METHODS

Subjects

12 volunteers (3 females) right-handed or ambidextrous mean age 29.3 (+/- 4.2) years

1) six "late" bilinguals who were exposed to a second language in early adulthood

   mean age of initial exposure: 11.2 (+/-1.5) years
   mean age of acquisition (as measured by conversational fluency): 19.2 (+/-4.1) years

   "Each of the 'late' bilingual subjects had lived in the country of the second language...." (p. 174)

2) six "early" bilinguals who were exposed to their two languages in infancy

   "Each of the early bilinguals was raised in a home where either the parents spoke one language and siblings and friends spoke another, or the parents spoke two languages." (p. 174)

   "All subjects reported approximately equal fluency and frequent usage in each language at the time of testing." (p. 174)

=> 10 languages represented altogether (!) (see Table 1)

Task

Subjects were instructed to use silent, internal speech to "describe" events that occurred during a specified period of the previous day (morning, afternoon, or night)

Procedure

Before each run, subject instructed which language to imagine speaking
Graphic cues for morning, afternoon, and night displayed in various orders for 10 seconds during the 30-second task
Languages alternated during imaging to prevent habituation

RESULTS

Late bilinguals:

Broca’s area (inferior frontal gyrus)

   distinct (but adjacent) areas of activation for the native and second
languages
mean distance between centers 6.43 (+/-1.83) mm

Wernicke’s area (superior temporal gyrus)
overlapping areas of activation
mean distance between centers 1.88 (+/-0.62) mm

Early bilinguals:

Broca’s area (inferior frontal gyrus)
overlapping areas of activation for the two languages
mean distance between centers 1.53 (+/-0.78) mm

Wernicke’s area (superior temporal gyrus, supramarginal gyrus)
overlapping areas of activation
mean distance between centers 1.58 (+/-0.79) mm

DISCUSSION

Anatomical separation of centers in Broca’s area varies with time of acquisition; this suggests that age of acquisition is a significant factor in organization of Broca’s

"It is possible that representations of languages in Broca’s area that are developed by exposure early in life are not subsequently modified. This could necessitate the utilization of adjacent cortical areas for the second language learned as an adult." (p. 173)

The difference between this and the Klein PET results showing overlapping regions of activation in Broca’s area (inferior frontal gyrus) may be due to:

a) differences in imaging technique: fMRI has higher resolution
b) differences in age of acquisition: mean age of initial exposure to L2 7.3 years in PET study