Appendix 3. Guidelines of usage of static and dynamic visual & sound variables, related methods of cartographic presentation, types of animation and functionalities

Age group	General recommendations	Detailed instructions and rules						
		Visual static variables (rank)		Dynamic variables (rank)	Sound variables (rank)	Methods of presentations	Types of animation	Functionalities
		A	B					
[1]	Common recommendations: 1. Avoid multidirectional changes; 2. Avoid to change the speed of animation; 3. The last frame should be static.	**1 size 8** **2 form 8** **3 value 8** **4 colour 8** *5 grain 3* *6 orientation 3* *7 brillance 4* 8 transparency 7 *9 aura ?*	**1 size 8** **2 form 8** **3 value 8** **4 colour 8** *5 grain 3* *6 orientation 3* *7 brillance 4* 8 transparency 7 *9 aura 4*	I display rate 8 **II duration 8** **III frequency 8** IV order 8 **V rate of change** 8 *VI synchronization 1* VII way of transition 8	② pitch 8 ③ register 8 ④ loudness 8 ⑤ timbre 8 ⑥ duration 8 ⑦ rhythm 8 ⑧ rate of change 8 ⑨ order 8 ⑩ frequency 8	Kc, Sβa, Sαa, MCa	**Simple synthetic animations:** 1M 1L	**F1**
[2]	Common recommendations	**1 size 9** **2 form 9** **3 value 9** **4 colour 9** 5 grain 8 6 orientation 8 *7 brillance 4* 8 transparency 8 *9 aura ?*	**1 size 9** **2 form 9** **3 value 9** **4 colour 9** 5 grain 8 6 orientation 8 *7 brillance 4* 8 transparency 8 9 aura 5	I display rate 8 **II duration 8** **III frequency 8** IV order 8 **V rate of change** 8 *VI synchronization 2* VII way of transition 8	② pitch 8 ③ register 8 ④ loudness 8 ⑤ timbre 8 ⑥ duration 8 ⑦ rhythm 8 ⑧ rate of change 8 ⑨ order 8 ⑩ frequency 8	Sαb, Kc, Sαc, Kdαc, *Sβb*, Sβa, *Sβc*, *Kγc*, *KDγc*, Sαa, MCa, *MZa*	**Simple synthetic animations:** 1M 1L; 1M ML; MM ML	**F1, F4:** a
[3]	Common recommendations	**1 size 9** **2 form 9** **3 value 9** **4 colour 9** 5 grain 8 6 orientation 8 7 brillance 8 8 transparency 7 *9 aura ?*	**1 size 9** **2 form t 9** **3 value 9** **4 colour 9** 5 grain 8 6 orientation 8 7 brillance 8 8 transparency 7 9 aura 7	I display rate 8 **II duration 8** **III frequency 8** IV order 8 **V rate of change** 8 *VI synchronization 4* VII way of transition 8	② pitch 7 ③ register 7 ④ loudness 8 ⑤ timbre 8 ⑥ *duration 6* ⑦ rhythm 8 ⑧ *rate of change 6* ⑨ *order 6* ⑩ *frequency 6*	Sαb, Kdαb, Kc, Sαc, Kdαc, Sβb, Ic, Sβa, Sβc, Kγc, KDγc, Sαa, MCa, MZa	**Simple synthetic animations:** 1M 1L; 1M ML; MM ML **Simple analytical animations:** 1M 1L; MM ML **Complex synthetic animations:** 1M ML	**F1, F4:** a, c, e, f, g
[4]	Common recommendations	**1 size 8** **2 form 8** **3 value 8** **4 colour 9** 5 grain 8 6 orientation 8 7 brillance 8 8 transparency 7 *9 aura ?*	**1 size 8** **2 form 8** **3 value 8** **4 colour 9** 5 grain 8 6 orientation 8 7 brillance 8 8 transparency 7 9 aura 7	I display rate 8 **II duration 8** **III frequency 8** IV order 8 **V rate of change** 8 *VI synchronization 5* VII way of transition 8	② pitch 7 ③ register 7 ④ loudness 8 ⑤ timbre 8 ⑥ *duration 5* ⑦ rhythm 8 ⑧ *rate of change 5* ⑨ *order 5* ⑩ *frequency 5*	Sαb, Kdαb, Kc, Sαc, Kdαc, Sβb, Ic, Sβa, Sβc, Kγc, KDγc, Sαa, MCa, MZa,	**Simple synthetic animations:** 1M 1L; 1M ML; MM 1L; MM ML **Simple analytical animations:** 1M 1L; 1M ML; MM 1L **Complex synthetic animations:** 1M ML: MM 1L; MM ML **Complex analytical animations:** 1M ML	**F1, F2, F3,** **F4:** a, c, e, f, g, **F7:**a, b, c, d,

Age group	General recommendations	Detailed instructions and rules							
		Visual static variables (rank)		Dynamic variables (rank)	Sound variables (rank)	Methods of presentations	Types of animation	Functionalities	
		A	B						
[5]	Common recommendations	**1 size 8**	**1 size 8**	I display rate 8	② pitch 7	Sαb, Kαb, Kdαb, Kc, Sαc, Kαc, Kdαc, Sβb, Kβb,	**Simple synthetic animations:**	**F1, F2, F3,**	
		2 form 8	**2 form 8**	**II duration 8**	③ register 7	Kdβb, Ic, Sβa, Sβc, Kβc, Kdβc, KαBb, Kγb,	1M 1L; 1M ML; MM 1L; MM ML	**F4:** a, b, c, d, e, f, g	
		3 value 7	**3 value 7**	**III frequency 8**	④ loudness 8	KDγb, KαBc, Kγc, KDγc, Sαa, MCa, MZa,	**Simple analytical animations:**	**F5, F6, F7: a, b, c, d, e**	
		4 colour 8	**4 colour 8**	IV order 8	⑤ timbre 8		1M 1L; 1M ML; MM 1L; MM ML		
		5 grain 7	5 grain 7	**V rate of change** 8	⑥ *duration 4*		**Complex synthetic animations:**		
		6 orientation 7	6 orientation 7	VI synchronization 6	⑦ rhythm 8		1M ML; MM 1L; MM ML		
		7 brillance 6	7 brillance 6	VII way of transition 8	⑧ *rate of change4*		**Complex analytical animations:**		
		8 transparency 7	8 transparency 7		⑨ *order 4*		1M ML; MM 1L; MM ML		
		9 aura ?	9 aura 8		⑩ *frequency 4*				
[6]	Common recommendations. Animations for peoples with hypermetropia.	**1 size 6**	**1 size 6**	I display rate 6	② *pitch 3*	Sαb, Kαb, Kdαb, Kc, Sαc, Kαc, Kdαc, Sβb, Kβb,	**Simple synthetic animations:**	**F1, F2, F3,**	
		2 form 6	**2 form 6**	**II duration 6**	③ *register 3*	Kdβb, Ic, Sβa, Sβc, Kβc, Kdβc, KαBb, Kγb,	1M 1L; 1M ML; MM 1L; MM ML	**F4:** a, b, c, d, e, f, g	
		3 value 3	**3 value 3**	**III frequency 6**	④ loudness 6	KDγb, KαBc, Kγc, KDγc, Sαa, MCa, MZa	**Simple analytical animations:**	**F5, F6, F7**: a, b, c, d, e	
		4 colour 6	**4 colour 6**	IV order 6	⑤ timbre 6		1M 1L; 1M ML; MM 1L; MM ML		
		5 grain 5	5 grain 5	**V rate of change** 6	⑥ *duration 3*		**Complex synthetic animations:**		
		6 orientation 5	6 orientation 5	*VI synchronization 5*	⑦ rhythm 6		1M 1L; MM 1L; MM ML		
		7 brillance 5	7 brillance 5	VII way of transition 6	⑧ *rate of change 3*		**Complex analytical animations:**		
		8 transparency 4	8 transparency 4		⑨ *order 3*		1M 1L; MM 1L; MM ML		
		9 aura ?	9 aura 5		⑩ frequency 3				
[7]	Common recommendations. Animations for peoples with hypermetropia and myopia.More light. Longer exposition. The way of transition should be more smoothly. Careful choice of variables of colour (risk of confusion in the case of green, blue and purple) and value (yellow seems to be brighter). The use of sound variables should be reduced to the minimum.	**1 size 5**	**1 size 5**	I display rate 5	② pitch 2	Sαb, *Kαb*, Kdαb, *Kc*, Sαc, *Kαc*, Kdαc, Sβb, Kβb,	**Simple synthetic animations:**	**F1, F2, F3,**	
		2 form 5	**2 form 5**	**II duration 5**	③ register 2	Kdβb, Ic, Sβa, Sβc, Kβc, Kdβc, *KαBb*, Kγb,	1M 1L; 1M ML; MM 1L; MM ML	**F4:** a, b, c, d, e, f, g	
		3 value 2	**3 value 2**	**III frequency 5**	④ loudness 5	KDγb, *KαBc*, Kγc, KDγc, Sαa, MCa, MZa	**Simple analytical animations:**	**F5, F6, F7:** a, b, c, d, e	
		4 colour 4	**4 colour 4**	IV order 5	⑤ timbre 4		1M 1L; 1M ML; MM 1L; MM ML		
		5 grain 2	*5 grain 2*	**V rate of change** 5	⑥ duration 2		**Complex synthetic animations:**		
		6 orientation 2	*6 orientation 2*	*VI synchronization 4*	⑦ rhythm 5		1M 1L; MM 1L; MM ML		
		7 brillance 3	7 brillance 3	VII way of transition 5	⑧ *rate of change 2*		**Complex analytical animations:**		
		8 transparency 2	*8 transparency 2*		⑨ *order 2*		1M 1L; MM 1L; MM ML		
		9 aura ?	*9 aura 2*		⑩ frequency 2				
[8]	Common recommendations. Animations for peoples with myopia. More light. Longer exposition. The way of transition should be more smoothly. Careful choice of variables of colour (risk of confusion in the case of green, blue and purple) and value (yellow seems to be brighter). The use of sound variables should be reduced to the minimum. Loudness and timbre can be higher. If possible to use the sounds of 4000 Hz or 13 kHz and time about 0.2 s.	**1 size 3**	**1 size 3**	I display rate 3	② pitch 2	Sαb, *Kαb*, *Kdαb*, *Kc*, Sαc, *Kαc*, Kdαc, Sβb, Kβb,	**Simple synthetic animations:**	**F1, F2, F3,**	
		2 form 3	**2 form 3**	**II duration 3**	③ register 2	Kdβb, Ic, Sβa, Sβc, Kβc, Kdβc, *KαBb*, Kγb,	1M 1L; 1M ML; MM 1L; MM ML	**F4:** a, b, c, d, e, f, g	
		3 value 2	**3 value 2**	**III frequency 3**	④ loudness 3	KDγb, *KαBc*, Kγc, KDγc, Sαa, MCa, MZa	**Simple analytical animations:**	**F5, F6, F7:** a, b, c, d, e	
		4 colour 3	**4 colour 3**	IV order 3	⑤ timbre 4		1M 1L; 1M ML; MM 1L; MM ML		
		5 grain 1	*5 grain 1*	**V rate of change** 3	⑥ duration 2		**Complex synthetic animations:**		
		6 orientation 1	*6 orientation 1*	*VI synchronization 2*	⑦ rhythm 3		1M 1L; MM 1L; MM ML		
		7 brillance 1	*7 brillance 1*	VII way of transition 3	⑧ *rate of change 2*		**Complex analytical animations:**		
		8 transparency 2	*8 transparency 2*		⑨ *order 2*		1M 1L; MM 1L; MM ML		
		9 aura ?	*9 aura 1*		⑩ frequency 2				

Key:

Static visual variables

1 size; 2 form; 3 value; 4 colour; 5 grain; 6 orientation; 7 brilliance; 8 transparency; 9 aura; dynamized variables are underlined

Sound variables
② Pitch; ③ Register; ④ Loudness; ⑤ Timbre; ⑥ Duration;⑦ Rhytm; ⑧ Rate of change; ⑨ Order; ⑩ Frequency

Entities / measurement levels

α point entities; β line entities; γ area entities;
a - nominal scale measurable entities; b - ordinary scale measurable entities; c - quantitative scale measurable entities

Elements shown in red are inaccessible

Methods of presentations		Functionalities		Types of animation
Sαb – Ordinary point signatures,	Sβc – Quantitative line signatures,	F1 - Navigation	F4g – choice of the extent	1M – mono module
Kαb – Ordinary point choropleth maps,	Kβc (cs) - Quantitative line choropleth maps,	F2 – Import of layers or sub-animations	F5 – Choice of the method of data processing	1L – mono level
Kdαb – Ordinary point cartodiagrams	Kdβc (cs) - Quantitative line cartodiagrams	F3 – Programming of animation	F6 – Choice of the type of visualization	MM – multi module
Kc – Dot method,	KαBb – Ordinary Bertin's choropleth map,	F4 – Edition of animation:	F7 – Analysis of spatio-temporal data	ML - multilevel
Sαc – Quantitative point signatures,	Kγb – Ordinary area choropleth maps,	F4a – choice of information	F7a – comparison of layers	
Kαc (cs) – Quantitative point choropleth maps,	KDγb – Ordinary dasimetric choropleth maps,	F4b - query of information	F7b – comparison of layers with animation	
Kdαc (cs) - Quantitative point cartodiagrams,	KαBc - Quantitative Bertin's choropleth map,	F4c – choice of the scope of information	F7c - comparison of animations	
Sβb – Ordinary line signatures,	Kγc(cs) - Quantitative area choropleth maps,	F4d - choice of them mode of information	F7d – intersection of layers and animation	
Kβb – Ordinary line choropleth maps,	KDγc(cs) - Quantitative dasimetric choropleth maps,	F4e – choice of period	F7e – intersection and/or incrustration of animations	
Kdβb - Ordinary line cartodiagrams	Sαa – Qualitative point signatures	F4f – choice of location		
Ic – isoline maps,	MCa – Chorochromatic method maps,			
Sβa – Qualitative line signatures,	MZa – Range maps			

The variables and methods distinguished by italics can be used conditionally