

# Contents

Abstract	iii
Contents	xvii
I Introduction	1
1 Introduction	3
1.1 Motivation . . . . .	3
1.2 Scientific goals and research hypotheses . . . . .	8
1.3 Thesis structure . . . . .	11
II Selected papers	13
2 3D Serious Dental Game	15
2.1 Abstract . . . . .	15
2.2 Introduction . . . . .	16
2.3 Background . . . . .	16

2.4 Developments . . . . .	18
2.5 Study . . . . .	20
2.6 Results . . . . .	21
2.6.1 Knowledge outcomes . . . . .	21
2.6.2 Usability, Depth Perception, and Satisfaction Outcomes . . . . .	22
2.6.3 Preferences about the Game Background . . . . .	23
2.7 Discussion . . . . .	24
2.8 Conclusions . . . . .	26
2.9 Acknowledgments . . . . .	27
3 MnemoCity Task	29
3.1 Abstract . . . . .	29
3.2 Introduction . . . . .	30
3.3 Background . . . . .	31
3.3.1 Virtual environments . . . . .	33
3.3.2 Natural User Interfaces . . . . .	34
3.3.3 Stereoscopy . . . . .	35
3.3.4 Short-term memory . . . . .	35
3.4 Materials and Methods . . . . .	36
3.4.1 The MnemoCity task . . . . .	36
3.4.2 Development . . . . .	41
3.4.3 Interaction . . . . .	43
3.4.4 Software and Hardware . . . . .	45
3.5 Study . . . . .	47
3.5.1 Participants . . . . .	47
3.5.2 Measurements . . . . .	48
3.5.3 Procedure . . . . .	49
3.6 Results . . . . .	51
3.6.1 Lang-Stereo-Test outcomes . . . . .	51
3.6.2 Interaction outcomes . . . . .	52
3.6.3 Gender outcomes . . . . .	53
3.6.4 Preference and depth perception outcomes . . . . .	54
3.6.5 Short-term memory outcomes . . . . .	55
3.6.6 Usability and satisfaction outcomes . . . . .	56

3.7 Discussion . . . . .	57
3.8 Conclusions . . . . .	62
3.9 Acknowledgments . . . . .	63
4 A Virtual Object-Location Task for Children	65
4.1 Abstract . . . . .	65
4.2 Introduction . . . . .	66
4.3 Materials and Methods . . . . .	70
4.3.1 Participants . . . . .	70
4.3.2 The Testing Room and Instrumentation for the VOL Task . . . . .	70
4.3.3 The VOL Task . . . . .	71
4.3.4 Videogame Exp., 3D Perception, Satisfaction, and Usability Questionnaires . . . . .	76
4.3.5 Spatial Ability Tests . . . . .	77
4.3.6 Emotional and Behavioral Rating Scale . . . . .	77
4.3.7 Procedure . . . . .	77
4.3.8 Data Analysis . . . . .	78
4.4 Results . . . . .	79
4.4.1 Effects of Age and Gender . . . . .	79
4.4.2 Usability, Satisfaction and 3D Perception . . . . .	81
4.4.3 Relationship between Performance on the VOL Task and the Participant's Outcomes . . . . .	84
4.5 Discussion . . . . .	84
4.6 Conclusion . . . . .	91
4.7 Funding . . . . .	92
4.8 Acknoledgments . . . . .	92
III Discussion	93
5 Discussion	95
5.1 VR system for the assessment of spatial memory . . . . .	95
5.2 VR system for dental learning . . . . .	99

IV Conclusions	101
6 Conclusions	103
6.1 Conclusions . . . . .	103
6.2 Future works . . . . .	106
6.3 Scientific contributions . . . . .	106
6.3.1 Papers in journals indexed in JCR . . . . .	106
6.3.2 Papers in conferences indexed in CORE 2017 . . . . .	107
6.3.3 Papers in other conferences . . . . .	107
6.3.4 Other difusions . . . . .	107
Bibliography	109