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Continued flight under visual flight rules into instrument meteorological conditions remains the predominant cause for fatal accidents by percentage for general aviation aircraft operations. There are gaps in the research in determining how motivation might influence the decision-making process. Therefore, the purpose of this study was to determine how motivation and meteorological conditions might affect a pilot's willingness to persist in flight into meteorological conditions. Four hundred and fifty-four general aviation pilots participated in a mixed factorial experiment to assess their willingness to persist in varying weather conditions. Participants were randomly assigned into one of three motivation groups (intrinsic, extrinsic, or no motivation) and were subjected to all three meteorological conditions (visual, marginal, and instrument) that were randomized in order of appearance. They were then asked to indicate their willingness to persist in each condition via a slider scale, scaled from 0 to 100. The results indicated the main effect of meteorological condition has a significant effect on willingness to persist, while the main effect of motivation did not. The interaction between meteorological condition and motivation resulted in a significant effect, particularly in the marginal meteorological condition.

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It was just after sunrise and the fog was still hanging over the airport. The private, instrument-rated pilot needed to complete a short flight across town for an important breakfast meeting. Joining the pilot on the flight was a business partner and the business partner's son. Expecting the fog to 'burn off' as forecasted, the pilot did not leave enough time to drive across town should they be unable to make this flight. Knowing an instrument flight plan would also add a severe delay due to air traffic control issues, the pilot chose to depart the field requesting a special VFR clearance, which required only one mile of visibility and remaining clear of clouds. The departure went smoothly, and the pilot was halfway across town before the fog began to thicken. Feeling committed at this point, the pilot began a zig-zag flight path to maintain visual references, when suddenly the aircraft was engulfed in clouds. Having lost visual reference, the pilot was unexpectedly forced to switch to using flight instruments to navigate and maintain aircraft control. However, the instruments were giving what felt like contradictory information. Were they climbing or descending? Turning left or turning right? As the wind began rushing by the outside of the aircraft, the pilot knew something was wrong, but it was not until the aircraft exited the clouds in a spiral dive toward to ground that the problem could be diagnosed. A last-minute effort to pull back on the control yoke proved futile as the aircraft plunged into the ground, fatally injuring all on-board.

Unfortunately, the fictitious scenario described above is not a unique one to those familiar with aviation. Many questions continue to plague aviation researchers, especially as it relates to why pilots persist in continuing flights into deteriorating weather conditions — a phenomenon that will be explored in this initial examination of what may be the influence of motivation on that willingness to persist. In 2017, the 26th Joseph T. Nall Report, a biennial review sponsored by the Aircraft Owners and Pilots Association (AOPA), examined the occurrences and suspected causal factors of GA mishaps based on 2014 data. The findings indicated that out of 1,163 GA accidents, 32 (3%) were attributed to weather-related causes (Kenny, Knill, Sable, & Smith, 2017). Of the weather category, 22 (69%) were VFR into IMC; and of those, 20 (91%) resulted in one or more fatalities. The 2014 VFR into IMC mishap fatality rate for the weather category is consistent to the previous years, which were recorded as 73% in 2013 (Perry, Kenny, Knill, Pangborn, & Sable, 2016), 95% in 2012 (Landsberg, Lenny, Smith, Pochettino, & Knill, 2015), and 93% in 2011 (Landsberg, Lenny, Smith, Pochettino, & Knill, 2014). Although weather-related issues have a relatively low occurrence, it also has a much higher fatality rate and has remained stubbornly fixed for over three decades. This is despite the development of weather forecasting technologies, the introduction of Automatic Dependent Surveillance-Broadcast (ADS-B), better training, and the presence of safety awareness campaigns.

In the past, aviation research has focused on the hazardous attitudes (*macho, impulsivity, resignation, invulnerability,* and *anti-authority*) that can disrupt the decision-making process and interfere with sound risk management (FAA, 2009). While these five hazardous attitudes were considered when developing the nature of the study, the focus of this research is on how motivation might impact the decision-making process. Motivations are the reasons why individuals behave, and therefore make decisions the way they do, while attitudes are more about a person's state of mind while making that decision.

Human factors and aviation safety researchers such as O'Hare and Owen (1999), Wilson and Sloan (2003), and Goh and Wiegmann (2001a) identified motivation as a key part of the aeronautical decision-making process, but their studies have not gone so far as to apply the behavioral subcomponents of motivation that other domains have had great success in developing. For this research, motivation is the reason or reasons a person might chose to act or behave in a certain way, or the general desire or willingness to do something. Motivation theory has been applied extensively in education, goal achievement, and job satisfaction, with the intent to quantify how human behavior and desires might translate into action and decision making. For a review of motivation in education and in job-satisfaction, it is recommended readers review Vansteenkiste, Lens, and Deci (2006), Herzberg (1966), and Herzberg, Mausner, and Snyderman (1967), respectively.

Foundational motivation theorists such as Maslow (1943, 1970), Reiss (2004), Herzberg (1966), Herzberg et. al. (1967), and McClelland (1988) have demonstrated that the manner by which a person is motivated has a direct effect on his or her decision-making process. The purpose of this study is to determine how motivation and meteorological conditions might affect a pilot's willingness to persist in flight into IMC. The following literature considered the severity of the issue in terms of occurrence and lethality, the prevailing theories that have and have not been addressed, what effect cognitive biases have on the decision-making process, and the theoretical foundations of motivation.

General Aviation Accident and Incident Archival Data Studies

According to the Federal Aviation Administration and the Code of Federal Regulations (2014), visual flight rules (VFR) are a set of regulations by which a pilot operates an aircraft in visual meteorological conditions (VMC), meaning a ceiling that is greater than 3,000 feet AGL and visibility is greater than 5 miles. Conversely, instrument flight rules (IFR) are the operating regulations pertinent to flying in instrument meteorological conditions (IMC), meaning those conditions that consist of a ceiling of less than 1,000 feet and a visibility of less than three miles. Marginal VMC (MVMC) is when the ceiling is between 1,000 and 3,000 feet and/or three to five miles of visibility.

VFR into IMC is when a pilot, who by rating or aircraft limitations, is obligated to fly by visual references only, and either chooses or inadvertently flies into weather conditions that require the use of instruments as a primary reference due to the lack of reliable out-of-window cues for orientation. Research teams have sought to determine why a pilot might persist into adverse weather conditions, particularly when he or she is flying under visual flight rules. Existing studies almost exclusively focus on risk assessment (O'Hare & Owen, 1999), skills self-assessment (Goh & Wiegmann, 2001a, 2001b), and the decision-making process (Goh & Wiegmann, 2001a, 2001b; Wilson & Sloan, 2003). For this research, *willingness to persist* is defined as the firm or obstinate continuance of action in spite of difficulty or opposition.

Goh and Wiegmann (2001a) reviewed accident data, specifically depicting VFR into IMC, and determined that *social pressure* was one of the prevailing theories as to why pilots persist. Social pressure might influence a pilot to persist, particularly when there are expectant passengers on board, or if the desire to perform in adverse conditions is present (Goh & Wiegmann, 2001a). Under this construct, social pressure most closely resembles motivation elements because the desire to please [extrinsic motivation] and the desire to perform [intrinsic motivation] become the basis for the decision to persist.

Wilson and Sloan (2003) used the NTSB and Transport Safety Board of Canada archival data from 1983 to 1999 to offer a comprehensive look at the common aspects of VFR into IMC mishaps. They noted that the pilots of the mishaps tended to be individuals who flew for personal reasons rather than commercial; and, just over 60% were flying their own aircraft. In addition to inclement weather, additional environmental factors [such as nighttime conditions, or topographical elements such as mountainous terrain] were also considered, as those elements greatly increased the lethality of the events (Wilson & Sloan, 2003). After they reviewed all of the events, the researchers asserted that pilot decision-making processes were not always rooted in rationality. Rather, most pilots were subject to bias and unrealistic optimism in their aeronautical decision making (Wilson & Sloan, 2003). An important distinction to note here is that while the Goh and Wiegmann (2001a) study attempted to assess the fundamental reasons why a person might persist in VFR flight into IMC, the Wilson and Sloan (2003) study focused on the reasons why the act would be considered a hazard.

Factors that Affect VFR into IMC

In a slight contrast to Wilson and Sloan's (2003) reasoning, Higgins (2000) argued that while all human beings are motivated to make good decisions, remaining objective is not a simple matter. There are psychological influences that take into account--not just the perceived gains and losses--but also social, moral, and emotional considerations. These additional considerations are subject to their limitations. Cognitive biases such as sunk cost, plan continuation error, and confirmation bias manipulates the resulting decision from being one that is purely objective (Goh & Wiegmann, 2001b; Muthard & Wickens, 2003; O'Hare & Owen, 1999). In the Goh and Wiegmann (2001b) study, 32 non-instrument rated participants had to fly a simulated Cessna 172 from one point to another. Unbeknownst to the participants, the flight scenario was programmed for rapidly deteriorating weather. Of the 32 participants, 22 continued with their flight. While not the focus of the study, the outcome highlighted how both cognitive bias and motivation could interact with the decision-making process.

In a similar experimental design, O'Hare and Owen (1999) subjected 20 VFR pilot participants to a scenario in which the undesirable condition marginal VFR was introduced either within the first 15 minutes of flight or the latter 15 minutes before reaching the intended destination. Participants were to fly the established flight plan and were immediately assessed once they either discontinued the flight or once marginal VFR was exceeded (O'Hare & Owen, 1999). The data showed that the timing of the introduction of inclement weather seemed to affect pilot situation awareness. The participant pilots seemed to fly longer because the perceived risk of diverting the aircraft was higher than the risk of proceeding. Confirmation bias can manifest as a pilot only seeks the data that validates his or her goal and disregards any information that runs contrary. Once vital cues and pertinent information are missed, the pilot fails to revise the plan and persists with the faulty course of action (Dehais, Causse, Vachon, & Tremblay, 2011).

In the O'Hare and Owen (1999) study, the pilots who persisted VFR into IMC exhibited very little indication that they would even consider an alternative option. The researchers postulated that this persistence, or willingness to continue, was attributed to the pilot's decision to proceed having been made far before the onset of inclement weather occurring. The willingness also indicated something else might more heavily influence the decision-making process. It is possible that whatever motivated the person to take the flight, to begin with, may have significant bearing on whether that person is willing to persist (O'Hare & Owen, 1999). In this state, the pilot is even more susceptible to bias in aeronautical decision making.

Theoretical Foundation of Motivation

Theorists such as Maslow (1943, 1954, 1970), McClelland (1998), Herzberg (1996), Reiss (2004), and Deci and Ryan (2008, 2014) have sought to better understand human behavior by conducting phenomenological studies on the attitudes, beliefs, ethics, and motivations of different groups of people. While there are a few points on which they disagree, what remains constant throughout the studies is that motivation plays a powerful role in how people conduct themselves and make decisions.

Maslow (1943, 1954, 1970) asserted that human behavior was derived from individuals seeking different levels of fulfillment. His theory of needs — from physiological to self-actualization — stands as one of the most commonly-recognized for understanding human motivation. Since Maslow, several researchers have attempted to identify further and isolate the behaviors, ideas, and characteristics that seem to affect why a person pursues an interest. Reiss (2004) argued that motives are the reasons by which a person will perform voluntary behavior. McClelland (1988) believed that people would exhibit different characteristics based on whichever motivator was more dominant and argued that the actual motivations were the result of learned behaviors rather than something inherent to the person. Lastly, Herzberg's (1966) two-factor theory determined that though job satisfaction is influenced by both forms of motivation, intrinsic motivators such as a sense of achievement and belief in the work might affect one's willingness to persist more than extrinsic elements such as pay or benefits.

The two sub-components of motivation are defined as being extrinsic or intrinsic. *Extrinsic motivation*, or external pressure, refers to when a person is driven to act by external influences such as financial reward, accolades, or the desire to avoid punishment (Deci, Ryan, & Koestner, 1999; Deci & Ryan, 2014). Extrinsic motivation can factor heavily in the pilot's decision to persist with a flight and therefore warranted additional research. Internal or *intrinsic motivation* arguably has an even more profound and yet almost imperceptible effect on the decision-maker. For the purpose of this study, intrinsic motivation is when the act or behavior is driven by internal or personal reward (Deci & Ryan, 2000).

Current Study

A willingness to persist refers to a willingness to continue in pursuit of a goal despite the contrary information indicating that doing so is no longer the optimum choice. Understanding how different motivations might affect ones' willingness to persist will help to refocus and build new platforms for pilot education, training, outreach, and prevention with the ultimate goal of decreasing the number of weather-related accidents and the associated fatality rate .

The purpose of the study was to determine how different motivations and types of meteorological conditions affect a pilot's willingness to persist flying into meteorological conditions. The literature did not support directional hypotheses, and therefore non-directional ones were proposed. The research sought to test the following hypotheses:

H_1 – There is a significant difference in indicated willingness to persist in VFR flight into IMC based on the type of motivation.
H_2 – There is a significant difference in indicated willingness to persist in VFR flight into IMC based on the type of meteorological conditions.
H_3 – There is a significant interaction between type of motivation and type of meteorological conditions on pilots' indicated willingness to persist in VFR flight into IMC.

Methods

Design

The research followed a quantitative, mixed factorial design. The between-participants factor was motivation, and the within-participants factor was meteorological condition. A two-way mixed analysis of variance was conducted to assess the main effects and interactions. All weather scenarios were presented randomly to the participants.

Participants

The target population was general aviation pilots who hold either a recreational, sport, private pilot, airline transport pilot (ATP), or commercial certificate. The accessible population was pilots who were available via electronic means of communication. The sample was sourced through the Curt Lewis' Flight Safety Information daily newsletter and the Federal Aviation Administration's *Safety Briefing Magazine*. Five hundred and twenty-nine responses were recorded resulting in 454 usable sets of results. The most common reason for case elimination was incomplete and non-qualifying data.

Of the participants, 226 (49.7%) held a private certificate, 140 (30.8%) held a commercial, 81 (17.8%) held an airline transport pilot, 6 (1.3%) held a sport, and 1 (.2%) participant held a recreational certificate. Experience level ranged from 40 hours to more than 34,000 hours, with an average of 3,443 hours (*SD* = 5,698), and median of 1,100 hours. The participants recorded ages ranging from 18 to 85 years old with a mean of 56.07 (*SD* = 14.80). The respondents were 92% male, 7% female (with 1% choosing not to answer). Sample ethnicities included: 89% white/Caucasian, 2% Latino/Hispanic, 1.5% Asian/Pacific Islander, fewer than 1% listed being Native American, 1% identified as other, and 6% chose not to answer.

Materials and Procedure

Participants were solicited through electronic recruitment, which provided a link to an online questionnaire accessed through SurveyMonkey™. Participants were presented with a consent form and instructions. The introductory scenario restricted the participant to flying a Cessna 172, equipped with a Garmin G1000 avionics suite, from an fictitious fixed-base operator for a VFR cross country flight from Colonel James Jabara Airport (AAO) just outside Wichita, Kansas, to Lancaster Regional Airport (LNC), Lancaster, Texas. Each participant was informed that they had a full tank of fuel with just over 40 gallons on board. The aircraft had a restricted certification for VFR flight only. Even if the participant was IFR qualified, the aircraft will not allow for that option.

Next, they were randomly assigned to one of three groups representing three motivation categories: *intrinsic*, *extrinsic*, and *no-motivation*. Regardless of the motivation the participant was assigned, each pilot encountered all of the meteorological conditions ─ *VMC, MVMC,* and *IMC* ─ to which each person expressed their attitudes toward their individual willingness to persist. Perceived willingness was determined by a slider scale set by percentage from 0 to 100 percent.

The three motivation scenarios are as follows:

Extrinsic – The two of you have bought nonrefundable VIP tickets to the "BIG" game and have a whole grand weekend planned out. In addition, you have won the "biggest fan" accommodations package that includes a stay at a 5-star luxury hotel. You will forfeit this if you do not show up on time.

Intrinsic – The two of you are looking forward to surprising friends and family whom you haven't seen in years. They are unaware you are flying in just to come see them. You are excited about the big traditional holiday gathering and are eager to show off your piloting skills.

No-motivation – The two of you have been given coupons to a famous aviation museum that has been getting good reviews online and by word of mouth. The coupons are good for free entry and they do not expire. You have nothing else going on so you decided to go check it out.

The types of meteorological conditions were crafted based on federal regulation criteria. Since all participants responded to all three weather scenarios, their appearance in the survey was randomized for each person to avoid order effects.
The meteorological scenarios are as follows:

VMC – You are about 40 minutes out from your destination. A quick check of the conditions at your destination indicate visibility is 10 nautical miles with a 6,000-foot ceiling.

MVMC – You are about 40 minutes out from your destination. A quick check of the conditions at your destination indicate visibility is 3 nautical miles with an overcast cloud layer at 2,500 feet AGL.

IMC – You are about 40 minutes out from your destination. A quick check of the conditions at your destination indicate visibility is 2 nautical miles with an 800-foot overcast cloud layer.

The participants also provided demographic data, were thanked and dismissed.

Results

Descriptive Statistics

SurveyMonkey™ automatically and randomly sorted the participants into different motivation categories with the breakdown equaling n = 145 participants for the *extrinsic* motivation category; n = 167 for the *no-motivation* category; and n = 142 for the *intrinsic* motivation category. The scores for the dependent variable *willingness to persist* was recorded via sliding scale by percentage. The mean scores recorded by the participants, for each weather condition, and each motivational category is shown in Table 1.

Table 1
Mean Scores and Standard Deviations for Dependent Variable by Type of Weather Condition and Type of Motivation.

	Motivations	Mean	Std. Deviation	*N*
VMC	Extrinsic	95.96	13.609	145
	No Motivation	97.37	10.323	167
	Intrinsic	96.51	11.453	142
	Overall	96.65	11.794	454
MVMC	Extrinsic	59.77	32.745	145
	No Motivation	51.59	34.924	167
	Intrinsic	59.21	34.907	142
	Overall	56.59	34.376	454
IMC	Extrinsic	15.83	25.466	145
	No Motivation	10.23	22.157	167
	Intrinsic	14.32	25.817	142
	Overall	13.30	24.482	454

Note: The summary of the mean, standard deviation, and sample size (*N*) for the dependent variable: willingness to persist.

Initial Data Analysis

It was determined that the majority of the outliers were truly representative of participants' indicated willingness to persist VFR flight into IMC, because identifying and assessing this willingness is the main purpose of this research, these scores were not removed from the dataset. A Shapiro-Wilk test for normality was significant ($p < .05$) therefore, the data did not meet the assumption of normal distribution. Due to the violation and without a sufficient non-parametric test to use, the robustness of the ANOVA was considered. With large sample sizes and particularly those over 100 (in this study N = 454), deviations from normality are not considered to have an influence on the results and result in only minor deviations in the findings (Field, 2009; Oztuma, Elhan, & Tuccar, 2006). This deviation has not been shown to affect the results of a parametric test (Pallant, 2007; Oztuma et al., 2006), and, therefore, many researchers accept the use of ANOVA whatever non-normal distribution exists within the dataset as long as this limitation is clearly disclosed (Carifio & Perla, 2008; Norman, 2010).

Inferential Statistics

Results of the two-way mixed ANOVA indicated no statistically significant main effect existed for Type of Motivation (H_1) on the dependent variable [$F(1, 451) = 2.428$, $p = .089$], partial $\eta^2 = .011$. This finding means that the type of motivation alone had no statistically significant effect on participants' indicated willingness to persist.

A statistically significant main effect ($p < .05$), with a large effect size, existed for the Type of Meteorological Condition (H_2) on the dependent variable, [$F(1.874, 845.195) = 1704.242$, $p < .001$], partial $\eta^2 = .791$. This finding means that the weather conditions alone had a statistically significant effect on the participants' indicated willingness to persist.

The main effects were qualified by a statistically significant interaction ($p < .05$), with a small effect size, between Type of Motivational and Type of Meteorological Condition (H_3) on the dependent variable, [$F(3.748, 845.195) = 2.524$, $p = .043$], partial $\eta^2 = .011$.

Three separate tests for simple main effects were accomplished on the data to determine which might be significant. The test for between-participants effects on willingness to persist in VMC or IMC indicated there were no statistically significant differences: $p = .542$ and $p = .111$, respectively. There was a significant difference in willingness to persist in the MVMC condition, [$F(2, 465) = 3.193$, $p = .042$], partial $\eta^2 = .014$. Two post hoc tests were then completed to determine which means were significantly different from each other within the MVMC category (Table 3). Figure 1 depicts the main effects and interaction.

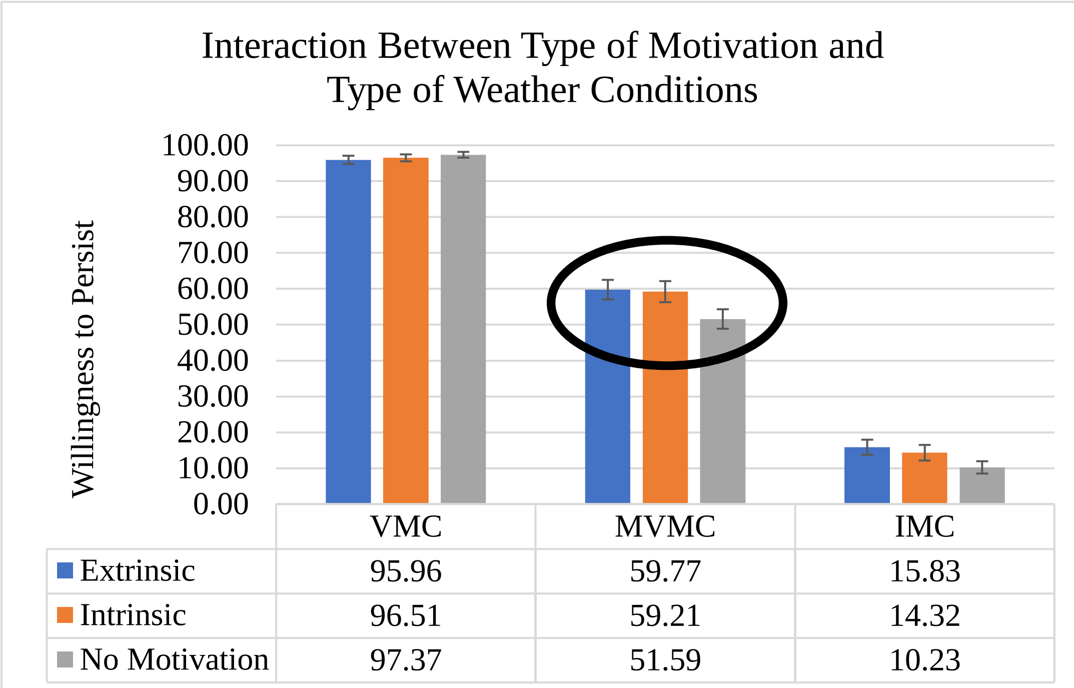

Figure 1. Pilot willingness to persist scores based on weather conditions and the type of motivation. The graph highlights the significantly greater willingness to persist of extrinsic and intrinsic motivation compared to no motivation within the MVMC category. The significant interaction is circled and visually depicted by the significant difference between the no motivation condition and the extrinsic and intrinsic conditions. Standard error bars depicted.

Using the Least Significant Difference (LSD) post hoc test, the extrinsic and intrinsic motivation categories indicated a statistically significant difference in mean scores (p = .032 and p = .030, respectively) from the no-motivation category in indicated willingness to persist. Both the extrinsic and intrinsic categories indicated a higher willingness to persist than the no-motivation category. They did not, however, indicate a significant difference from one another.

Discussion

The purpose of this study was to conduct a quantitative factorial design on general aviation pilots to determine how different motivations and different types of meteorological conditions might affect one's willingness to persist in flight. The data indicate that motivation by itself did not have a significant effect on the willingness to persist. This question was posed because, while motivation is often mentioned by researchers as having a profound effect on the decision-making process, the theoretical components of motivation have not been specifically mentioned or applied to this domain. Herzberg's (1966) and Herzberg et. al. (1967) two-factor theory was one of the first to identify the two different fundamental components of motivation — intrinsic and extrinsic — and their relative effect on the decision-making process. It suggests that though people are influenced by both forms of motivation, intrinsic motivators affect one's willingness to persist more so than extrinsic elements (Herzberg, 1966). Although this theory was ultimately not corroborated within this research, there was some expectation that the trend of intrinsic motivation having more influence might reflect in the effect of motivation on the dependent variable.

The results also indicated that the meteorological condition had a significant effect on willingness to persist. Higgins (2000) postulated that all human beings are motivated to make good decisions and that an objective-based decision is one where the outcome achieves the highest benefit while requiring the lowest costs. Therefore, it made sense and was expected that the participants' willingness to persist in-flight decreased as meteorological conditions decreased. There were, however, significant outliers that indicated some participants' willingness did not decrease as conditions decreased at all; or it did not decrease at the same rate as the majority of participants. While outliers are often seen as anomalies that must be dealt with in experimental designs, these outliers represent attitudinal data that indicates some participants are willing to persist into inclement weather despite not being equipped to do so and therefore reinforce the need for this research. The findings from these main effects were qualified by a significant interaction between meteorological conditions and motivation, although with a small effect size. Specifically, intrinsic and extrinsic applications seemed to reflect a difference from the no-motivation application. The former categories reflected a higher willingness to persist over no motivation, within the marginal VMC weather condition. This finding implies that *some* motivation might affect willingness to persist over no motivation at all.

A consideration of what motivation and goal-achievement behavior entails, combined with an understanding of the inherent cost-benefit analysis all individuals partake in when confronted with a decision, helps to explain why this interaction might have occurred. First, a person is more likely to persist when he or she has a goal to achieve. Second, the requirement to make such a decision is only necessary at the onset of any obstacle that runs contrary to that initial task.

On some level, motivation can factor into willingness to persist, particularly when the ability to make an accurate assessment of the weather condition becomes challenged as it is in MVMC. Studies have shown that deteriorating weather identification is not as simple as recognizing the FAA standard, appreciating the danger, and reacting to it. In the Goh and Wiegmann's (2001a) study, their concept of *situation assessment* postulated a pilot likely persists into flight simply because they are unaware that they are doing so at the time. This concept considers a pilot's ability to correctly diagnose the weather and presumes that were a pilot to accurately assess the situation for the hazard it is, they wouldn't persist (Goh & Wiegmann, 2001a).

Further research into weather dissemination tactics from the FAA's William J. Hughes Technical Center confirms that a pilot's actual ability to correctly diagnose the weather can be quite limited (Ahlstrom & Jaggard, 2010; Ahlstrom & Suss, 2015). These limitations would be the same for the effect of the interaction between motivational category and meteorological condition on the dependent variable. Compounded with a motivationally-backed desire to continue and the result is an unintentionally skewed pilot risk assessment process and leave him or her more susceptible to bias. The result is negatively affected aeronautical decision making and situation awareness. To what level motivation can be a factor on decision making, still has to be defined.

Practical Applications

GA advocates such as the FAA Safety Team, the Aircraft Owners and Pilots Association, and the Experimental Aircraft Association have already contributed significant resources and research on the subject of proceeding VFR into IMC. Each of these organizations, as well as many others have produced seminars, courses, online content, and case studies to educate the flying community. Currently, much of the focus on mitigating the VFR into IMC phenomenon has been on developing new weather forecasting and dissemination technologies. This has been done with the belief that a pilot who is supplied with tools necessary to better predict meteorological conditions would then avoid inclement weather. While the reasoning is well-founded, the fixed accident rates do not support the theory that better weather applications help decrease VFR into IMC mishaps. The current study suggests that the decision to continue is affected by more than just the available forecast at the time.

Humans have a limited amount of mental energy to devote to making choices. In the highly-dynamic environment of piloting an aircraft, that mental energy is likely to deteriorate even quicker, while the need to respond very quickly is likely to be quite high. When confounders such as motivation and desire are introduced, the ability to select the decision that renders the most desirable outcome can become challenged. Motivation directs a person’s behavior towards specific goals, determines how much he or she is willing to persist and therefore affects the choices he or she makes. For pilots to make better decisions, they have to be educated about their limitations, and fully informed about the contributing factors affecting that decision. The argument is that a knowledgeable pilot will be more encouraged to develop different courses of action that he or she can then activate depending on the situation. The absence of the proverbial *plan B* can often encourage an individual to continue in a known course of action rather than risking the relative unknown result of a deviation. In addition, a pilot who is mindful of his or her own limitations is more likely to set and adhere to personal minimums, such as the avoidance of inclement weather. The ultimate goal is to decrease the number of weather-related accidents and, therefore the associated fatality rate.

Limitations

While the results of the study were interesting, the data was limited in its ability to present a clear picture of how motivation and the interaction of motivation and meteorological conditions affects aeronautical decision making and the willingness to persist. There was some expectation that the motivations alone would interact with the dependent variable differently, following the trends already established by research in education performance and job satisfaction. The fact that motivation has not affected the dependent variable in the same manner under this specific experimental construct does not preclude the idea that a differently designed experiment might produce divergent results.

As for the interaction between motivation and meteorological condition on the dependent variable, the initial results warrant further investigation. Additional research would help refine some of the ambiguity so that a clearer depiction of which variables have a significant interaction could come to fruition.

Lastly, a fundamental limitation of this type of experimental research is that it represents an artificial situation that does not always depict real-life situations. For future research, the study could be repeated in a direct observation experimental design in either a full or partial motion simulator to see if any of the results are replicated. An observational study of this type would result in higher-fidelity scenarios and situation circumstances for the participants. The participants would still be randomly sorted into the motivational categories; however, the weather scenarios would become a visual depiction within the simulator. Observing the participants' reaction to encountering different meteorological conditions would provide a more direct method of interpreting deteriorating conditions and would mitigate the risk of the participants recognizing the weather condition as it is written. Instead of indicated willingness to persist annotated as a percentage on a slider scale, the time the participant continued in simulated flight would be recorded on a ratio scale.

Conclusions

Using a quantitative factorial experimental design, the study gathered data to support the idea that motivation may affect a general aviation pilot's willingness to persist in VFR flight into IMC. Of the three research questions and associated hypotheses the most interesting result indicated that the interaction between both meteorological conditions and motivation might have a significant effect on willingness to persist in marginal visual meteorological conditions. The potential for some motivation, versus no motivation, to effect willingness to persist aligns with Higgins (2000) research on objective-based decision making. It also supports what researchers have determined about plan continuation error and the biases that interfere with a pilot's decision-making process and risk analysis. The motivation to proceed manifests as confirmation bias and continuation error and limitations in the pilot's decision-making capacity manifest into bias (Goh & Wiegmann, 2001b; Walmsley & Gilbey, 2016). The result is a desire to continue and the unwillingness to revise the plan despite a rapidly mounting hazardous situation. Understanding how different motivations might affect ones' willingness to persist will help to refocus and build new platforms for pilot education, training, outreach, and prevention with the ultimate goal of decreasing the number of weather-related accidents and the fatality rate associated with them.

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