulus factor had a highly significant effect, with 61% correct identifications (CI) for /aka/, 58% for /ata/, but only 36% for /apa/ ( $F_{2,66} = 9.1$ ,  $p < .0005$ ). Background noise also had a highly significant effect ( $p < .0001$ ), with a CI rate of 83% in the silent condition, 38% in 0 dB, and 32% in -12 dB.

*Visual-only condition.* The group factor had a significant effect ( $F_{2,33} = 8.2$ ,  $p < .005$ ). Group CA outperformed (71% CI) groups DYS (41%) and RA (47%), which did not differ significantly. The /apa/ viseme was identified better (72%) than /ata/ (46%) and /aka/ (40%), with no significant differences between groups.

*Audiovisual condition.* In this condition, the noise and stimulus factors had main effects for coherent stimuli. The more intense the noise, the lower the correct identification rate. The stimulus identified the best was /apa/ (81%), followed by /ata/ (69%), and then /aka/ (59%). While the three groups performed equally well in the silent condition, groups DYS and RA were more disturbed by noise than group CA. For conflicting stimuli, the three groups were not significantly different. The noise factor had an effect on the number of illusory percepts, which was higher in noisy conditions than in silence. Stimulus /aka/√ + /apa/√ produced

the largest number of illusions in the three groups, and was the only one to produce illusions in group DYS, especially in noisy conditions.

#### **4. Discussion**

For the auditory task, we did not find any significant differences between the three groups, and stimulus /apa/ was the least well identified. Background noise reduced the level of correct identification for all three groups. Thus, the DYS group did not differ from the other two groups in its auditory performance. For the visual task, group CA performed better than the other two groups. In all three groups, the viseme /apa/ was identified better than the other two visemes, which is consistent with the fact that bilabial consonants carry salient visual information.

These results showed that the dyslexic group had fewer illusory percepts than did the group of the same chronological age, but did not really perform differently from their reading control group. This study suggests that dyslexic children merely exhibit a developmental lag and that reading level may be linked to audiovisual integration. This last point could be investigated in future research.

#### **5. References**

- [1] Kauffman, A.S., & Kauffman, N.L. (1993). *K-Abc, batterie pour l'examen psychologique de l'enfant*. Paris : Editions du Centre de Psychologie Appliquée.
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<sup>i</sup> This research complies with the bio-ethical rules in use in France for experiments with human beings.