

Supplementary Materials

Training material for the experimental group

FLIGHT PERFORMANCES FEEDBACK

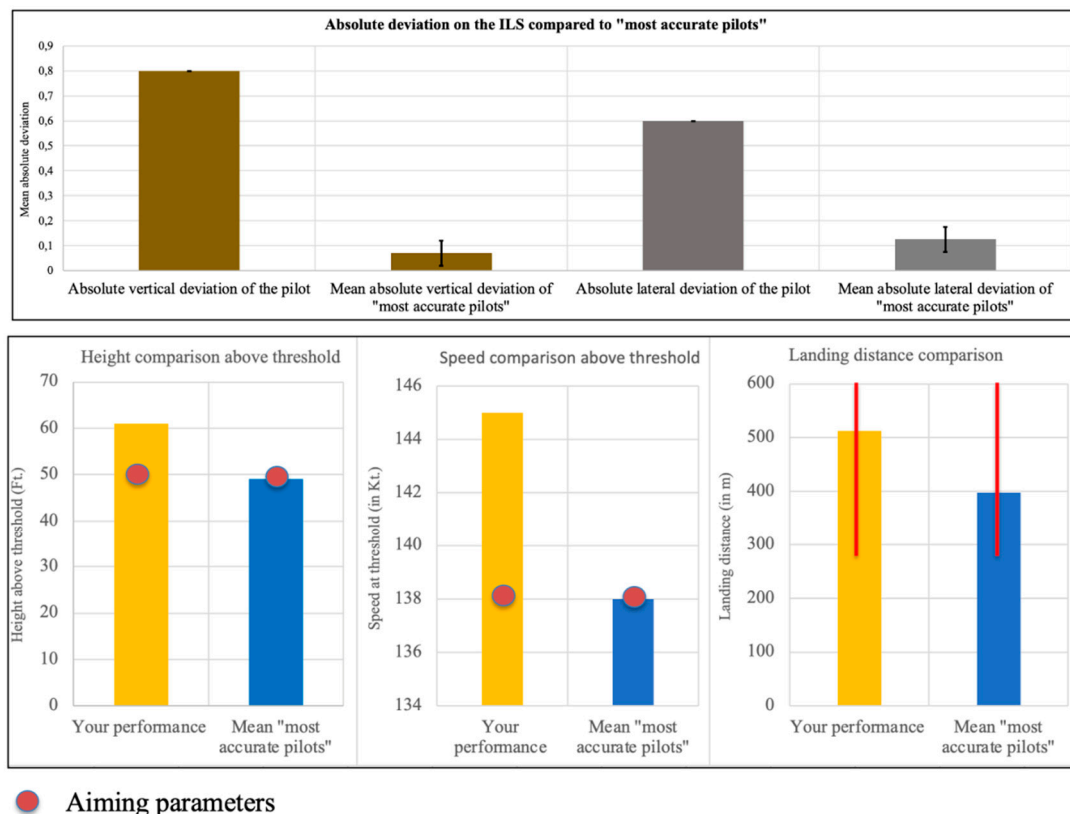


Figure S1. Top, vertical and lateral deviations of the considered participant compared to the most accurate pilots. Bottom, other performance metrics of the considered participant compared to the most accurate pilots.



Figure S2. Eye tracking video showing the gaze behavior of the considered participant. The red circle indicated by the arrow represents the current fixation point.

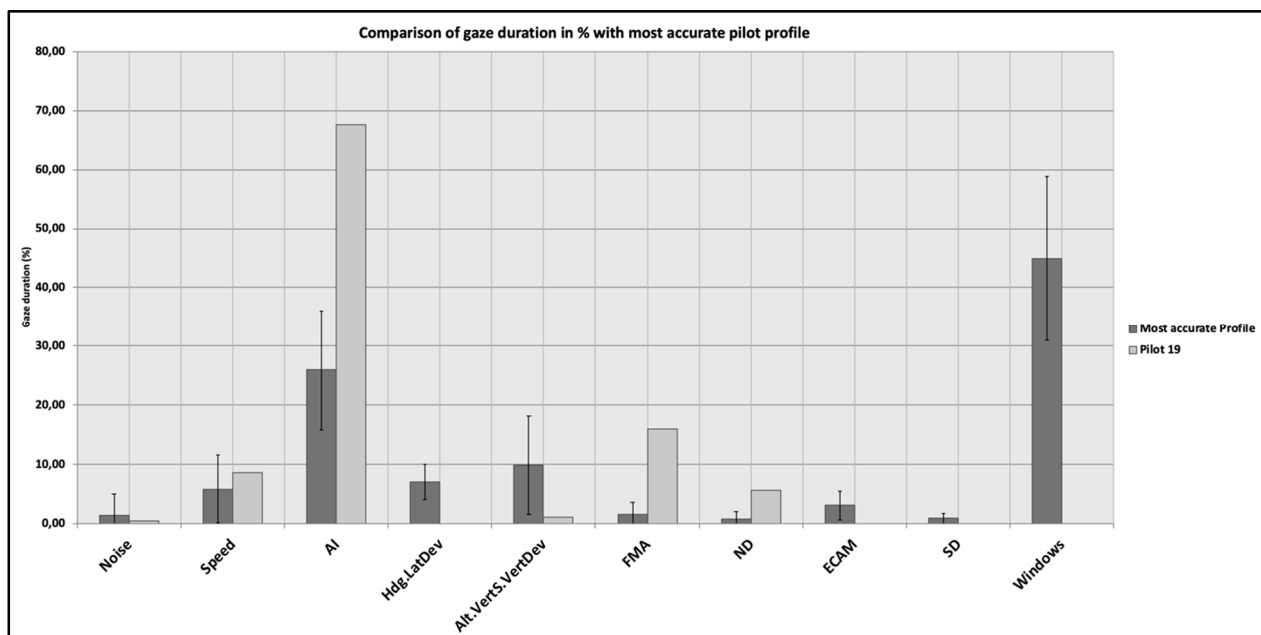


Figure S3. Bar chart showing the percentage of dwell times spent by the most accurate pilots on each of the 9 AOIs and by the considered pilots. Error bars of the dark gray bars represent the efficient interval. Dwell times of the considered pilot are represented with the light gray bar.

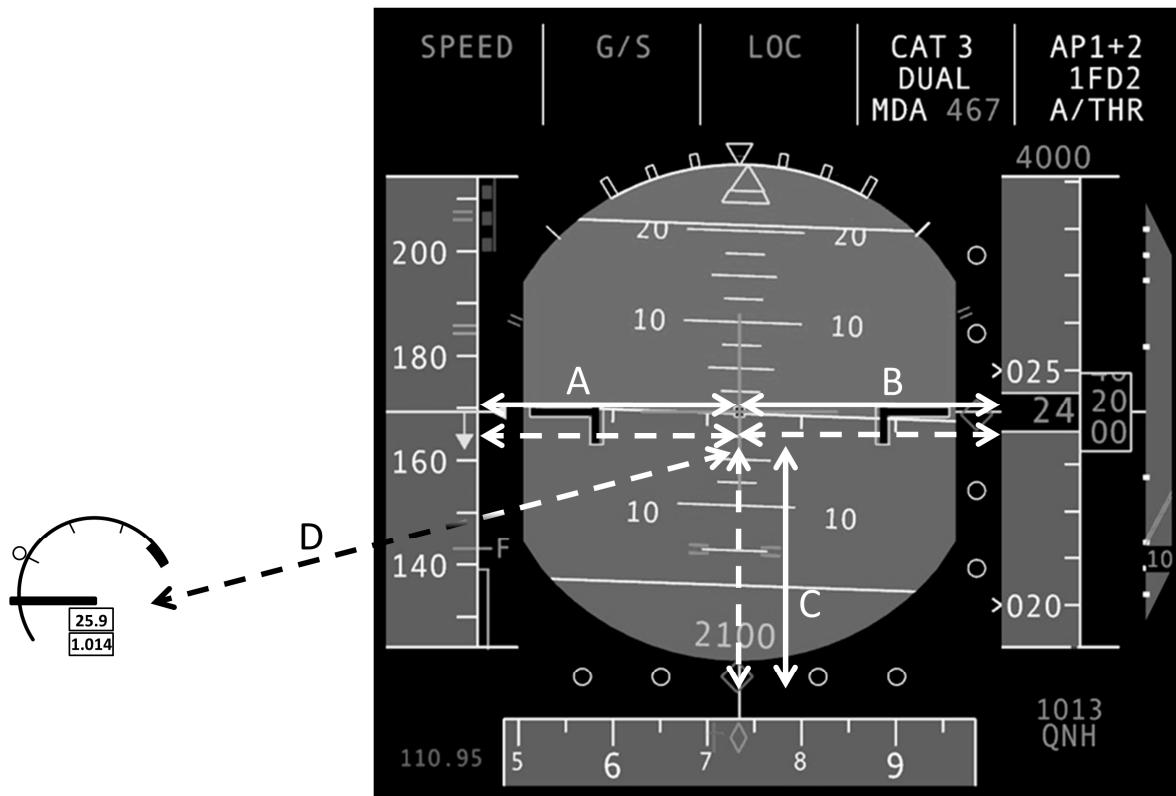


Figure S4. Representation of the four efficient visual patterns, as showed to the eye tracking group. These visual patterns were related to the speed (visual pattern A), the vertical deviation (visual pattern B), the lateral deviation (visual pattern C), and the general attitude of the aircraft including engine (visual pattern D). Patterns represented in solid lines (A, B, C) are more frequent than the one represented with dashed lines (D).



Figure S5. Eye tracking video showing the gaze behavior of one of the most accurate pilots. The red circle indicated by the arrow represents the current fixation point.

Training material for the control group

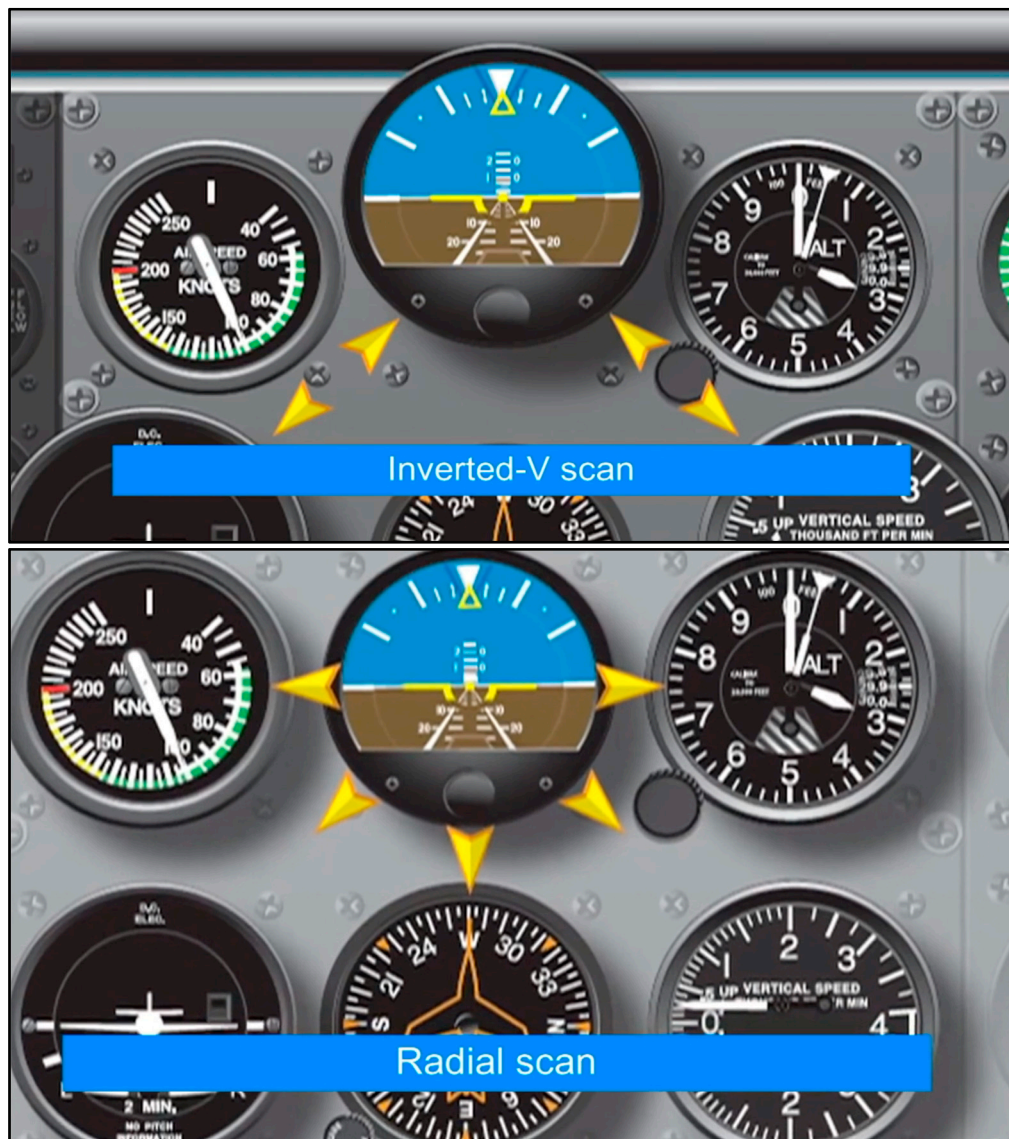


Figure S6. Each pilot from the control group were presented with a generic video about aircraft attitude changes maneuvers and associated visual scan strategies used during pilots' initial training.

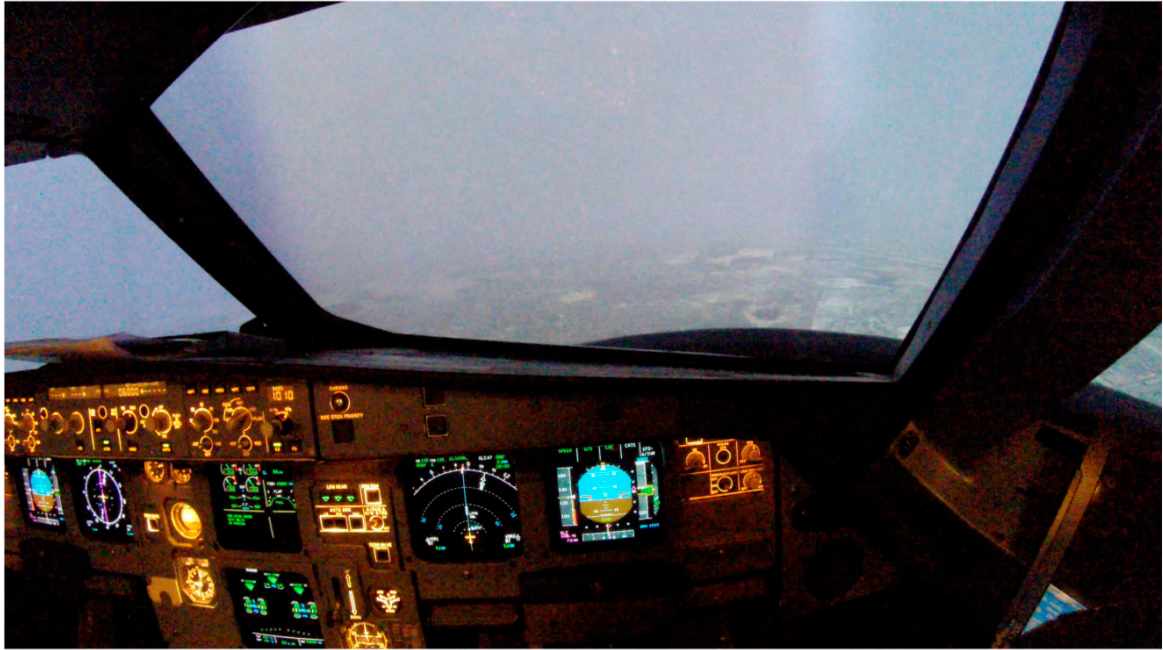


Figure S7. Video of the approach without gaze allocation of the pilot (without the moving red circle). The video was recorded with a head-mounted GoPro camera and had the same point of view as the eye tracking video.

Tables

Table S1. Percentage of dwell times on each cockpit AOI for all PFs during the pre-training session. (Undefined = undefined locations plus loss of gaze). HLD = Heading and Lateral Deviation, AVSVD = Altitude, Vertical Speed and Vertical Deviation.

PF of the Pre- Training Session	Pilot's Profiles Pre- Training Session	Areas Of Interest									
		<i>Undefined</i>	<i>Speed</i>	<i>AI</i>	<i>HLD</i>	<i>AVSVD</i>	<i>FMA</i>	<i>ND</i>	<i>ECAM</i>	<i>SD</i>	<i>Windows</i>
Pilot 1	<i>Standard Pilot</i>	1.7	4.8	23.7	4.9	8.0	0.9	1.8	3.1	1.0	51.1
Pilot 2	<i>Standard Pilot</i>	1.7	3.4	23.3	6.2	9.3	0.2	0.0	3.4	0.0	52.1
Pilot 3	<i>Standard Pilot</i>	2.9	8.2	33.2	6.1	9.2	1.4	0.3	4.6	0.1	34.1
Pilot 4	<i>Unstabilized</i>	7.0	4.0	42.7	6.1	25.0	0.1	13.3	1.7	0.0	1.1
Pilot 5	<i>Most Accurate</i>	1.2	8.5	32.2	9.9	13.0	1.4	1.3	2.3	1.3	28.4
Pilot 6	<i>Standard Pilot</i>	1.3	5.1	23.0	4.6	9.8	0.3	0.5	0.9	1.6	55.4
Pilot 7	<i>Unstabilized</i>	2.7	2.2	19.6	1.5	4.6	1.5	1.6	0.6	0.9	64.5
Pilot 8	<i>Most Accurate</i>	1.1	8.0	29.5	9.6	14.9	1.5	0.3	1.8	0.8	34.4
Pilot 9	<i>Standard Pilot</i>	2.8	8.3	28.4	6.9	10.3	0.8	1.0	4.2	1.4	38.0
Pilot 10	<i>Standard Pilot</i>	3.0	1.0	26.9	5.7	8.1	0.7	0.2	1.8	0.1	53.2
Pilot 11	<i>Unstabilized</i>	1.4	5.7	10.6	19.4	1.9	0.2	0.2	2.5	0.2	57.6
Pilot 12	<i>Standard Pilot</i>	0.2	4.5	24.7	7.9	0.2	4.1	2.8	1.7	3.2	53.4
Pilot 13	<i>Most Accurate</i>	2.8	4.0	23.3	6.6	9.6	3.1	0.2	2.6	2.9	44.8
Pilot 14	<i>Standard Pilot</i>	1.1	10.4	24.2	3.1	8.0	2.7	0.1	0.2	1.4	50.7
Pilot 15	<i>Standard Pilot</i>	3.8	5.4	27.4	1.8	8.2	0.8	0.2	0.1	0.2	51.5
Pilot 16	<i>Standard Pilot</i>	2.1	3.6	25.4	6.0	13.2	1.8	0.4	2.2	1.3	42.5
Pilot 17	<i>Unstabilized</i>	2.7	4.5	2.9	10.1	16.3	0.6	0.2	3.9	0.4	57.8
Pilot 18	<i>Standard Pilot</i>	2.6	2.2	19.7	1.5	4.6	1.4	1.5	0.6	0.9	64.4
Pilot 19	<i>Unstabilized</i>	0.4	8.4	67.6	0.0	0.9	16.5	5.6	0.0	0.0	0.0
Pilot 20	<i>Most Accurate</i>	3.4	4.7	27.0	5.6	11.5	2.3	1.2	3.0	3.2	38.0

Table S2. Total dwell times (s) on each cockpit AOI for all PFs during the pre-training session. (Undefined = undefined locations plus loss of gaze). HLD = Heading and Lateral Deviation, AVSVD = Altitude, Vertical Speed and Vertical Deviation.

PF of the pre-training session	Pilot's profiles pre-training session	Areas Of Interest									
		<i>Undefined</i>	<i>Speed</i>	<i>AI</i>	<i>HLD</i>	<i>AVSVD</i>	<i>FMA</i>	<i>ND</i>	<i>ECAM</i>	<i>SD</i>	<i>Windows</i>
Pilot 1	<i>Standard Pilot</i>	1.9	5.7	27.7	5.7	9.4	1.1	2.1	3.6	1.2	59.7
Pilot 2	<i>Standard Pilot</i>	1.9	3.8	26.2	6.9	10.5	0.2	0.0	3.8	0.0	58.4
Pilot 3	<i>Standard Pilot</i>	3.0	8.4	34.2	6.3	9.5	1.4	0.3	4.7	0.1	35.1
Pilot 4	<i>Unstabilized</i>	6.6	3.8	40.2	5.8	23.6	0.1	12.5	1.6	0.0	1.0
Pilot 5	<i>Most Accurate</i>	1.3	9.3	35.4	10.8	14.2	1.5	1.4	2.5	1.4	31.2
Pilot 6	<i>Standard Pilot</i>	1.6	6.3	28.1	5.6	12.0	0.4	0.6	1.1	2.0	67.6
Pilot 7	<i>Unstabilized</i>	2.6	2.1	18.9	1.4	4.4	1.4	1.6	0.6	0.9	62.1
Pilot 8	<i>Most Accurate</i>	1.1	8.2	30.1	9.8	15.2	1.5	0.3	1.8	0.8	35.1
Pilot 9	<i>Standard Pilot</i>	2.8	8.2	28.1	6.8	10.2	0.8	1.0	4.2	1.4	37.6
Pilot 10	<i>Standard Pilot</i>	3.2	1.1	29.1	6.2	8.8	0.8	0.2	2.0	0.1	57.5
Pilot 11	<i>Unstabilized</i>	1.3	5.4	10.0	18.2	1.8	0.2	0.2	2.3	0.2	54.1
Pilot 12	<i>Standard Pilot</i>	0.2	5.2	28.0	8.9	0.2	4.6	3.2	1.9	3.6	60.4
Pilot 13	<i>Most Accurate</i>	3.0	4.2	24.9	7.1	10.3	3.3	0.2	2.8	3.1	47.9
Pilot 14	<i>Standard Pilot</i>	1.1	10.7	25.0	3.2	8.2	2.8	0.1	0.2	1.5	52.3
Pilot 15	<i>Standard Pilot</i>	4.6	6.6	33.4	2.2	10.0	1.0	0.6	0.1	0.2	62.7
Pilot 16	<i>Standard Pilot</i>	2.1	3.6	25.5	59.7	13.2	1.8	0.4	2.2	1.3	42.6
Pilot 17	<i>Unstabilized</i>	2.4	4.0	2.6	8.9	14.6	0.5	0.2	3.5	0.4	51.9
Pilot 18	<i>Standard Pilot</i>	2.7	2.3	20.8	1.6	4.8	1.5	1.6	0.6	0.9	67.9
Pilot 19	<i>Unstabilized</i>	0.4	7.7	61.5	0.0	0.8	15.0	5.1	0.0	0.0	0.0
Pilot 20	<i>Most Accurate</i>	3.5	4.8	27.8	5.8	11.9	2.4	1.3	3.1	3.3	39.1

Table S3. Percentage of the four efficient visual scanning patterns and other patterns for all PFs during the pre-training session.

PF of the pre-training session	Proportion of the four efficient visual scan patterns				
	<i>Speed pattern (A)</i>	<i>Vertical deviation pattern (B)</i>	<i>Lateral deviation pattern (C)</i>	<i>General attitude pattern (D)</i>	<i>Other pattern</i>
Pilot 1	5.3%	6.3%	14.1%	9.2%	65.1%
Pilot 2	3.9%	13.2%	12.2%	8.1%	63.0%
Pilot 3	4.3%	10.2%	12.3%	8.6%	64.8%
Pilot 4	2.3%	7.9%	3.1%	2.3%	84.3%
Pilot 5	17.2%	14.1%	19.2%	11.3%	38.2%
Pilot 6	8.1%	8.3%	12.2%	3.9%	67.5%
Pilot 7	5.7%	3.2%	6.8%	1.9%	82.4%
Pilot 8	12.9%	15.1%	9.7%	17.2%	41.9%
Pilot 9	9.4%	8.6%	7.9%	9.7%	64.4%
Pilot 10	16.1%	12.3%	9.3%	2.4%	60.0%
Pilot 11	5.0%	15.8%	2.2%	6.5%	70.6%
Pilot 12	8.2%	11.3%	13.1%	6.0%	61.4%
Pilot 13	10.4%	9.7%	14.7%	13.9%	52.0%
Pilot 14	9.5%	10.7%	9.2%	9.2%	61.5%
Pilot 15	12.7%	8.9%	9.9%	5.1%	63.7%
Pilot 16	8.5%	8.3%	10.3%	9.1%	64.1%
Pilot 17	2.1%	6.8%	9.9%	2.8%	78.3%
Pilot 18	9.5%	6.6%	10.6%	7.0%	66.3%
Pilot 19	9.5%	2.7%	1.4%	1.4%	85.1%
Pilot 20	16.2%	12.5%	9.9%	12.5%	49.0%

Table S4. Percentage of dwell times on each cockpit AOI for the PFs of the control group during the post-training session. (Undefined = undefined locations plus loss of gaze). HLD = Heading and Lateral Deviation, AVSVD = Altitude, Vertical Speed and Vertical Deviation.

PF of the control group	Areas Of Interest									
	<i>Undefined</i>	<i>Speed</i>	<i>AI</i>	<i>HLD</i>	<i>AVSVD</i>	<i>FMA</i>	<i>ND</i>	<i>ECAM</i>	<i>SD</i>	<i>Windows</i>
Pilot 3	1.2	4.4	23.4	7.7	13.7	0.1	2.0	2.1	0.0	45.4
Pilot 12	0.8	3.1	32.6	11.6	15.8	0.1	1.5	3.1	0.1	31.4
Pilot 13	0.6	7.3	29.3	10.2	14.1	1.1	0.3	1.3	1.0	35.5
Pilot 15	3.5	6.4	26.4	9.4	9.3	0.5	1.0	4.1	0.2	38.7
Pilot 16	4.3	5.8	27.8	15.5	14.3	0.2	2.3	2.6	0.1	26.9
Pilot 19	1.2	4.9	39.3	12.7	23.2	1.0	3.6	0.6	0.0	13.4
Pilot 20	1.1	4.1	33.3	11.7	9.3	3.0	2.7	1.7	0.0	32.3

Table S5. Dwell times (s) on each cockpit AOI for the PFs of the control group during the post-training session. (Undefined = undefined locations plus loss of gaze). HLD = Heading and Lateral Deviation, AVSVD = Altitude, Vertical Speed and Vertical Deviation.

PF of the control group	Areas Of Interest									
	<i>Undefined</i>	<i>Speed</i>	<i>AI</i>	<i>HLD</i>	<i>AVSVD</i>	<i>FMA</i>	<i>ND</i>	<i>ECAM</i>	<i>SD</i>	<i>Windows</i>
Pilot 3	1.2	4.5	24.1	8.0	14.1	0.1	2.1	2.1	0.0	46.8
Pilot 12	0.9	3.5	36.9	13.1	17.8	0.2	1.7	3.5	0.1	35.5
Pilot 13	0.6	7.9	31.6	11.0	15.2	1.2	0.4	1.5	1.1	38.3
Pilot 15	4.4	8.1	33.2	11.8	11.7	0.6	1.2	5.2	0.3	48.8
Pilot 16	4.3	5.7	27.5	15.4	14.1	0.2	2.3	2.6	0.1	26.6
Pilot 19	1.0	4.1	32.6	10.5	19.3	0.8	3.0	0.5	0.0	11.1
Pilot 20	1.2	4.6	37.3	13.1	10.4	3.4	3.1	1.9	0.0	36.2

Table S6. Percentage of dwell times on each cockpit AOI for the PFs of the experimental group during the post-training session. (Undefined = undefined locations plus loss of gaze). HLD = Heading and Lateral Deviation, AVSVD = Altitude, Vertical Speed and Vertical Deviation.

PF of the experimental group	Areas Of Interest									
	<i>Undefined</i>	<i>Speed</i>	<i>AI</i>	<i>HLD</i>	<i>AVSVD</i>	<i>FMA</i>	<i>ND</i>	<i>ECAM</i>	<i>SD</i>	<i>Windows</i>
Pilot 1	0.7	10.7	25.8	10.2	11.4	1.3	1.1	3.0	0.0	35.9
Pilot 5	1.2	7.4	31.3	11.6	11.2	3.0	1.0	2.0	0.0	31.4
Pilot 6	2.4	5.2	32.0	10.2	13.8	1.7	1.0	2.1	0.1	31.5
Pilot 7	2.9	6.6	28.3	5.3	15.6	3.2	1.0	3.2	0.2	34.9
Pilot 8	0.9	9.2	28.4	9.4	15.3	1.9	0.8	2.6	0.0	31.3
Pilot 10	2.6	5.6	26.1	8.1	16.0	1.4	1.2	1.5	0.0	37.7
Pilot 11	1.9	4.0	34.9	5.4	11.9	1.5	0.8	2.3	0.0	37.4

Table S7. Dwell times (s) on each cockpit AOI for the PFs of the experimental group during the post-training session. (Undefined = undefined locations plus loss of gaze). HLD = Heading and Lateral Deviation, AVSVD = Altitude, Vertical Speed and Vertical Deviation.

PF of the experimental group	Areas Of Interest									
	<i>Undefined</i>	<i>Speed</i>	<i>AI</i>	<i>HLD</i>	<i>AVSVD</i>	<i>FMA</i>	<i>ND</i>	<i>ECAM</i>	<i>SD</i>	<i>Windows</i>
Pilot 1	0.7	10.9	26.3	10.4	11.6	1.3	1.1	3.0	0.0	36.6
Pilot 5	1.3	8.2	34.4	12.8	12.3	3.3	1.1	2.2	0.0	34.5
Pilot 6	2.7	5.8	36.2	11.5	15.6	1.9	1.1	2.3	0.1	35.6
Pilot 7	2.8	6.5	27.8	5.2	15.3	3.1	1.0	3.1	0.1	34.2
Pilot 8	1.0	9.8	30.4	10.0	16.4	2.0	0.9	2.8	0.0	33.5
Pilot 10	2.8	6.1	28.4	8.8	17.4	1.5	1.3	1.6	0.0	41.1
Pilot 11	1.9	4.2	35.9	5.6	12.2	1.5	0.8	2.4	0.0	38.5

Table S8. Percentage of the four efficient visual scanning patterns and other patterns for the control group during the post-training session.

PF of control group	Proportion of the four efficient visual patterns				
	<i>Speed pattern (A)</i>	<i>Vertical deviation pattern (B)</i>	<i>Lateral deviation pattern (C)</i>	<i>General attitude pattern (D)</i>	<i>Other pattern</i>
Pilot 12	11.8%	8.8%	13.9%	6.6%	76.4%
Pilot 13	9.7%	7.6%	14.6%	11.2%	56.9%
Pilot 14	11.8%	14.0%	9.7%	16.1%	48.4%
Pilot 15	4.5%	12.0%	14.6%	7.6%	63.1%
Pilot 16	9.8%	8.8%	14.5%	10.1%	60.5%
Pilot 19	2.8%	7.1%	8.3%	2.7%	79.2%
Pilot 20	13.7%	11.1%	6.8%	12.0%	57.3%

Table S9. Percentage of the four efficient visual scanning patterns and other patterns for the experimental group during the post-training session.

PF of the experimental group	Proportion of the four efficient visual patterns				
	<i>Speed pattern (A)</i>	<i>Vertical deviation pattern (B)</i>	<i>Lateral deviation pattern (C)</i>	<i>General attitude pattern (D)</i>	<i>Other pattern</i>
Pilot 1	10.8%	10.5%	21.3%	16.4%	43.2%
Pilot 5	13.4%	7.6%	14.6%	13.4%	51.6%
Pilot 6	11.4%	11.9%	9.3%	11.9%	56.0%
Pilot 7	9.1%	15.5%	11.5%	13.5%	51.1%
Pilot 8	10.7%	9.0%	15.6%	15.6%	50.3%
Pilot 10	13.0%	16.8%	9.2%	13.7%	48.1%
Pilot 11	11.7%	9.0%	10.4%	16.2%	57.2%