

## Original Research Article

### The design and evaluation of children's voice audiometry lists in Moroccan dialect

#### **Abstract:**

The objective of our work is to elaborate word lists in moroccan dialect, mono and bisyllabic, adapted to children from three to five years old, represented by corresponding pictures boards that allow the screening of hearing disorders in children as young as 3 years old, who cannot repeat the word, must be able to point to the corresponding image.

Develop and record word lists in Moroccan dialect, mono and bisyllabic, adapted to children aged 6 years and older, who will be able to recognize and repeat them in recorded voice and to test these lists on a sample of Moroccan children in order to evaluate their reliability and to validate them.

#### **Material and methods:**

During the year, boards of words/images intended for children from 3 to 5 years old and recorded voice lists intended for

children aged 6 and over were created in the ENT and CCF department of Hospital 20 Aout then they were tested at the consultation (84 children) and corrected. We have then proceeded to the audiometric validation of the test by comparing it to the pure tone audiometry result.

#### **Results:**

All recorded words/pictures and words have been recognized by the children. The 40 lists evaluated made it possible to collect audiometry results speech consistent with the results of pure-tone audiometry.

#### **Conclusion:**

At the end of this study, 20 illustrated vocal lists intended for moroccan children from 3 years old and 20 recorded vocal lists intended for moroccan children from 6 years old have been validated in normal-hearing children. This is a first step before the validation of these lists in deaf children and by extension in children with cochlear implants.

**KEYWORDS:** Audiometry, Bisyllabic , Monosyllabic, psychomotor development

## **1. INTRODUCTION:**

Subjective audiometry allows the exploration of the different auditory pathways with the help of an acoustic stimulus. In children, it must take into account a certain number of parameters whose combination determines different audiometric strategies. This is called behavioral audiometry.

Pure tone audiometry explores hearing with a sound stimulus made of pure tones, voice audiometry requires the use of well-chosen words to complete the hearing exploration tests.

Indeed, voice audiometry in children has several interests in clinical practice, including:

A diagnostic interest: it confirms the results of the tonal audiometry by making it possible to control it and predicts the participation of the perception apparatus each time there is a deformation of the intelligibility curve

A social interest: The deafness disturbs the deaf child, and can affect his school life, but the tonal audiometry can only give an idea on the depth of deafness and the possible site of hearing impairment but cannot assess the social problems that the deaf child may encounter in his daily life, this is the case for children with either a language delay or speech disorders or a delay in school / hyperactivity in which the diagnosis of deafness has gone unnoticed.

Behavioral audiometry allows us to show several cases of patients who have only a minimal hearing loss in tonal audiometry, but who present serious problems of intelligibility and speech comprehension. This is the case of central hearing impairment that can be seen in late onset genetic deafness.

An interest in the follow-up: In the post-operative follow-up, speech audiometry objectifies and quantifies the hearing gain after surgery. It is particularly useful for children in post cochlear implant follow-up.

A prosthetic interest: speech audiometry allows audio prosthesis to judge the prosthetic possibilities much better than with the information obtained by tone audiometry and also helps in the prosthetic adjustments.

In our daily practice, the majority of Moroccan otologists do not use this voice audiometry test in children. This is mainly due to the fact that the word lists are not adapted to the child: words not used or not known by the child.

## **2. MATERIALS AND METHODS:**

### **2.1 OBJECTIVES:**

This study has 3 objectives:

- To elaborate mono and bi-syllabic word lists in Moroccan dialect, adapted to children from 3 to 5 years old, which can be represented by corresponding picture boards, allowing the screening of auditory disorders in children from 3 years' old who cannot repeat the word, must be able to point to the corresponding picture.

- Develop and record monosyllabic and bi-syllabic word lists in Moroccan dialect, adapted to children aged 6 years and older, who will be able to recognize and repeat them in recorded voice.

- To test these lists on a sample of normal hearing Moroccan children in order to evaluate their reliability and to validate them

### **2.2 MATERIALS AND METHODS:**

### **A- Elaboration of vocal lists adapted to the child:**

- The study of lists in the literature, particularities of the lists in Moroccan dialect and their adaptation in children, Design of the lists: according to 2 populations: group A (children between 3 and 5 years old), group B (children 6 years old and more)

a- The choice of words: These words were first written in Arabic letters, translated according to their meaning in French, then transcribed according to the international phonetic transcription

b- The conception of the lists: These words were divided according to the number of syllables, the syllabic architecture, and the lexical field. A proportional count of these different parameters was calculated and distributed equally between each list. The phonetic complexity index was respected as proposed by Jakielsky (2000).

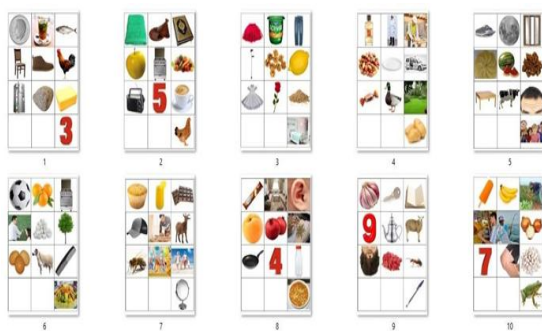
### **B- Recording of the lists:**

The recording of the words was done by professional voice-overs (male and female voices), in a professional studio, and with the collaboration of a sound engineer, in accordance with the ISO 8253-3 standard, the words, thereafter, were integrated into an audiogram, of the brand AD629 of Interacoustics.

### **C- Development of picture words:**

Picture identification is a widely used technique for the description of children's known vocabulary, this technique based on pictures representing objects that we make sure during the pretest are known to the child, allows us to detect auditory difficulties if the child has not heard the word and hesitates to point out the corresponding object. The lists intended for the children of group A (aged 3 to 5 years), we constituted boards of recognizable images from the age of three years, ten lists, of ten words each, are proposed (fig1)

**Figure 1: Example of images developed for the children's lists**



The constraints were representability: excluding all abstract words, and simplicity of identification: the images had to have only one common name (the unknown images were changed by other more significant ones (fig2)).

**Figure 2: Example of changed pictures**



#### **D- Evaluation of the lists:**

For the evaluation of these lists, 84 normal hearing children aged 3 to 12 years were recruited at the ENT consultation 20 August in Casablanca. The test was performed in an audiometric booth and room as quiet as possible, with an audiometer and built-in microphone connected to two loudspeakers, the latter placed at the height of the child's head while seated. The distance between the loudspeaker and the test subject is equal to 1m, headphones adapted to the different cranial perimeters and adapted chairs: parents + child on the knees, or child alone (armrests and footrest), game material, word/picture set including the vocal lists to be validated on plasticized sheets, easy to store (binder)

The reinforcement is the playful maneuver proposed to the child to encourage him to renew his answers. We used 3 types of conditioning: Verbal reward, PeeP Show, Embedding game.

#### **Figure 3: Word lists**

##### **1- Lists designed for Group A children (ages 3 to 5)**

##### **Monosyllabic lists:**

Liste 1			liste 2			liste 3			liste 4			Liste 5		
1- CVCV	حوتة	fish	1- CVCV	فوططة	towel	1- CVCV	صابنة	skirt	1- CVCV	رجنة	parfum	1- CVCV	باطو	boat
2-CVCVC	أاي	tea	2-CVCVC	طاجين	tajine	2-CVCVC	دانون	yogurt	2-CVCVC	بوليس	police	2-CVCVC	فمر	moon
3-CVCCVC	درهم	dirham	3-CVCCVC	قرآن	quran	3-CVCCVC	مروال	pant	3-CVCCVC	بناي	shaaban	3-CVCCVC	شرحه	window
4-CVCCVC	فروج	chicken	4-CVCCVC	تفاح	apple	4-CVCCVC	عكاز	numbers	4-CVCCVC	كاوكو	cacao	4-CVCCVC	بغبر	baghir/moi
5-CVCCVC	صباط	shoe	5-CVCCVC	فران	oven	5-CVCCVC	كرع	walnut	5-CVCCVC	طبسيل	plate	5-CVCCVC	دلاح	watermelon
6-CVCCV	كرسي	chair	6-CVCCV	خضرة	vegetable	6-CVCCV	حامضه	lemon	6-CVCCV	طاكسي	taxi	6-CVCCV	شبكة	basket
7-CVCCV	زبدة	butter	7-CVCCV	راديو	radio	7-CVCCV	كسوة	dress	7-CVCCV	حلوة	cookies	7-CVCCV	طيلة	table
8-CVCCV	حجرة	rock	8-CVCCV	خمسة	five	8-CVCCV	وردة	rose	8-CVCCV	بطة	goose	8-CVCCV	بقرة	cow
9-CVCCV	بقرة	cow	9-CVCCV	قهوة	coffee	9-CVCCV	رملة	sand	9-CVCCV	جردة	garden	9-CVCCV	جبهة	forehead
10-X	ثلاثة	three	10-X	دجاجة	chicken	10-X	سبطار	hospital	10-X	بطاطا	potato	10-X	دراري	children
Liste 6			liste7			liste8			liste 9			Liste 10		
1- CVCV	كورة	ball	1- CVCV	كبة	cake	1- CVCV	ببمو	biscuit	1- CVCV	نومة	garlic	1- CVCV	بولو	icecream
2-CVCVC	ليمون	orange	2-CVCVC	عصير	juice	2-CVCVC	صالون	living room	2-CVCVC	ساروت	key	2-CVCVC	بانان	banana
3-CVCCVC	فران	oven	3-CVCCVC	شكلاط	chocolate	3-CVCCVC	وذنين	ears	3-CVCCVC	دفنار	notebook	3-CVCCVC	فلاح	farmer
4-CVCCVC	أستاذ	professor	4-CVCCVC	طربوش	hat	4-CVCCVC	مشمش	apricot	4-CVCCVC	تسعود	nine	4-CVCCVC	عطار	perfumer
5-CVCCVC	سكر	sugar	5-CVCCVC	نجار	carpenter	5-CVCCVC	رمان	grenade	5-CVCCVC	برلا	tea-pot	5-CVCCVC	صياد	le chasseur
6-CVCCV	شجرة	tree	6-CVCCV	معة	goat	6-CVCCV	حنة	henna	6-CVCCV	نعجة	sheep	6-CVCCV	بصلة	onion
7-CVCCV	بيضة	egg	7-CVCCV	نحلة	bee	7-CVCCV	مقلاة	stove	7-CVCCV	لحبة	bear	7-CVCCV	سبعة	seven
8-CVCCV	حولي	sheep	8-CVCCV	حفلة	party	8-CVCCV	رعة	four	8-CVCCV	كفنة	meat	8-CVCCV	ركبة	knee
9-CVCCV	مشط	brush	9-CVCCV	عطلة	vacation	9-CVCCV	فرعة	bottle	9-CVCCV	نملة	ant	9-CVCCV	لوبيا	bean
10-X	كسكس	couscous	10-X	مرآيا	mirror	10-X	حريزة	moroccan s	10-X	سنيو	pencil	10-X	جرانة	frog

**Bissylabic lists:**

Liste 1		Liste 2		liste 3		Liste 4		Liste 5	
1-CCVC	طبيب doctor	1-CCVC	سحاب cloud	1-CCVC	لسان tongue	1-CCVC	ظلام darkness	1-CCVC	فريز strawberry
2-CCVC	خريف spring	2-CCVC	تران train	2-CCVC	حليب milk	2-CCVC	فلوس money	2-CCVC	سنان sin
3-CCVC	أبيض white	3-CCVC	كحل black	3-CCVC	أزرق blue	3-CCVC	احمر red	3-CCVC	شعر hair
4-CCVC	بحر sea	4-CCVC	رجل foot	4-CCVC	لحم meet	4-CCVC	نسر eagle	4-CCVC	جبل mountain
5-CVC	دار house	5-CVC	وجه face	5-CVC	نوف nose	5-CVC	خوخ peaches	5-CVC	باب door
6-CVC	الصور wall	6-CVC	فول فول	6-CVC	بيت room	6-CVC	فيل elephant	6-CVC	بئر well
7-CVC	حوت fish	7-CVC	كاس glass	7-CVC	توت blueberry	7-CVC	كار bus	7-CVC	جوج two
8-CCV	لما water	8-CCV	دوش shower	8-CCV	عصا stake	8-CCV	عنى ablution	8-CCV	شتا rain
9-CVCC	أرض floor	9-CVCC	خبز bread	9-CVCC	قلب heart	9-CVCC	عين eye	9-CVCC	كرش belly
10-CvCC	لص lettuce	10-CvCC	بنت girl	10-CvCC	ولد boy	10-CvCC	حج pilgrimage	10-CvCC	عرس marriage ce
Liste 6		Liste 7		liste8		liste 9		liste10	
1-CCVC	كتاف shoulder	1-CCVC	حمار donkey	1-CCVC	نهار day	1-CCVC	ربيع spring	1-CCVC	دقيق flour
2-CCVC	شفاير eyelash	2-CCVC	كتاب book	2-CCVC	الليل night	2-CCVC	طريق road	2-CCVC	زبيب grape
3-CCVC	تمر date	3-CCVC	صبع finger	3-CCVC	قصر castle	3-CCVC	سبع lion	3-CCVC	ضغار nail
4-CCVC	عسل honney	4-CCVC	عنب grappe	4-CCVC	جمال camel	4-CCVC	اخضر green	4-CCVC	ظهر back
5-CVC	روز rice	5-CVC	سوق souk	5-CVC	وادي river	5-CVC	موس knife	5-CVC	أصفر yellow
6-CVC	فأر mouse	6-CVC	عود stick	6-CVC	ذئب wolf	6-CVC	نار fire	6-CVC	لوز almond
7-CVC	زيف scarf	7-CVC	دود worm	7-CVC	طون tuna	7-CVC	صوف wool	7-CVC	فوق artichoke
8-CCV	الدوا medicine	8-CCV	كلب dig	8-CCV	سما sky	8-CCV	دب bear	8-CVC	الزيت oil
9-CVCC	عود stick	9-CVCC	عنق neck	9-CVCC	مش cat	9-CvCC	عش	9-CCV	جرو
10-CvCC	فرد	10-CvCC	لفت radish	10-CvCC	ثلج snow	10-CvCC	عنق neck	10-CvCC	جد grand-fathe

## 2- Lists designed for children in group B (ages 6 and up)

### - Monosyllabic lists:

Liste 1		Liste 2		liste 3		Liste 4		Liste 5	
2-CCVC	طبيب doctor	1-CCVC	سحاب cloud	1-CCVC	لسان tongue	2-CCVC	ظلام darkness	2-CCVC	فريز strawberry
3-CCVC	خريف spring	3-CCVC	تران train	3-CCVC	حليب milk	3-CCVC	فلوس money	3-CCVC	سنان sin
4-CCVC	أبيض white	4-CCVC	كحل black	5-CCVC	أزرق blue	4-CCVC	احمر red	4-CCVC	شعر hair
6-CCVC	بحر sea	5-CCVC	رجل foot	6-CCVC	لحم meet	6-CCVC	نسر eagle	6-CCVC	جبل mountain
7-CVC	دار house	6-CCVC	وجه face	7-CVC	نوف nose	7-CVC	خوخ peaches	7-CVC	باب door
8-CVC	الصور wall	7-CVC	فول فول	9-CVC	بيت room	9-CVC	فيل elephant	9-CVC	بئر well
9-CVC	حوت fish	9-CVC	كاس glass	10-CVC	توت bluebe	10-CVC	كار bus	10-CVC	جوج two
11-CCV	لما water	10-CVC	دوش shower	11-CCV	عصا stake	11-CCV	عنى ablution	11-CCV	شتا rain
12-CVCC	أرض floor	12-CVCC	خبز bread	12-CVCC	قلب heart	12-CVCC	عين eye	13-CvCC	كرش belly
13-CvCC	لص lettuce	14-CvCC	بنت girl	14-CvCC	ولد boy	13-CvCC	حج pilgrimage	14-CvCC	عرس marriage ce
Liste 6		Liste 7		liste 8		Liste 9		Liste 10	
1-CCVC	حديد iron	1-CCVC	إمام imam	1-CCVC	ريال cent	1-CCVC	لسان tongue	1-CCVC	نعاس sleep
2-CCVC	سلام salam	2-CCVC	طلاق divorce	2-CCVC	حليب milk	2-CCVC	دقيق flour	2-CCVC	فريز strawberry
3-CCVC	نهار daylight	3-CCVC	سلاح weapon	3-CCVC	سبرع baptism	3-CCVC	فلوس money	3-CCVC	خميس Thursday
4-CCVC	عقل brain	4-CCVC	وجه face	4-CCVC	شعر hair	4-CCVC	شجر tree	4-CCVC	سبع lion
5-CCVC	لحم meet	5-CCVC	أصفر yellow	5-CCVC	حبل rope	5-CCVC	قصر castle	5-CCVC	تمر dates
6-CCVC	سفر travel	6-CCVC	رجل leg	6-CCVC	زرق blue	6-CCVC	خبز bread	6-CCVC	عسل honney
7-CVC	فوق artichoke	7-CVC	لوز almonds	7-CVC	فول broad bean	7-CVC	عين eye	7-CVC	خوخ peaches
8-CVC	نوف nose	8-CVC	طين mud	8-CVC	دين religion	8-CVC	ذئب wolf	8-CVC	عيد eid
9-CVC	وادي river	9-CVC	فأر mouse	9-CVC	عام year	9-CVC	كول eat	9-CVC	غار cave
10-CVC	زيف scarf	10-CVC	رعد thorns	10-CVC	دود worms	10-CVC	موس knife	10-CVC	كار bus
11-CCV	برإ needle	11-CCV	خارج outside	11-CCV	شوا barbecue	11-CCV	طفا turn off	11-CCV	شتا rain
12-CvCC	علف hay	12-CvCC	قلب heart	12-CvCC	طير bird	12-CvCC	ورد rose	12-CvCC	عود horse
13-CvCC	دم blood	13-CvCC	جد grandfather	13-CvCC	سد he closed	13-CvCC	خط line	13-CvCC	شم snif
14-CvCC	فرد monkey	14-CvCC	بنت girl	14-CvCC	ولد boy	14-CvCC	كرش belly	14-CvCC	جرح hurt

### Bissyllabic lists:

Liste 1			liste 2			liste 3		liste 4			Liste 5			
1- CVCV	بولة		1- CVCV	قاضي	judge	1- CVCV	صورة	photo	1- CVCV	ريحة	parfum	1- CVCV	موجة	wave
2-CVCVC	أناي	tea	2-CVCVC	طاجين	tajine	2-CVCVC	دائون	yogurt	2-CVCVC	بوليس	police	2-CVCVC	فقير	poor
3-CvCCVC	درهم	dirham	3-CvCCVC	قرآن	quran	3-CvCCVC	سروال	pant	3-CvCCVC	شعبان	shaaban	3-CvCCVC	شرجم	window
4-CvCCVC	نعناع	mint	4-CvCCVC	تفاح	apple	4-CvCCVC	أرقام	numbers	4-CvCCVC	كاكاو	cacao	4-CvCCVC	بغريز	baghrir/morc
5-CvCCVC	صباط	shoe	5-CvCCVC	فرحان	happy	5-CvCCVC	كركع	walnut	5-CvCCVC	طيسيل	plate	5-CvCCVC	دلاح	watermelon
6-CVCCV	كرسي	chair	6-CVCCV	خضرة	vegetable	6-CVCCV	مكة	mecca	6-CVCCV	طاكسي	taxi	6-CVCCV	سبكة	basket
7-CVCCV	زبدة	butter	7-CVCCV	جردة	garden	7-CVCCV	صحة	health	7-CVCCV	حلو	cookies	7-CVCCV	طيلة	table
8-CVCCV	صخرة	rock	8-CVCCV	خمسة	five	8-CVCCV	وردة	rose	8-CVCCV	بطلة		8-CVCCV	ضحكة	smile
9-CVCCV	بقرة	cow	9-CVCCV	قهوة	coffee	9-CVCCV	رملة	sand	9-CVCCV	جردة	garden	9-CVCCV	خيمة	tent
10-X	مدينة	city	10-X	دجاجة	chicken	10-X	سبيطار	hospital	10-X	بطاطا	potato	10-X	زينة	beautiful
Liste 6			liste7			liste8		liste 9			Liste 10			
1- CVCV	كورة	ball	1- CVCV	كعكة	cake	1- CVCV	بهمو	biscuit	1- CVCV	تومة	garlic	1- CVCV	بولو	icecream
2-CVCVC	إمام	imam	2-CVCVC	عصير	juice	2-CVCVC	صالون	living room	2-CVCVC	ساروت	key	2-CVCVC	بانان	banana
3-CvCCVC	فران	oven	3-CvCCVC	شكلاط	chocolate	3-CvCCVC	وذنين	ears	3-CvCCVC	يزاف	a llot	3-CvCCVC	شبعان	
4-CvCCVC	أستاذ	professor	4-CvCCVC	طربوش		4-CvCCVC	مشماش	apricot	4-CvCCVC	تسعود	nine	4-CvCCVC	سلوم	ladder
5-CvCCVC	سكر	sugar	5-CvCCVC	نجار	carpenter	5-CvCCVC	منشار	saw	5-CvCCVC	براد	tea-pot	5-CvCCVC	صيد	hunter
6-CVCCV	شجرة	tree	6-CVCCV	جمعة	Friday	6-CVCCV	حنة	henna	6-CVCCV	نعجة	sheep	6-CVCCV	بصلة	onion
7-CVCCV	بيضة	egg	7-CVCCV	حجرة	rock	7-CVCCV	حضرة	talk	7-CVCCV	لحية	bear	7-CVCCV	سبعة	seven
8-CVCCV	راديو	radio	8-CVCCV	حفلة	party	8-CVCCV	رابعة	four	8-CVCCV	كفتة	meat	8-CVCCV	دمعة	tear
9-CVCCV	خدمة	job	9-CVCCV	عطلة	vacation	9-CVCCV	قربة	bottle	9-CVCCV	زئفة	street	9-CVCCV	لوبيا	bean
10-X	كسكس	couscous	10-X	مرآيا	mirror	10-X	حورية	morrcan soi	10-X	سبيلو	pencil	10-X	جرانة	frog

### 3. RESULTS:

We designed a total of 40 lists distributed as follows: 20 Lists for children aged 3 to 5 years: 10 monosyllabic lists of 10 words and 10 bisyllabic lists of 10 words

20 lists for children aged 6 years and older: 10 monosyllabic lists of 14 words and 10 bisyllabic lists of 10 words, and we included in our study 84 normal hearing children under 12 years of age.

#### 3.1 Quantitative results :

Age: The average age was 6.4 years with extremes ranging from 3 to 12 years. The population was divided into 2 age groups: Group A: age between 3 and 5 years (n=40) Group B: age between 6 and 12 years (n=44) The average age in group A was 4.2 years with extremes (5-3 years) and in group B was 8.3 years with extremes (12-6).

Schooling, 9.52% of the children were not in school, all were under 5 years old.

#### 3.2 Audiometric validation:

On average, the time of realization of the tonal and vocal audiometric tests was 40 minutes with extremes ranging from 30 minutes to 60 minutes

#### Group A:

Pure tone audiometry was performed with headphones in 45% of the children (n=18) with a hearing threshold was between 10 and 20dBHL in 100%, and in free field in 55% of the children (n=22) the hearing threshold was between 15 and 30dB in 100% of the children, the S-shaped elongated speech audiometry curve was present in 100% of the cases.

#### Group B:

Pure tone audiometry was performed with headphones in 100% of the children in group B (n=44), the hearing threshold was above 20dBHL in 100% of the children (n=44), the elongated S-shaped speech audiometry curve was present in 100% of the cases at the level of both ears combined.

#### 3.3: Qualitative results:

10 lists of 10 monosyllabic words and 10 lists of 10 bisyllabic words were tested for group A. The identification difficulties were due to the same reasons: the word was not known to the child and despite the pretest the child could not repeat it, the image was not evocative enough and the child hesitated or made mistakes.

All words in the mono- and bisyllabic lists studied for Group B children were recognized and repeated at conversational thresholds.

#### **4. DISCUSSION:**

##### **4.1 List Design:**

Speech lists must meet a number of rules that differ according to each country's language. In the Arab Maghreb countries, Hadi Messouak was the first to produce and publish phonetic material in Maghrebian Arabic for Tunisians, Algerians and Moroccans in 1956(1). In French-speaking countries, the most widely used lists for children are those of Lafon, but those of Fournier represent the basis of intelligibility tests (2).

In our study, we used the Moroccan monosyllabic and dissyllabic lists for adults, which we adapted to the child, taking into account all the stages of his oral, cognitive and motor development.

##### **4.2 Elaboration of pictorial voices lists:**

Picture identification is a widely used technique for describing children's known vocabulary (3). For an image to be easily recognized by the child, it must meet two criteria: representability and simplicity of identification.

##### **4.3 Recording of lists:**

Voice material shall be recorded in accordance with ISO 8253- 3 (4).

##### **4.4 Evaluation of the lists:**

For a child to understand a word, several parameters must be involved: psychomotor development, hearing, cognitive and cultural aspects, linguistic aspects, intelligence, and mental reserve strength.

A/ **psychomotor development of the normal child:** Development is often divided into specific domains, such as gross motor, fine motor, language, cognitive and developmental (5).

B/ **Behavioral audiometry** is essential, regardless of the child's age. It aims to study the entire auditory field, especially the 250, 500 and 1000 Hz frequencies that are not always explored by conventional objective audiometry techniques. It guides the indication of objective tests. It also provides information on the psychological behavior and communication level of the child (6).

In our study, we evaluated the lists on children from 3 years old, the 3 means of conditioning were the PeepShow, the embedding game and the verbal reward.

The helmet is often poorly accepted by small children. We can then resort to the study of the threshold by air conduction in free field. This corresponds to the air conduction threshold of the better ear (6).

In our study, 55% of the children aged 3 to 5 years were tested in the free field compared to 45% in the headphones. Whereas 100% of the children aged 6 years and older adhered without difficulty to the headphones.

C/ **Voice audiometry:** Voice audiometry is a complement to behavioral audiometry to verify the concordance of the results, and this from the age of 6 months. This examination is therefore essential to perform.

This audiometry involves understanding the message that induces a response, which varies according to the age of the child. The voice constitutes for the child a much more natural stimulus than pure sounds. It is recognized as a significant message depending on linguistic acquisitions (6).

## **5. CONCLUSION:**

This work is an extension of a first study carried out by the ENT team of the University Hospital of Casablanca, which concerned the design and validation of Moroccan voice lists for adults.

Behavioral and vocal audiometry of small children requires a trained, patient, and attentive examiner.

At the end of this study, 20 illustrated voice lists for Moroccan children from 3 years of age and 20 recorded voice lists for Moroccan children from 6 years of age were validated in normal hearing children.

This is a first step before the validation of these lists in deaf children and by extension in cochlear implanted children.

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