New speech intelligibility tests for Spanish and Russian

A. Warzybok, S. Hochmuth, M. Zokoll-van der Laan, B. Kollmeier

Medical Physics, University Oldenburg

E-mail: sabine.hochmuth@uni-oldenburg.de, a.warzybok@uni-oldenburg.de

The HurDig project is aimed at development of speech intelligibility tests in noise for different languages to establish minimum requirements in speech audiometry, to reach highest comparability across different countries, and to implement tests on common measurement platform. This study focuses on the development of the Matrix Test and the Digit Triplet Test for the Spanish and Russian languages. Tests described here were created on the basis of previously developed European speech intelligibility tests (1,2,3,4).

MATRIX TEST

A matrix test is a sentence test based on semantically unpredictable utterances of a fixed grammatical structure (*name, verb, numeral, adjective, noun*). The sentences are composed on the basis of a 50-word base matrix. Since each word is available as a separate wav file, it is possible to generate different sentences by juxtaposing randomly selected words taken from a base matrix.

The Spanish and Russian Matrix Test development consists of several stages: a selection of words for a base matrix, recording, preparation of speech signals and masker, measurements of word-specific intelligibility functions, and optimization. During measurements the speech signals were presented to subjects against a babble noise at different signal-to-noise ratios (SNR) and speech reception threshold (SRT), i.e. SNR providing 50%- speech intelligibility and S_{50}, the slope of an intelligibility function at the SRT point were determined. Table 1 and 2 contains the base matrix for the Spanish and Russian Matrix Test, respectively. Median SRT and S_{50} for the Spanish and Russian Matrix Test are shown in Table3.

name	verb	numeral	object	adjective
Claudia	tiene *(has)*	dos *(two)*	libros *(books)*	grandes *(big)*
Carmen	hace *(makes)*	tres *(three)*	barcos *(ships)*	viejos *(old)*
Elena	toma *(takes)*	doce *(twelve)*	platos *(plates)*	nuevos *(new)*
Teresa	busca *(searches)*	siete *(seven)*	regalos *(presents)*	pequeños *(small)*
Josefa	quiere *(would like)*	seis *(six)*	guantes *(gloves)*	enormes *(colossal)*
José	compra *(buys)*	diez *(ten)*	zapatos *(shoes)*	azules *(blue)*
Antonio	pinta *(paints)*	cuatro *(four)*	juegos *(games)*	bellos *(nice)*
Carlos	mira *(sees)*	veinte *(twenty)*	dados *(dice)*	lindos *(pretty)*
Pedro	pierde *(looses)*	ocho *(eight)*	sillones *(armchairs)*	baratos *(cheap)*
Manuel	vende *(sells)*	mil *(thousand)*	anillos *(rings)*	negros *(black)*

Table 1: The 50-word base matrix for the spanish language

median SRT [dB SNR]	interquartale range	median slope [%/dB]	interquartale range
-10,3	-11,9 to -8,4	16,72	13,21 to 20,53
-9,6	-11,3 to -7,4	12,6	9,6 to 19,0

Table 2: The 50-word base matrix for the russian language

name	verb	numeral	adjective	object
Саша *(Sascha)*	ищет *(looks for)*	Пять *(five)*	больших *(big)*	фильмов *(movies/films)*
Павел *(Paul)*	хочет *(wants)*	Девять *(nine)*	главных *(main)*	улиц *(streets)*
Пётр *(Peter)*	Видит *(sees)*	десять *(ten)*	старых *(old)*	книг *(books)*
Коля *(Kolya)*	Даёт *(gives)*	мало *(a few)*	нужных *(necessary)*	шаров *(spheres)*
Иван *(Ivan)*	делает *(makes)*	много *(many)*	чужих *(foreign)*	газет *(newspapers)*
Юрий *(Yurij)*	любит *(likes)*	семь *(seven)*	целых *(entire/full)*	рядов *(rows)*
Анна *(Anne)*	найдёт *(will find)*	сто *(hundred)*	разных *(different)*	комнат *(rooms/enclosures)*
Лена *(Lyena)*	помнит *(will remember)*	восемь *(eight)*	серых *(gray)*	часов *(clocks)*
Я'на *(Yana)*	берёт *(takes)*	шесть *(six)*	лучших *(better)*	залов *(halls)*
Мария *(Marie)*	купит *(will buy)*	Двести *(two hundred)*	красных *(red)*	марок *(stamps)*

Table 3: Median SRT and S_{50} for the Spanish and Russian Matrix Test before optimization

DIGIT TRIPLET TEST

The digit triplet test is an auditory screening test for speech intelligibility measurement via telephone or Internet. The test comprises digit triplets*;* complexes of three digits that are spoken separately. Speech material is presented against a background noise.

The development of the digit triplet test for the Spanish and Russian languages contained exactly the same steps like for the matrix test. Test specific SRT and S_{50} before and after optimization for both tests are presented in Table 4.

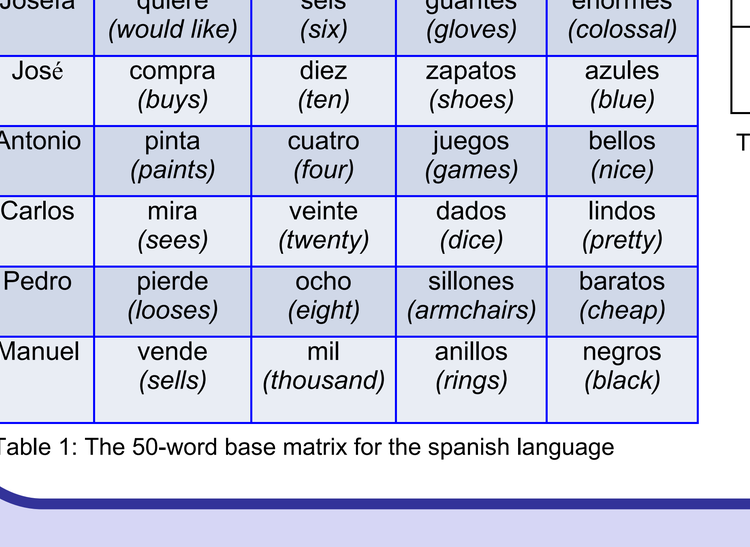

Figure 1: Digit-specific intelligibility functions before and after optimization for the Spanish Digit Triplet Test (averaged across position in a triplet)

	mean SRT [dB SNR]	SD [dB]	mean S_{50word} [%/dB]	SD [dB]	S_{50test} [%/dB]
The Spanish Digit Triplet Test					
before optimization	-13,4	1,9	24,1	0,06	15,7
after optimization	-13,3	0,26	24,1	0,06	23,7
The Russian Digit Triplet Test					
before optimization	-13,2	2,3	15,0	0,04	11,0
after optimization	-13,0	0,9	15,0	0,04	14,0

Table 4: Mean SRT and S50 before and after optimization for the Spanish and Russian Digit Triplet Test

Figure 2: Digit-specific intelligibility functions before and after optimization for the Russian Digit Triplet Test (averaged across position in a triplet)

1. Smits, C., Kapteyn,T. & Houtgast, T. 2004. Development and validation of an automatic speech-in-noise screening test by telephone. *Int J Audiol*, 43, 15-28.

2. Wagener, K., Brand. T & Kollmeier. B. 1999a. Development and evaluation of a German sentence test I: Design of the Oldenburg sentence test. *Z Audiol,* 38, 4-15.

3. Wagener, K., Brand. T & Kollmeier. B. 1999b. Development and evaluation of a German sentence test II: Optimization of the Oldenburg sentence tests. *Z Audiol*, 38, 44-56.

4. Wagener, K., Eeenboom, F., Brand,T. & Kollmeier, B. 2005. *Ziffer-Tripel-Test: Spracherverstandlichkeitstest uber das Telefon.* Tagungs-CD der DGA Jahrestagung.