Comparing the emotional and cognitive components of initial trust formation in air traffic controller-autonomy teams

Pushparaj, Kiranraj; Alam, Sameer; Vijayaragavan, Vimalan; Gulyás, Balázs; Duong, Vu N.

2022

Pushparaj, K., Alam, S., Vijayaragavan, V., Gulyás, B. & Duong, V. N. (2022). Comparing the emotional and cognitive components of initial trust formation in air traffic controller-autonomy teams. HFES 66th International Annual Meeting (HFES2022), 66, 167-171. https://dx.doi.org/10.1177/1071181322661050

https://hdl.handle.net/10356/162643

https://doi.org/10.1177/1071181322661050

Comparing the Emotional and Cognitive Components of Initial Trust Formation in Air Traffic Controller-Autonomy Teams

Kiranraj Pushparaj[1], Sameer Alam[1], Vimalan Vijayaragavan[2], Balázs Gulyás[2], and Vu N. Duong[1]
[1]Air Traffic Management Research Institute, Nanyang Technological University, Singapore
[2]Cognitive Neuroimaging Centre, Nanyang Technological University, Singapore

The use of intelligent decision aids in Air Traffic Management is recommended to manage the exponential rise in global air traffic. Consequently, trust, which is one of the main drivers of how Air Traffic Controllers use such decision aids, has become an important area of research. It has been suggested that there is a strong emotional influence in the formation of Human-Human Trust, and it is unclear if this paradigm is valid for Human-Autonomy Trust. The extent of the cognitive and emotional components in the initial trust relationship between Air Traffic Controllers and a simulated conflict detection autonomous decision aid was examined with the use of functional Magnetic Resonance Imaging. The results confirmed that the emotional component showed higher activation than the cognitive component for the initial formation of trust between Air Traffic Controllers and autonomous decision aids.

INTRODUCTION

The International Air Transportation Association (IATA) predicted that customer demand for air transportation will increase twofold between 2015 to 2035, with Asia-Pacific being the main contributor to this surging trend (IATA, 2016). This increases the strain on Air Traffic Controllers (ATCOs) to maintain safe future Air Traffic Control (ATC) operations within the context of current Air Traffic Management (ATM) infrastructure. Attempts to mitigate this strain has called for increased technological support provided to ATCOs, which was strategized as an efficient method to liberate the ATCOs' cognitive resources to concentrate on more complex operational tasks. Particularly with the increasing application of autonomous systems in various industries, the potential for the integration of autonomous decision aids into ATM is vast, and this is reflected in the significant allocation of resources towards developing them (Rooijen, Ellerbroek, Borst, & Kampen, 2020). However, with the developments in the technical aspects of Human-Autonomy Teams (HATs) exceeding that of the human elements (Hancock, 2017), human factors, and more specifically, work on trust, must attempt to catch up.

HATs were defined as groups that incorporated an autonomous aid as a distinctive teammate who had a specific function (O'Neill, McNeese, Barron, & Schelble, 2020). Even with the inevitable progression from automation to autonomy, an operator-centric approach would be more suitable in HATs operating in safety-critical fields (Hancock, 2017).

Especially with the human-centric nature of ATM expected to be maintained even with the introduction of intelligent decision aids into operation (Billings, 2018), ATCOs will be expected to team up with these autonomous decision aids and operate in tandem with them. They will likely need to approve any recommendations provided by autonomous teammates before implementation, which underlines the importance of calibrated trust in such a setting.

When considering Human-Human Trust, it was found that it can take less than 0.1s for a subject to decide if another individual was trustworthy (Willis & Todorov, 2006). As the saying goes, "You never get a second chance to make a first impression". The reason for such a short evaluation time was due to the strong emotional component of such a decision, which is likely to apply to technology as well (Lee & See, 2004). If indeed it is valid for Human-Autonomy Trust, it could explain ATCOs' reluctance in even accepting efficient solutions, if they were inconsistent with their own strategies (Hilburn, Westin, & Borst, 2014). This emphasizes the need to understand the initial formation of trust, particularly to improve the initial acceptance of ATCOs. Subsequent evolution of trust will be dependent on other environmental factors as well as performance (Lee & See, 2004). However, the initial hurdle in starting the process of building trust must be overcome before the aptitude of the autonomous decision aid can be demonstrated over time to allow the calibration of ATCO trust levels, and more efficient HAT performance. Determining the extent of the emotional and/or cognitive components in the initial formation of trust will aid in the smoother integration of autonomous teammates into ATCO-Autonomy operations.

NEUROIMAGING

Understanding the mechanisms behind human performance in addition to behavioral observations could yield valuable insights that facilitate the development of more robust models of Human-Machine interaction. However, identifying the origins of behavior is not an easy task. In recent times, neuroergonomics, which is a field where the use of principles grounded in neuroscience are applied to the study of human factors, has aided in this venture. Using neuroimaging tools satisfies both this criterion, as well as the need to obtain less subjective data to verify the results. Neuroimaging techniques, such as Electroencephalography (EEG) have proven to be useful when used in human factors studies in ATM, with the EEG being used to investigate the neural basis of cognitive workload, situational awareness, and vigilance.

The EEG's broad usage in ATM ergonomic studies is primarily attributed to the fact that it is portable and non-intrusive, which allows for human-in-the-loop experiments to be conducted in a realistic, operational environment (Pushparaj, Ky, Ayeni, Alam, & Duong, 2021). Furthermore, it also offers excellent temporal resolution, as compared to most neuroimaging devices. However, the objective of this study crucially requires the identification of brain activity across the more sub-cortical regions of the brain, and this requires superior spatial resolution, which functional Magnetic Resonance Imaging (fMRI) can provide (Parasuraman, 2011). As such, the trade-off of an operational environment and temporal resolution for spatial resolution was necessitated.

Brain Regions Associated with Cognition and Emotion

The Prefrontal Cortex (PFC), which is the anterior region of the frontal cortex (FC), is associated with higher order cognitive tasks, particularly tasks that require the subject to retain information, and process it to complete the task (Frith & Dolan, 1996). Narrowing down further, the medial PFC (mPFC) is associated with accumulating both short term and long term memories, recalling specific long term memories, as well as decision making (Euston, Gruber, & McNaughton, 2012). The lateral PFC (lPFC) on the other hand, is associated with time-based planning and execution, or to rephrase, deciding the order of actions and decisions chronologically when given an open-ended problem (Fuster, 2015).

When considering emotion, one of the most prominent regions that is mentioned in neuroscience literature is the insular cortex. A review paper concluded that the insular cortex has been reliably associated with emotion, risk assessment, outcome prediction, and decision making under uncertainty (Gogolla, 2017). Another region that is strongly associated with emotion is the amygdala. A meta-analysis of neuroimaging studies revealed strong association between the amygdala and emotion, in addition to emotion processing; more specifically, negative emotions, such as fear (Baas, Aleman, & Kahn, 2004). This may explain the strong links between the amygdala and distrust (Riedl & Javor, 2012).

There have been no comprehensive neuroimaging studies identifying the brain regions associated with Human-Autonomy Trust (Pushparaj et al., 2021). As such, neuroimaging studies on Human-Human Trust served as the main reference point for this study. The brain regions associated with trust were obtained from a meta-analysis of Human-Human Trust studies, from which, the brain regions that a multitude of studies concluded were associated with trust, were synthesized (Riedl & Javor, 2012). These brain regions include nucleus accumbens, caudate nucleus, putamen, amygdala, insular cortex, anterior and posterior cingulate cortex (ACC & PCC), and the FC. Some of these regions were also strongly associated with cognition and emotion, which illustrates the cognitive and emotional elements of trust.

Activation of the mPFC and lPFC, which indicates increased oxygenated blood flow into the PFC, together with statistically significant correlated activation of the brain regions associated with trust from (Riedl & Javor, 2012), will be indicative of the cognitive component of trust, while the same is true for the insular cortex and amygdala for the emotional component of trust. The extent of these individual components of initial trust will be contingent upon the frequency of the respective statistically significant activations.

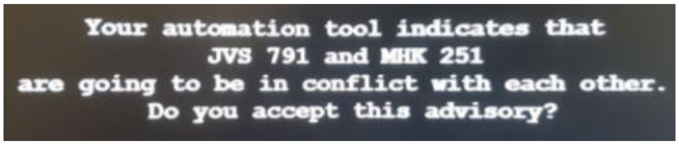
TRUST FORMATION

The initial formation of trust was suggested to be conceptually different from post-experimental measurements of trust that are commonly taken in Human-Automation Trust studies (Merritt & Ilgen, 2008). Dispositional trust, situational trust, and initial learned trust was identified to inform the initial reliance strategy by operators (Hoff & Bashir, 2015). Dispositional trust primarily deals with trustor characteristics. Situational trust accounts for environmental qualities and setting-based interaction properties, while initial learned trust represents the trustor's past experiences with technology. Situational trust and initial learned trust could very well encompass some emotional elements such as self-confidence and present moods.

The study of trust in ATM has largely been conducted from the perspective of cognition, and the role of emotion in trust formation has not been given the consideration that it requires (Jensen et al., 2020). As such, Human-Human Trust literature, which does indeed acknowledge the presence of emotion in trust, proved to be the foundation upon which this study was designed.

METHODOLGY

Ethics approval for this study was permitted by the Nanyang Technological University (NTU) institutional review board (IRB) (NTU IRBIRB-2018-12-002). This study was designed to be a pilot study, hence, only 4 subjects took part (2 former professional ATCOs and 2 student ATCOs). The mean age of participants was 39.75 years old, with a range of 41 years. The task given to them was that of conflict detection since it is one of the principal tasks of any ATCO. The simulation of air traffic scenarios was created using ATS-Cap software, which was subsequently recorded and embedded using E-Prime. This allowed the air traffic scenarios to be followed up by an onscreen prompt, as shown in Figure 1, upon which subjects had to decide whether to accept or reject a simulated autonomous decision aid's advisory on conflict detection. The prompt lasted for a maximum of 10 seconds to enforce the time constraints that are characteristic of ATC operations.



Your automation tool indicates that
JVS 791 and MHK 251
are going to be in conflict with each other.
Do you accept this advisory?

Figure 1: Prompt Advisory Example

The subjects were not given any prior information about the intelligent decision aid to ensure that their reliance strategy was specifically based on initial trust formation. The ATS-Cap software provided a set of 5 ambiguous conflict detection scenarios lasting 2-3 minutes of varying degrees of difficulty. The scenarios were intentionally designed to be ambiguous so that the ATCOs had no tangible way of discerning the accuracy of the advisories. Unequivocal scenarios may negate the need for recommendations in the first place. However, the advisories provided were indeed accurate. The simulation of 5 scenarios were based on an arbitrary airspace with sparse traffic density, making it harder to predict if the aircraft identified would truly experience a loss of separation.

The fMRI has the capability to provide objective evidence of the activated brain regions with respect to specific tasks being performed, providing insight into that region's functionalities for the tasks being completed. Indeed, by using fMRI whilst the participants were deciding to accept or reject the advisories offered to them, the statistically significant activation of the brain during this 10 second window can be identified, which will help to determine the extent of the emotional and cognitive components during the initial formation of trust in ATCO-Autonomy teams.

Figure 2: fMRI with Subject Conducting Task

The experiment took place at the Cognitive Neuroimaging Centre (CoNIC) at Nanyang Technological University within a Siemens 3-Tesla MAGNETOM Prisma MRI scanner (Siemens Medical Solutions, Erlangen, Germany), as shown in Figure 3. A 64-Channel Head-Neck coil was used for the acquisition. The protocol consists of the following sequences:

i.) Localizer scan.
ii.) 3D T1 MPRAGE for co-registration, with the acquisition parameters: TR/TE = 2400/2.28ms, Slice thickness (ST) = 1mm, Number of slices = 208, FOV = 256×256mm, Matrix size = 256×256.
iii.) fMRI sequence with a measurement of 409 for the ATC simulation. The rest of the acquisition parameters are TR/TE = 2000/28ms, Slice thickness (ST) = 2.5mm, Number of slices = 64, FOV = 250×250mm, iPAT = 2, Matrix size = 100×100.

The flight simulation was programmed in E-Prime 2.0 software and was synchronised with the fMRI scans. Whilst in the fMRI, subjects viewed the simulation through a mirror that displayed the stimuli from a screen and head motion was restricted using padded clamps. In order to visualise the brain regions that were most activated when the advisory prompt came up on the subjects' screens, ATCOs made their decision to either accept or reject the suggestions via a binary remote controller that they had access to whilst in the fMRI device. The responses were recorded to provide a frame of reference for their final trust behaviour as well. Since a distinctive ATC autonomous decision aid was not available to be used for this experiment, the custom prompt was pre-programmed into the simulation, but the participants were unaware of this to preserve the integrity of this study.

RESULTS AND DISCUSSION

Data preparation and analysis was conducted using the Connectivity Toolbox (CONN) and Statistical Parametric Mapping 12 (SPM12). fMRI pre-processing was performed using the default processing pipeline provided by CONN, which included correction for head motion artefacts, temporal and spatial normalization in Montreal Neurological Institue (MNI) Space and brain smoothing using a Gaussian kernel with an isotropic kernel of 8 mm. To account for random artefacts associated with spiking and motion, which could lead to false correlations, CONN's artefact detection feature was used which identifies principal components associated with white matter and cerebrospinal fluid (CSF) for each subject. White matter, CSF, and realignment parameters were entered into CONN as first-level analysis confounds, which were then band-pass filtered to [0.008 to 0.09Hz], to normalize the data.

The basis of subsequent analysis by CONN was that of functional connectivity, which refers to the connectivity between brain regions that share functional properties. More specifically, it can be defined as the temporal correlation between spatially remote neurophysiological events, expressed as deviation from statistical independence across these events in distributed neuronal groups and areas (Biswal, Kylen, & Hyde, 1997). Functional connectivity between any two brain regions can be attributed to connectivity within a network, or connectivity between two separate networks. Thus, seed-based connectivity and by extension, a seed-based correlation analysis (SCA) is the customary method of exploring functional connectivity within the brain. Dependent on the time series of the seed voxel or the primary brain, Region of Interest (ROI), seed-based connectivity is calculated as the degree of correlation between the time series for all other voxels in the brain. As such, to test the brain activation hypotheses, seed-based functional connectivity analysis was performed using the CONN toolbox utilizing the standard weighted general linear model (GLM), which can be thought of as an extension of the linear regression statistical technique.

The GLM technique used in fMRI experiments consists of the same conceptual equation ($Y = X\beta + \varepsilon$) as a simple linear regression example ($Y = a + bX + \varepsilon$). The GLM states that Y, (which in the case of fMRI, represents the measured fMRI signal from a single voxel as a function of time) can be expressed as the sum of one or more experimental design variables (X), each multiplied by a weighting factor (β), plus random error (ε). This technique was applied across all 4 subjects to ensure that only the brain regions that showed statistically significant activation and an effect size of larger than ($d = 0.6$) across all 4 subjects were reported in the analysis.

Statistical significance was determined with the use of False Discovery Rate (p-FDR). Only the ROI that showed activation across all subjects, with a p-FDR of less than 0.05 was reported. In general, the Bonferroni procedure is widely used in ergonomic studies for the reduction of Type 1 error. However, Bonferroni correction has the drawback of failing to consider the correlation in spatial neuroimaging data (Singh & Dan, 2006). Furthermore, it could be too conservative in the context of this study as it has only 4 subjects (Pushparaj et al., 2021). The p-FDR was a good alternative, because it takes into account the co-dependent nature of brain activation.

Before any of the neuroimaging results are presented, the behavioral data, represented by the acceptance and rejection of autonomous tool advisory is presented below on Table 1. Subjects 1 and 2 were student ATCOs, while subjects 3 and 4 were former ATCOs.

Table 1: Acceptance Data

Prompt Number	**Subject 1**	**Subject 2**	**Subject 3**	**Subject 4**
Prompt 1	Reject	Reject	Reject	Reject
Prompt 2	Reject	Accept	Reject	Reject
Prompt 3	Reject	Reject	Accept	Accept
Prompt 4	Accept	Accept	Accept	Accept
Prompt 5	Accept	Reject	Reject	Reject

As can be seen from Table 1, most participants seem to start off by rejecting the decision aid's advisory before gradually starting to accept it. This could be due to the safety-first culture characteristic of ATM, or it could also be due to the varying difficulty levels of the air traffic scenarios. They could have been willing to accept the advisory in scenarios that were relatively straightforward, even in ambiguity, while they could have the perceived safer option of rejecting the advisory in more complex scenarios. What is indisputable though, is that the acceptance rate of every subject was 40% under ambiguous conditions.

When considering the seeds for SCA, the first level analysis was required to be a broad analysis that would provide a spectral view of the brain activity, before narrowing the focus to specific ROI. As such, the seed for the initial analysis was the ACC, which is strongly associated with cognitive conflict in trust (Riedl & Javor, 2012). The reasoning behind this choice is that the decision-making process on whether to accept the advisory or not is likely to induce cognitive conflict, especially in the context of initial trust formation. This will serve as a preliminary indication of the cognitive and emotional root of the conflict, if there is correlated activation to the regions that they are respectively associated with. The results are presented below in Table 2, where the regions associated with emotion are in red, while the regions associated with cognition are in blue. Other regions are simply in black.

Table 2: Areas with Significant Effects

Prompt Number	**Seed: Anterior Cingulate Cortex Network**
	Regions where p-FDR < 0.05
Prompt 1	Insular Cortex Network
Prompt 2	Insular Cortex Network, Amygdala, Putamen
Prompt 3	-
Prompt 4	-
Prompt 5	Nucleus Accumbens, Insular Cortex Network

As can be seen from Table 2, there was no statistically significant correlated activation in regions associated with cognition. However, regions associated with emotion had a statistically significant correlated activation with the ACC during 3 out of the 5 decision windows. Another fascinating point to note is the fact that this activation coincides with the prompts where most of the participants rejected the advisory provided by the autonomous tool, which supports previous findings that distrust has a stronger emotional component than trust (Dimoka, 2010).

Subsequent analysis was conducted to narrow down the focus by utilizing the regions associated with cognition and emotion as the seed, to observe if any trust-related areas showed statistically significant correlated activation to determine the extent of functional connectivity of the respective elements in trust. The same color scheme mentioned above for Table 2 was used when presenting the results of the analysis in Tables 3 and 4. There was no statistically significant correlated activation when the lPFC and the amygdala were used as seeds, implying that the tasks given to the subjects did not necessarily require a chronological decision-making process. Similarly, it is possible that the participants did not experience particularly strong negative emotions when they were evaluating the prompt advisory. However, there was activation of the amygdala during one of the prompts, when the ACC was used as the seed, which suggests that failure to achieve statistical significance could simply be due to a small sample size.

Table 3: Areas with Significant Effects

Prompt Number	**Seed: Medial Prefrontal Cortex**
	Regions where p-FDR < 0.05
Prompt 1	-
Prompt 2	Nucleus Accumbens
Prompt 3	-
Prompt 4	-
Prompt 5	-

Table 4: Areas with Significant Effects

Prompt Number	**Seed: Insular Cortex**
	Regions where p-FDR < 0.05
Prompt 1	-
Prompt 2	Insular Cortex Network
Prompt 3	-
Prompt 4	-
Prompt 5	Posterior Cingulate Cortex

Trust related regions experienced statistically significant correlated activation during one prompt window, when the mPFC was used as a seed, indicating that there is indeed a cognitive component in initial trust formation. However, when the Insular Cortex was used as the seed, there was a higher incidence of statistically significant correlated activation of trust-related areas, with 2 prompts eliciting such activation, including the Insular Cortex Network, that is also associated with emotion. A larger number of trust-related regions were activated too, suggesting a greater extent of emotional components in the initial formation of trust, which will inform their initial reliance strategy. As such, this strong emotional component is valid in the context of ATCO-Autonomy teams.

CONCLUSION AND FUTURE WORK

This paper presents a pilot study designed to test a novel neuroimaging approach that was inspired by Human-Human Trust studies, to examine the emotional and cognitive elements in Human-Autonomy Trust. This study needs to be conducted with more subjects to allow deeper insights into the nature trust. A larger number of subjects will also allow the evaluation of the regions of correlated activation that approached statistical significance. If it is simply due to a small sample size, they would become statistically significant with a larger sample size. Furthermore, a larger number and wider variety of air traffic scenarios will allow for a more precise evaluation of the extent of the cognitive and emotional components of initial trust formation.

Nevertheless, this dichotomy has been verified by this pilot study. Moreover, the larger emotional component has also been established, which could explain the initial reluctance of ATCOs to accept intelligent decision aids that are mostly designed with cognitive features. Preventing negative emotional salience in the beginning of the relationship can boost initial acceptance by ATCOs. Emotion was also shown to play a significant role in perceived trustworthiness of autonomous aid, team resilience, and team performance (Krausman et al., 2022). Accounting for this emotional component could help to bridge the gap between ATCOs and their autonomous teammates.

ACKNOWLEDGEMENTS

This research is supported by the National Research Foundation, Singapore, and the Civil Aviation Authority of Singapore, under the Aviation Transformation Programme, with Research Grant 04SBS000704C160.

IRB approval for this study was granted by the Nanyang Technological University Institutional Review Board (IRB) (NTU IRBIRB-2018-12-002). All participants were offered an information sheet about the study. Signed consent was also explicitly acquired from all experimental subjects. They were not requested to reveal identifiers at any point, and only anonymised data was collected.

Any opinions, findings and conclusions or recommendations expressed in this material are those of the authors and do not reflect the views of National Research Foundation, Singapore and the Civil Aviation Authority of Singapore.

REFERENCES

Baas, D., Aleman, A., & Kahn, R. S. (2004). Lateralization of amygdala activation: a systematic review of functional neuroimaging studies. *Brain Research Reviews, 45*(2), 96-103. doi:https://doi.org/10.1016/j.brainresrev.2004.02.004

Billings, C. E. (2018). *Aviation automation: The search for a human-centered approach*: CRC Press.

Biswal, B. B., Kylen, J. V., & Hyde, J. S. (1997). Simultaneous assessment of flow and BOLD signals in resting-state functional connectivity maps. *NMR in Biomedicine, 10*(4-5), 165-170. doi:https://doi.org/10.1002/(SICI)1099-1492(199706/08)10:4/5<165::AID-NBM454>3.0.CO;2-7

Dimoka, A. (2010). What Does the Brain Tell Us About Trust and Distrust? Evidence from a Functional Neuroimaging Study. *MIS Quarterly, 34*(2), 373-396. doi:10.2307/20721433

Euston, David R., Gruber, Aaron J., & McNaughton, Bruce L. (2012). The Role of Medial Prefrontal Cortex in Memory and Decision Making. *Neuron, 76*(6), 1057-1070. doi:https://doi.org/10.1016/j.neuron.2012.12.002

Frith, C., & Dolan, R. (1996). The role of the prefrontal cortex in higher cognitive functions. *Cognitive Brain Research, 5*(1), 175-181. doi:https://doi.org/10.1016/S0926-6410(96)00054-7

Fuster, J. (2015). *The Prefrontal Cortex*: Academic Press.

Gogolla, N. (2017). The insular cortex. *Current Biology, 27*(12), R580-R586. doi:https://doi.org/10.1016/j.cub.2017.05.010

Hancock, P. A. (2017). Imposing limits on autonomous systems. *Ergonomics, 60*(2), 284-291. doi:10.1080/00140139.2016.1190035

Hilburn, B., Westin, C., & Borst, C. (2014). Will controllers accept a machine that thinks like they think? The role of strategic conformance in decision aiding automation. *Air Traffic Control Quarterly, 22*(2), 115-136.

Hoff, K. A., & Bashir, M. (2015). Trust in Automation:Integrating Empirical Evidence on Factors That Influence Trust. *Human Factors, 57*(3), 407-434. doi:10.1177/0018720814547570

IATA. (2016). IATA Forecasts Passenger Demand to Double Over 20 Years [Press release]. Retrieved from https://www.iata.org/en/pressroom/pr/2016-10-18-02/

Jensen, T., Khan, M. M. H., Albayram, Y., Fahim, M. A. A., Buck, R., & Coman, E. (2020). Anticipated Emotions in Initial Trust Evaluations of a Drone System Based on Performance and Process Information. *International Journal of Human–Computer Interaction, 36*(4), 316-325. doi:10.1080/10447318.2019.1642616

Krausman, A., Neubauer, C., Forster, D., Lakhmani, S., Baker, A. L., Fitzhugh, S. M., . . . Schaefer, K. E. (2022). Trust Measurement in Human-Autonomy Teams: Development of a Conceptual Toolkit. *J. Hum.-Robot Interact.* doi:10.1145/3530874

Lee, & See. (2004). Trust in Automation: Designing for Appropriate Reliance. *Human Factors, 46*(1), 50-80. doi:10.1518/hfes.46.1.50_30392

Merritt, S. M., & Ilgen, D. R. (2008). Not All Trust Is Created Equal: Dispositional and History-Based Trust in Human-Automation Interactions. *Human Factors, 50*(2), 194-210. doi:10.1518/001872008x288574

O'Neill, T., McNeese, N., Barron, A., & Schelble, B. (2020). Human–Autonomy Teaming: A Review and Analysis of the Empirical Literature. *Human Factors*.

Parasuraman. (2011). Neuroergonomics:Brain, Cognition, and Performance at Work. *Current Directions in Psychological Science, 20*(3), 181-186. doi:10.1177/0963721411409176

Pushparaj, K., Ky, G., Ayeni, A. J., Alam, S., & Duong, V. N. (2021). A quantum-inspired model for human-automation trust in air traffic controllers derived from functional Magnetic Resonance Imaging and correlated with behavioural indicators. *Journal of Air Transport Management, 97*, 102143. doi:https://doi.org/10.1016/j.jairtraman.2021.102143

Riedl, R., & Javor, A. (2012). The biology of trust: Integrating evidence from genetics, endocrinology, and functional brain imaging. *Journal of Neuroscience, Psychology, and Economics, 5*(2), 63-91. doi:10.1037/a0026318

Rooijen, S. J. v., Ellerbroek, J., Borst, C., & Kampen, E. v. (2020). Toward Individual-Sensitive Automation for Air Traffic Control Using Convolutional Neural Networks. *Journal of Air Transportation, 28*(3), 105-113. doi:10.2514/1.D0180

Singh, A. K., & Dan, I. (2006). Exploring the false discovery rate in multichannel NIRS. *NeuroImage, 33*(2), 542-549. doi:https://doi.org/10.1016/j.neuroimage.2006.06.047

Willis, J., & Todorov, A. (2006). First Impressions:Making Up Your Mind After a 100-Ms Exposure to a Face. *Psychological Science, 17*(7), 592-598. doi:10.1111/j.1467-9280.2006.01750.x