Speech Recognition Performances of Early and Late Turkish-German Bilinguals

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Abstract

Turkish is the 16th most spoken language in the world, with approximately 83 million users. Today, based on social reasons, bilingualism and multilingualism are prevalent. Similarly, studies on bilingualism or multilingualism in literature have been increasing. This study aims to show the preliminary results of the Turkish word recognition performance of Turks (Turkish-German bilinguals) living in Germany. In this study, 60 early and late bilingual subjects whose ages ranged from 18 to 65 years old were tested. Speech recognition test material consisted of 120 three-syllabic Turkish words recorded on CD which were played to the bilingual individuals using an IBM 386sx personal computer, Westra Audiometer CAD- 03, and sound insulated room per Industrial Acoustics Company (IAC) standards. The individuals were asked to repeat the Turkish words they listened to. The words were recorded by the author in the way they had been repeated by the individuals. The results were assessed per percentages of word recognition. Turkish-German early bilinguals performed more poorly than late bilinguals in terms of word recognition. This finding indicates that bilingualism may affect early bilinguals' word recognition performance in terms of auditory processing. It was observed in the literature that bilingual children lag behind their monolingual peers in terms of both vocabulary and grammatical development. The findings in this study are consistent with those studies. More studies are needed for bilingual individuals.
Keywords: bilingualism, language, word recognition, speech recognition

Erken ve Geç Türkçe- Almanca Bilinguallerde Konuşmayı Tanıma Performansı
Öz
Türkçe, yaklaşık 83 milyon konuşanı ile dünyada en çok konuşulan 16. dildir. Günümüzde toplumsal nedenlere dayalı iki dillilik veya çok dillilik yaygındır. Benzer şekilde, konu ile ilgili alınyazında yapılan çalışmaların sayısı da artmaktadır. Bu çalışmanın amacı Almanya'da yaşayan Türklerin (Türkçe-Almanca iki dillilerin) Türkçe sözcük tanıma performansının preliminer sonuçlarını sunmaktır. Bu çalışmada, yaşları 18-65 arasında değişen 60 erken ve geç iki dilli bireyler dâhil edilmiştir. Konuşmayı Tanıma Testi materyali 120 adet üç heceli Türkçe sözcükten oluşmaktadır ve IBM 386sx kişisel bilgisayar, Westra Odyometre CAD- 03 ve Industrial Acoustics Company (IAC) standartlarında sesten arındırılmış odada kayıtlı ses olarak CD'den iki dilli bireylere kulaklıklar ile dinletilmiştir. Bireylerden işitsel olarak dinledikleri sözcükleri tekrar etmeleri istenmiştir. Tekrar ettiği sözcükler çalışmayı yapan yazar tarafından tekrar edildiği şekilde kayıt formuna el ile kaydedilmiştir. Elde edilen sonuçlar sözcüğü ayırt etme yüzdesi olarak değerlendirilmiştir. Türkçe-Almanca erken iki dilli, geç ikidilli bireylere göre sözcük tanıma performansı açısından daha kötü performans göstermiştir. Bu bulgu, erken iki dillilerin işitsel işlemleme boyutunda sözcük tanıma performansını etkileyebileceğini göstermiştir. Literatürde, iki dilli çocukların iki farklı dilleri için de ayrı ayrı tek dilli akranları ile karşılaştırıldıklarında hem sözcük bilgisi hem de dil bilgisel gelişim hızı açısından tek dilli akranlarına kıyasla daha geride oldukları görülmüştür. Çalışmamızda literatür ile uyumlu bulgular göstermektedir. İkidilli bireyler için daha fazla çalışma yapılmasına ihtiyaç duyulmaktadır.
Anahtar Kelimeler: bilingualizm, dil, sözcük tanıma, konuşma tanıma

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Introduction

German is the official language in schools, governmental agencies, and is used for formal communication in Germany. However, Turkish-German bilingual individuals use their mother tongue in informal communication. Turkish is the largest language of the Turkish language family (25 written and several non-written languages; Menz, 2011), with almost 83 million native speakers (Göksel & Kerslake, 2005; Menz, 2011; Lewis et al., 2014). It is spoken predominantly in the Turkish Republic, in European countries (nearly four million people), Australia, and North America (Göksel & Kerslake, 2005). In Germany, for example, Turkish is the most important immigrant language, with about two million speakers (Lewis et al., 2014).

Few studies have investigated the speech recognition performances of individuals who have learned two languages in early or late childhood and are competent in both languages (Rogers et al., 2006). Speech recognition tests are used to evaluate listeners' auditory capacity and speech in daily life. Speech recognition tests are developed only for monolingual use. Rogers et al. (2006) used monosyllabic words to evaluate the performance of 15 monolingual English listeners and 12 relatively early bilingual Spanish-English listeners (onset of English immersion by age 6). They found similar word-recognition performance in both groups in the quiet environment and poorer performance in bilingual listeners in the reverberant and noisy environment. Using the English and Spanish versions of the hearing-in noise test (HINT), Weiss and Dempsey (2008) compared the performance of Spanish-English listeners in each version of the test. They found that bilingual Spanish-English listeners showed lower speech recognition scores for the Spanish version than for the English version. Although studies showed the speech recognition abilities of bilingual subjects (Cutler et al., 2008; Golestani et al., 2009; Shi & Sanchez, 2010; van Engen, 2010), differences in language and culture led to differences in the performance of bilingual populations, necessitating further studies.

The present study shows preliminary results of bilingual individuals who speak Turkish and German bilingually. In terms of linguistic proficiency gains, bilinguals are classified as early and late. Early bilingualism is divided into two as simultaneous and sequential. Late bilingualism is defined as the acquisition of a second language sequentially after the age of eight, and in this classification, the second language is not accepted as a native language (Moradi, 2014). This study was conducted with Turkish-German early sequential bilingual individuals who learned their first and second languages in childhood but not at the same time. The Turkish version of a speech recognition test developed by Cevanşir (Şahin Kamışlı & Kemaloğlu, 2022) was utilized to examine the word recognition performance of Turkish-German bilinguals.

Method

Research Design

This study is quantitative and used a non-experimental, causal-comparative research design in which the researcher sought to identify whether there was a difference in Turkish speech recognition test percentage scores between early and late Turkish-German bilinguals. The independent variable was the multi-syllable word material of the Turkish speech recognition test.

Sample/Research Group

The sample consisted of 60 Turkish-German early and late bilinguals who were residents of Germany and visited Türkiye during their holidays. The G*Power program was used to determine the sample size with 95% confidence (1-α), 95% test power (1-β), and d=0.5 effect size.

A total of 60 late Turkish-German bilinguals took part in this study. They had been intensively exposed to German when they immigrated to Germany; their ages ranged from 26-63 (mean 38.9 ± 12.07). Early sequential bilinguals were born in Germany whose ages ranged from 18-24 (mean 19.06 ± 3.24). Education levels of the participants ranged from secondary school to high school (years of education = 13.96; SD = 3.59). The age and socioeconomic status (SES) of both groups were şimilar. All subjects completed health and language history questionnaires with self-ratings of speaking, listening, reading, and writing skills which included the criteria left-handedness, history of speech,

language, hearing, or uncorrected visual deficits, proficiency or prolonged exposure to languages other than the tested Turkish or German and medical history (e.g., seizures, head injury and anoxia) (Figure 1).
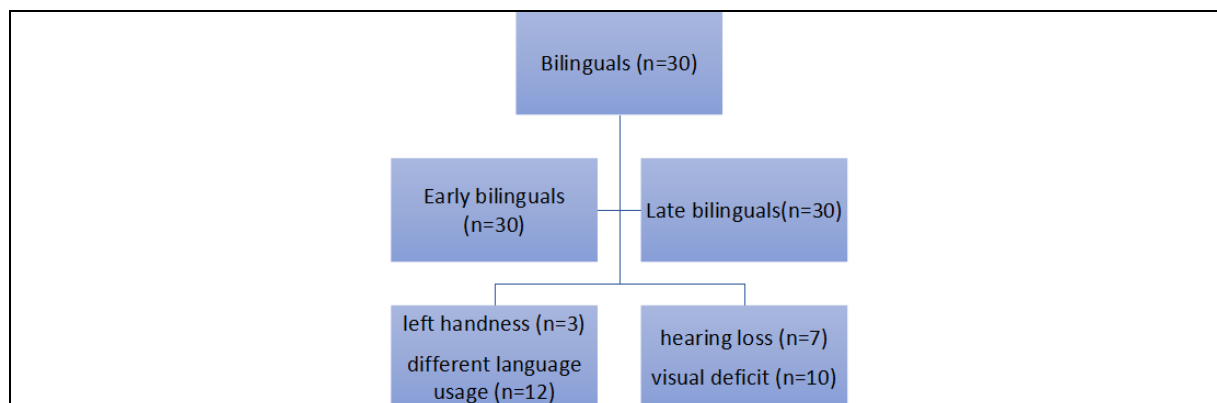

Figure 1. Participants of this study

All participants declared themselves to be very fluent in both listening and reading in the two languages, and they passed a hearing screening at 30 dB HL for the frequencies 250 Hz through 6000 Hz (Table 1). The participants signed written consent forms approved by the Institutional Review Board (24.11.2022-07-2022/19) of the author's institution.

Table 1.
Demographic features of individuals

	Female	Male	Mean age (year)	Duration of stay (year)
Early bilinguals	14 f	16 m	19.06 ± 3.24	18.16± 3.65
Late bilinguals	15 f	15 m	38.9 ± 12.07	21.43±10.2
Total	29 f	31 m	29.01±13.21	19.08±7.91

Data Collection Tools

The speech recognition test material consisted of 120 three-syllabic Turkish words (Appendix 1). The words were spoken by a female Turkish native speaker and recorded on CD in the Bavaria Radio Studios in Munich, Germany, and analyzed using the "cool edit pro version 2" software with linear time base procedure spectrographically. Fast Fourier frequency analysis graphics examined the Blackman-Harris window with the FFT size 16384, and an equal RMS (Root Mean Square) order listing was used. The speech recognition test was conducted with the CD, an IBM 386sx personal computer, and the Westra Audiometer CAD-03 in an Industrial Acoustics Company (IAC) standard sound-insulated room. The optimal duration between words was 5 seconds. The words in SRT varied in six groups but each group had 20 words. The test was administered at a 60 dB Sound Pressure Level (SPL) in a single session, and subjects had to repeat the words after they listened to them. The participants were instructed to face the loudspeaker at 0º azimuth during the stimuli presentation.

Data Collection Procedure

Following the approval of the Ethics Committee (reference no: 24.11.2022-07-2022/19), the study was carried out per the ethical principles of the Helsinki Declaration. All participants were admitted to the audiology clinic of a City Hospital in Türkiye. The participants were informed about this study and signed the consent forms. Each participant underwent an ear examination by an ENT physician before speech recognition testing.

Data Analysis

Statistical analysis was performed using SPSS 21.0; Mann-Whitney U Test was conducted to investigate the word recognition performance of the groups. The subjects' responses were recorded as percentages. The chi-square independent sample t-test and Fisher's exact test were also used to investigate the homogeneity of gender, age, and education level, respectively. These tests showed no difference between the early and late bilingual groups in terms of gender (p 0.421), age (p 0.112), and education level (p 0.223).

Declaration of Ethical Code

In this study, the authors undertake that they comply with all the rules within the scope of the "Higher Education Institutions Scientific Research and Publication Ethics Directive" and that they do not take any of the actions under the heading "Actions Contrary to Scientific Research and Publication Ethics" of the relevant directive.

Ethics Committee Approval

Committee: This study was approved by the Tarsus University of Committee of Noninvasive Experimental Research, Tarsus- Mersin.

Date of Approval: 24.11.2022

Approval Number: 2022/19

Findings

The average age for language learning for the early bilingual group was 5.42 years (sd: 2.81). Early bilinguals learned their mother tongue in Germany. The average age for language learning for the late bilingual group was 12.22 years (sd: 1.93). Late bilinguals learned their mother tongue in Türkiye. All individuals participating in the study were right-handed. Table 2 below presents the six early and late bilingual groups' means, standard deviations, Mann-Whitney U test results (z values), and p-values. The mean word recognition percentage for early bilinguals' speech recognition score was 94.5% ± 5.14. For late bilinguals, it was 97.8% ± 2.84, as shown in Figure 2 below. The differences between the early and late bilingual groups in the six speech recognition test word lists were calculated through the Mann-Whitney U test. The difference was statistically significant in the second speech recognition test word list ($p< 0.05$). The difference in the other speech recognition test word list was not statistically significant ($p> 0.05$).

Table 2.

Speech recognition test score means and z values among word groups

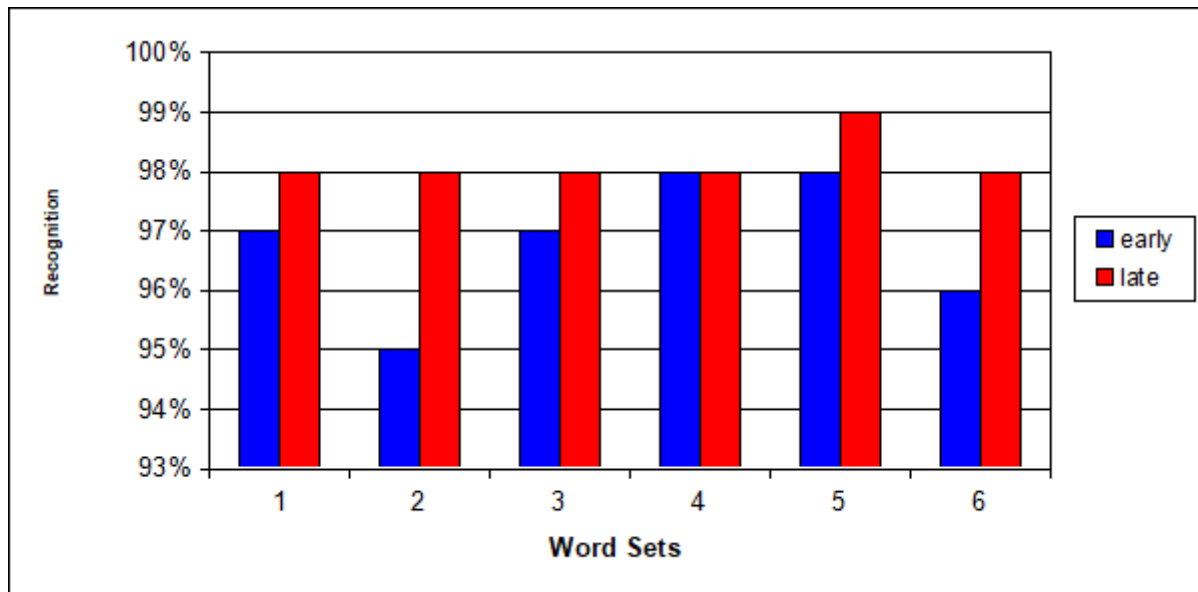| Word list | means (%) p- and z values | | | |
	Early Bilinguals	Late Bilinguals	z value	p-value
1	97	98	-.248	0.804
2	95	97	-3.03	0.02
3	97	98	-.135	0.892
4	98	98	-.674	0.5
5	98	99	-1.301	0.193
6	96	98	-1.329	0.184

Figure 2. Mean speech recognition test scores among word sets

Results and Discussion

Early bilinguals performed equally in Turkish speech recognition performance in quiet compared with late bilinguals. Recent studies (Crandell & Smaldino, 1996; von Hapsburg et al., 2004; Mayo et al., 1997; Rogers et al., 2006) also report the same finding for both groups of bilinguals. According to Stuart et al. (2010) and Zhang et al. (2011), English monolingual-speaking individuals perform significantly better than bilingual individuals. Stuart et al. (2010) ascribe the poorer performance of the late bilinguals to the age of second language acquisition which was between 10 and 13 years of age. The early bilinguals acquired the second language earlier, and the more they used the second language, the better their performance became in perceiving the second language.

Speech recognition testing is most affected by bilingualism because tests are language-based. In clinical practice with bilinguals, it is often observed that the measured speech recognition performance does not match auditory performance (Gat & Keith, 1978). Neurophysiological studies have shown that bilingualism could provoke central auditory processing and make it highly efficient in challenging listening conditions (Sharifinik et al., 2021).

Phonological performance in speech recognition is an important criterion when evaluating bilingual populations. Recent studies indicate that early bilinguals' speech patterns differ from the speech patterns of their monolingual peers. Wrembel et al. (2016) found in their analysis of the background factors that the degree of cross-linguistics influence in the speech of early Polish-English bilinguals depended on the quantity and quality of the late bilinguals' input.

No significant recognition differences were found regarding late bilinguals, but for early bilinguals, lower scores were obtained for the second word set. These findings may be due to the fact that many words in the second set included the Turkish phoneme /ɯ/ which does not exist in German. This language-specific characteristic may have played a role in word recognition in this bilingual population.

The findings indicate that bilingualism does not considerably affect speech recognition test material in early bilinguals although some modifications would be useful. The speech recognition threshold test material for late bilinguals doesn't need to be changed.

The Turkish-German early bilinguals in this study performed more poorly than late bilinguals. This finding indicates that bilingualism may affect word recognition performance in early bilinguals. In this ongoing study, the Turkish speech recognition test materials should include phonological and morpho-syntactic features to identify bilingual speech recognition mechanisms in Turkish- German languages.

Declaration of Ethical Code

In this study, the authors undertake that they comply with all the rules within the scope of the "Higher Education Institutions Scientific Research and Publication Ethics Directive" and that they do not take any of the actions under the heading "Actions Contrary to Scientific Research and Publication Ethics" of the relevant directive.

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Authors Contribution

I have participated sufficiently in the conception and design of this work or the analysis and interpretation of the data, as well as the writing of the manuscript, to take public responsibility for it. I believe the manuscript represents valid work. I have reviewed the final version, and I approve it for publication. Neither this manuscript nor one with substantially similar content under my authorship has been published or is being considered for publication elsewhere, except as may be described in an attachment to this statement.

Conflicts of Interest

No conflict of interest was declared by the author.

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Appendix

Appendix-1. Turkish Speech Recognition Test Form

Name-Surname:	Date of Exam:
Date of Birth:	Clinician:
Address:	Duration of stay:
Telephone:	

Set 1	
Harita	
Aracı	
Pusula	
Telefon	
Sekreter	
Yasama	
Ağustos	
Unite	
Danışma	
Arkadaş	
Kızılcık	
Tabaka	
Kıvırcık	
Sürekli	
Sandalye	
Ihlamur	
Öneri	
Harita	
Denetim	
Kelime	
Set 2	
Hatıra	
Fotoğraf	

Hediye	
Tebeşir	
Hemşire	
Havadar	
Paskalya	
Parmaklık	
Korkulu	
Satılık	
Kapalı	
Marmara	
Güvercin	
Kıvılcım	
Fabrika	
Aralık	
Karanfil	
Pastane	
Domates	
Süpürge	
Set 3	
Merdiven	
Sıradağ	
Asansör	
Coğrafya	
Dokuma	
Halıcı	
Sonbahar	
Kaymaklı	
Köstebek	
Cevizli	
Indirim	
Fıstıklı	
Tarafsız	
Kaplıca	
Çiçekli	
Akarsu	
Kanarya	
Çankırı	
Şikayet	
Karavan	
Set 4	
Sinema	
Tükenmez	
Salıncak	
Oduncu	
İşitme	
Sarıyer	
Limonlu	
Adana	
Değerli	
Çilingir	
Yakacak	
Dönemeç	
Çaydanlık	
Tüketim	
Otobüs	

Harabe	
Tabure	
Tutacak	
Gemici	
Eflatun	

Set 5	
Şekerli	
Kafadar	
Yükseklik	
Kiracı	
Kaçamak	
Aydınlık	
Boyalı	
Yoğurtlu	
Hastalık	
Demirci	
Kulaklık	
Okyanus	
Üretim	
Serinlik	
Postacı	
Dağıtım	
Köstebek	
Eczane	
Kanepe	
Haziran	

Set 6	
Harika	
Bayraklı	
Hamarat	
Hünerli	
Yasemin	
Kolonya	
Karanlık	
Badana	
Elbise	
Kızamık	
Papatya	
Yiyecek	
Kıymetli	
Cesaret	
Kahveci	
Begonya	
Beceri	
Öğrenci	
Hastane	
Lokanta	