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"Impact of the Covid-19 pandemic on psychological stress factors in the cockpit“

Jonas Nicolas Dengler

Work project carried out under the supervision of:

Professor Miguel Pina e Cunha

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Abstract

According to the American aircraft manufacturer Boeing, human error is the key factor in approximately 80 percent of all aircraft accidents (Boeing, 2008). Often, difficult life circumstances lead to so-called life stress, which has a significant impact on the cognitive performance of pilots. However, stressful situations such as flying through severe weather or system failures can also lead to cognitive impairments. Due to the constant changes of measures, the unstable aviation industry and the irregular schedules for pilots, it is hypothesized that the increased stress caused by the new situation could influence the safety. This thesis therefore investigates how psychological stress factors in the cockpit influence the safety of flights and to what extent are these factors aggravated by the Covid-19 pandemic. To be able to measure the changes, incident reports from the anonymous reporting tool ASRS of the U.S. aerospace agency NASA were examined. The study found that there was a trend shift in stressors and errors committed, but no aggravation could be detected with the available data.

Keywords: aviation, stress, pilots, airline, incidents, covid-19

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1. Background and Content

On May 22nd 2020 just after 2:30pm an Airbus A320-200 by Pakistan's National Airline PIA was approaching the international airport of Karachi, Pakistan. The airplane originated from Lahore and was carrying 91 passengers and 8 crew members. The first landing attempt was aborted and during the climb out both engines failed at an altitude of only 2000 feet above the ground. The flight crew immediately declared an emergency and requested to turn back towards the airport. A landing clearance was granted by the air traffic controller shortly after, but unfortunately, the aircraft had not gained enough altitude during the climb out and with no engine thrust available the aircraft impacted a residential area just 1340m short of the runway's 25L threshold. All crew members, one person on the ground and 89 out of the 91 passengers perished in the accident. (CAA Pakistan, 2020)

On June 24th Pakistan`s Aviation Minister stated, while introducing the preliminary report, that the flight crew not only failed to comply with standard procedures, but also discussed the Coronavirus during the critical phases of the flight. Furthermore, it was discovered, that the pilots had lowered the gear, but just before landing retracted it for an unknown reason. The resulting ground contact of the engines presumably caused them to fail after the go around. (Aviation Herald, 2021)

This accident raises the hypothesis that the pandemic is reducing the safety level in aviation through intensified stress factors. Therefore, the main purpose of this thesis is to investigate how psychological stress factors are influencing the performance of the flight crews and therefore the safety of the flight and if these stress factors have aggravated or changed through this pandemic situation. First, the term "stress" is defined, with a distinction between life stress and acute stress. In chapter 4 the impact of stress on a person's cognitive abilities is described. Chapter 5 discusses various stressors, both internal and external. Chapters 6 and 7 addresses which categories of error have played a role in aviation accidents. The findings obtained to this

point are then mapped onto a case study. In the final chapters of the thesis the impact of COVID-19 related incidents will be analyzed and categorized through the anonymous reporting tool ASRS by the American space agency NASA.

2. Scientific Approach and Hypothesis

Methodology

The research question of this thesis is how psychological stress factors in the cockpit are influencing the safety of the flight and to what extend are these factors aggravated by the Covid-19 pandemic?

Research on the effects of stress on the human body is available in numerous publications. However, only a few specifically address the effects on pilots. For this reason, general research approaches had to be used to answer the first part of the research question, on how stress is affecting the performance and therefore the safety of the flight. In this context, the widely recognized research papers of the NASA institute were primarily used.

To answer the second part of the research question, a qualitative research was conducted. For this purpose, the anonymous reporting tool ASRS was systematically examined for specific incident reports. In order to generate only those reports relevant for the research, the following filter functions were defined:

1. Date: The time period for the analyzed reports was defined between March 2020 (approximate beginning of the pandemic) and May 2021 (completion of the research on the thesis).
2. Federal Aviation Regulation (FAR): Only reports falling under part 121 (air carrier) or part 135 (regional, charter, air taxi etc.) were included in order to exclude general aviation incidents.
3. Mission: Passenger, cargo, ferry, as well as test flights were defined as mission filters.

4. Reporter function: Only cockpit crews were allowed as reporter function in order to exclude reports from flight attendants or air traffic controllers.

5. Text search: In order to obtain only Corona-related incident reports, "Covid" and "Corona" were implemented as text filter functions in the search request.

For the analysis, the 159 results were manually filtered to analyze only safety-critical incidents. This manual filtering left 77 usable reports. A detailed content analysis was then performed, in which the errors were categorized and the various stressors present in the incident were counted. The method described above was chosen because it provides first-hand data and most of the reports are recorded shortly after the incident, which makes them more accurate, since it is easier to remember the details if they are reported without delay. In addition, it can be assumed that the data is valid, since each incoming report is checked for plausibility and a categorization of the incident is performed.

Hypothesis

In this thesis, two hypotheses are discussed:

H1: There is a shift in the distribution of stressors.

The external circumstances of the pandemic (aircraft disinfections and therefore less time for flight planning, less staffing in air traffic control, entry regulations, etc.) cause a significant change in working conditions in many respects. It is not expected that there will be a shift within the environmental drivers, but a change regarding the psychological, physiological and cognitive factors can be expected.

H2: The fraction of reported incidents regarding human error committed by pilots has increased through the pandemic

It can be assumed that a general instability of the aviation market leads to a general dissatisfaction, which in turn leads to increased stress perception. In addition, pilots currently

lack recent flight experience, which creates additional stress, especially in abnormal situations such as emergencies. Therefore, it is expected, that the percentage of human error increases.

3. Literature Review

3.1 Definition of Stress

The definition of stress is generally difficult, since the word "stress" is not universally defined in the literature. In addition, studies vary significantly from one another with regards to the examination of stress factors. There is no uniform approach concerning the induction of stress factors (psychological or physiological), the type of task to be performed, or the measurement of performance. Nevertheless, numerous studies that have been conducted implying that recurring factors have an impact on an individual's performance. (Goldsmith et al., 2013: 2)

According to a published research in 1986 by Hockey, stress is an "unusual state or condition of work and the responses to those occurring conditions". In this context, numerous manipulations are listed which can be described as stressors. These factors include: workload, time pressure, noise, sleep deprivation, fatigue, social anxiety, threat of electric shock, heat and cold. (Hockey, 1986: 1-49)

Another concept to define stress is the *cognitive appraisal model* from 1984: When a person perceives a possible danger to his or her well-being, he or she assesses the essence of the challenge and his or her abilities to handle the situation effectively, according to this model. As the situation becomes more difficult, the person becomes increasingly nervous and, at some stage, unsure of how to manage a successful outcome. This anxiety has a significant impact on the way a human’s cognitive procedures and the general results are changed. Anxiety tends to obstruct some part of the potential for working and redirects attention. (Lazarus, Folkman, 1984: 38-49)

3.2 Differentiation between Life Stress and Acute Stress

In the context of this thesis, a distinction is made between life stress and acute stress. Generally speaking, life stress is the stress that can be attributed to critical life circumstances or events, while acute stress arises in a critical situation, such as flying through severe weather or a mechanical malfunction. A more detailed distinction between the two categories of stress is drawn in the following.

Life Stress

Airman are often unwilling to report physical or psychological issues or diseases to their employers in fear of temporary or even complete grounding, which could have an enormous impact on their flying career. For most pilots, there is hardly a greater fear than losing their so-called medical. (Young, 2008: 1) Airline pilots are required to undergo a medical examination once a year and every six months after the age of 40 (EASA, n.d.).

In this thesis, life stress considers both physical and psychological aspects that lead to difficulties in managing life. In certain exceptional situations, it can even lead to extended suicides, such as the Germanwings crash in the French Alps in 2015 (BEA Aero, 2016). These life circumstances include, for example, financial concerns, health problems, relationship difficulties or problems at work. According to stress researchers, pilots have one of the most stressful jobs of all industries (Bowles at al.: 1093)

The fact that pilots very rarely speak about their stress situations makes researching the relationship between life, performance and stress particularly difficult. According to a 2008 Nasa study, this underreporting is primarily due to the following two reasons: First, in many cases pilots are unaware of a stress situation and of the effects that stress has on their body. The second reason is that they often do not want to talk about their problems due to fear of losing face in front of colleagues or their company (Young, 2008: 2).

A study of British commercial pilots, conducted in 1986 by Sloan and Cooper, gives some insights about pilot's experience of stress. In this study 1,000 randomly chosen pilots, who were part of the British Airline Pilots Association, received questionaires about their perceiption of stress-performance relationship. About half of the received responses were usable and the outcome showed some interesting results: 16.2% of the questioned pilots indicated they would recognize stress by the fact that they "usually" or "almost always" felt tired, while 13.1% of the pilots stated that they had recurring thoughts when their workload was low. 9.1% said they did not listen as attentively, while 8.4% said they had a tendency to worry and suffered from decreased concentration from time to time. Taking a less conservative approach to the evaluation and considering reported symptoms that occurred only „sometimes", the percentage of pilots who reported being able to deliver only decreased concentration performance due to stress increased to 45%. Nearly 93% of the surveyed airline pilots stated that in their believe negative life situations can adversely influence a pilot's performance. According to Sloan and Cooper, the observed effects can be attributed to cognitive perceptions. (Sloan, Cooper, 1986)

Another study from 1990 further extended Cooper and Sloan's study and examined the extent to which employer instability affects pilots' stress symptoms. The stability of an airline was assessed by its 12-month history (e.g., merger, sale, profits/losses and employee wage/work rule concessions in the past contracts with management). A random sample of 432 pilots was surveyed, 212 from unstable airlines and 220 from stable airlines. Substantial and statistically significant differences were found between the two examined groups: Pilots of unstable airlines indicated significantly more often to be affected by symptoms such as the feeling of hopelessness regarding the future, lack of concentration or reduced attention. Pilots of unstable airlines reported almost eight times more often to be suffering from hopelessness in regards to the future, while all other stress variables were about two to three times more often reported than with stable airlines. Particularly interesting is the fact that only factors were evaluated in which the symptomatology was indicated as "almost always" or "frequently" occurring. This

cautious interpretation of the results suggests that the actual frequency of occurrences of the symptomatology is higher than it was reported. (Little et al., 1990: 977-982)

The results of this study are particularly interesting in regards to the pandemic situation, since at the moment all airlines, without exception, are in some way instable. This fact at least suggests that life stress has increased in the industry as a whole. Although research on the correlation between life stress and pilot performance is inconclusive, the literature and the numerous studies that have been conducted suggest that performance nonetheless declines as stress increases. Thus, a high amount of airman, experience notable symptoms of stress when facing challenging life circumstances. A large proportion of these pilots also think that this life stress adversely impacts their performance in the cockpit. Although there are no clear results regarding the nature of the relationship, some correlations suggest that there is a connection between life stress and accidents. (Young, 2008)

Acute Stress

In comparison to life stress, acute stress, also referred as situational stress, defines the situation that triggers a high level of immediate stress. Examples of situational stress include emergencies or other life-threatening situations. These scenarios demand from pilots to correctly perform infrequently flown procedures and adequately use both their skills and judgment to avert the critical situation in a positive manner. Often, such maneuvers must be performed under significant time pressure (e.g., terrain escape maneuvers), heavy workloads (e.g., tight airspaces with high traffic volumes), or ambiguous and conflicting information (e.g., system failures). (Dismukes et al., 2015: 1)

The *cognitive appraisal model*, assumes that persons in intriguing circumstances combine both their cognitive and physiological resources to overcome the situation. On a physiological level, the body responds with an increased heart rate, faster breathing, and the limitation of peripheral blood flow - the body is prepared for a "fight or flight" situation. On a cognitive level, the

individual focuses his/her full attention on the stressful situation and mentally prepares for any action that may be required. (Lazarus, Folkman, 1984: 1-49) However, when the situation becomes threatening and doubts about coping with it grow, anxiety arises. This anxiety impairs the individual's ability to cope, which is mainly explained by the deterioration of attention and working memory. (Eysenck et al., 2007: 336-337)

3.3 Impact of stress

After defining stress, the following section examines the extent to which the individual stress factors affect different areas of human consciousness. According to various studies, stress has numerous effects on how we act and the outcome of our actions. Stress can affect our memory, attention, but also our decision-making process. Stress can lower a person's team performance. In this case, individuals no longer communicate to the extent they would be expected to. In addition, stress can also have an impact on an individual's fulfillment of frequently practiced or performed tasks. These are then not acted upon in stressful situations as they would be processed in non-stressful situations. (Dismukes et al., 2013: 2-6)

An example of this could be the landing gear retraction of the incident mentioned in the introduction. Pilots extend the landing gear before every landing and have performed this procedure so many times in their piloting career that a certain automatism has been established. In this instance, we can see that the presence of stress (caused by the rapid descent due to the proximity to the airport) has led to the incorrect execution of such a simple task. In the case of the PIA flight other factors had more impact on the outcome, however.

In the following section, which is based on a NASA research paper by Dismukes, Goldsmith and Martinez-Papponi (2013), some areas of human behavior, as well as various psychological effects, will be outlined and the extent to which stress has a negative impact on them will be discussed.

Attention

Attention has a variety of dimensions, which are determined just as often by laboratory techniques as by innate cognitive mechanisms. Attentive cognitive capability is very limited, basically, one can only manage one source of information attentively at a time; therefore, performing multiple tasks that require attentive processing necessitates transferring focus back and forth between the tasks. The current object of attention approximately refers to the contents of our conscious awareness which, in several ways, is a part of the characteristics of working memory. Unlike attentive processing, highly practiced activities with little to no new elements become increasingly automated, requiring little cognitive control. However, real-world operations (for example, driving) almost always entail a degree of conscientious control, if only to ensure that automated processing is accomplishing the individual's objectives. (Dismukes et al., 2013: 6-7)

What are the implications for pilot performance with regard to attention?

What various researches indicate is that stress changes the proportional sum or weighting of focus paid to different sources of information depending on the task's particular function and how certain sources of information are used. Processing can be enhanced or degraded depending on the task. In accordance with numerous studies that used monitoring of items, especially multiple objects, show that individuals under stress are typically less able to control their focus efficiently as a function of task requirements. Additionally, multiple factors, such as fatigue and sleep deprivation, can influence performance in these studies through multiple mechanisms. A cognitive paradigm of hazard appraisal that is generally compatible with both complex experimental research and naturalistic studies is one in which fear dominates working memory and impairs executive regulation of focus. Pilots must constantly move their focus between tasks whose priorities change dynamically, and pilots are often required to execute several tasks simultaneously. Many of the tasks they execute have been extensively practiced

and have developed a high degree of automaticity. Exceptional circumstances, like in-flight emergencies, add additional task requirements, which may have been performed infrequently or not at all. Additionally, pilots must incorporate these new task demands into standard procedures, which can induce increased multitasking and workload, as well as time constraints in some cases. Thus, effective focus control is critical. One cannot determine with certainty how pilots' attention control will be interrupted in any given situation; indeed, it is likely that the type of disruption will differ according to the situation. A pilot may become fixated on one task or one part of a task and ignore others, or he or she may become distractible, incapable of concentrating properly on any one task. (Dismukes et al., 2013: 6-10)

Startle Response Effect

Sometimes, abnormal situations begin with a sudden occurrence, such as a master caution warning, the aircraft lurching unexpectedly, or an excessive noise. Individuals are hardwired to respond to certain prominent sensory stimuli, which cause them to immediately orient to the stimulation, undergo physiological arousal, and experience an emotion analogous to fear. These responses are collectively referred to as the startle response (Thackray, 1988: 6-11). This response briefly stops the individual's current activity. If the person recognizes the nature of the emergency, he or she will be able to quickly assess the situation and recall an appropriate response. If the situation is unfamiliar and appears to be potentially dangerous, stress may quickly ensue. Unexpected incidents can astound pilots because what occurs in the environment does not correspond to the individual's mental model of the situation and what should occur. Refocusing attention on the shocking or unexpected occurrence, in combination with increasing stress, can cause the person to lose control of ongoing activities or to fail to assess the overall situation. (Dismukes et al., 2013: 11)

Working Memory

Working memory is composed of two distinct components: a storage portion that contains temporarily enabled and readily accessible information, and a central executive system that facilitates goal-directed action by manipulating information, transferring focus between tasks, and choosing among competing responses. In comparison to the vast store of long-term memory, working memory capacity is limited - only a few things can be actively stored at any given time.

Beilock (2008: 339-343) discovered that while individuals with a high working memory ability were better equipped to handle high-demand situations that required extensive use of working memory, they were also more likely to be negatively affected by stressful situations. Performance declines were observed only in individuals with a high working memory capacity when confronted with high demand and high-pressure situations. Beilock assumed that the concerns associated with a stressful situation deprive the working memory resources on which individuals with a higher working memory rely for their superior output.

Numerous researches strongly support the view that stressful circumstances induce worry and intrusive thinking, which partially obstruct working memory function. This result has significant consequences for pilots' (and other professionals') performance in emergency scenarios, as those situations usually include numerous tasks demands that place a substantial load on working memory. (Dismukes et al., 2013: 11-14)

Decision Making

In numerous investigations into the cause of aviation accidents, the U.S. National Transportation Safety Board (NTSB) has concluded that errors in judgment or decision making by pilots have played a tragic role in many of the events. The terms judgment and decision making refer to a broad category of cognitive processes that include reasoning, selecting,

diagnosing, inferring, prioritizing, incorporating, and forecasting. In the flight deck, there are a variety of decisions that must be made that are related to flying.

Examples may include diagnosing the cause of a malfunction of electronic units or assessing system failures and the potential impact on other systems (e.g., impact of a hydraulic failure on the landing gear extension process). Dismukes cites Arkes and Hammond (1986), who state that uncertainty is an essential aspect of decision making and plays a relatively large role, especially when emergencies occur.

There is ample evidence that stress affects human performance in general especially judgment and decision making. One research on stress and decision making showed that under stressful circumstances, decisions are made less systematically and tend to be rushed and fewer alternatives are considered (Janis, Mann, 1977 cited in Dismukes et al. 2013).

In general, there is an assumption that stress impairs rational decision making by reducing both the quality of processing of alternative actions and the number of alternatives considered. (Dismukes et al., 2013: 15-21)

Conclusion and additional findings

The study by Goldsmith, Dismukes and Martinez-Papponi published in 2013 examined the influences of stress on the cognitive characteristics of pilots in detail. The team criticized the fact that the large number of studies examined could not ultimately be applied completely, but largely, to the conditions that pilots encounter in emergency situations. Additionally, the studies were mostly based on " ordinary" participants, who had to perform rather simple tasks. Further, it was criticized that the stress was "artificially induced", thus social factors (e.g. embarrassing moments) or environmental influences, such as light and noise, were created artificially. The fact that these laboratory conditions do not fully map to reality must be kept in mind when evaluating the studies. (Goldsmith et al, 2013: 29-30)

Nevertheless, some conclusions can be drawn from the studies examined. For example, stress definitely has an impact on attention or memory performance. Particularly noteworthy is the reduced working memory and processing capacity. Furthermore, negative effects on decision making as well as on team performance can be observed.

In general, it can be stated that certain cognitive structures and processes are disturbed by stress. Goldsmith and his team emphasize in their conclusion that experienced pilots are not expected to "fall apart" in an emergency situation. Rather, they can draw on their existing experience and practical skills. Nevertheless, special situations require exceptional performance, which is not always easy to achieve under the influence of stress. For this reason, it is elementary important to effectively counteract the influences of stress. (Goldsmith et al, 2013: 30)

One point that is unfortunately often forgotten when analyzing stress factors is the fatigue factor. Fatigue is not a stressor in the traditional sense, but it can be caused by constant stress and in stressful situations it can further reduce human performance. In 15-20% of all accidents caused by human error, excessive fatigue played a significant role (BBC, 2012). Probably the most prominent recent accident in which one of the primary causes was overfatigue represents the crash of a Continental Connection aircraft (Flight 3407) in 2009. In the official NTSB investigation report, investigators speak of "chronic fatigue" by the captain and possible "chronic sleep loss" by the co-pilot (NTSB, 2010: 105). The NTSB cites fatigue as one of the main factors in the captain's erroneous behavior that ultimately led to the crash (NTSB, 2010: 151-154).

In a survey of regional airline pilots in the U.S., it was discovered that a significant number of respondents confirmed that fatigue was seen as a major safety concern (Rosekind et al., 1996: 3). Due to the high incidence of fatigue syndrome in incidents and a connection with stress that cannot be completely ruled out, fatigue is added to the analysis as another stress factor. Furthermore, it is conceivable that the circumstances of the Corona pandemic (irregular duty

schedules, but longer working hours especially on cargo flights due to high demand) made fatigue even more tangible.

4. Classification of Stressors

After having analyzed the effects of stress on cognitive abilities, the causes of stress will be outlined in the following. This is important in order to identify more precisely how the pandemic-related stressors should be classified later in this thesis.

Stressors can be categorized as both external and internal. External stressors include environmental and psychological factors. These predominantly relate to the human surroundings, such as environmental influences or the prevailing working conditions. Internal stressors can be physiological in nature or due to cognitive limitations. Internal stressors arise within the person and are typically regarded as controlled by the individual. (Rash, Manning, 2009: 39) In the following table, examples of the different stressors can be found. This overview also serves as a basis for the later evaluation of the reported incidents related to COVID-19.

External		Internal	
Environmental	Psychological	Physiological	Cognitive
• Poor flight conditions • Extreme heat or cold • High noise level • Excessive vibration • Altitude effects • Crowded space • Air pollution • Humidity extremes	• Workplace conflicts • Family conflicts • Insufficient flight time • Low job satisfaction • Feeling lack of support • Lack of control • Spousal conflict • Family illness or death • Unrealistic expectations • Financial problems • Loneliness • Devalued self-worth	• Poor diet (Nutrition) • Tobacco • Muscular fatigue • Sleep deprivation • Alcohol • High blood pressure • Prescription or over-the-counter medications • Caffeine • Decreased vision • Hearing loss • Diseases • Dehydration	• Lack of information • Information overload • Mental fatigue • Fear • Feeling of helplessness • Boredom • High workload

Table 1: Classification of Stressors; Source: Rash, C., Manning, S. (2009): p.39

5. Stress and Errors in Airline Accidents

In addition to the research about stress and the implications for pilot performance conducted in 2013, the team around Dismukes and Goldsmith also performed another study, where they analyzed the types of errors occurring in airline incidents – this time with the help of Janeen Kochan, an expert in aviation research. The researchers examined a set of 12 airline accidents, where either or both a loss of life or aircraft hull loss occurred. A further criterion for choosing the specific incidents for analysis was the presence of certain circumstances that could be identified as likely being very stressful for the pilots. The presence of these conditions was evaluated based on the review of accident reports, including the analysis of the cockpit voice recorders.

The team identified a total of 212 errors committed by crews across the accidents. Of these, a total of 45 occurred during descent, 77 during approach and 6 during landing. The remaining errors took place in the takeoff or cruise phase, with the exception of 10 errors occurring during evacuation. 46 times a procedure was unintentionally not performed and in 16 cases intentionally.

Inadequate comprehension, interpretation and assessment of the situation accounted for around a quarter of all errors in the accidents investigated. It was often the case that the pilots did not understand the situation correctly or interpreted it incorrectly. In addition, it often happened that the gravity of the situation was not correctly recognized and the wrong response was taken. These situations are often caused by inadequate situational awareness.

Situational awareness can be divided into three levels: Level 1 is the perception of elements in the current situation, Level 2 is the comprehension of the current situation and Level 3 is the projection of the future status. From this situational awareness people derive their decisions. (Endsley, 1995: 35)

Poor Management of Competing Task Demands" and "Inadvertent Omission of Required Actions" each accounted for 17 percent and 36 of 212 errors, respectively, the second largest proportion of errors committed. In the accidents investigated, poor prioritization of tasks and failure to use available resources were criticized. In all the investigated cases, there was a high workload and time pressure present. Nevertheless, after a detailed analysis of the accidents, it was determined that the crews had had enough time to react adequately to the situation. It is considered likely that stress had a strong impact on the pilots' perception of the situation and thus they were not able to perform their tasks correctly.

Errors in the category "Inadvertent omission of required actions" include not performing tasks that are normally expected in a certain situation. Omissions happen even in normal flight operations for a variety of reasons: Some pilots acquire bad habits over the years or it can be attributed to the pilot's faulty memory (Dismukes, 2012: 217-220). Nevertheless, the likelihood of pilots unintentionally skipping tasks or omitting to complete checklists increases significantly in stressful situations. (Dismukes, et al., 2014: 13-20)

The error categories found by Dismukes' team can be seen in the table below.

Error Category	Number of Errors	Percentage
Inadequate Comprehension, Interpretation, and/or Assessment of the Situation	50	23.6%
Poor Management of Competing Task Demands	36	17.0%
Inadvertent Omission of Required Actions	36	17.0%
Inadequate or Improper Communication	30	14.0%
Inadequate/improper Execution of Tasks	23	11.0%
Poor Decision-making or Choice of Actions	16	7.5%
Inadequate Physical Execution of Action	11	5.2%
Failure to Acquire Information	10	4.7%

Table 2: Error Categories of Airline Accidents; Source: Dismukes, et al. (2014): p.13

To provide a better understanding of how error chains are composed in aviation accidents, the accident of Continental Connection Flight 3407 was analyzed in a case study. This analysis is attached to the thesis in the appendix. In this section, the accident sequence is described and the errors found by the investigators are discussed. In addition, the influence of the stressors on the behavior of the pilots is examined.

6. Impact of the Covid-19 pandemic

6.1 General Impact on air traffic

Following the outbreak of the Corona virus in Wuhan, China, and the spread of the virus throughout the world, air traffic came to a near complete stop in March 2020. Passenger numbers reached just over a third of the pre-outbreak levels (Statista, 2021). According to Times Magazine, at the time of the article's publication in April 2020, more than 16,000 aircrafts were grounded, representing approximately 62% of the world's passenger aircraft (Time, 2020). This has left many pilots unable to fly for three, six, or even more months. An incident from Indonesia shows how dangerous it can be when pilots do not have adequate recent flight experience. In this incident in September 2020, an Airbus A330 carrying 307 passengers landed with its left main landing gear next to the runway on grass. Only with considerable effort the pilots were able to steer the jet back onto the centerline of the runway. No one was injured in the incident and only two runway edge lights were damaged. Nevertheless, this incident is of concern because the investigators discovered that the flight crew had very little recent flight time. The captain had completed only 3 flights in the last 90 days; the co-pilot (also a captain) had not been in a real cockpit for over half a year. (Bloomberg, 2020)

The crew's limited flight time may also have played a critical role in the crash of the PIA flight.

This thesis provides an analysis of whether the Covid-19 pandemic had an impact on pilots' stress experience by evaluating data from the ASRS anonymous reporting tool. The ASRS is a reporting tool initiated by NASA to allow serious incidents to be reported anonymously without

having to face consequences from the authorities or the employer. This feature helps to prevent future errors and to detect possible weaknesses in the system at an early stage.

6.2 Increased Life Stress due to the Pandemic

According to the European Cockpit Association (ECA), over 18,000 cockpit jobs worldwide are at risk or have already been lost as a result of the pandemic (as of January 2021). Many airlines that were struggling even before the crisis have been brought down by the pandemic (e.g. Flybe and Air Italy). Many major airlines have already announced plans to dismiss a large number of employees. These include British Airways (12,000), Lufthansa (22,000), SAS Scandinavian Airlines (7,000), KLM (5,000), easyJet (4,500) and Ryanair (3,000). The exact category of job positions that will be cut will be defined and negotiated in the coming months, but the ECA expects that about 15-20% of them will be jobs in the cockpit. (ECA, 2021) Many airlines are retiring entire aircraft types from their fleets (IFN, 2021), requiring cockpit crews to either be retrained or laid off. Furthermore, the pilots have to face unwelcomed changes to their work contract, lower pay and increased working hours (Vuorio, Bor, 2020)

This great uncertainty causes pilots' life stress to increase significantly. Cooper and Sloan's 1990 study implies that life stress is significantly higher for unstable airlines. The Corona crisis has made the entire industry unstable, which means that life stress is likely to have increased significantly among all airlines.

6.3 Analysis of recent Incidents related to the pandemic

6.3.1 Methodology

To allow a significant evaluation regarding the stress generated by the Corona pandemic, the ASRS was systematically searched. For the purpose of the research, the following parameters were established: The time period from March 2020 (when WHO assessed COVID-19 as a pandemic) until May 2021 was specified for the analysis. In addition, only reports that were either based on a cargo, passenger, or test flight were examined. Furthermore, these flights had to fall under Federal Aviation Regulation Part 121 (Air Carrier) or Part 135 (Regional Airline/Air Taxi). The reporter function had to be provided by the cockpit crew - which means that reports from flight attendants, for example, were left out. The keywords "Covid" and "Corona" were added to the mentioned filters, producing 159 results in the search request. Of these 159 search results only 77 were significant for the purpose of this research. These 77 results are the basis of the following analysis.

6.3.2 Analysis

Stressors

In the examination of the stressors, only those that were explicitly mentioned by the reporting person were counted. For example, the stressor "poor flight conditions" was counted when a crew encountered severe turbulence, but it was not concluded that the person was fatigued when he or she mentioned that the incident occurred at night. This approach is intended to ensure that no misinterpretations are introduced into this analysis.

During the analysis of the incidents, it was found that the most common factor by far was "Insufficient Flight Time" (63!). This means that in 82% of the reported cases, pilots indicated that lack of flying was a determining factor in the incident. Fatigue was cited as a factor in 14%

of the cases (11*)[1]. In total, 115 different stressors were reported. The exact distribution can be obtained from the following table.

External		Internal	
Environmental	Psychological	Physiological	Cognitive
• Poor flight conditions (8) • Extreme heat or cold (2) • Crowded space (2)	• Workplace conflicts (4) • Family conflicts (1) • Insufficient flight time (63!) • Feeling lack of support (2) • Lack of control (2) • Financial problems (1)	• Poor diet (Nutrition) (1) • Sleep deprivation (11*) • Dehydration (1)	• Lack of information (8) • Mental fatigue (11*) • High workload (9)

Table 3: Stressors identified in the analysis of the ASRS database

Error Categories

After researching the stressors, the errors that occurred in the reported incidents were categorized for their respective error categories. A total of 130 errors were found, which were only counted if they were clearly described by the reporting individual. The most common source of error was inadequate/improper execution of tasks (21.5%). For example, a captain who forgot to release the parking brake before pushback was counted in this category. A flight crew forgot to shut down an engine due to distraction at the gate, which caused the engine to continue running while the gangway had already connected to the aircraft and the door was opened. This error was counted in the second most frequent error category "Poor Management of Competing Tasks" (16.2%). The other error categories and their distribution can be seen in *table 4*.

[1] Fatigue was mentioned in the reports in general. There was no distinction between mental fatigue and sleep deprivation. Therefore, the 11 cases are shown both in the physiological and the cognitive column, nevertheless, they were only counted once.

Error Category	Number of Errors	Percentage	Deviation
Inadequate Comprehension, Interpretation, and/or Assessment of the Situation	15	11.5%	-12.1%
Poor Management of Competing Task Demands	21	16.2%	-0.8%
Inadvertent Omission of Required Actions	14	10.8%	-6.2%
Inadequate or Improper Communication	16	12.3%	-1.7%
Inadequate/improper Execution of Tasks	28	21.5%	+10.5%
Poor Decision-making or Choice of Actions	8	6.1%	-1.4%
Inadequate Physical Execution of Action	17	13.1%	+7.9%
Failure to Acquire Information	11	8.5%	+3.8%

Table 4: Error Categories according to the findings from the ASRS database

6.3.3 Findings

The analysis revealed that a very high fraction of reporting pilots cited lack of recent flying as one of the main reasons for the respective incidents. In addition, it was found that a large share of reports cite fatigue as one of the main factors. To provide a comparative value, a query was created for the pre-pandemic period (Jan 19 - Mar 19) using the same parameters. In 784 reported incidents, "lack of recent flying" was not cited once and only 16 of the 784 can be attributed to fatigue. This represents only two percent of all cases.

In addition, the time factor was also criticized in many cases. Due to the pandemic, aircrafts have to be additionally disinfected before boarding. Cockpit crews must also disinfect instruments and flight controls prior to flight. This results in increased time pressure, as aircraft slot times have not been extended in return. In addition, some pilots stated that they were negatively affected both cognitively and physiologically by wearing the mask in the cockpit, which can also increase stress.

In addition, a deviation was found among the error categories. The categories "Inadequate/improper Execution of Tasks" and "Inadequate Physical Execution of Action"

were identified 10.5% and 7.9% more often, respectively, than in the comparative studies of Dismukes. The other deviations can be obtained from *Table 4*.

Furthermore, an analysis in ASRS of the proportion of human errors in relation to all reported incidents within the year of the pandemic did not reveal any significant changes relative to the previous years. Thus, the periods between March 2020 and March 2021 were compared with the three previous time periods. It was found that human error led to incidents in 73.6% of the reported cases. Compared to the previous periods, no large increase was detected here, but rather a very slight improvement (2019-2020: 76.6%; 2018-2019: 74.5%; 2017-2018: 69.4%).

6.3.4 Limitations

There are some limitations to the conducted study nonetheless. The first limitation that arises in the analysis is that only incidents that occurred either in U.S. airspace or on board an aircraft registered in the United States were considered. While the European Aviation Safety Agency (EASA) also offers an anonymous reporting tool, it is not publicly viewable without being a registered flight crew or air traffic controller. The fact that only cases from the USA were considered does not change the validity of the analysis, since it can be assumed that the stress factors during the pandemic on pilots are roughly the same worldwide.

Another limiting factor is the database itself. Due to the large amount of reports, it is not possible to examine each case individually. For this reason, the filters specified in the previous chapters were used to identify the incidents significant to this study. However, if the reporting person incorrectly categorized the entry, the report drops out of the analysis. In addition, the subjective perception of the pilot often plays a role in the entries. It is conceivable, for example, that other factors, such as insufficient training or fatigue, played a role in addition to the limited flying hours during the lockdown. It is possible that errors are thus blamed on obvious facts (e.g. lack of recent flying), while in reality other factors were much more decisive.

Another limiting factor is that some incidents may not be reported. This may be due to a variety of reasons. On the one hand, the severity of a situation may not be recognized or a report may not be generated due to time constraints. Obviously, unreported cases cannot be included in the analysis. It should also be noted that due to the pandemic there is significantly less air traffic, which means that the total number of reports has decreased.

Nevertheless, some conclusions about the change in the stress behavior of pilots due to the pandemic can be drawn from the data obtained.

7. Final Conclusions

General

The effects of stress can have serious consequences on the human body. It is irrelevant whether this is due to life stress or acute stress in critical flight situations. Both have a considerable influence on the cognitive performance of the human body. If this performance is impaired, mistakes are bound to be made, which can lead to serious accidents under certain circumstances.

The pandemic has increased life stress for pilots, while the conditions for acute stress have not changed substantially. Overall, the aviation industry has become very unstable, causing even large national carriers to struggle. As a result of the pandemic, pilots are receiving fewer flying hours and are faced with constantly changing regulations (e.g., disinfecting aircraft, entry requirements, etc.). As a consequence, there is overall uncertainty and, to some extent, dissatisfaction about the situation in the minds of the airmen. This can lead, as in the case of the crash in Pakistan, to reduced attention among the pilots, resulting in incorrect execution of tasks. But also, other cognitive skills can be limited due to these circumstances.

Hypothesis-based discussion

H1: A different distribution of stressors was observed when analyzing the ASRS reports. In general, there is a tendency for pilots to have less practice due to the low flying time, resulting in the loss of certain automatisms. In addition, the overall stress leads to a higher number of cases where fatigue plays a role. When evaluating the error categories, this problem is reflected to some extent. For example, the categories "Inadequate/improper execution of tasks" and "Inadequate physical execution of action" were each found to be 10.5% and 7.9% higher than in Dismukes' comparative study. These results suggest that indeed the lack of recent flying experience and fatigue have a significant impact on the errors committed by pilots (see Appendix XII). Therefore, H1 will be *accepted*.

H2: Based on the underlying data, it could not be determined that there was an accumulation of human error caused incidents due to the Corona pandemic. One explanation for this observation may be the fact that the number of mechanical defects increased as a result of the long groundings and inactivity of the aircrafts. Another possibility is that the limitations of the evaluation described earlier may have led to this result. Based on the available data, the H2 hypothesis has to be *rejected*.

Outlook and future research

The findings of the conducted research have revealed that approximately 75% of the incidents are caused by human error. For this reason, further studies should be performed to determine exactly which situations cause these human errors. This could potentially prevent many incidents in the future. Further automation in the aviation industry could help to reduce the workload of pilots, especially in stressful situations.

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Appendix

X. Accident Case Study of Continental Connection Flight 3407

For a better understanding of how exactly stress can have an influence on incidents, the accident case study of Continental Connection flight 3407 will be analyzed in the following. First, the accident sequence is briefly summarized, and then the crew's behavior is categorized according to the respective error category, the stressors present in this situation, and the influence on the cognitive abilities of the crew. This approach is also used in the final part of the thesis, the analysis of the reported cases from the ASRS database.

The case examined in the following section is an accident that was not included in the study by Dismukes and his team (2014). Nevertheless, the chosen incident likely had a high potential for stress among the flight crew. For the research of this accident, only the official investigation report of the National Transportation Safety Board was used.

Accident sequence

On February 12, 2009 a Bombardier DHC-8-400 operating as Continental Connection flight 3407 (the flight was conducted by Continental's regional contractor Colgan Air) departed from La Guardia airport in New York City and was on an instrument approach to Buffalo, New York (State). The aircraft crashed 5 nautical miles northeast of the airport killing all four crewmembers and all 45 passengers on board. When the aircraft hit a house during impact one additional person on the ground was killed. It was found out that during these winter conditions, ice was starting to form on the wings and horizontal stabilizers. Unnoticed by the crew, the aircrafts speed was bleeding off due to the added drag caused by the ice. While the autopilot was still engaged, a stall warning was triggered. A stall is a flight condition where the lift produced by the aircraft's engines and wings is not enough to keep the aircraft flying. This is usually a result of low speed and/or high angle of attack (angle between the chord line of the wing and the relative wind). The warning is designed to sound before the stall occurs to give

the pilots time to follow the right procedure (push the nose down and increase engine power). However, in this accident the captain did the opposite and pulled the yoke back, forcing the aircraft into a stall. In the meantime, the co-pilot retracted the flaps, which even worsened the situation. Due to the low altitude the crew was unable to recover the stall and the aircraft impacted a residential neighborhood. (NTSB, 2010: 81-91, 151-155)

Findings

It was discovered, that the captain had failed multiple check rides (examinations) during his career, but was nevertheless upgraded to captain and a new aircraft type just two months before the crash. (NTSB, 2010: 117)

There is no evidence that suggests the pilots were having any symptoms of life stress at the time of the accident. It was only discovered that the First Officer had a very low income of just 23,900$ per year (NBC, 2009). Nevertheless, her husband reported that her finances "were stable", even though she had a significant pay decrease when she started working for Colgan (NTSB, 2010: 12).

Since the pilots were having a "normal communication" (a violation of the "sterile cockpit rule", which forbids non-essential talking during critical phases of the flight and below 10,000 feet), there is also no reason to believe that the flight crew was dealing with any acute stress until the moment the stall warning sounded.

There are some indications that the crew might have dealt with fatigue, since both needed to commute to work (the First Officer (FO) took an overnight cargo flight as a passenger to New York) and both were seen sleeping on couches in the crew room. There are also some indications that the FO was having some symptoms of a cold on the CVR (blocked ears and sneezing).

Which stressors were present in the accident of flight 3407?

The NTSB named a few possible stressors in their accident report. For some stressors, it is not certain that they were present at the time of the accident, but if so, they may have contributed to the accident sequence. The following table lists the various stressors associated with this accident. Stressors that were not certain but may have been involved are grayed out. For example, it is not evident that the First Officer was suffering from her low income, but it is possible that she would have called in sick, if she would not be paid by an hourly rate.

External		Internal	
Environmental	Psychological	Physiological	Cognitive
• Poor flight conditions • Decreased vision • Extreme heat or cold • Altitude effects	• Workplace conflicts • Low job satisfaction • Financial problems	• Sleep deprivation • Prescription or over-the-counter medications • Hearing loss • Diseases	• Information overload • Mental fatigue • Fear • High workload

Table 5: Stressors on Continental Connection flight 3407

What influence did the stressors have on the pilots' behavior?

It is considered proven through the analysis of the CVR that the **attention** of the pilots was significantly reduced. This fact is less due to the influence of stress, but more attributable to the misbehavior of the cockpit crew, who did not comply with the "sterile cockpit rule." Nevertheless, it is very likely that the crew was very focused on the conversation and over-relied on the autopilot.

The **startle response effect** almost certainly played a contributing role in this accident. In this incident, the pilots were so deeply involved in the conversation that the stall warning practically caught them on the wrong foot. The pilots were trusting the autopilot to maintain speed and were so surprised by the stall warning, that they misjudged the situation and reacted in the opposite way than required.

It is very unlikely that the stressful situation had an impact on the pilot's **working memory** or **decision making**. These cognitive attributes are more likely to be affected by prolonged life stress.

A critical factor in this accident was found to be pilot **fatigue**. It is likely that the captain made a decision based on intuition (pulling the yoke) and did not understand the condition the aircraft was facing at that moment.

Which error categories were involved in the accident?

Without going into every detail, a large number of the error categories defined by Dismukes and his team played an elemental role in this accident. This is also a reason why this particular example was chosen. When the stall occurred on flight 3407, the pilots both misunderstood the situation: The captain pulled the yoke, which ultimately triggered the stall, and the co-pilot made the situation worse by retracting the flaps. This error can also be classified in the 3rd error category "Inadvertent omission of required tasks". In addition, "inadequate / improper communication" was also present, since the pilots were communicating with each other during a critical stage of the flight. Poor decision making (not activating the anti-ice system and not deactivating the autopilot) only led to the critical situation in the first place. In addition, the crew failed to ask for an updated weather report (NTSB, 2010: 154), which falls into the category of "Failure to Acquire Information".

Conclusion

Flight 3407 is often used as an example in the training of new pilots. It shows the whole range of mistakes that even pilots with good reputations (co-pilot) can make. However, it also shows how dangerous the influence of stress can be and how well-trained pilots can take actions in unexpected scenarios that are exactly the opposite of the required reaction.

XI. Reported Incidents based on Human Error

Your search returned 2654 ACNs

Search Criteria:
Date of Incident was between March-2017, March-2018
and **Federal Aviation Regs** (FAR) Part was Part 121, Part 135
and **Mission** was Cargo / Freight, Passenger, Test Flight, Training
and **Reporter Function** was Captain, Check Pilot, First Officer, Flight Engineer / Second Officer, Instructor, Other / Unknown, Pilot Flying, Pilot Not Flying, Relief Pilot, Single Pilot, Trainee

Your search returned 1229 ACNs

Search Criteria:
Date of Incident was between March-2020, March-2021
and **Federal Aviation Regs** (FAR) Part was Part 121, Part 135
and **Mission** was Cargo / Freight, Passenger, Test Flight, Training
and **Reporter Function** was Captain, Check Pilot, First Officer, Flight Engineer / Second Officer, Instructor, Other / Unknown, Pilot Flying, Pilot Not Flying, Relief Pilot, Single Pilot, Trainee

Your search returned 3137 ACNs

Search Criteria:
Date of Incident was between March-2019, March-2020
and **Federal Aviation Regs** (FAR) Part was Part 121, Part 135
and **Mission** was Cargo / Freight, Passenger, Test Flight, Training
and **Reporter Function** was Captain, Check Pilot, First Officer, Flight Engineer / Second Officer, Instructor, Other / Unknown, Pilot Flying, Pilot Not Flying, Relief Pilot, Single Pilot, Trainee

Your search returned 2876 ACNs

Search Criteria:
Date of Incident was between March-2018, March-2019
and **Federal Aviation Regs** (FAR) Part was Part 121, Part 135
and **Mission** was Cargo / Freight, Passenger, Test Flight, Training
and **Reporter Function** was Captain, Check Pilot, First Officer, Flight Engineer / Second Officer, Instructor, Other / Unknown, Pilot Flying, Pilot Not Flying, Relief Pilot, Single Pilot, Trainee

Your search returned 2403 ACNs

Search Criteria:
Date of Incident was between March-2019, March-2020
and **Federal Aviation Regs** (FAR) Part was Part 121, Part 135
and **Mission** was Cargo / Freight, Passenger, Test Flight, Training
and **Reporter Function** was Captain, Check Pilot, First Officer, Flight Engineer / Second Officer, Instructor, Other / Unknown, Pilot Flying, Pilot Not Flying, Relief Pilot, Single Pilot, Trainee
and **Human Factors** (since 6/09) were Communication Breakdown, Confusion, Distraction, Fatigue, Human-Machine Interface, Other / Unknown, Physiological - Other, Situational Awareness, Time Pressure, Training / Qualification, Troubleshooting, Workload

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Your search returned 2142 ACNs

Search Criteria:
Date of Incident was between March-2018, March-2019
and **Federal Aviation Regs** (FAR) Part was Part 121, Part 135
and **Mission** was Cargo / Freight, Passenger, Test Flight, Training
and **Reporter Function** was Captain, Check Pilot, First Officer, Flight Engineer / Second Officer, Instructor, Other / Unknown, Pilot Flying, Pilot Not Flying, Relief Pilot, Single Pilot, Trainee
and **Human Factors** (since 6/09) were Communication Breakdown, Confusion, Distraction, Fatigue, Human-Machine Interface, Other / Unknown, Physiological - Other, Situational Awareness, Time Pressure, Training / Qualification, Troubleshooting, Workload

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Your search returned 905 ACNs

Search Criteria:
Date of Incident was between March-2020, March-2021
and **Federal Aviation Regs** (FAR) Part was Part 121, Part 135
and **Mission** was Cargo / Freight, Passenger, Test Flight, Training
and **Reporter Function** was Captain, Check Pilot, First Officer, Flight Engineer / Second Officer, Instructor, Other / Unknown, Pilot Flying, Pilot Not Flying, Relief Pilot, Single Pilot, Trainee
and **Human Factors** (since 6/09) were Communication Breakdown, Confusion, Distraction, Fatigue, Human-Machine Interface, Other / Unknown, Physiological - Other, Situational Awareness, Time Pressure, Training / Qualification, Troubleshooting, Workload

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Your search returned 1843 ACNs

Search Criteria:

Date of Incident was between March-2017, March-2018
and **Federal Aviation Regs** (FAR) Part was Part 121, Part 135
and **Mission** was Cargo / Freight, Passenger, Test Flight, Training
and **Reporter Function** was Captain, Check Pilot, First Officer, Flight Engineer / Second Officer, Instructor, Other / Unknown, Pilot Flying, Pilot Not Flying, Relief Pilot, Single Pilot, Trainee
and **Human Factors** (since 6/09) were Communication Breakdown, Confusion, Distraction, Fatigue, Human-Machine Interface, Other / Unknown, Physiological - Other, Situational Awareness, Time Pressure, Training / Qualification, Troubleshooting, Workload

XII. Chi-Square Tests

	No errors before Covid	No errors after Covid	Total		p=	0,001789
Inadequate Comprehension, Interpretation, and/or Assessment of the Situation	50	15	65			
Poor Management of Competing Task Demands	36	21	57			
Inadvertent Omission of Required Actions	36	14	50			
Inadequate or Improper Communication	30	16	46			
Inadequate/improper Execution of Tasks	23	28	51			
Poor Decision-making or Choice of Actions	16	8	24			
Inadequate Physical Execution of Action	11	17	28			
Failure to Acquire Information	10	11	21			
Total	212	130	342			

	N. errors Accident	N. errors Incident	Total
Inadequate Comprehension, Interpretation, and/or Assessment of the Situation	40,29239766	24,70760234	65
Poor Management of Competing Task Demands	35,33333333	21,66666667	57
Inadvertent Omission of Required Actions	30,99415205	19,00584795	50
Inadequate or Improper Communication	28,51461988	17,48538012	46
Inadequate/improper Execution of Tasks	31,61403509	19,38596491	51
Poor Decision-making or Choice of Actions	14,87719298	9,122807018	24
Inadequate Physical Execution of Action	17,35672515	10,64327485	28
Failure to Acquire Information	13,01754386	7,98245614	21
Total	212	130	342

XIII. Synopsis of Incidents

77 Air Carrier flight crew reported loading the incorrect departure runway in the FMS but no track deviation occurred due to the flight path being the same. The First Officer reported distraction and COVID-19 job related concerns contributed to the event.

Helicopter Pilot reported a possible sporting event TFR violation. Pilot states the times of these active TFRs appear to change with little notice because COVID-19 is causing many changes to event schedules.

Air Carrier Captain reported company procedures were not followed during a mechanical irregularity. Captain stated outside issues, including pressure to maintain schedule, disrupted the normal flow of crew duties.

This was my second day of work coming back from a 7 month leave

Air Carrier flight crew reported thinking they were cleared for takeoff, but were only cleared to line up and wait.

Air carrier flight crew reported a runway change prior to departure and departing without the correct load closeout.

Air carrier Captain reported taking off with the pneumatics panel misconfigured and the left pack in Auto.

Air carrier Captain reported the Operations Manager was unable to help the crew during an in-flight mechanical problem due to being involved with a COVID-19 situation.

Air carrier flight crew reported a track heading deviation and cited lack of flying as a contributing factor.

Air carrier First Officer reported an aircraft went around due to winds, while they were departing a parallel runway causing an airborne conflict.

Air carrier flight crew reported a track heading deviation during arrival and both pilots cited lack of flying as a contributing factor.

Air carrier flight crew reported turning right instead of left on departure. Both pilots referenced lack of flying as a contributing factor.

Air carrier flight crew reported departing with an incorrect pack configuration.

Air carrier First Officer reported a slat/flap indication problem on departure resulting in a return to departure airport. Little flying experience in the last 7 months. Any flight control issue is an emergency, even when corrected. Better maintenance on aircraft.

Air carrier Captain reported having no pillows on flights due to COVID-19 and not being able to adequately rest.

Air carrier flight crew reported executing a go-around due to a ground proximity warning. Stress due to covid-19 and little flying time

Air carrier flight crew reported an altitude deviation during arrival resulting in an airborne conflict.

Air carrier flight crew reported setting up for the incorrect runway during approach.

60 Air carrier flight crew reported an unstablized approach and landing and cited lack of flying as a contributing factor.

Air carrier flight crew reported track heading and altitude deviations during departure and cited confusing ATC instructions as a contributing factor.

Air Carrier First Officer reported landing without a clearance and stated lack of flying was a contributing factor.

Air carrier Captain reported an altitude deviation during approach.

Air carrier flight crew reported a track heading deviation and cited First Officer's lack of flying as a contributing factor.

Air carrier First Officer reported altitude deviation on a departure and cited lack of flying as a contributing factor.

Air Carrier Captain reported taking an ATC clearance for a similar sounding aircraft on the same frequency. The Captain reported the Controller was working multiple sectors at the time. Lack of flying

Air carrier First Officer reported the flight departed with incorrect release documentation. The First Officer referenced not having flown in the last 6 months due to the COVID-19 pandemic. Lack of flying

Air carrier First Officer reported being high and fast on an approach and cited lack of flying as a contributing factor.

Air carrier First Officer reported an altitude deviation was the result of too much time away from work because of COVID-19 lack of flying.

Air carrier flight crew reported landing without a clearance. Lack of flying

Air carrier flight crew reported being high and fast as they were "leading the pack" during a visual approach. The crew cited lack of flying and pressure to maintain their speed to not hold up other aircraft behind as contributing factors.

Air carrier Captain reported not making a crossing restriction during arrival and cited lack of flying as a contributing factor.

Air carrier flight crew reported landing without a clearance. Fatigue lack of flying

First Officer reported receiving an RA and overshooting the assigned altitude by 500 feet due to a light load. Lack of flying

Air carrier Captain reported departing with an inoperative safety item that should have been inspected by maintenance prior to departure. Stress on ground

Air carrier flight crew reported a communication issues with TRACON Control during arrival. TRACON was working departures and arrivals on two frequencies. ATC informed the crew they were short staffed due to COVID-19.

Air carrier First Officer reported an aircraft issue during cruise resulted in a diversion. First Officer stated they did not have the correct charts onboard the aircraft due to possible cost saving measures by the airline during the COVID-19 pandemic.

Air carrier First Officer reported they taxied to the ramp as cleared by EWR Tower and did not contact Ramp Control because it appeared to be closed. First Officer stated that due to the changing responsibilities of controllers, it was difficult to know what the correct procedures were.

Air carrier Captain reported the First Officer made a sudden steep turn on departure while following command bars. The Captain took control of the aircraft and noted that the FO was very tired and had not done a takeoff or landing in over a year. Fatigue Lack of flying

Air carrier Captain reported departing without proper takeoff data, citing high workload and career uncertainties related to COVID-19 cutbacks as contributing.

Air carrier flight crew reported landing without a clearance. Lack of flying

Air carrier Captain reported failure to call for the Before Push checklist, then also failing to call for the Before Taxi checklist, citing lack of flying due to COVID-19 cutbacks as contributing.

Air carrier First Officer reported landing without a clearance, citing fatigue and scarcity of other aircraft operating due to COVID-19 reductions as contributing.

Air carrier First Officer reported inadvertently moving the pack switches to off instead of high flow causing a cabin depressurization during climbout. Fatigue & lack of flying

General uncertainty of COVID-19 and preoccupation of being furloughed (for both myself and my husband who is junior to me).

Air carrier flight crew reported taking off without a clearance and stated that being distracted by the COVID-19 pandemic and the state of the airline contributed to the event.

Air carrier flight crew reported retracting the flaps during climb before the appropriate airspeed and stated that fatigue, hunger, and excessive heat in the aircraft contributed to the event, and the COVID-19 mask was a distraction.

Air carrier flight crew reported they left an engine running after parking at the gate. They cited as contributing factors the failure to complete a checklist due to distraction.

lack of flying

Air carrier Captain reported non functional PAPI lights at airport for a specific runway and the safety hazards it could pose in weather conditions, especially when crews are not flying as often due to the COVID-19 pandemic.

Air carrier flight crew reported a taxiway incursion and stated distraction from COVID-19 pre-flight related procedures contributed to the event. Lack of flying

Air carrier flight crew reported experiencing an unstabilized approach and flaps not at final setting before 1,000 feet AGL. Captain stated he should have commanded the First Officer to go-around and cited lack of flying as a contributing factor.

Air carrier flight crew reported flying an incorrect departure transition that had a similar sounding name as the clearance transition. The crew stated that lack of flying was a contributing factor.

Pilot reported flying a trip with the aircraft being over due on the CFR 135.185 weighing requirement. Lack of flying

Captain reported experiencing a speed deviation below 10,000 feet and stated First Officer's lack of flying contributed to the event.

Air taxi flight crew reported landing at an airport and being advised that the runway was closed.

Air Carrier Captain reported fatigue issues while flying as a reserve pilot for a 4 day pairing during the COVID-19 pandemic.

Air carrier flight crew reported they began taxiing out without clearance. Captain stated lack of flying was a contributing factor.

Air carrier Captain reported experiencing a track heading deviation due to FO entering the wrong heading on the PFD. Captain and ATC caught the mistake and corrected the heading. Lack of flying

Air carrier flight crew reported experiencing an unstabilized approach and setting up to land on a closed runway with anticipation of changing to landing runway later. Lack of flying

Air carrier flight crew reported forgetting to turn off APU and later exceeding the APU ceiling. Lack of flying

Pilots reported being advised that the aircraft was flown with open write ups on three legs. Distraction due to Covid-19 regulations

Air carrier flight crew reported experiencing an unstabilized approach resulting in a go-around. Unfamiliarity with the airport and rustiness from lack of flying were cited as contributing factors.

Pilot reported being rusty after lack of flying due to the COVID-19 pandemic resulting in communication issues with ATC.

Air carrier First Officer reported forgetting to turn on the probe heat and stated lack of flying was a contributing factor.

Air carrier Captain reported not recognizing until cruise that the transponder was set incorrectly. Captain recommended that crews visually confirm checklist items since many pilots are flying infrequently due to COVID-19 reductions in travel demands.

Lack of flying

Air carrier flight crew reported multiple changes to the arrival and runway resulted in a track heading deviation. Flight crew stated lack of flying was a contributing factor.

Air carrier First Officer reported taking off without a required alternate. A delay due to spraying for COVID-19 was cited as a contributing factor.

Air carrier flight crew reported not calling Ramp before taxiing. Lack of flying

Air carrier Captain reported pushing back before brakes were release causing the tow bar shear pin to break. Lack of flying

Air carrier Captain reported various issues relating to the COVID-19 pandemic including FAs not properly using masks, passenger complaints regarding seating issues and lack of flying time. Lack of flying

Air carrier flight crew reported overshooting a charted altitude during a go-around. The Captain stated the very low aircraft weight associated with the COVID-19 pandemic resulted in an abnormally high climb rate.

Air carrier flight crew reported that during climbout, the aircraft rate of climb exceeded the pressurization system rate of climb resulting in a warning message. The crew reported an extremely light passenger and cargo load due to the COVID-19 pandemic contributed to the event.

Air carrier flight crew reported an erroneous frequency change that resulted in a track heading deviation. Lack of flying

Air carrier Captain reported receiving a TCAS RA related to an abnormally high climb rate associated with very lightly loaded aircraft because of the COVID-19 pandemic.

First Officer reported issues relating to NOTAMS and towers closing for COVID-19 cleaning.

Air carrier flight crew and an enroute Controller reported an airborne conflict occurred when the flight crew took a descent clearance intended for another aircraft. Controller suggested that increased workload associated with COVID-19 procedures contributed to the event.

Air carrier Captain reported deviating from charted course on departure in part because the aircraft was climbing quicker than normal due to a very low passenger count as a result of the COVID-19 pandemic.

Air carrier flight crew received a momentary EGPWS terrain warning while turning base on a nighttime visual approach. The flight continued to a safe landing. The crew noted that distraction due to the COVID-19 pandemic, its impact on the company, and family concerns contributed to the event.

Air Carrier Captain reported that concerns about COVID-19 and possible furlough resulted in an unstabilized approach.