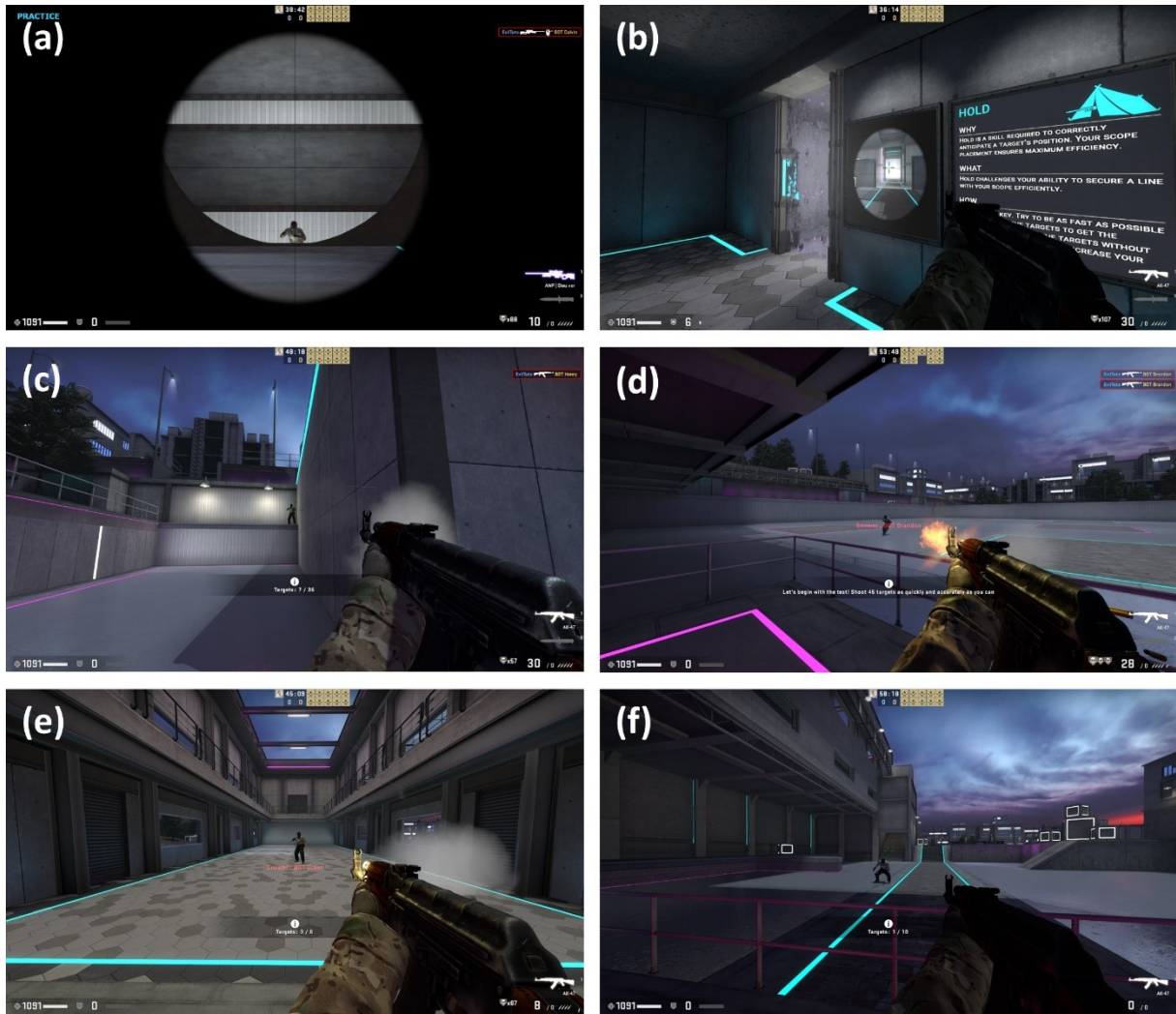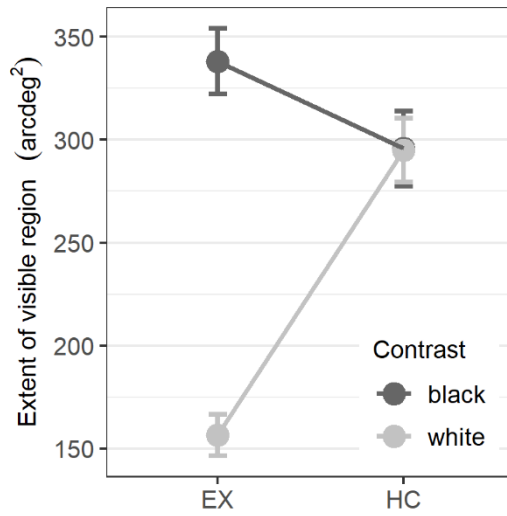# Supplementary File – How do visual skills relate to action video game performance?

Aline F. Cretenoud, Arthur Barakat, Alain Milliet, Oh-Hyeon Choung, Marco Bertamini, Christophe Constantin, & Michael H. Herzog
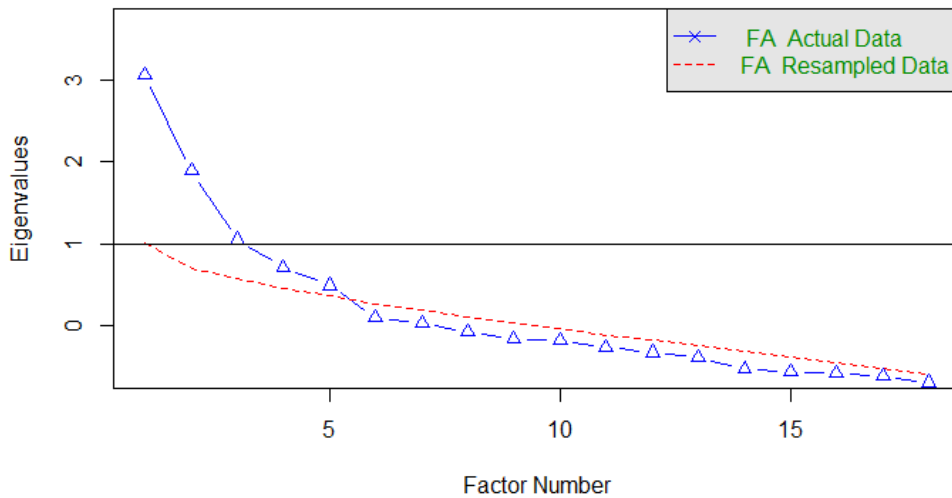
1. Supplementary Figures

Figure S1. Screenshots of the (a) flick, (b) hold, (c) peek, (d) shoot, (e) spray, and (f) track CS:GO mini-games, which are publicly available on playmaster.gg.

Figure S2. Mean extent of the region (in units of arcdeg^2) in which barbs (Honeycomb, HC) and disks (Extinction, EX) were perceptible as a function of the contrast polarity (black or white) in the HC/EX paradigm. Error bars show standard errors (*SE*).

Figure S3. Scree plot from an exploratory factor analysis on the visual variables only. A common factor analysis was computed to extract the factors. Eigenvalues are shown for the actual data (in blue) and for resampled data (in red). A three-factor model is suggested by scree plot inspection, while a parallel analysis suggested a five-factor model.

2. Supplementary Tables

Table S1. Conversion from ordinal CS:GO ranks to numerical equivalents

Ordinal	Numerical
Silver I	1
Silver II	2
Silver III	3
Silver IV	4
Silver Elite	5
Silver Elite Master	6
Gold Nova I	7
Gold Nova II	8
Golda Nova III	9
Gold Nova Master	10
Master Guardian I	11
Master Guardian II	12
Master Guardian Elite	13
Distinguished Master Guardian	14
Legendary Eagle	15
Legendary Eagle Master	16
Supreme Master First Class	17
The Global Elite	18

Table S2. Reliability estimates expressed as an intraclass coefficient (ICC) of type (3,1) for each variable extracted from the HC/EX and Illusion paradigms, visual acuity (VisAcuity) and visual backward masking (VBM). Highlighted in orange are the variables, which showed a 95% confidence interval of the ICC including 0.5 (or below), indicating poor reliability according to Koo and Li (2016).

Paradigm	Variable	ICC		F test with true value 0			
		Coefficient	95% CI	F	df	p	pBonf
EX/HC	EX black	0.787	[0.713, 0.844]	8.398	[93, 93]	<0.001	<0.001
	EX white	0.848	[0.793, 0.890]	12.184	[93, 93]	<0.001	<0.001
	HC black	0.872	[0.824, 0.908]	14.647	[93, 93]	<0.001	<0.001
	HC white	0.822	[0.758, 0.870]	10.213	[93, 93]	<0.001	<0.001
Illusions	CS left	0.561	[0.432, 0.667]	3.551	[93, 93]	<0.001	<0.001
	CS right	0.569	[0.442, 0.674]	3.644	[93, 93]	<0.001	<0.001
	EB left	0.723	[0.630, 0.795]	6.213	[93, 93]	<0.001	<0.001
	EB right	0.605	[0.485, 0.703]	4.062	[93, 93]	<0.001	<0.001
	ML in	0.638	[0.525, 0.729]	4.522	[93, 93]	<0.001	<0.001
	ML out	0.528	[0.393, 0.640]	3.234	[93, 93]	<0.001	<0.001
	PD left	0.722	[0.629, 0.794]	6.196	[93, 93]	<0.001	<0.001
	PD right	0.666	[0.560, 0.751]	4.989	[93, 93]	<0.001	<0.001
	PZ down	0.639	[0.526, 0.729]	4.533	[93, 93]	<0.001	<0.001
	PZ up	0.371	[0.215, 0.509]	2.181	[93, 93]	<0.001	0.003
	TT left	0.317	[0.156, 0.462]	1.929	[93, 93]	<0.001	0.021
	TT right	0.399	[0.246, 0.533]	2.329	[93, 93]	<0.001	<0.001
	VH hor	0.530	[0.395, 0.642]	3.251	[93, 93]	<0.001	<0.001
	VH ver	0.756	[0.672, 0.820]	7.182	[93, 93]	<0.001	<0.001
	WH left	0.110	[-0.061, 0.275]	1.248	[93, 93]	0.144	1
	WH right	0.508	[0.370, 0.624]	3.062	[93, 93]	<0.001	<0.001
	ZN left	0.714	[0.620, 0.788]	6.001	[93, 93]	<0.001	<0.001
	ZN right	0.715	[0.620, 0.789]	6.009	[93, 93]	<0.001	<0.001
VisAcuity		0.811	[0.743, 0.862]	9.561	[93, 93]	<0.001	<0.001
VBM		0.847	[0.791, 0.889]	12.064	[93, 93]	<0.001	<0.001

Table S3. Statistics from Shapiro-Wilk tests and lambda (λ) exponent from an optimized Tukey transformation that maximizes normality for each visual (green), gaming (orange), and questionnaire (purple) variable according to the Shapiro-Wilk test

	CrowdSize	CrowdPeri	Contrast	HC black	HC white	EX black	EX white
SW statistic	0.925**	0.877**	0.732**	0.904**	0.947**	0.960*	0.820**
SW statistic Z	0.987	0.989	0.982	0.987	0.992	0.993	0.987
lambda (λ)	-0.70	0.45	0.10	0.40	0.40	0.55	0.45
	Poggendorff	**Zöllner**	**NBack**	**Orient**	**RDK hor**	**RDK rad**	**ReacTime**
SW statistic	0.986	0.977	0.960*	0.623**	0.765**	0.796**	0.923**
SW statistic Z	0.987	0.990	0.967*	0.988	0.971*	0.976	0.991
lambda (λ)	0.90	1.15	1.95	-0.35	0.05	0.05	-1.90
	proTravel	**proSac**	**antiTravel**	**antiSac**	**VisAcuity**	**VBM**	**VisSrch4**
SW statistic	0.554**	0.808**	0.486**	0.967*	0.982	0.820**	0.947**
SW statistic Z	0.989	0.985	0.983	0.993	0.986	0.968*	0.989
lambda (λ)	1.55	-0.75	0.70	-0.80	1.40	0.20	0.00
	VisSrch16	**Shoot**	**Spray**	**Track**	**Hold**	**Flick**	**Peek**
SW statistic	0.812**	0.975	0.983	0.955*	0.989	0.983	0.986
SW statistic Z	0.991	0.988	0.983	0.955*	0.991	0.990	0.987
lambda (λ)	-1.10	2.05	0.85	1.00	2.00	1.85	1.10
	AQ SS	**AQ AS**	**AQ AD**	**AQ CO**	**AQ IM**	**BIS NI**	**BIS MI**
SW statistic	0.943**	0.939**	0.956*	0.959*	0.950*	0.976	0.976
SW statistic Z	0.954*	0.940**	0.958*	0.959*	0.950*	0.977	0.980
lambda (λ)	0.80	1.10	1.20	1.00	1.05	0.75	0.60
	BIS AI	**CI EC**	**CI CO**	**HEXACO HH**	**HEXACO EM**	**HEXACO EX**	**HEXACO AG**
SW statistic	0.965*	0.932**	0.977	0.986	0.988	0.978	0.987
SW statistic Z	0.981	0.979	0.978	0.990	0.988	0.985	0.990
lambda (λ)	0.25	2.65	0.85	1.45	1.10	1.65	1.40
	HEXACO CO	**HEXACO OP**	**Handedness**	**O-LIFE UE**	**O-LIFE CD**	**O-LIFE IA**	**O-LIFE IN**
SW statistic	0.960*	0.975	0.725**	0.929**	0.958*	0.932**	0.950*
SW statistic Z	0.983	0.990	0.933**	0.954*	0.968*	0.945**	0.959*
lambda (λ)	2.35	1.95	3.55	0.75	0.75	0.80	0.80
	PRFd	**NbHours PerWeek**	**NbTotal Hours**	**Actual CS:GO rank**	**Best CS:GO rank**	**NbHours Sleep**	
SW statistic	0.974	0.828**	0.555**	0.929**	0.928**	0.946**	
SW statistic Z	0.976	0.975	0.973*	0.946**	0.930**	0.968*	
lambda (λ)	0.80	0.00	0.25	0.45	1.20	2.45	

The Shapiro-Wilk test was run both before (SW statistic) and after (SW statistic Z) data were transformed using a Tukey transformation with the optimized λ exponent (outliers were removed only in the visual variables). Significant statistics indicate a violation of the normality assumption. * $p < 0.05$, ** $p < 0.05/55$ (Bonferroni correction for multiple comparisons).

Table S4. Correlations between personality traits and all other variables expressed as correlation coefficients (Pearson's *r*). A color scale from blue to red shows effect sizes from *r* = -1 to *r* = 1. Numbers in italics indicate significant results without correction (α = 0.05). None of the significant correlations survived Bonferroni correction (α = 0.05/990; 990 correlations were computed in total, see Table 2 in the main text). Green, orange, and purple indicate visual, gaming, and questionnaire variables, respectively.

	AQ	BIS	CI	HEXACO HH	HEXACO EM	HEXACO EX	HEXACO AG	HEXACO CO	HEXACO OP	Handedness	O-LIFE	PRFd
CrowdSize	.18	-.09	-.02	.11	.18	-.10	-.15	.09	-.03	.01	.09	-.02
CrowdPeri	.03	.04	.03	.11	-.06	-.02	.05	.12	.16	-.02	-.08	.00
Contrast	-.10	.15	-.08	-.01	.18	.19	.19	-.12	.02	*-.26*	-.03	.01
HC black	*-.26*	-.09	*.25*	.02	*-.24*	.13	.00	*.23*	-.06	.19	-.07	.07
HC white	*-.21*	-.07	*.24*	.03	*-.27*	.11	.02	.19	-.05	*.23*	-.10	.02
EX black	-.14	-.19	*.23*	.12	*-.21*	.06	.06	.19	.01	*.20*	-.06	.01
EX white	-.16	-.04	*.29*	*.28*	*-.31*	.07	.02	.03	-.02	.13	-.08	-.03
Poggendorff	-.13	-.04	-.10	.12	-.02	.13	.06	.05	.13	-.15	-.08	.09
Zöllner	-.06	-.12	.13	-.13	-.06	-.01	.08	.11	.00	-.15	.07	.14
NBack	.03	.08	.08	.07	.00	.08	-.04	-.06	.08	-.07	.09	.07
Orient	-.14	.03	.06	*.22*	.04	-.12	.12	-.03	.10	-.01	.05	-.01
RDK hor	.04	-.04	-.19	-.05	.04	-.16	-.02	-.03	-.18	-.18	.06	-.09
RDK rad	-.13	-.02	-.09	.04	.05	-.08	.11	-.03	-.04	.05	-.07	.04
ReacTime	-.05	-.02	-.02	-.01	-.04	.00	-.10	.01	-.15	.06	-.06	.08
proTravel	-.05	.12	-.03	-.04	.02	-.03	.07	-.01	-.01	-.08	-.01	.03
proSac	-.18	-.02	-.17	-.02	-.03	.10	.05	-.12	-.11	.16	-.02	-.02
antiTravel	-.12	.19	.05	-.05	-.11	-.03	.03	-.06	.03	.01	.00	.06
antiSac	*-.25*	-.07	-.14	.05	-.03	.08	.04	.04	-.07	.14	*-.21*	.05
VisAcuity	-.08	-.09	-.16	.14	-.03	.02	.15	-.10	.03	*-.22*	-.09	-.05
VBM	-.04	.12	-.13	-.11	*.23*	.10	.18	*-.24*	-.06	*-.23*	.10	-.06
VisSrch4	*-.20*	.04	.08	-.15	.07	.14	-.14	-.02	-.05	-.08	.01	.03
VisSrch16	-.15	-.02	.00	-.11	.01	.04	-.14	.08	-.05	-.08	.09	.01
Shoot	-.06	.00	-.02	.18	-.11	.02	.02	.01	-.09	.04	-.06	-.15
Spray	.06	-.13	-.06	*.29*	-.19	-.17	.09	.11	-.13	.11	-.15	*-.25*
Track	-.06	.02	-.04	.15	-.12	-.06	.13	.02	-.14	-.06	-.18	-.13
Hold	-.12	-.14	.04	.19	-.01	.11	.03	-.07	.00	.00	*-.24*	.09
Flick	.07	.16	.01	.15	.03	-.08	.10	-.07	-.12	.10	.01	-.07
Peek	*-.30*	-.01	.07	.19	-.14	.16	*.24*	-.05	*.27*	.03	-.18	.09
NbHoursPerWeek	*-.23*	.13	.03	*.23*	-.09	.01	.07	-.05	-.08	.06	.00	*-.24*
NbTotalHours	-.13	.17	-.07	.16	-.17	.12	.08	-.07	*-.28*	.13	-.06	-.12
Actual CS:GO rank	-.03	.14	.00	*.23*	-.12	.04	.05	-.09	*-.28*	.13	-.05	*-.25*
Best CS:GO rank	-.07	.12	-.03	.18	-.10	.07	.05	-.07	*-.31*	.11	-.09	*-.21*
NbHoursSleep	-.02	.10	-.20	-.15	.08	-.14	.07	*-.23*	.00	.02	.03	-.12