

# SUPPLEMENTARY MATERIALS - Influence of Scenarios and Player Traits on Flow in Virtual Reality.

Élise Lavoué, Sophie Villenave, Audrey Serna, Clémentine Didier, Patrick Baert, and Guillaume Lavoué

**Abstract**—This document contains supplementary figures and tables regarding the article entitled "Influence of Scenarios and Player Traits on Flow in Virtual Reality".



## 1 SESSION DURATIONS

	Exploration	Role-playing	Adventure	Total
Minimum	5	6	8	22
1st Quartile	11	9	11	34
Median	14	11	14	41
3rd Quartile	19	13	16	47
Maximum	29	28	21	72
Mean	15	12	14	41

TABLE 1

Distribution of the duration of the scenarios (including the Flow questionnaire) in minutes

## 2 RQ1: COMPLETE SET OF BOXPLOTS ILLUSTRATING THE EFFECT OF THE TYPE OF SCENARIO ON USERS' FLOW EXPERIENCE

We report in this section all figures that illustrates the distributions of scores for flow dimensions for each scenario (see Figure 1).

## 3 RQ2: COMPLETE SET OF BOXPLOTS ILLUSTRATING THE EFFECT OF THE MASTERY AND PRACTICE OF THE VR ENVIRONMENT ON USERS' FLOW EXPERIENCE

We report in this section all figures that illustrates the distributions of scores for flow dimensions for each order (see Figure 2), and for each order per scenario (see Figures 3, 4, and 5).

## 4 RQ3: PLS SEM PATH MODEL ANALYSIS

We report the values of internal consistency reliability (CR), convergent validity (AVE) and discriminant validity (HTMT) to assess our model for the three scenarios (see Tables 2, 3 and 4). We also report the percentage of variability accounted for by the latent variables in each model (R<sup>2</sup>) and the factor loadings (see Tables 5, 6 and 7).

## 5 RQ3: P-VALUES OF THE PATH COEFFICIENTS

We report in this section the p-value of the path coefficients corresponding respectively to the *Exploration* (see Table 8), *Role-Playing* (see Table 9) and *Adventure* scenarios (see Table 10).

- É. Lavoué is with the Université Jean Moulin Lyon 3, iaelyon school of Management, INSA Lyon, CNRS, LIRIS, UMR5205, Villeurbanne, F-69621.  
E-mail: elise.lavoue@univ-lyon3.fr
- A. Serna is with the Univ Lyon, INSA Lyon, CNRS, LIRIS, UMR5205, F-69621 Villeurbanne, France.  
E-mail: audrey.serna@insa-lyon.fr
- S. Villenave, P. Baert and G. Lavoué are with the Univ Lyon, Centrale Lyon, CNRS, LIRIS, UMR5205, ENISE, F-42023 Saint Etienne, France.  
E-mail: {sophie.villenave, patrick.baert, guillaume.lavoue@enise.fr}

- C. Didier is with Univ Lyon, Centrale Lyon, CNRS, LTDS, ENISE, 69130 Ecully, France.  
E-mail: clementine.didier@enise.fr

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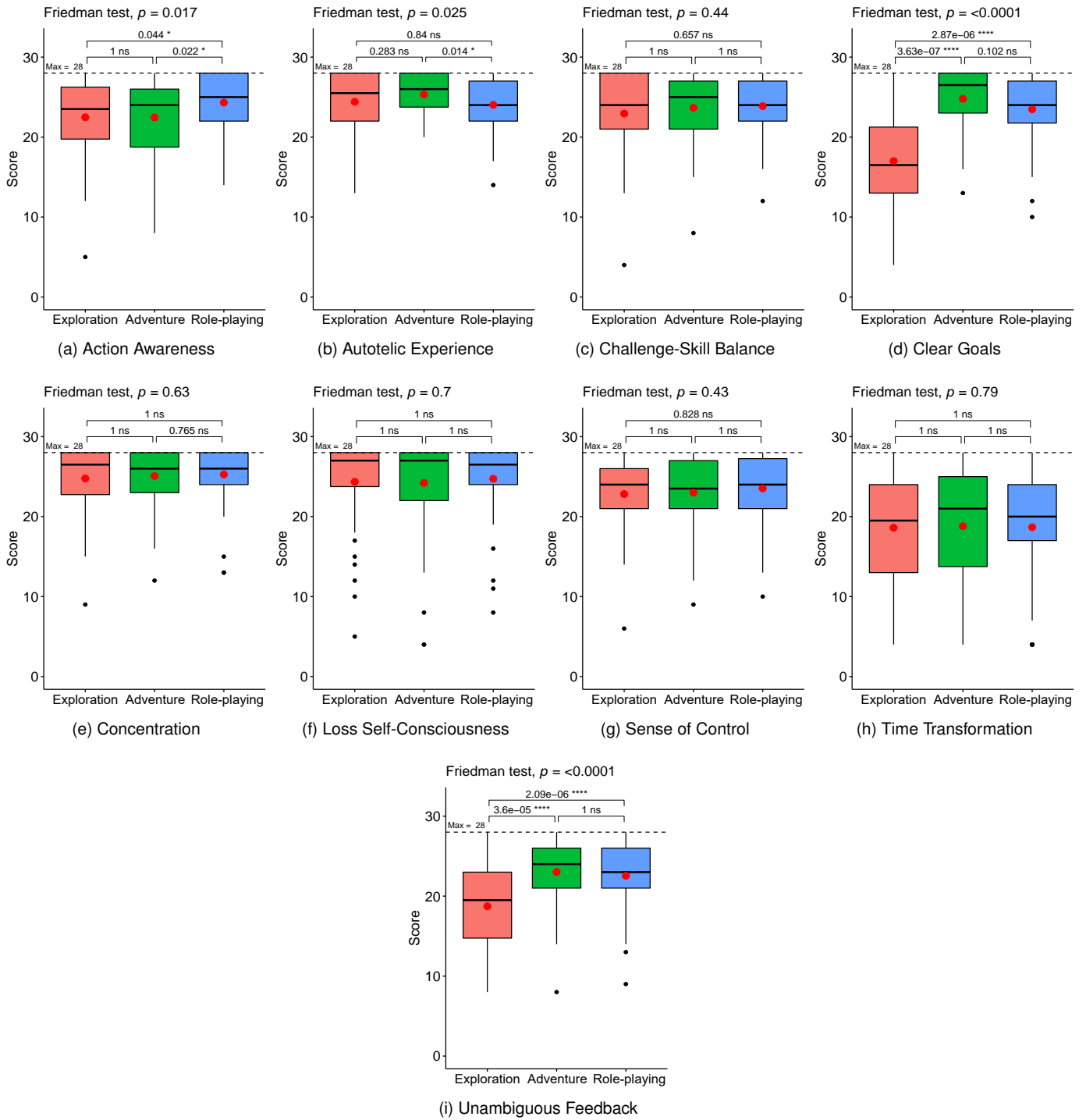


Fig. 1. Boxplots considering all Orders per Scenario

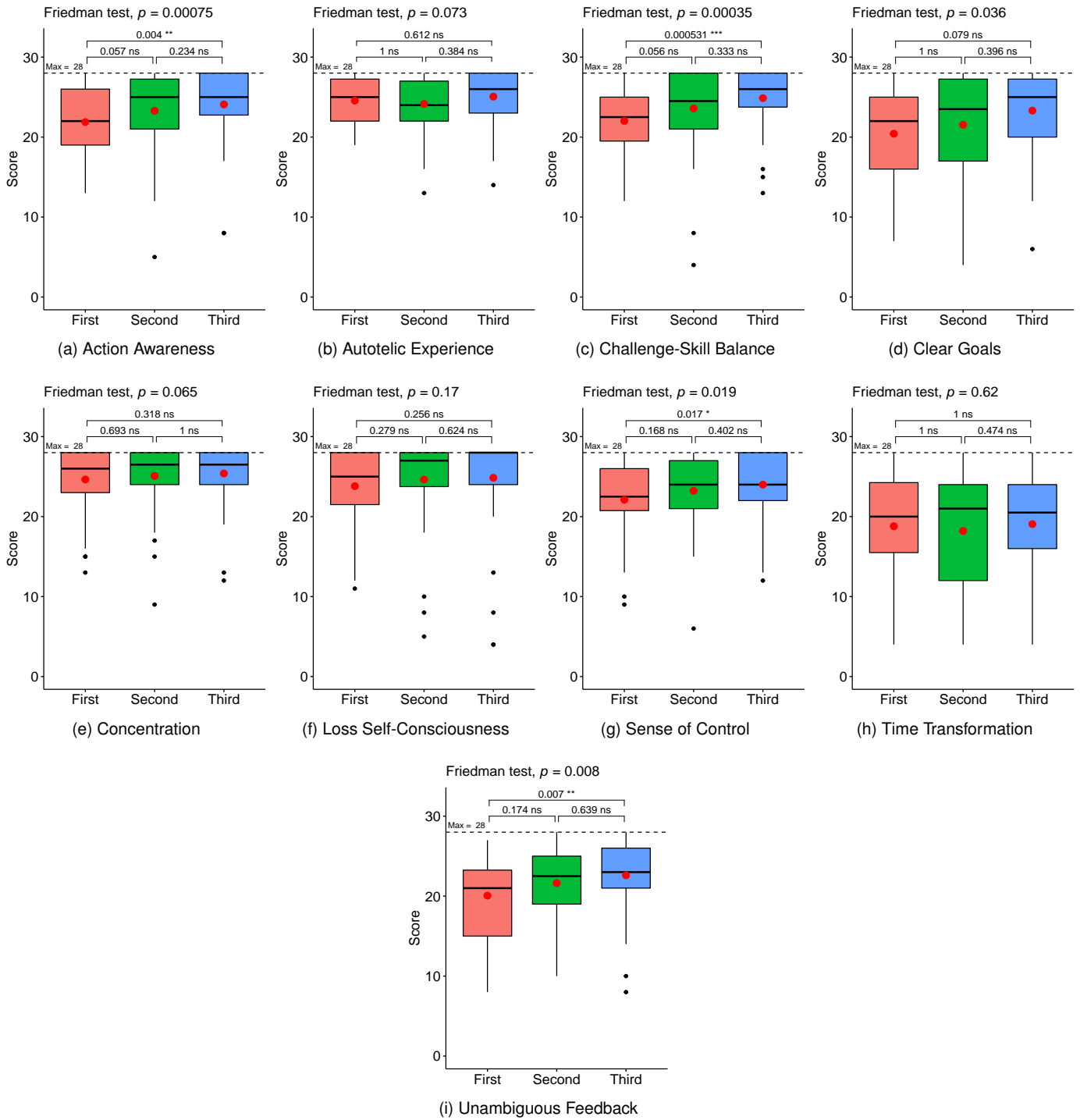


Fig. 2. Boxplots considering all Scenarios per Order

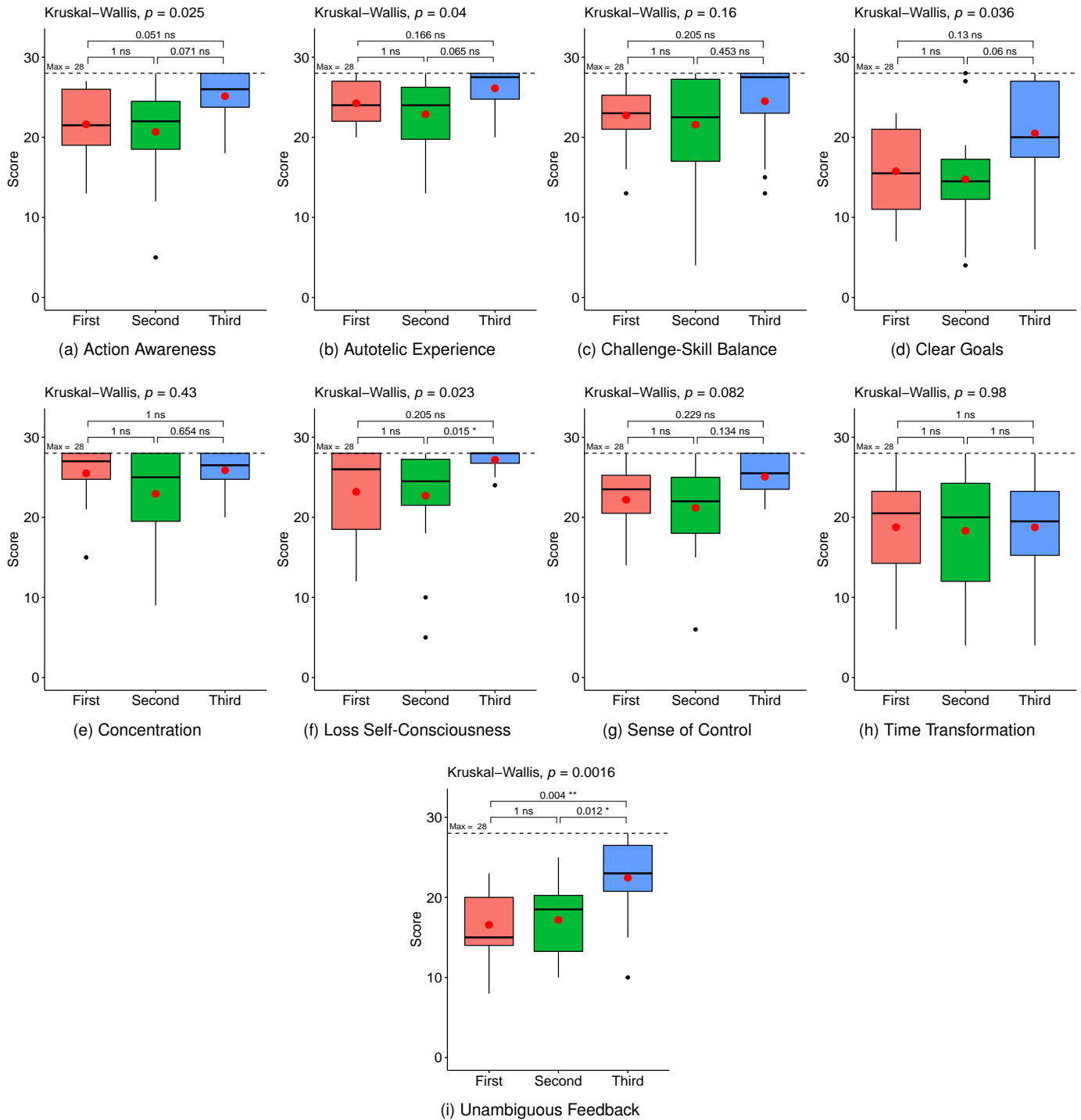


Fig. 3. Boxplots considering Exploration Scenario per Order

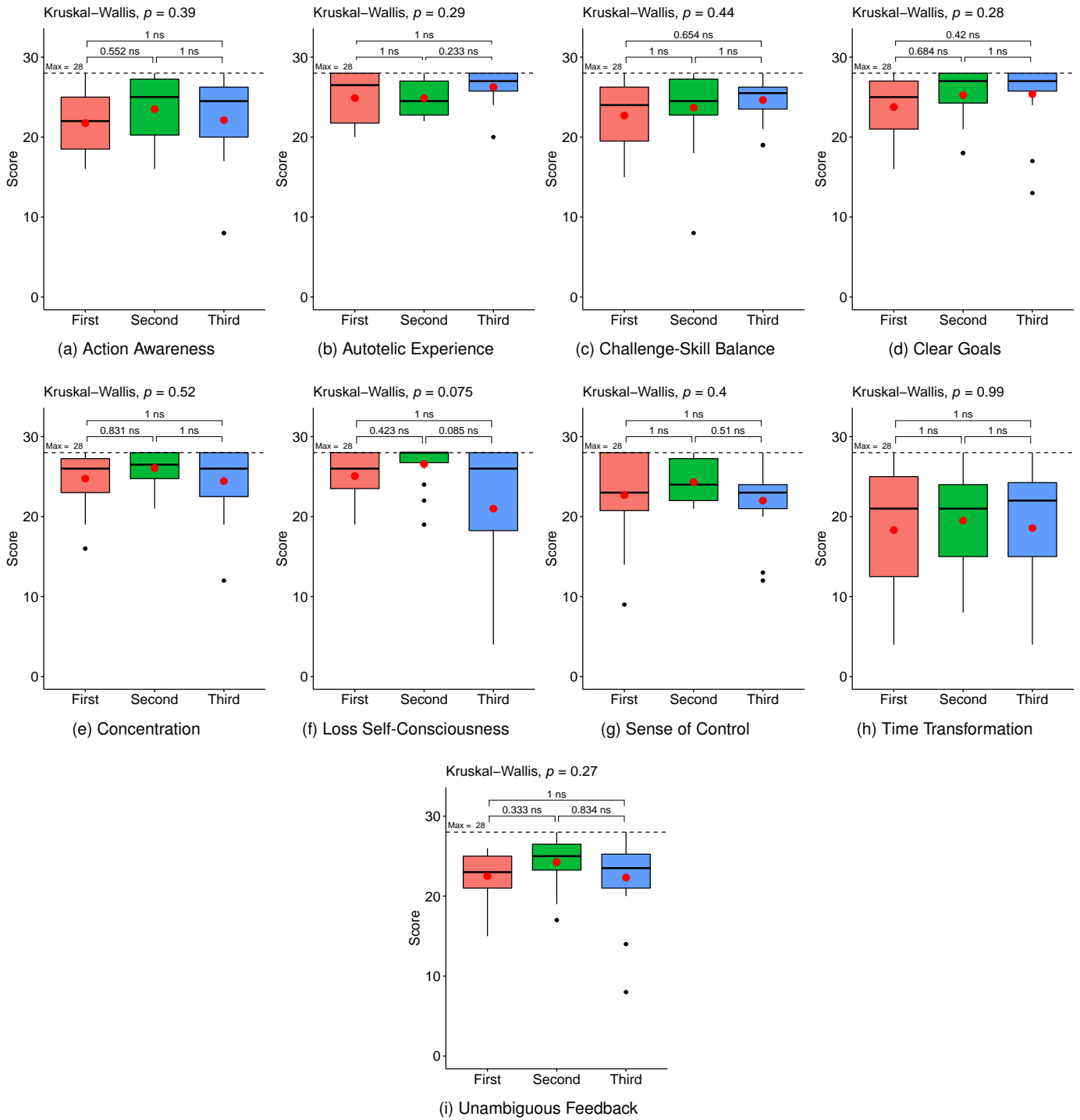


Fig. 4. Boxplots considering Adventure Scenario per Order

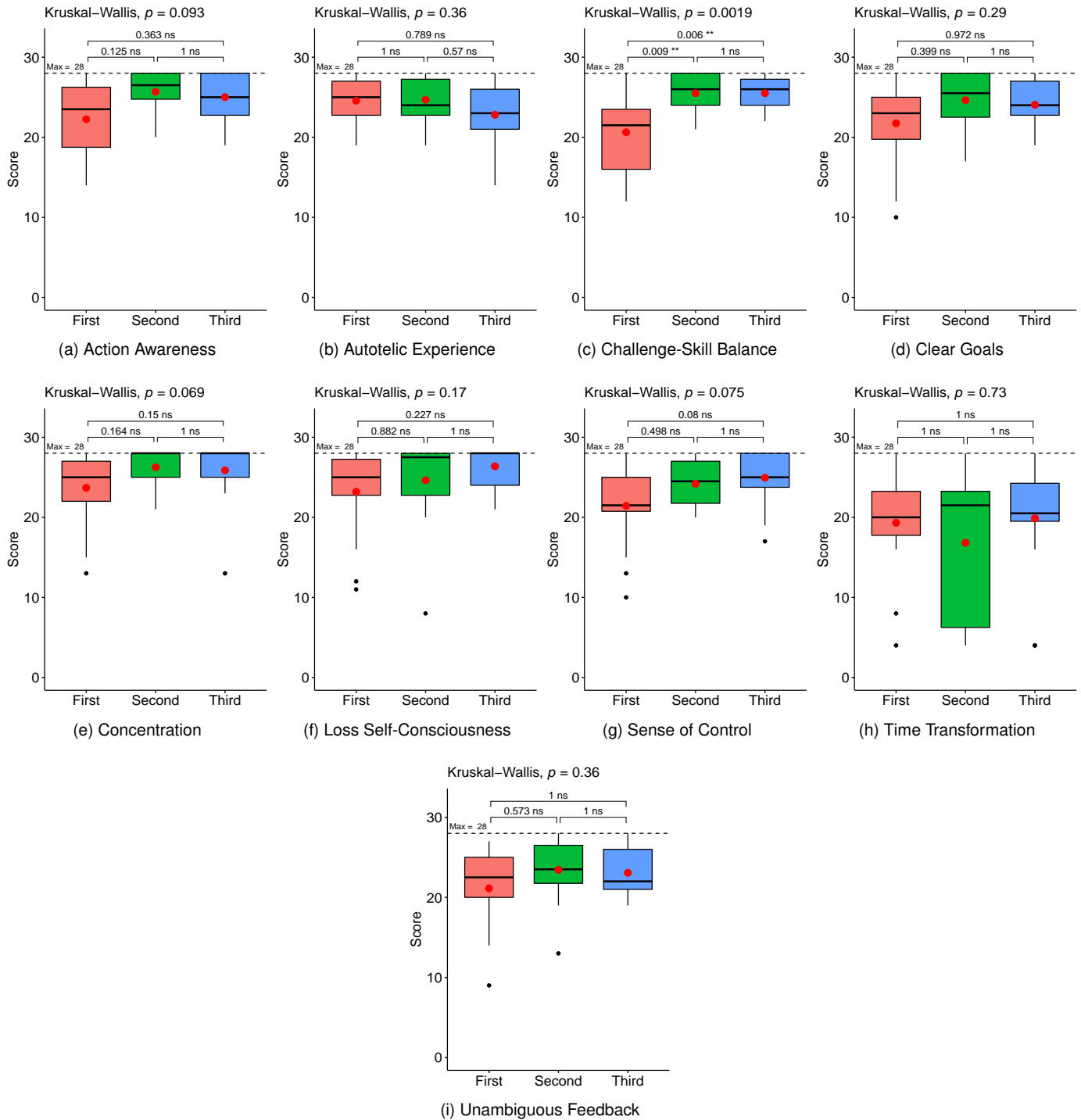


Fig. 5. Boxplots considering Role-Playing Scenario per Order

	AVE	CR	R2	AA	A	AE	C	CSB	CG	Co	G	LSC	N	SC	S	TT	UF
AA	0.731	0.916	0.167														
A	0.613	0.826		0.445													
AE	0.736	0.917	0.041	0.595	0.228												
C	0.738	0.942		0.215	0.226	0.173											
CSB	0.816	0.946	0.057	0.642	0.198	0.509	0.127										
CG	0.731	0.890	0.175	0.806	0.463	0.586	0.185	0.588									
Co	0.803	0.942	0.214	0.685	0.378	0.530	0.120	0.528	0.556								
G	0.614	0.863		0.157	0.439	0.157	0.293	0.122	0.268	0.349							
LSC	0.805	0.942	0.189	0.600	0.194	0.407	0.391	0.550	0.278	0.538	0.120						
N	0.576	0.871		0.191	0.621	0.177	0.269	0.190	0.147	0.312	0.289	0.165					
SC	0.717	0.909	0.243	0.953	0.532	0.618	0.193	0.585	0.731	0.578	0.238	0.692	0.222				
S	0.563	0.861		0.176	0.449	0.125	0.184	0.132	0.195	0.142	0.254	0.108	0.304	0.207			
TT	0.765	0.929	0.140	0.227	0.346	0.155	0.129	0.202	0.129	0.116	0.137	0.255	0.134	0.128	0.162		
UF	0.547	0.821	0.157	0.943	0.448	0.589	0.188	0.642	1.063	0.549	0.187	0.551	0.239	0.871	0.204	0.313	

TABLE 2

**Exploration scenario.** Convergent Validity (AVE), Composite Reliability (CR) and Explained Variance (R2). HTMT are reported in the diagonal. Player traits (Aesthetic: A, Challenge: C, Goal: G, Narrative: N, Social: S), Flow (Action Awareness: AA, Autotelic Experience: AE, Challenge-Skill Balance: CSB, Clear Goals: CG, Concentration: Co, Lost of Self-Consciousness: LSC, Sense of Control: SC, Time Transformation: TT, Unambiguous Feedback: UF).

	AVE	CR	R2	AA	A	AE	C	CSB	CG	Co	G	LSC	N	SC	S	TT	UF
AA	0.717	0.910	0.225														
A	0.613	0.826		0.544													
AE	0.597	0.855	0.096	0.250	0.225												
C	0.731	0.915		0.224	0.226	0.246											
CSB	0.551	0.828	0.195	0.951	0.479	0.223	0.202										
CG	0.783	0.916	0.228	0.791	0.538	0.248	0.169	0.796									
Co	0.797	0.940	0.184	0.717	0.383	0.250	0.122	0.626	0.675								
G	0.621	0.867		0.199	0.439	0.161	0.293	0.248	0.389	0.237							
LSC	0.703	0.904	0.183	0.403	0.356	0.231	0.212	0.569	0.270	0.584	0.142						
N	0.571	0.869		0.356	0.621	0.293	0.269	0.325	0.207	0.281	0.289	0.288					
SC	0.731	0.916	0.214	0.125	0.829	0.381	0.207	0.151	0.822	0.872	0.788	0.257	0.477	0.206			
S	0.643	0.899		0.143	0.449	0.199	0.184	0.174	0.150	0.149	0.254	0.279	0.304	0.122			
TT	0.847	0.957	0.182	0.126	0.370	0.089	0.128	0.113	0.248	0.105	0.289	0.152	0.270	0.189	0.154		
UF	0.595	0.852	0.259	0.805	0.579	0.254	0.205	0.887	1.058	0.656	0.391	0.512	0.296	0.857	0.217	0.193	

TABLE 3

**Role-Playing scenario.** Convergent Validity (AVE), Composite Reliability (CR) and Explained Variance (R2). HTMT are reported in the diagonal. Player traits (Aesthetic: A, Challenge: C, Goal: G, Narrative: N, Social: S), Flow (Action Awareness: AA, Autotelic Experience: AE, Challenge-Skill Balance: CSB, Clear Goals: CG, Concentration: Co, Lost of Self-Consciousness: LSC, Sense of Control: SC, Time Transformation: TT, Unambiguous Feedback: UF).

	AVE	CR	R2	AA	A	AE	C	CSB	CG	Co	G	LSC	N	SC	S	TT	UF
AA	0.731	0.916	0.188														
A	0.613	0.826		0.488													
AE	0.736	0.917	0.088	0.305	0.206												
C	0.738	0.942		0.125	0.226	0.187											
CSB	0.816	0.946	0.141	0.435	0.151	0.301	0.274										
CG	0.731	0.890	0.148	0.653	0.417	0.385	0.121	0.218									
Co	0.803	0.942	0.158	0.504	0.464	0.335	0.116	0.242	0.827								
G	0.614	0.863		0.213	0.439	0.155	0.293	0.136	0.223	0.345							
LSC	0.805	0.942	0.173	0.437	0.165	0.109	0.276	0.079	0.272	0.316	0.221						
N	0.576	0.871		0.214	0.621	0.217	0.269	0.182	0.228	0.204	0.289	0.208					
SC	0.717	0.909	0.214	0.394	0.455	0.327	0.149	0.284	0.651	0.638	0.311	0.174	0.163				
S	0.563	0.861		0.157	0.449	0.148	0.184	0.272	0.184	0.155	0.254	0.231	0.304	0.212			
TT	0.765	0.929	0.079	0.157	0.231	0.243	0.106	0.113	0.087	0.103	0.197	0.167	0.131	0.101	0.146		
UF	0.547	0.821	0.207	0.811	0.565	0.333	0.168	0.253	0.968	0.808	0.183	0.487	0.248	0.597	0.249	0.134	

TABLE 4

**Adventure scenario.** Convergent Validity (AVE), Composite Reliability (CR) and Explained Variance (R2). HTMT are reported in the diagonal. Player traits (Aesthetic: A, Challenge: C, Goal: G, Narrative: N, Social: S), Flow (Action Awareness: AA, Autotelic Experience: AE, Challenge-Skill Balance: CSB, Clear Goals: CG, Concentration: Co, Lost of Self-Consciousness: LSC, Sense of Control: SC, Time Transformation: TT, Unambiguous Feedback: UF).

	AA	A	AE	C	CSB	CG	CO	G	LSC	N	SC	S	TT	UF
A1		0.8												
A2		0.801												
A5		0.746												
AA1	0.847													
AA2	0.86													
AA3	0.838													
AA4	0.876													
AE1			0.94											
AE2			0.709											
AE3			0.967											
AE4			0.789											
C1				0.861										
C3				0.829										
C4				0.868										
C5				0.877										
CG1						0.906								
CG2						0.9								
CG4						0.749								
CO1							0.927							
CO2							0.901							
CO3							0.832							
CO4							0.921							
CSB1					0.785									
CSB2					0.948									
CSB3					0.939									
CSB4					0.932									
G1								0.67						
G3								0.761						
G4								0.817						
G5								0.871						
LSC1									0.73					
LSC2									0.975					
LSC3									0.898					
LSC4									0.965					
N1										0.704				
N2										0.747				
N3										0.831				
N4										0.766				
N5										0.739				
S1												0.725		
S2												0.474		
S3												0.934		
S4												0.841		
S5												0.698		
SC1											0.646			
SC2											0.931			
SC3											0.863			
SC4											0.916			
TT1													0.91	
TT2													0.831	
TT3													0.856	
TT4													0.9	
UF1														0.614
UF2														0.91
UF3														0.862
UF4														0.491

TABLE 5

Outer loadings for the *Exploration* scenario. Player traits (Aesthetic: A, Challenge: C, Goal: G, Narrative: N, Social: S), Flow (Action Awareness: AA, Autotelic Experience: AE, Challenge-Skill Balance: CSB, Clear Goals: CG, Concentration: Co, Lost of Self-Consciousness: LSC, Sense of Control: SC, Time Transformation: TT, Unambiguous Feedback: UF).



	AA	A	AE	C	CSB	CG	CO	G	LSC	N	SC	S	TT	UF
A1		0.763												
A2		0.836												
A5		0.753												
AA1	0.84													
AA2	0.805													
AA3	0.807													
AA4	0.893													
AE1			0.571											
AE2			0.915											
AE3			0.742											
AE4			0.753											
C1				0.834										
C3				0.853										
C4				0.892										
C5				0.857										
CG1						0.889								
CG2						0.901								
CG4						0.868								
CO1							0.609							
CO2							0.815							
CO3							0.919							
CO4							0.921							
CSB1					0.739									
CSB2					0.918									
CSB3					0.875									
CSB4					0.917									
G1								0.779						
G3								0.85						
G4								0.775						
G5								0.764						
LSC1									0.97					
LSC2									0.949					
LSC3									0.867					
LSC4									0.965					
N1										0.585				
N2										0.637				
N3										0.821				
N4										0.862				
N5										0.771				
S1												0.836		
S2												0.734		
S3												0.867		
S4												0.866		
S5												0.727		
SC1											0.785			
SC2											0.91			
SC3											0.918			
SC4											0.913			
TT1													0.975	
TT2													0.98	
TT3													0.772	
TT4													0.969	
UF1														0.723
UF2														0.755
UF3														0.763
UF4														0.861

TABLE 6

Outer loadings for the *Adventure* scenario. Player traits (Aesthetic: A, Challenge: C, Goal: G, Narrative: N, Social: S), Flow (Action Awareness: AA, Autotelic Experience: AE, Challenge-Skill Balance: CSB, Clear Goals: CG, Concentration: Co, Lost of Self-Consciousness: LSC, Sense of Control: SC, Time Transformation: TT , Unambiguous Feedback: UF).

	AA	A	AE	C	CSB	CG	CO	G	LSC	N	SC	S	TT	UF
A1		0.803												
A2		0.807												
A5		0.736												
AA1	0.835													
AA2	0.854													
AA3	0.837													
AA4	0.86													
AE1			0.808											
AE2			0.643											
AE3			0.825											
AE4			0.802											
C1				0.799										
C3				0.912										
C4				0.867										
C5				0.837										
CG1						0.89								
CG2						0.915								
CG4						0.85								
CO1							0.878							
CO2							0.873							
CO3							0.885							
CO4							0.933							
CSB1					0.691									
CSB2					0.67									
CSB3					0.692									
CSB4					0.893									
G1								0.738						
G3								0.804						
G4								0.765						
G5								0.841						
LSC1									0.792					
LSC2									0.912					
LSC3									0.817					
LSC4									0.827					
N1										0.732				
N2										0.809				
N3										0.782				
N4										0.734				
N5										0.717				
S1												0.838		
S2												0.657		
S3												0.854		
S4												0.85		
S5												0.795		
SC1											0.882			
SC2											0.888			
SC3											0.784			
SC4											0.863			
TT1													0.964	
TT2													0.956	
TT3													0.81	
TT4													0.943	
UF1														0.585
UF2														0.751
UF3														0.868
UF4														0.848

TABLE 7

Outer loadings for the *Role-Playing* scenario. Player traits (Aesthetic: A, Challenge: C, Goal: G, Narrative: N, Social: S), Flow (Action Awareness: AA, Autotelic Experience: AE, Challenge-Skill Balance: CSB, Clear Goals: CG, Concentration: Co, Lost of Self-Consciousness: LSC, Sense of Control: SC, Time Transformation: TT , Unambiguous Feedback: UF).

	Aesthetic	Challenge	Narrative	Goal	Social
Challenge.Skill.Balance	0.398	0.607	0.514	0.531	0.776
Clear.Goals	0.034	0.819	0.304	0.509	0.771
Unambiguous.Feedback	0.059	0.455	0.650	0.719	0.991
Sense.of.Control	0.013	0.312	0.971	0.859	0.741
Action.Awareness	0.030	0.320	0.790	0.936	0.804
Concentration	0.327	0.346	0.296	0.097	0.690
Loss.of.Self.Consciousness	0.534	0.003	0.489	0.970	0.950
Time.Transformation	0.076	0.619	0.917	0.409	0.804
Autotelic.Experience	0.823	0.662	0.783	0.594	0.654

TABLE 8

p-values of PLS path coefficients for each player trait of flow dimensions for the *Exploration* scenario.

	Aesthetic	Challenge	Narrative	Goal	Social
Challenge.Skill.Balance	0.092	0.514	0.485	0.476	0.476
Clear.Goals	0.140	0.955	0.807	0.071	0.611
Unambiguous.Feedback	0.139	0.712	0.977	0.067	0.408
Sense.of.Control	0.198	0.913	0.957	0.448	0.978
Action.Awareness	0.051	0.424	0.342	0.839	0.497
Concentration	0.108	0.529	0.388	0.749	0.237
Loss.of.Self.Consciousness	0.145	0.221	0.434	0.558	0.566
Time.Transformation	0.233	0.219	0.523	0.242	0.771
Autotelic.Experience	0.769	0.195	0.569	0.905	0.786

TABLE 9

p-values of PLS path coefficients for each player trait of flow dimensions for the *Role-Playing* scenario.

	Aesthetic	Challenge	Narrative	Goal	Social
Challenge.Skill.Balance	0.297	0.223	0.608	0.613	0.091
Clear.Goals	0.214	0.403	0.598	0.595	0.931
Unambiguous.Feedback	0.011	0.742	0.876	0.466	0.960
Sense.of.Control	0.114	0.775	0.185	0.171	0.334
Action.Awareness	0.012	0.728	0.655	0.376	0.442
Concentration	0.211	0.800	0.900	0.209	0.671
Loss.of.Self.Consciousness	0.087	0.003	0.318	0.292	0.527
Time.Transformation	0.404	0.651	0.413	0.383	0.460
Autotelic.Experience	0.724	0.289	0.717	0.668	0.517

TABLE 10

p-values of PLS path coefficients for each player trait of flow dimensions for the *Adventure* scenario.