



中国科学院软件研究所

Institute of Software

Chinese Academy of Sciences

三维虚拟说话人对汉语发音学习的影响

Evaluating a 3-D virtual talking head on pronunciation learning

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International Journal of Human-Computer Studies, 2018, 109: 26-40.

3D说话人已有研究和应用



Technische Universität
Berlin, Germany.

辅助听障儿童进行言语
康复训练



KTH, Sweden.

辅助听障患者交流
计算机辅助发音训练



University of Memphis.
University of California, Davis

言语自然呈现方式
人机对话系统、类人交互

Microsoft Research Asia.

提供一种基于互联网的、
低成本、多模态、高质
量的语言学习服务



2008

2010

2010

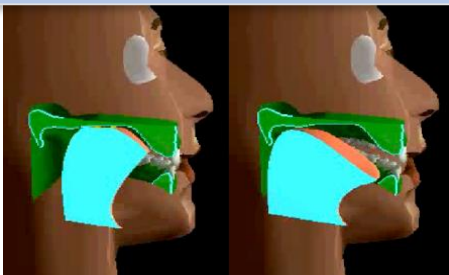
2012

2014

2018

言语产生、言语理解、发音训练

University of California at Santa Cruz, USA.



计算机辅助发音训练
语言学习、音视转换、说话人标准化

Université Stendhal (Grenoble III)



HCS: 言语表达方式
言语理解、认知负荷

The thinking head
project in MARCS
Institute, University of
Western Sydney, Australia.

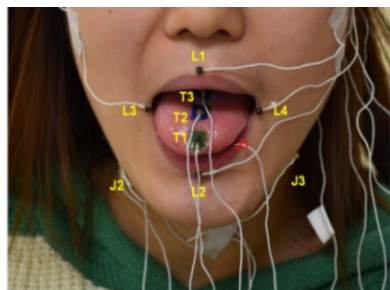


Epic Games、3Lateral、Next Studio
(腾讯)、Vicon和Cubic Motion.



本文3D说话人

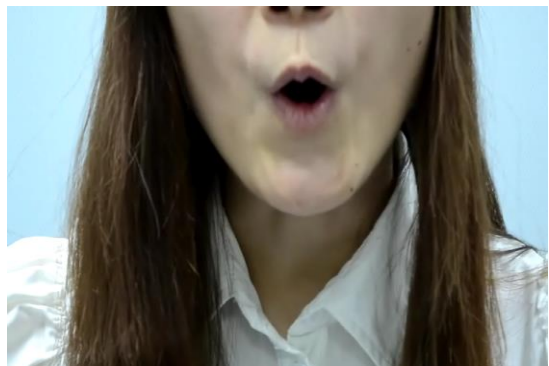
biāo



biāo



qióng



EMA数据驱动

qióng



本文3D说话人

biāo



qióng



3D说话人对母语非汉语者汉语发音学习的影响

研究目的

Q1

用户对3D talking head的接受程度

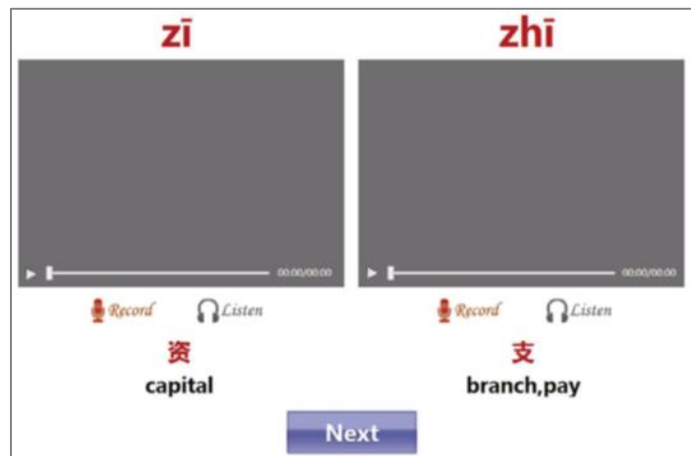
Q2

用户对“声音(AU)”、“真人(HF)”、“虚拟说话人(3D)”在interest、functionality、future use三方面的对比评价

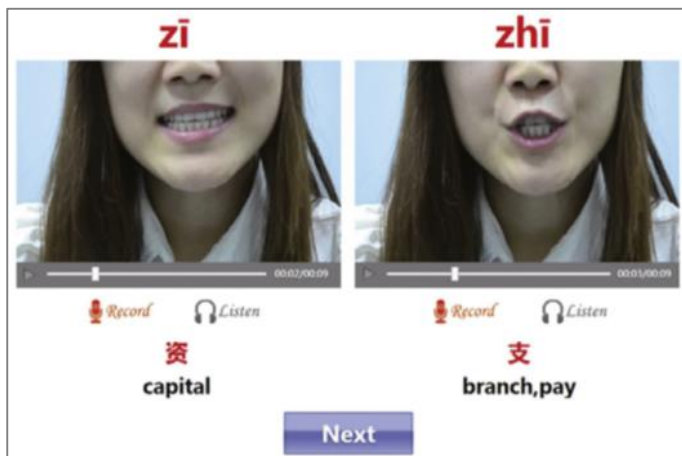
Q3

用户在AU、HF、3D三种学习界面中的发音学习效果对比

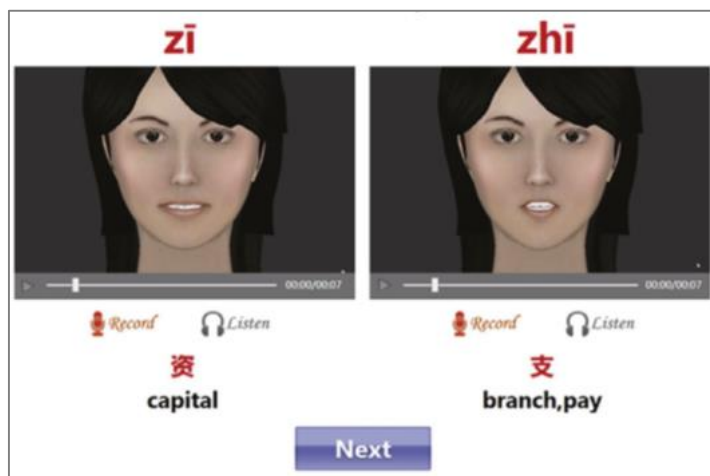
三种学习界面——AU、HF、3D



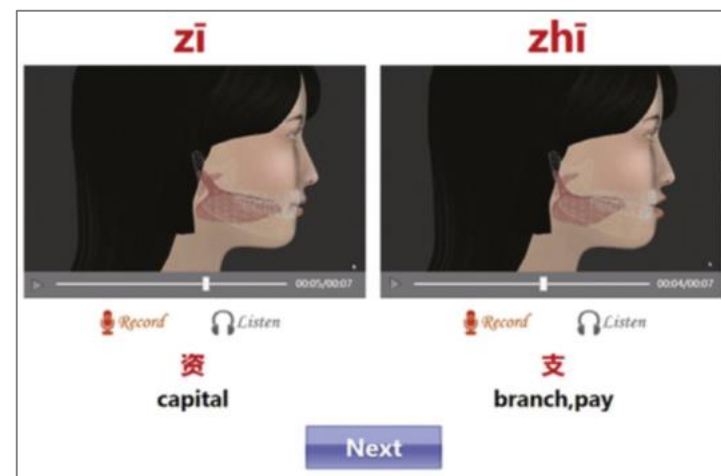
AU-只有声音



HF-真人视频

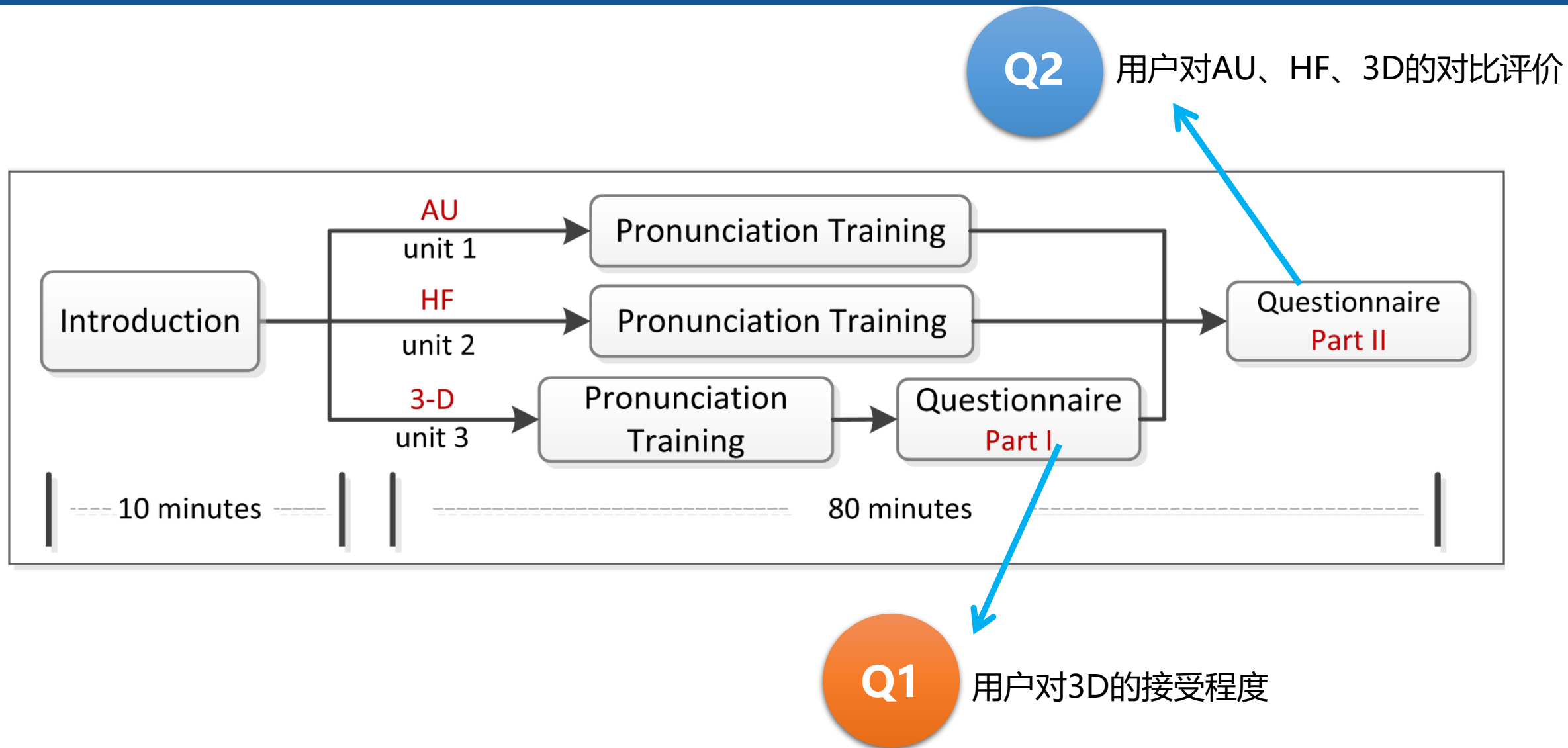


+



3D-内部可视化（正面一次+侧面一次）

实验一：Q1、Q2



Q1

Table 1

Questionnaire I: a questionnaire to investigate language learners' acceptance of the ALT with the 3-D talking head (RQ1); maximum score is 5 ("strongly agree"), and minimum score is 1 ("strongly disagree").

Question	Description	Mean score	Standard deviation
(1)	The ALT tool is easy to use.	4.83	0.379
(2)	I can accept the 3-D talking head for pronunciation training.	4.20	0.714
(3)	The 3-D talking head offers me a nice look and feeling.	4.17	0.834
(4)	The 3-D talking head shows clear and natural movements of the pronunciation.	4.13	0.819
(5)	I feel uncomfortable when looking at the 3-D talking head.	1.77	0.935
(6)	I could not accept the internal articulators which are normally unaccustomed to see in daily life.	2.17	0.874
(7)	It is difficult to follow the movements of both external and internal articulators of the 3-D talking head.	2.40	1.070
(8)	The transparent face of the 3-D talking head is difficult to accept.	1.83	0.834

Table 2

Questionnaire I: factor naming, internal consistency and explained variance.

Factor	Question	Factor loading	Cronbach's alpha	Eigen-value	% of variance	Cumulative %
Factor 1. Appearance	(3)	0.897	0.856	2.565	42.7	42.7
	(4)	0.916				
	(5)	0.832				
Factor 2. Articulatory movements	(6)	0.796	0.741	1.793	29.9	72.6
	(7)	0.926				
	(8)	0.688				

Q1 结果

用户对3D的主观接受程度

appearance

articulatory movements

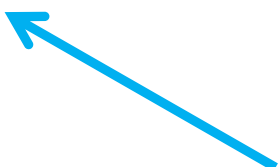


Table 3

Questionnaire II: a questionnaire to compare language learners' impressions of the three presentation conditions (RQ2); maximum ranking is 3 ("the least good one"), and minimum ranking is 1 ("the best one").

Question	Description	Condition	Mean ranking	Standard deviation	Percentage distribution of ranking 1 (%)
(9)	Which condition you are the most interested in?	3-D	1.63	0.765	53.3
		HF	1.63	0.615	43.3
		AU	2.73	0.521	3.3
(10)	Which condition helps you the most to understand the correct movements of pronunciation?	3-D	1.43	0.679	66.7
		HF	1.77	0.626	33.3
		AU	2.80	0.407	0
(11)	Which condition offers you the most complete instruction?	3-D	1.33	0.711	80.0
		HF	1.87	0.507	20.0
		AU	2.80	0.407	0.0
(12)	Which condition helps you the most to identify the differences of each pair?	3-D	1.57	0.728	56.7
		HF	1.73	0.640	36.7
		AU	2.70	0.596	6.7
(13)	Which condition helps you the most to learn new pronunciation materials?	3-D	1.63	0.718	50.0
		HF	1.60	0.621	46.7
		AU	2.77	0.504	3.3
(14)	If you want to learn more pronunciation materials, which condition would you like the most?	3-D	1.80	0.761	40.0
		HF	1.60	0.724	53.3
		AU	2.60	0.621	6.7

Q2 结果

用户在
interest
Functionality
future use
三个方面的主观评价

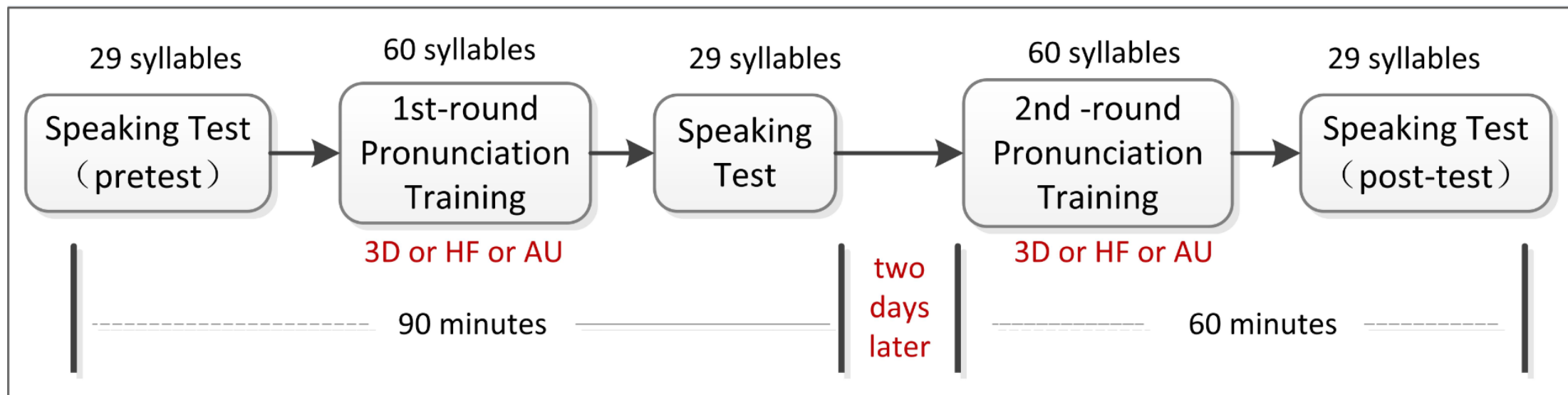


HF = 3D > AU

实验二： Q3

Q3

用户在AU、HF、3D三种学习界面中的发音学习效果对比



实验二： Q3

有效被试	实验次数	学时	有效音节	打分者	总
36人	72次	90时	6480个	5人	64800个
	36*2次	36*2.5 h	36*60 音*3遍		36*60音 *2次*5 人*3

Unit 1	Unit 2	Unit 3
kā, kē	mā, hā	niǔ, niǎo
mō, mē	mái, méi	nǚ, lǚ
dē, g ē	fān, fēn	qú, qún
tē, h ē	fāng, fēng	guī, gān
lē, ēr	pīn, p īng	guā, guān
qiā, qiē	lēng, lōng	quān, chuān
bāo, biāo	qiáng, qióng	xuān, shuān
pān, pi ān1	juān, zhu ān	qá, rá
má, mú4	zī, zhī	cī, chī
sī, shī	sīi, shīi	ca1, chā

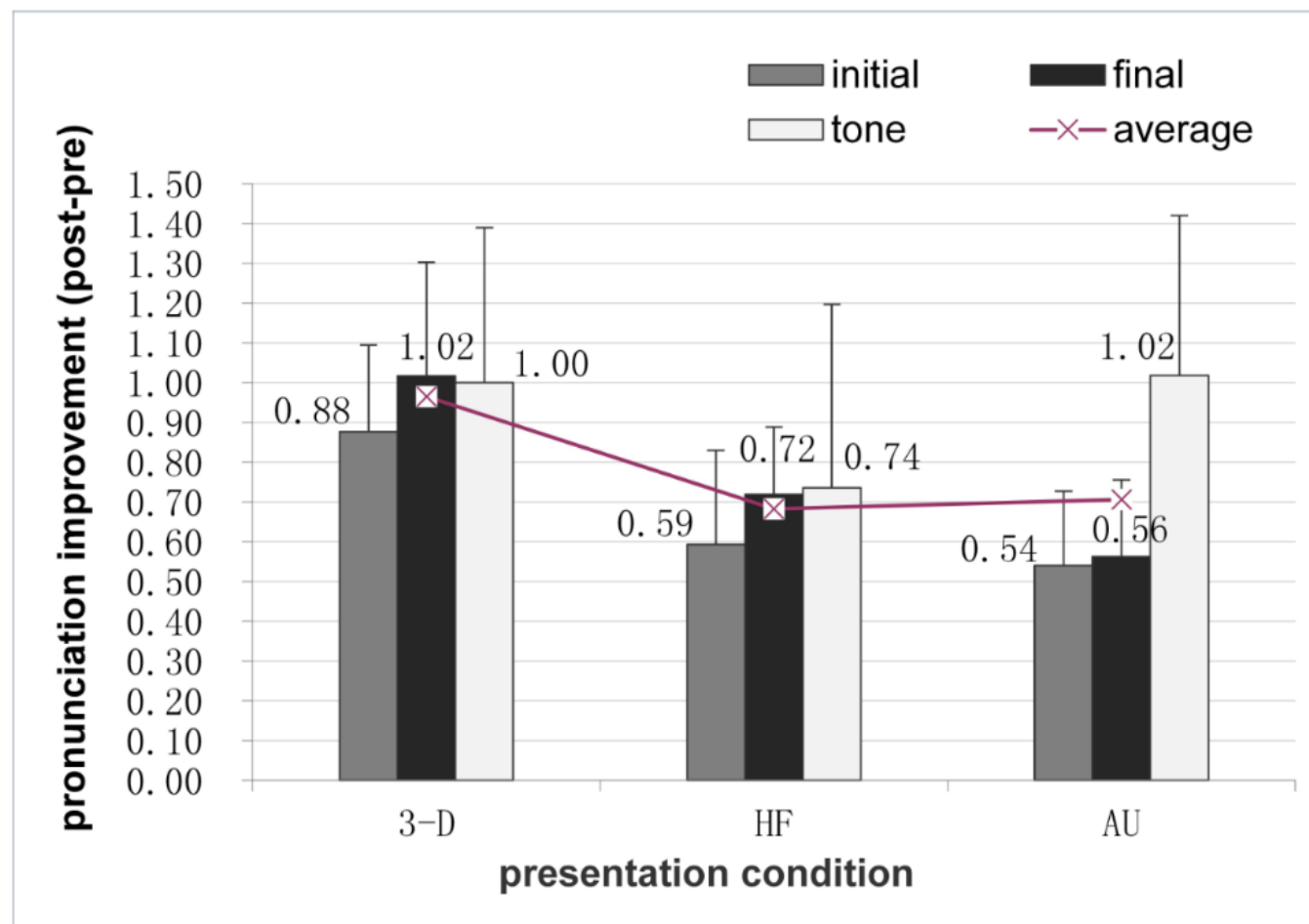
Q3 结果

大部分声母、韵母:

3D > AU = HF

第三声调:

3D = AU > HF



AU、HF、3D三种界面条件下的发音提高量

Q3结果-发音分类统计分析

1. 按发音部位分类（声母）

- ◆ 双唇音：b p m
- ◆ 唇齿音：f
- ◆ 舌尖前音：z c s
- ◆ 舌尖中音：d t n l
- ◆ 舌尖后音：zh ch sh r
- ◆ 舌面音：j q x
- ◆ 舌根音：g k h

2. 按发音部位分类（“四呼”韵母）

- ◆ 开口呼：
a、o、e、ê、er、i(前)、i(后)开头的韵母
- ◆ 齐齿呼：
i或i开头的韵母 如 iou、iao、ie、ia
- ◆ 合口呼：
u或u开头的韵母 如 ua、uo、uai、uei
- ◆ 撮口呼：
ü或以ü开头的韵母 如 üe、ün、üan

Q3结果可能的解释

◆ 声母、韵母：3D > AU = HF

3D > AU

主要表现在内部发音器官驱导的发音音节

AU = HF

HF有无关细节干扰了学习

3D > HF

主要表现在内部发音器官驱导的发音音节

◆ 第三声调：3D = AU > HF

3D = AU

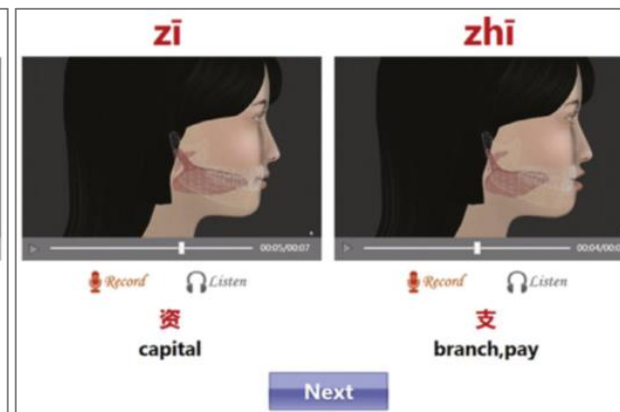
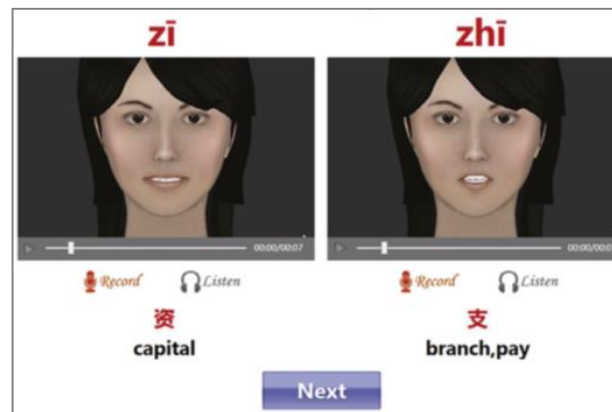
音调主要由听觉通道习得

3D > HF

HF有无关细节干扰了学习

AU > HF

音调主要由听觉通道习得



不足

- ◆ 由于**3D**和**HF**不仅内部发音器官呈现不同、它们的形象也不同，故本文只能推断是内部可视化导致了**3D**的优势，但不能确定其中形象这个因素所起的作用。
- ◆ 汉语是音调语言，音调的可视化呈现一直是难点，本文学习材料中音调多以一声为主，对于音调的评估不够全面。
- ◆ 只测了**performance of production**，没有评估**performance of perception**。

**欢迎交流、批评、指正！
谢谢！**

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