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LEARNING STYLE, MOTIVATION, EMOTIONAL STATE AND WORKLOAD OF HIGH PERFORMERS

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Abstract

This study aims to characterize the learning style, motivation, emotional state, physiological activation and workload of high performers at the beginning of a practical flight training course. Instructor ratings of flight performance, psychophysiological parameters of heart rate and heart rate variability, and self-ratings of workload, emotion and motivation of 61 trainees enrolled on an ab initio flight training course were used for the assessment. The students were assigned to three performance groups based on the instructor ratings: high (N=19), low (N=20) and average (N=22). Data of the high and low performance groups were compared. The results show that high performers perceived the physical demand of the flight task as being lower compared to the low performance group, probably because they performed better and made fewer corrections. In line with this finding, the results also show that effort as perceived by students, was lower in the high performance group as compared to the low performance group. The own performance was rated better in the high performance than by the low performance group. The high performance group scored lower in negative emotions than the low performance group. No significant group differences in motivation, positive emotion and physiological activation were found. However, the results show differences in learning styles of the groups. High performers scored higher on the visual and sensing learning index and lower on the intuitive learning index than low performers. The results will be used to improve the effectiveness of flight instruction by addressing different learning styles.

Keywords: High performer, learning style, motivation; emotion, workload, flight training.

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1. Introduction

An extremely high demand for 617,000 new commercial airline pilots worldwide was forecast by the industry for the next 20 years (Boeing, 2017). A major research field in aviation psychology addresses the selection and training of future pilots, for improving the safety and efficiency of flight training (Koglbauer 2015a, 2015b; Lee, Bates, Murray & Martin, 2017; Martinussen & Hunter, 2017).

2. Problem Statement

This study addresses top performance at the beginning of a practical flight training course in relation to the emotion, motivation, workload and learning style of the students. Felder and Silverman (1988) investigated the learning style of engineering students and classified different learning styles depending on their preferred type of information perception and processing. Students with a sensory learning style prefer to perceive external information whereas those with an intuitive learning style prefer to extract information from ideas and insights (Felder & Silverman, 1988). Visual learners prefer visual information such as pictures or animations, and verbal learners prefer spoken or written words (Felder, 1988). Felder and Silverman (1988) classify learning styles in active (prefer to perform tasks physically or to discuss them) and reflective (prefer introspection). Students with a sequential learning style prefer a successive encoding whereas those with a global learning style prefer a simultaneous coding (Felder &Spurlin, 2005). High learning performance is seen as a match and low learning performance as a mismatch between teaching and learning styles (Felder & Silverman, 1988). For practical flight training the most used teaching means are flight simulators, real aircraft and a combination of both. The training environment can affect students' learning performance (Farmer, Van Rooij, Riemersma, Jorna, & Moraal, 2003; Koglbauer, Riesel, & Braunstingl, 2016; Oberhauser, Braunstingl, Dreyer, & Koglbauer, 2018). Performance is also influenced by the type of training (Koglbauer, Braunstingl, Haberkorn, & Prehofer, 2012; Koglbauer 2015a; Koglbauer, 2018a; Koglbauer, Braunstingl, Riesel, & Braunstingl, 2014).

Student emotion has been widely investigated in educational research, showing that emotions influence the teaching and learning process (Schultz & Pekrun, 2007). Eccles al., (2011) strengthened the role of emotional regulation and preparation for performance, motor behaviour and risk taking in sports. In the area of flight training Koglbauer, Kallus, Braunstingl and Boucsein (2011) showed that pilot frustration decreased, and the intensity of positive emotions increased after several sessions of training in a simulator and real aircraft. Higher training intensity had a significant effect on improving pilots' performance and positive emotions and decreasing pilots' subjective workload and frustration (Koglbauer et al., 2011). The motivational factors anxiety/ fear of failure, probability of success, interest, and challenge are considered relevant for learning situations (Rheinberg, Vollmeyer, & Burns, 2001). Several studies showed that initial motivation was related to learning behaviours and performance (Vollmeyer & Rheinberg, 1999, 2000). Rheinberg et al. (2001) showed that performance is related to the motivational factors challenge and interest, but also to the type of task and the amount of practice. In the aviation context Koglbauer (2018b) showed that coaching reduced students' anxiety/ fear of failure of disgracing themselves during flight training. However, coaching did not significantly influence other motivational factors such as challenge, probability of success and interest (Koglbauer, 2018b). The learning plan is a complex process that generates an objective and thorough knowledge of the surrounding world, social

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life, knowledge that subsumes both the processes and products of human thought, experience and collective creations (Manea, 2014). Professional satisfaction correlates with the consolidation of the personal position within the membership group, with the optimization of interpersonal relations, and with the increase of participation (Manea, 2013). Students' motivation is positively related to effort and persistence (Gao, Podlog, & Harrison, 2012).

Workload is seen as a mediating factor among task demands, skills, and performance (Wickens, 2002). Koglbauer et al. (2011) showed that pilots' performance improved after intensive training whereas their perceived effort and perceived task demand (e.g., mental and temporal) decreased. Research showed that parameters of cardiac activity reliably distinguished different levels of workload during flight (Lee& Liu, 2003; Metalis, 1991; Veltman & Gaillard, 1998), higher workload being associated with higher heart rates and lower heart rate variabilities.

3. Research Questions

This study addresses the characteristics of high performing student pilots enrolled in an *abinitio* flight training program by comparing the groups of high and low performers with regard to emotion, motivation, workload and learning style.

4. Purpose of the Study

This study aims to identify measures for improving the efficiency of flight training

5. Research Methods

5.1. Participants.

Sixty trainees enrolled into an ab initio flight training course volunteered for the assessment. All students signed an informed consent form. The students were assigned to three performance groups based on the instructor ratings of their real-flight performance: high performers (N=19, Mean=3.92, SD= 0.09, Median=3.86, Minimum=3.50, Maximum=4,92), low performers (N=20, Mean=2.62, 0.10, Median=2.79, Minimum=1.07, Maximum=3.00) and average performance (N=22, Mean=3.26, 0.02, Median=3.21, Minimum=3.07, Maximum=3.43). The high performance group had a mean age of 25.22 years (Median=25.5, SD=.55) and the low performance group had a mean age of 26.52 years (Median=25, SD=1.2).

5.2. Dependent Measures.

Motivation. The learning motivation was assessed using the Questionnaire on Current Motivation (QCM; Rheinberg et al., 2001) with four subscales: Anxiety, probability of success, interest, and challenge. The reliability of QCM was demonstrated with six populations of 944 subjects. In this study the student pilots filled the QCM questionnaire before the practical training.

Learning styles. Learning preferences of the students were assessed using the ILS questionnaire with 44 items developed by Felder and Soloman (2004). The index is based on the learning styles formulated by Felder and Silverman (1988) and revised by Felder (1988) containing four dimensions: Active/reflective, sensing/intuitive, visual/verbal, and sequential/global.

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Emotion. The students evaluated their emotions after the flight using the Positive and Negative Affect Schedule (PANAS) (Watson & Clark, 1988). Each item was rated by the pilots on a scale ranging from 1 (very slightly or not at all) to 5 (extremely). Total scores for positive and negative emotion can range from 10 to 50.

Subjective workload. Workload was assessed using the NASA Task Load Index (NASA–TLX; Hart, & Staveland, 1988) with six subscales (mental, physical and temporal demand, effort, performance and frustration in handling the task). The scale ranged from –5 (very low) to 5 (very high).

Objective workload. Chest electrocardiogram (ECG) was recorded with the Polar system. Five baseline measurements of 120 sec were collected in rest after the flight. Heart rate (HR) in beats per minute (bpm) and heart rate variability (HRV) calculated as mean square of successive differences (MSSD) were the parameters selected for analysis. Baseline recording were used for standardization of physiological data using the procedure described in (Koglbauer et al., 2011).

5.3. Data Analysis.

The non-parametric test Mann-Whitney-U was used for analysing differences between the groups high vs. low performers). A significance level of $\alpha = .05$ was adopted for all statistical tests. Results were presented descriptively considering statistical probabilities up to $p < .10$.

6. Findings

The median values of the high and low performers and the results of statistical analyses are listed in Table 1. As Fig. 1 shows, the high performers had significantly lower scores of physical demand, effort and frustration as compared to the low performers. High performers rated their own performance significantly better than the low performance group. The high performance group scored lower in negative emotions and frustration than the low performance group. No significant group differences in motivation, positive emotion and physiological activation were found. In addition, the results show differences in learning styles of the groups. High performers scored higher on the sensing and visual learning style index and lower on the intuitive learning style index than low performers. No significant group differences were found on the learning style indexes: active, reflective, verbal, sequential and global.

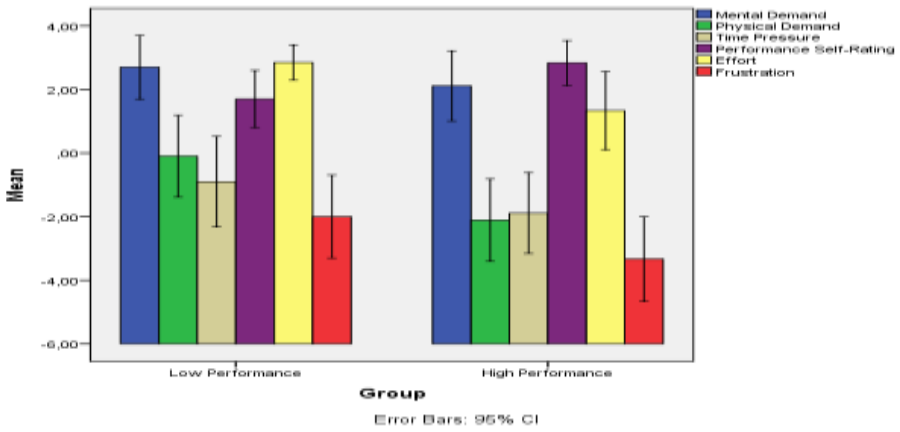

Figure 01. Mean scores of subjective workload. Error bars show the 95% confidence interval

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Table 01. Results of statistical tests

Dependent Variable	Mann-Whitney-U	Exact Significance (1-tailed)	Median Low Performers	Median High Performers
Motivation				
Challenge	174.50	0.439	19.50	20.00
Success Probability	145.50	0.158	5.00	6.00
Interest	166.00	0.342	27.50	29.00
Fear of Failure	141.00	0.130	12.50	10.00
Emotion				
Positive Emotion	158.00	0.350	41.00	41.00
Negative Emotion	106.50	0.039	15.00	12.00
Physiological Activation				
ΔMeanHR(bpm)	147.00	0,322	0.51	0.32
Δ HRV(RMSSD)	119.00	0,201	0.59	-0.13
NASA Task Load Index				
Mental Demand	152.00	0.206	3.00	2.00
Physical Demand	105.50	0.013	0.00	-3.00
Time Pressure	146.00	0.161	-1.00	-3.00
Performance Self-Rating	114.00	0.024	2.50	3.00
Effort	123.00	0.044	3.00	2.00
Frustration	131.50	0.074	-3.00	-5.00
Learning Style				
Active	149.00	0.181	7.00	8.00
Reflective	157.00	0.250	3.50	3.00
Sensing	133.50	0.087	6.50	8.00
Intuitive	134.00	0.089	4.50	3.00
Visual	124.00	0.046	9.00	10.00
Verbal	133.00	0.127	1.50	1.00
Sequential	152.50	0.213	4.50	5.00
Global	156.50	0.247	6.00	6.00

7. Conclusion

The results show that high performers perceived the physical demand of the flight task as being significantly lower compared to the low performance group, probably because they performed better and made fewer corrections. In line with this finding, the results show also that effort and frustration were lower in the high performance group compared with the low performance group. Group differences in positive emotion did not reach statistical significance. The performance self-ratings were significantly better in the high performance as compared to the low performance group. The high performance group scored lower in negative emotions than the low performance group. Since students' emotions influence the learning process (Schultz & Pekrun, 2007) they should be taken into consideration especially when the learning progress is below expectations, despite student effort.

The difference between heart rate test and baseline values was greater in the low performance as compared to high performance groups, but the differences did not reach statistical significance. The data matches previous findings that reported an increased heart rate in association with high workload during flight (Lee & Liu, 2003; Veltman & Gaillard, 1998). Group differences in the baseline corrected heart rate variability did not reach statistical significance either, despite previous research showing that lower effort is associated with higher heart rate variability. Our results of heart rate variability appear to contradict the expectations, but may have been distorted by other factors. According to Veltman and Gaillard (1998) the respiratory activity around 0.10 Hz interacts with the heart rate variability and this could have been the

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case in our subjects, too. Unfortunately the respiration rate was not monitored in this study. This is a limitation that needs to be addressed in future research.

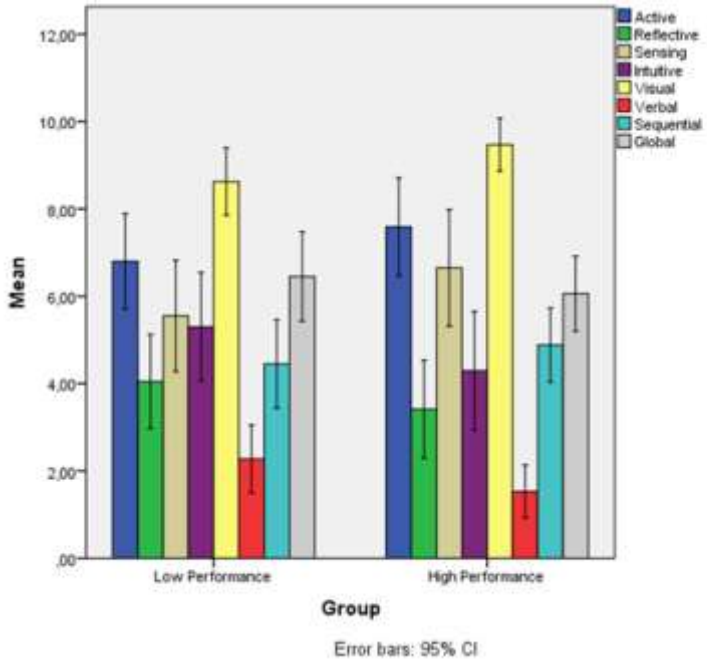

Figure 02. Mean scores on the Learning Style Index. Error bars show the 95% confidence interval

Interestingly, the results did not show any significant group differences in the investigated motivational factors such as anxiety/ fear of failure, probability of success, interest, and challenge. The initial motivation of students is considered to be related to learning behaviours and performance (Vollmeyer & Rheinberg, 1999, 2000). The motivational factors challenge and interest were shown to have an especially positive influence on performance (Rheinberg et al., 2001). In this study, however, the differences in performance between groups cannot be attributed to differences in motivation.

More insight into the results is provided by the differences in learning styles of the groups. In this study high performers showed a stronger preference for visual information processing, than low performers. In addition, our findings indicate a tendency towards sensing information in high performers (e.g., visual auditory information) and a stronger preference for intuitive information processing in low performers (e.g., ideas, thoughts). Felder and Silverman (1988) affirmed that high learning performance is the result of a match between students' learning style and instructors' teaching style. In this study the learning task (e.g., visual flight procedures) is predominantly sensory-motor and visual and may account for the differences in performance between groups. Since the mastery of basic flight skills is critical for advancing in the flight training, teaching strategies need to be developed that can support students with different learning styles. Thus, according to Felder and Silverman (1988), the flight instructors must facilitate the interpretation of theories that link the facts, actions and results for students with an intuitive style. The intuitive students may be prone to errors because they are impatient with details and don't like repetition. Thus, the instructors should be prepared to approach the student and create the right expectations about flight training, especially with regard to the required discipline, precision and consistency in the repetition of exercises.

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In conclusion, this study shows that in ab initio flight training high and low performers differ in their learning styles. High performers had a stronger preference for visual and sensing information processing and achieved better performance with less effort than low performers. Low performers were less visual and more intuitive, and they invested more effort and showed stronger negative emotions than high performers. Student learning styles, workload, emotions and motivation must be considered in flight training, especially in dealing with sub-standard performance.

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