Previous bilingual studies showed reduced hemispheric asymmetry in visual tasks such as face perception in bilinguals compared with monolinguals, suggesting experience in reading one or two languages could be a modulating factor. Here we examined whether difference in hemispheric asymmetry in visual tasks can also be observed in bilinguals who have different language backgrounds. We compared the behavior of three language groups in a tachistoscopic English word sequential matching task: English monolinguals (or alphabetic monolinguals, A-Ms), bilinguals with an alphabetic-L1 and English-L2 (alphabetic-alphabetic bilinguals, AA-Bs), and bilinguals with Chinese-L1 and English-L2 (logographic-alphabetic bilinguals, LA-Bs). The results showed that AA-Bs had a stronger right visual field/ left hemispheric (LH) advantage than A-Ms and LA-Bs, suggesting that different language learning experiences can influence how visual words are processed in the brain. In addition, we showed that this effect could be accounted for by a computational model that implements a theory of hemispheric asymmetry in perception (i.e. the Double Filtering by Frequency theory, Ivry & Robertson, 1998); the modeling data suggested that this difference may be due to both the difference in participants’ vocabulary size and the difference in word-to-sound mapping between alphabetic and logographic languages.