BEHAVIOURAL MARKERS OF CONTROLLER DEVELOPMENT WITH ELECTRONIC FLIGHT PROGRESS STRIPS

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The central premise of this research is that Air Traffic Controllers display a variety of behaviours when interacting with a new system, dependent on their level of expertise, exposure, and experience. It is proposed that the occurrence and frequency of certain Non Technical user behaviours may be recorded and this data used to evaluate the level of development a user has established with a system. This research has undertaken 30 separate observations of controllers interacting with a new Electronic Flight Progress System during training and live ATC operations. Observations reveal the frequency of early stages of development behaviours reduce over time, however no positive significant correlation was observed for behaviours associated with advanced stages of development. The findings confirm that user behaviour changes as exposure to a system increases; however further research is needed to determine whether the behavioural markers associated with expert users increase in frequency as system exposure increases.

Introduction

Over many years the discipline of Crew Resource Management (CRM) has been gained increasing uptake across the airline industry. Indeed CRM skill training and refreshment is now a mandatory training component for UK pilots; set by the CAA . CRM is often assessed using behavioural observation during training . The Observation and assessment of Non-Technical Skills is performed using an observational sheet containing predefined behavioural markers. .

The central premise of this research is that users will display a variety of Non-Technical Skills and behaviours when interacting with a new system, dependent of their level of expertise, exposure, and experience. These behaviours may reflect the progress of certain NTS (e.g. communication), or their levels of engagement with the system (e.g. dexterity manipulating the interface). It is proposed that the occurrence and frequency of certain user behaviours may be recorded through structured observation. This data may then be used to evaluate the level of development a user has established with a system. It is suggested that this is to be a complementary technique to other assessment methods examining task performance and technical skill competency .

The goals of this research are to establish the phases of behavioural change from an air traffic controller's initial exposure to a new system through to proficient and mature use, to develop a structured framework and tool for use to determine an individual controller's state of behavioural development., and to provide the knowledge that underpins the design of both technology and training to support efficient and effective behavioural development.

Earlier research work that has identified and developed a set of structured behavioural markers for the purpose of assessing user engagement and development with an Electronic Flight Progress System (EFPS); a system which replaces paper flight strips within NATS UK tower operations . These individual behavioural markers are contained within an observation sheet, and organised into the following categories: Input and interaction with the HMI; Interaction with others; Physical Posture and Body Language; Attitude and Mood; Communications and Verbal Commentary. Furthermore, each individual behavioural marker is classified within a 4 level user development framework (Neophyte, Initiate, Adept, Magus). This observation sheet has been used during EFPS training, and later during live operational use in order to assess how controller behaviour changes as exposure to the new flight strip system increases.

Method

An Electronic Flight Progress Strip System is in the process of being introduced into UK Air Traffic Control operations to replace paper flight strips. Several NATS control towers have had this system introduced into their operations. Other control towers are in the process of receiving this technology. This situation allows a rare opportunity to observe users with a wide variation in exposure to this electronic flight strip system over a shortened time frame, compared to linearly tracking a single set of system users over an extended time period.

A total of 30 Observations were undertaken on the Air and Ground Tower Controller positions at three NATS units. 17 observations were undertaken during EFPS training (6 at Edinburgh, 11 at Glasgow). 13 were undertaken during EFPS post implementation live operational use (6 at Edinburgh, 7 at London City). An observation sheet developed during earlier research was used during these observations in order to capture users' behaviours whilst engaging and manipulating the system Thompson 2010); with each of the observations lasting approximately 30 minutes. A total of 20 individual controllers were observed.

Controller's exposure to the EFPS system ranged from 30 minutes, to approximately 80 hours. Hours of EFPS system exposure are based upon the training record, and for live operations the duty rota and an estimated number of hours daily exposure.

The observation task involved the occurrence of a specific behaviour noted down against the appropriate marker each instance it was displayed. A frequency limit of 5 instances for each marker within the observation period was set. User's exposure to the EFPS, prior to the observation session, ranged from 30 minutes to circa 80 hours.

Results

An analysis using Spearman's correlation reveals a significant negative correlation between Time and Neophyte behaviours P = .002 (N = 30), R = -.539 as well as a significant negative correlation between Time and Initiate behaviours P = .008 (N = 30), R = -.474. A significant negative correlation is found between Time and Adept behaviours P = .021 (N = 30), R = -.420. A non-significant positive correlation is found between Time and Magus behaviours P = .825 (N = 30), R = .042.

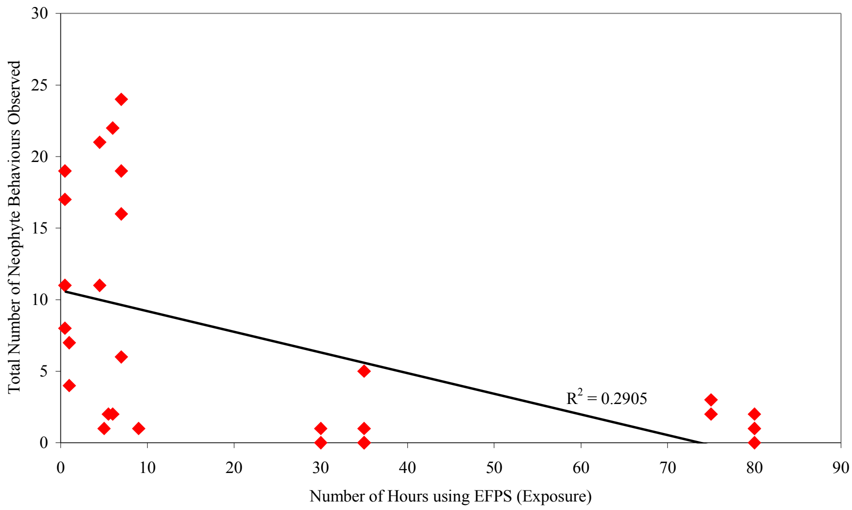

Figure 1 – Total Neophyte Behaviours Observed over EFPS Exposure (Time)

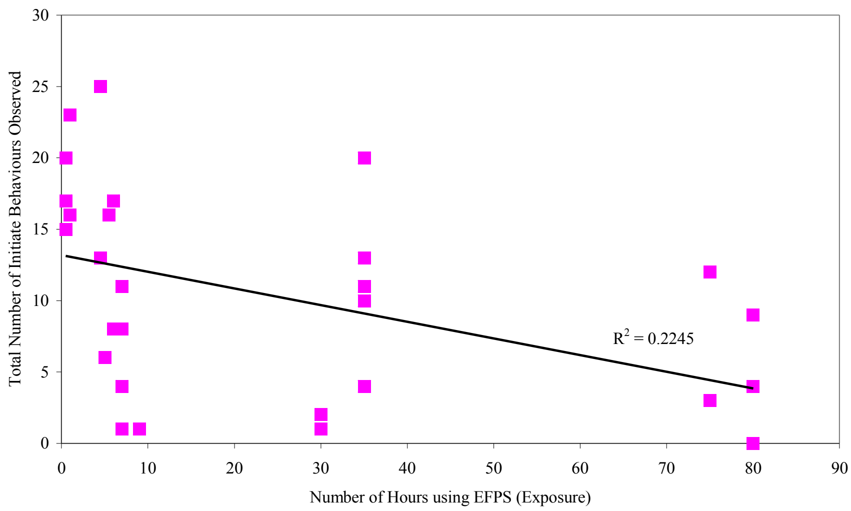

Figure 2 – Total Initiate Behaviours Observed over EFPS Exposure (Time)

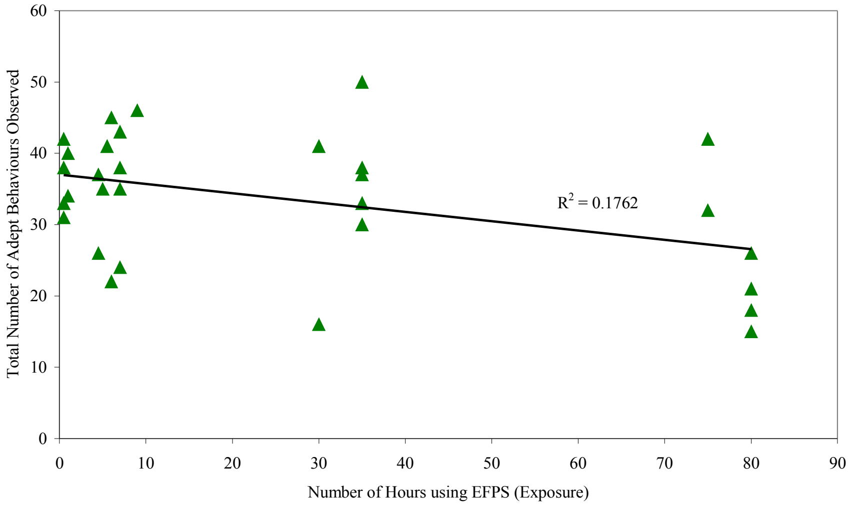

Figure 3 – Total Adept Behaviours Observed over EFPS Exposure (Time)

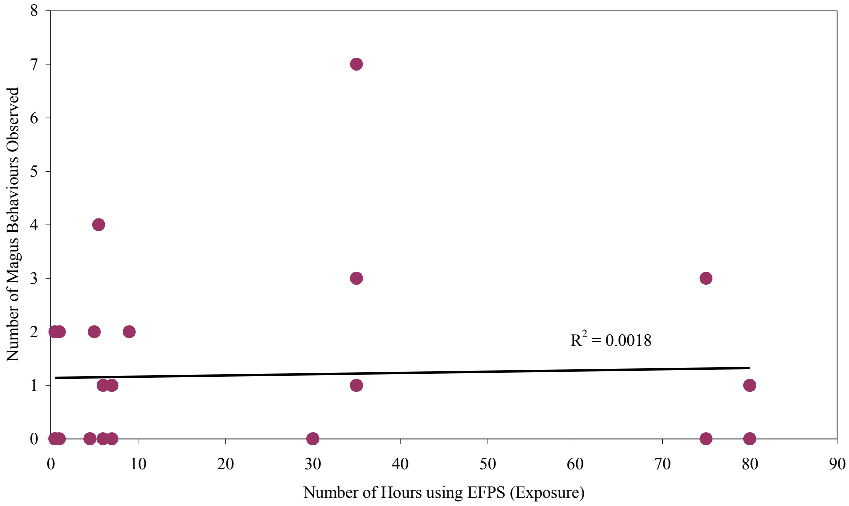

Figure 4 – Total Magus Behaviours Observed over EFPS Exposure (Time)

Discussion

Examining the correlation between the frequency of Neophyte behaviours and the amount of EFPS exposure, the results are strongly significant and indicate that behaviours associated with users at the earliest stages of system exposure reduce over time. This correlation is repeated for frequency of behaviours in the next lowest user development category, namely Initiate. As is seen with Neophyte behaviours, the frequency of Initiate behaviours also reduces significantly over time.

When examining the relationship between the frequency of more advanced 'Adept' behaviours and the amount of EFPS exposure, a significant negative correlation is revealed. This finding is unexpected, as it is anticipated these behaviours would increase over-time as controllers become familiar and advanced with the EFPS system.

A further unanticipated result is the frequency of Magus behaviours over-time remaining unchanged, and revealing no significant correlation. It is anticipated that over time, Magus behaviours would show a significant positive correlation. There are several conceivable reasons to account for these anticipated results. The clustering of data may hide potential variation in behaviour, this has occurred on a practical basis where observation has taken place when possible, working around the needs of the EFPS project. Further proposed observation should provide a broader coverage of results; this will be undertaken as EFPS is introduced to other NATS units.

The non-emergence of a significant positive correlation between Magus behaviours and EFPS system exposure may suggest that these behaviours take longer to develop than anticipated. In order to determine whether this is the case, it is proposed to undertake behavioural observation at a NATS ATC unit which has been operating with EFPS for some considerable time. Although Adept and Magus behaviours were first identified at such units when developing the marker set, it is now timely to capture the frequency of such behaviours to explore the relationship further. Further observation may also provide insight into Adept behavioural development.

A re-structuring of behaviours within the hierarchy is timely; an exercise is being constructed for human performance observational experts to undertake such a restructuring of the behavioural markers. A restructuring may change the significant negative correlation for Adept behaviour, this would result in greater consistency of results when contrasted with Magus behaviour. Several hierarchical frameworks exist for skill development, and vary in the number of levels within the hierarchy . Any exercise to re-categorise the behavioural markers will also consider alternative hierarchies.

Conclusion

Observations of controllers using an electronic replacement to paper flight progress strips reveal indications that overt behaviours and associated behavioural makers vary over time. From the observations undertaken, behaviours associated with Neophyte, Initiate stages of development decrease significantly in frequency over time. However anticipated increases to Adept and Magus stages of development show no significant correlation over time. Further application of the developed behavioural markers, observing users of EFPS who have been exposed to the system for a considerable period of time will allow these behaviours to be studied over an extended time period.

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