
Contents

Part I Has Photosensitivity Changed over the Years?

1 Epidemiology of Sensitivity of the Brain to Intermittent Photic Stimulation and Patterns	3
Luiz C. Barreto Silva, Dorothee Kasteleijn-Nolst Trenite, Maria L. G. Manreza, and Richard E. Appleton	
1.1 General Introduction	3
1.2 Epidemiology of Photosensitivity	4
1.2.1 Studies of IPS in Normal Adults	4
1.2.2 Studies of IPS in Normal Children and Adolescents	5
1.3 Studies in People with Epilepsy	17
1.3.1 Pattern Sensitivity in Normal Children and Adolescents	19
1.3.2 Pattern Sensitivity in People with Epilepsy	20
References	23
2 Provocative Factors	27
Pasquale Striano and Salvatore Striano	
2.1 Introduction	27
2.2 Natural and Environmental Provocative Stimuli	29
2.3 Provocative Factors in the “Electronic Era”	29
2.4 Patterns	30
2.5 Television	30
2.6 Videogames (Electronic Screen Games)	31
2.7 Laboratory Investigations	31
2.7.1 Flickering (Stroboscopic) Light Stimulation	31
2.7.2 Standardized Methods of IPS	31
2.7.3 The Role of the Colours	32
2.8 Eye-Closure Sensitivity	32
2.9 Fixation-Off Sensitivity	32
2.10 Pathophysiology of PS Mechanism(s) and Networks Involved	34
References	35
3 The History of Photic Sensitivity in Epilepsy	39
Pierre Genton, Michelle Bureau, and Dorothee Kasteleijn-Nolst Trenite	
3.1 Introduction	39

3.2	The Recognition of Photogenic Seizures.....	39
3.3	The Assessment of Photosensitivity by Electroencephalography (EEG).....	41
3.4	Photogenic Epilepsies	45
3.5	Conclusion.....	46
	References.....	47
4	Photosensitivity Within the Classification Systems	49
	Richard E. Appleton and Betül Baykan	
4.1	Introduction	49
4.2	The Chronology of Photosensitivity Within the Seizure and Epilepsy Classifications	49
4.2.1	Initial Classification (1981).....	50
4.2.2	Second Classification (1989).....	50
4.2.3	Third Classification (2001)	50
4.2.4	Fourth Classifications (2010 and 2017).....	50
4.3	The Classification of Photosensitivity and Visual-Sensitive Seizures	50
4.4	Photosensitivity within the Current Classification of Epilepsy Syndromes and Epilepsies	52
4.4.1	Myoclonic Epilepsy in Infancy/Childhood	52
4.4.2	Absence Epilepsies with Variable Ages at Onset....	53
4.4.3	Eyelid Myoclonia with Absences (Jeavons Syndrome)	53
4.4.4	Myoclonic-Astatic Epilepsy (Doose Syndrome)....	54
4.4.5	Juvenile Myoclonic Epilepsy.....	55
4.4.6	Epilepsy with Generalised Tonic-Clonic Seizures...	55
4.4.7	The Epileptic Encephalopathies.....	55
4.4.8	Progressive Myoclonic Epilepsies.....	56
4.4.9	Idiopathic Focal Epilepsies	57
4.4.10	Other Focal Epilepsy Syndromes with Known or Unknown Origin	57
4.4.11	Genetic Epilepsy with Febrile Seizures ‘Plus’	57
4.4.12	Other Rare Clinical Disorders Associated with Photosensitivity	58
4.4.13	Pattern-Sensitivity	58
4.5	How Photosensitivity Should Be Integrated Within the ILAE Classifications of the Epilepsy Syndromes and Epilepsies	58
4.6	Conclusion.....	59
	References.....	59
5	Genetics of Photosensitivity	63
	Ayşe D. Elmali and Nerses Bebek	
5.1	Introduction	63
5.2	Genetic Clues of Photosensitivity: What Have Family Studies Brought Us So Far?	63
5.3	What We Have Learned from Animal Models.....	64
5.4	Genetic Background of Epileptic and Neurologic Syndromes Accompanied by Photosensitivity.....	64

5.5	Does Genetics of Photosensitivity Share the Same Genetic Background of Epilepsies.	65
5.6	Results of Molecular Genetic Analysis of Photosensitivity. . .	65
5.7	Use of PPR Phenotype for Genetic Studies.	68
	References.	68

Part II Does Photosensitivity Matter; Clinical Relevance?

6	Correlation EEG and Clinic	75
	Giuseppe Capovilla and Antonio Gambardella	
6.1	Introduction	75
6.2	Different Types of Photosensitivity	75
6.3	Collection of Seizure Types Evoked by IPS	76
6.3.1	Generalized Seizures	78
6.3.2	Focal Seizures	87
6.3.3	Unclassifiable Response.	92
	References.	94
7	Prognosis	95
	Bernhard J. Steinhoff, Anke M. Staack, and Christoph Kurth	
7.1	Introduction	95
7.2	The Distribution and Prognosis of PPR as an Isolated Phenomenon	95
7.2.1	Prognosis of PPR as an Isolated Phenomenon and Therapeutic Consequences.	96
7.3	PPR, Epilepsy and Underlying Epileptic Syndromes	96
7.4	Therapeutic Approaches in Patients with Epilepsy and a PPR Including a Case Report.	98
7.5	Concluding Remarks	100
	References.	100
8	Epileptic Syndromes with Photosensitivity.	103
	Silvana Franceschetti and Maurizio Elia	
8.1	PPR at Different Ages	103
8.1.1	PPR in Infancy	103
8.1.2	PPR in Childhood	104
8.1.3	PPR in Adolescence and Adult Age.	105
8.2	Pure Photosensitive Epilepsies	105
8.3	Epilepsies with Chromosomal Abnormalities and PPR.	106
8.4	PPR in Progressive Myoclonic Epilepsies (PME).	107
8.4.1	Unverricht–Lundborg Disease	107
8.4.2	Lafora Disease	108
8.4.3	PMEs in Mitochondrial Disorders.	108
8.4.4	PME in Neuronal Ceroid Lipofuscinoses	108
8.4.5	Other Rare PME.	109
8.5	Pathophysiology and Treatment.	110
	References.	111

9	Does Photosensitivity Exist in Focal Epilepsy?	115
	Christian Brandt and Fabrice Bartolomei	
9.1	Introduction	115
9.1.1	Focal Epilepsy: Definition, Classification and Epidemiology	115
9.2	Neurophysiological/Anatomical Basis PPR in Focal Epilepsies	115
9.3	Different Focal Epilepsy Syndromes	116
9.3.1	Occipital Lobe Epilepsy	116
9.3.2	Other Forms of Focal Epilepsy	117
9.4	Provocation of Focal Seizures by IPS	117
9.5	Overlap Syndromes	117
9.5.1	PPR in Dravet Syndrome	117
9.6	AED Proof-of-Concept Trials	117
9.7	Discussion	117
9.8	Conclusion	118
	References	118
10	Does Photosensitivity Exist in Focal Epilepsy?	121
	Antonio Martins da Silva	
10.1	Introduction	121
10.2	Auras and Focal EEG Signs in Generalized Epilepsies	121
10.3	Auras and Focal EEG Signs in Photosensitive Epilepsies	122
10.4	Structures Stimulated Generating Focal EEG Signs and “Localized” Symptoms in Photosensitive Epilepsies	123
10.5	Conclusion	125
	References	125
11	Does Photosensitivity Exist in Focal Epilepsy?	127
	Bosanka Jovic-Jakubi	
11.1	Introduction	127
11.2	Special Focal Syndromes and Photosensitivity	128
11.2.1	Idiopathic Photosensitive Occipital Epilepsy	128
11.2.2	Benign Childhood Epilepsy with Centrottemporal Spikes (Rolandic Epilepsy)	130
11.2.3	Idiopathic Occipital Lobe Epilepsy with Early Onset (Panayiotopoulos Syndrome)	131
11.2.4	Idiopathic Childhood Occipital Epilepsy-Late Onset Gastaut Type	132
11.2.5	Fixation-off Sensitivity	134
11.2.6	Photosensitivity of Extra-Occipital Origin	134
11.3	Conclusion	135
	References	136

12	Photosensitivity in Various Disease States	139
	Umberto Raucci, Giovanni Di Nardo, Melania Evangelisti, Maria Pia Villa, and Pasquale Parisi	
12.1	Introduction	139
12.2	Headache	140
12.3	ADHD	142
12.4	Autism	142
12.5	Schizophrenia	143
12.6	Brain Tumors	143
12.7	Panic Disorders	144
12.8	Depression and Mania	144
12.9	Alzheimer Disease	145
12.10	Other Neurodegenerative Conditions	145
12.11	Post-traumatic Conditions	145
12.12	Chronic Pain	146
12.13	Parkinson Disease	146
	References	147
13	What Can We Learn from a Photosensitive Patient?	151
	Paul Timmings and Marta Piccioli	
13.1	Introduction	151
13.2	Genetic Factors	152
13.3	Age Factors	153
13.4	Influence of Sex	154
13.5	EEG Interpretation and Evaluation of PPR	154
	13.5.1 Types of PPR	155
	13.5.2 Clinical Correlation	156
	13.5.3 Other Factors Influencing the Likelihood of Provoking a PPR	157
	13.5.4 Use of PPR	160
	13.5.5 Stability of the PPR over Time and Its Use in Investigational Drug Studies	161
13.6	Pathophysiological Mechanisms	163
13.7	Fixation-off Sensitivity as a Subset of Photosensitivity	164
13.8	Prognosis of the PPR	165
	13.8.1 Prognosis over Years	165
	13.8.2 Consistency of the PPR over the Waking Day	166
13.9	Drug and Therapeutic Effects on the PPR	167
13.10	Conclusions from PPR Review	169
	References	170

Part III Abnormal Electroencephalographic Response to Photic Stimulation in Humans and Animals

14	How to Interpret Photoparoxysmal EEG Results?	175
	Carmen Barba and Renzo Guerrini	
14.1	Introduction	175
14.2	Classification of Photoparoxysmal EEG results	175

14.3	Factors Influencing Photoparoxysmal EEG Results	176
14.4	How to Interpret Photoparoxysmal EEG Results in Different Epilepsy Syndromes?	177
14.4.1	Generalised Epilepsies	177
14.4.2	Focal Epilepsies	179
14.4.3	Other Myoclonic Epilepsy Syndromes	180
	References	182
15	Motor Manifestations in Epileptic Photosensitivity: Clinical Features and Pathophysiological Insights	185
	Guido Rubboli, Elena Gardella, and Stefano Meletti	
15.1	Introduction	185
15.2	Overview of the Clinical Manifestations of Epileptic Photosensitivity	185
15.2.1	Subjective Symptoms	185
15.2.2	Photomyoclonic Response	186
15.2.3	Eyelid Myoclonus	186
15.2.4	Self-Induced Behavior	187
15.2.5	Photic Reflex Myoclonus	187
15.2.6	Absence Seizures	188
15.2.7	Focal Seizures	188
15.2.8	Generalized Tonic-Clonic Seizures	189
15.3	Photic-Induced Myoclonic Phenomena: Clinical Aspects, Neurophysiological Features, and Pathophysiological Considerations	189
15.3.1	Eyelid Myoclonia with Absences	189
15.3.2	Photic Reflex Myoclonus	191
	References	195
16	The Basics: What Constitutes a Photoparoxysmal Response? FMRI, PET, TMS and MEG Studies	199
	Matthias Koepp, Lorenzo Caciagli, Edward Kane, and Daichi Sone	
16.1	Introduction	199
16.2	Structural Imaging	200
16.3	Functional Magnetic Resonance Imaging (fMRI)	200
16.4	Positron Emission Tomography (PET)	200
16.4.1	Animal Models	200
16.4.2	Human Studies	201
16.5	Transcranial Magnetic Stimulation (TMS)	201
16.6	Magnetoencephalography (MEG)	203
16.7	Conclusion	203
	References	204
17	Gamma Oscillations and Photosensitive Epilepsy	207
	Giuliano Avanzini, Jaime Parra, and Dora Hermes	
17.1	Introduction	207
17.2	Gamma Oscillations	207
17.2.1	History and Terminology	207
17.2.2	Definition of Gamma Oscillations	208

17.2.3	Gamma Oscillations and Intermittent Photic Stimulation	208
17.2.4	Neurophysiology of Gamma Oscillations	210
17.2.5	Stimulus Dependence of Gamma Oscillations	210
17.2.6	Models of Gamma Oscillations	214
17.3	The Neuronal Circuit Involved in Gamma Oscillations and Photosensitive Epilepsy.	215
17.4	Conclusions	215
	References.	216
18	Animal Models of Photosensitivity: Clinical Significance and Windows into Mechanisms	219
	Charles Ákos Szabó and Andrea Fischer	
18.1	Introduction	219
18.2	Fayoumi Chicken	220
18.2.1	Origins	220
18.2.2	Electroclinical Features	220
18.2.3	Response to Anti-seizure Therapies.	221
18.2.4	Mechanisms Underlying Photosensitivity	221
18.3	Rhodesian Ridgeback.	222
18.3.1	Origins	222
18.3.2	Electroclinical Features	223
18.3.3	Response to Anti-seizure Therapies.	223
18.3.4	Mechanisms Underlying Photosensitivity	224
18.4	Baboon	224
18.4.1	Origins	224
18.4.2	Electroclinical Features	224
18.4.3	Response to Anti-seizure Therapies.	226
18.4.4	Mechanisms Underlying Photosensitivity	227
18.5	Canine Models of Progressive Myoclonic Epilepsies	231
18.5.1	Origins	231
18.5.2	Electroclinical Features	231
18.5.3	Response to Anti-seizure Therapies.	231
18.5.4	Mechanisms Underlying Photosensitivity	231
18.6	Experimental Models.	232
18.6.1	Kindling Modeling in Cats	232
18.6.2	Genetically Induced Photosensitivity	232
18.7	Conclusions	232
18.8	Future Directions	232
	References.	233
19	Photic Stimulation in Rats and What Does It Tell Us About Absence Epilepsy	237
	Gilles van Luijtelaar	
19.1	Introduction	237
19.2	Afterdischarges as a Model for Oscillatory Activity	241
19.3	The Facilitation of Afterdischarges by Pentylentetrazol	242
19.4	Visual Evoked Potentials in Genetic Absence Epileptic Rats.	243

19.5	The State of the Brain During Absence Spike Wave Discharges	244
19.6	Photosensitivity in the Genetic Models?	245
19.7	Brain Circuits for Spike Wave Discharges and PPR	247
19.8	Concluding Remarks	248
	References	248

Part IV Peculiarities of Photosensitivity in Diagnosis and Treatment

20	Genetic (Ethnic) Differences	255
	Hideaki Shiraishi and Bola Adamolekun	
20.1	Introduction	255
20.2	Genetics of Photosensitivity	255
20.3	Influence of Ethnicity on the Photoparoxysmal Response ..	255
20.3.1	The Pigmentary Protection Hypothesis	256
20.3.2	Photoparoxysmal Response Rates and Exposure to Sunlight	257
20.3.3	Photoparoxysmal Responses to Other Visual Stimuli	257
	References	257
21	Epidemiology of Photosensitivity: Gender Comparisons	259
	Carne Vila-Sala and Norman Delanty	
21.1	Introduction	259
21.2	Gender Differences in the Epidemiology of Photosensitivity	259
21.2.1	Epidemiology in General Population	259
21.2.2	Epidemiology of Photosensitivity in Epilepsy	260
21.3	Possible Causes of Gender Differences	262
21.3.1	Sex Hormones	262
21.3.2	Genetic Transmission	263
21.4	Summary	264
	References	264
22	Photosensitivity in Epilepsy Syndromes: Age Differences?	267
	Stefano Seri, Bryony Carr, and Antonella Cerquiglini	
22.1	Introduction	267
22.2	Pathophysiology and Its Relationship to Brain Maturation ..	268
22.3	The PPR in Age-Related Epileptic Syndromes	268
22.3.1	Benign Myoclonic Epilepsy of Infancy	269
22.3.2	Myoclonic Astatic/Atonic Epilepsy (Doose Syndrome)	269
22.3.3	Childhood Absence Epilepsy	269
22.3.4	Jeavons Syndrome or Eyelid Myoclonia with Absences	270
22.3.5	Juvenile Absence Epilepsy	270
22.3.6	Idiopathic Photosensitive Occipital Lobe Epilepsy ..	270
22.3.7	Juvenile Myoclonic Epilepsy	271

22.3.8	Epilepsy with GTCS Alone	271
22.4	Photosensitivity in Epileptic Encephalopathies	272
22.4.1	Symptomatic Epilepsies with Photosensitivity	272
22.4.2	Progressive Myoclonic Epilepsies	272
22.5	Final Considerations	274
	References	275
23	Photosensitivity in Dravet Syndrome	279
	Berten Ceulemans, An-Sofie Schoonjans, and Anouk Van de Vel	
23.1	Introduction	279
23.2	Materials and Methods	280
23.2.1	Dravet Syndrome Cases in Literature	280
23.2.2	Dravet Syndrome Cases in Our Epilepsy Monitoring Unit	280
23.3	Results	285
23.3.1	Case 1: Patient 2 (F, 7 Years)	291
23.3.2	Case 2: Patient 26 (M, 2–4 Years)	292
23.3.3	Case 3: Patient 41 (M, 6 Years)	294
23.3.4	Case 4: Patient 50 (M, 12 Years)	295
23.3.5	Case 5: Patient 55 (M, 13 Years)	296
23.3.6	Not Classified as Photosensitive	297
23.4	Discussion	299
23.5	Conclusion	302
	References	302
24	Creative Use of the Conventional ‘Human Photosensitivity Model in Epilepsy’	305
	Ronald C. Reed, William E. Rosenfeld, Susan M. Lippmann, Bassel Abou-Khalil, and Dorothee Kasteleijn-Nolst Trenite	
24.1	Novel Use of the ‘Photosensitivity Model of Epilepsy’ to Identify the Rapidity of AED Central Nervous System Penetration	305
24.1.1	Introduction of the Photosensitivity Model	305
24.1.2	Operation of the Conventional Model	306
24.1.3	Levetiracetam (LEV) and Brivaracetam (BRV) Both Tested in the Conventional Model	306
24.1.4	Adaptation of the ‘Model’ to Compare Efficacy of LEV and BRV Within Minutes after Intravenous Infusion	308
24.2	Novel Use of the ‘Photosensitivity Model of Epilepsy’ to Identify the Pharmacodynamic PPR Response on EEG to Small Incremental Increases in Plasma Valproate (VPA) Concentration: Implications for the Study of Generic vs. Brand AEDs	314
24.2.1	Background on Generic vs. Brand Drug Formulations, in General	314
24.2.2	Generic vs. Brand AED Formulations: The Controversy	314

24.2.3	Impact of Small Changes in Plasma [VPA] Concentration	317
24.2.4	Photosensitivity Model and Slow Increase of Plasma [VPA] Concentrations after IV Infusion of VPA	317
24.3	Conclusion	319
	References	319
25	Identification of Geographic Sites Studying Photosensitivity	323
	Nicola Specchio, Alessandro Ferretti, and Janet Mifsud	
25.1	Introduction	323
25.2	Methods of Search of Available Resources	324
25.3	Results	324
25.4	Conclusion	327
25.5	Unmet Needs and Recommendations	328
	References	329
Part V	How to Approach the Photosensitive Patient, the Caregiver and the Surrounding	
26	Optimizing the Patient's History: A Modern Approach	339
	Mario Brinciotti, Viviane Bouilleret, and Pascal Masnou	
26.1	Introduction	339
26.2	How to Investigate the Presence of Reflex Seizures	339
26.3	How to Investigate the Clinical Characteristics of Visually-Induced Seizures	341
26.4	How to Investigate the Presence of Self-Induced Seizures	341
26.5	Epileptic Syndromes Associated with Photosensitivity	342
26.5.1	Genetic Generalized Epilepsies	342
26.5.2	Focal Epilepsies	343
26.5.3	Encephalopathies and Specific Diseases Associated with Photosensitivity	343
26.5.4	Other Encephalopathies and Specific Epilepsy Syndromes	344
26.6	Conclusions	345
	References	345
27	Maximizing EEG Methodology in Photosensitivity: Do's and Don'ts	349
	Bassel Abou-Khalil, Alberto Spalice, and Thomas Mayer	
27.1	Introduction	349
27.2	Minimum Technical Standards for Clinical Electroencephalography	349
27.3	Electrode Placement: The 10–20 and 10–10 Systems	350
27.4	Montages	352
27.4.1	Localization in Different Montages	354
27.5	Physiological Monitoring: Polygraphy	355
27.6	Simultaneous Video Recording	355
27.7	EEG Methodology for Photic Stimulation	356

27.8	The EEG in Advanced Clinical and Research Studies of Photosensitivity	358
27.9	Summary	358
	References.....	359
28	Safety of EEG Methodology in Photosensitivity	361
	Kimberley Whitehead and Victor Biton	
28.1	Introduction	361
28.2	Safety Risks of Photic Stimulation: Generalized Tonic-Clonic Seizures	361
28.3	Safety Benefits of Photic Stimulation	362
28.3.1	Identifying Neural Photosensitivity by Capturing an Evoked Photoparoxysmal Response	362
28.3.2	Identifying Lowered Seizure Threshold by Capturing an Evoked Clinical Seizure	363
28.3.3	Capturing an Evoked Habitual Psychogenic Non-epileptic Attack	363
28.4	Practical Methods to Optimize Safety During Photic Stimulation.....	363
28.4.1	Guidelines	363
28.4.2	Risk Factors	364
28.4.3	Protocol	364
28.5	Conclusion.....	364
	References.....	365
29	Photosensitivity: Treatment and Prevention: When?	367
	Elza M. T. Yacubian	
29.1	Introduction	367
29.2	Photosensitivity	367
29.3	‘Pure’ Photosensitive Epilepsies	368
29.3.1	Photosensitive Epilepsy	369
29.3.2	Idiopathic Photosensitive Occipital Lobe Epilepsy ..	369
29.4	Epileptic Syndromes with Photosensitivity.....	370
29.4.1	Genetic Generalized Epilepsies	370
29.4.2	Progressive Myoclonic Epilepsies	372
29.4.3	Developmental and/or Epileptic Encephalopathies with Prominent Photosensitivity..	372
29.5	Final Remarks	373
	References.....	374
30	Photosensitive Epilepsy: Treatment and Prevention: How?	377
	Leah Brancheck, Pavel Klein, and R. Edward Hogan	
30.1	Introduction	377
30.2	Treatment with Stimulus Control and/or Pharmacological Management.....	377
30.3	Defining the Stimulus for Optimal Stimulus Control	377
30.3.1	Managing Exposure to Provocative Stimuli	378
30.3.2	The Role of Special Lenses	378

30.4	Anti-seizure Medications for Photosensitive Epilepsy	379
30.4.1	In General.	379
30.4.2	Valproate	380
30.4.3	Levetiracetam.	381
30.4.4	Brivaracetam	382
30.4.5	Valproate, Levetiracetam and Other ASM in Jeavons Syndrome	382
30.4.6	Lamotrigine, Vigabatrin, Carbamazepine, and Other ASM	382
30.4.7	Anti-seizure Medication Withdrawal.	383
30.4.8	Summary	384
	References.	385
31	Diagnosis and Treatment of Photosensitive Patients in Daily Practice: A Nationwide Inventory	387
	Kira Voronkova and Dorothee Kasteleijn-Nolst Trenite	
31.1	Introduction	387
31.2	Methods	387
31.3	Results	387
31.3.1	Inventory of Detection of Photosensitivity	387
31.3.2	Inventory of Advice and Treatment	388
31.3.3	Inventory of Wishes	388
31.4	Discussion	389
	Appendix.	390
	References.	392
32	Photosensitive and Pattern-Sensitive Epilepsy: A Guide for Patients and Caregivers.	393
	Athanasios Covanis and Jessica Solodar	
32.1	Introduction	393
32.2	Defining Photosensitivity.	393
32.2.1	The Photoparoxysmal Response	394
32.2.2	Photosensitive Seizures	394
32.2.3	Common Triggers of Photosensitive Seizures	394
32.2.4	Self-Induced Seizures	395
32.3	Who Is Affected?	396
32.4	Challenges of Diagnosing Photosensitivity and Seizure Vulnerability.	396
32.4.1	EEG Results and Actual Photosensitive Seizure Risk.	397
32.4.2	The EEG Procedure.	397
32.4.3	Factors That Affect EEG Readings and Interpretation.	397
32.5	How to Prevent Seizures Due to Visual Stimuli.	398
32.5.1	Avoid and Modify Visual Stimuli	399
32.5.2	Antiseizure Medication	401
32.6	Photosensitive Epilepsy as a Public Health Issue	401
32.6.1	Television.	401
32.6.2	Movies	402

32.6.3	Video Games	402
32.6.4	Social Media and the Internet	402
32.6.5	Indoor Lighting	403
32.6.6	Safety Guidelines from International Standards Bodies	403
32.7	Conclusion	404
	References	405
33	Technical Issues for Video Game Developers and Architects to Prevent Photosensitivity	407
	Edoardo Ferlazzo, Chiara Sueri, Pascal Masnou, Umberto Aguglia, Sergio Mercuri, Edoardo Caminiti, Sara Gasparini, and Marta Piccioli	
33.1	Introduction	407
33.2	Individual Propensity to Photosensitivity	407
33.3	The Role of Screen Characteristics in Photosensitivity	408
33.4	The Role of Content Properties in Photosensitivity	409
33.5	Special Considerations for Manufacturers or Regulatory Agency	409
33.6	Special Considerations for Architects	410
33.7	Conclusions	410
	References	411
34	Summary of Current Knowledge and the Path Forward for New Research into Photosensitivity and Epilepsy	413
	Dorothee Kasteleijn-Nolst Trenite and Ronald C. Reed	
34.1	Introduction	413
34.2	Highlights of What We Have Learned About Photosensitivity in the Past Decades	413
34.3	Unsolved Issues in Photosensitive Patients	414
	34.3.1 Puzzling Cases	414
	34.3.2 Puzzling EEG Phenomena	416
	34.3.3 Clinical Non-pharmacological Issues	421
	34.3.4 Clinical Pharmacological Related Issues	422
34.4	Why Photosensitivity Is Important for Epilepsy	424
34.5	Summary	425
	References	426